INCIDENT-RESPONSE MONITORING TECHNOLOGIES FOR AIRCRAFT-CABIN AIR QUALITY

by

PAUL W. MAGOHA

M.S., Lvov Polytechnic Institute, Ukraine, 1984

AN ABSTRACT OF A DISSERTATION

submitted in partial fulfillment of the requirements for the degree

DOCTOR OF PHILOSOPHY

Department of Mechanical Engineering
College of Engineering

KANSAS STATE UNIVERSITY
Manhattan, Kansas

2012

Abstract

Poor air quality in commercial aircraft cabins can be caused by volatile organophosphorus (OP) compounds emitted from the jet engine bleed air system during smoke/fume incidents. Tri-cresyl phosphate (TCP), a common anti-wear additive in turbine engine oils, is an important component in today's global aircraft operations. However, exposure to TCP increases risks of certain adverse health effects. This research analyzed used aircraft cabin air filters for jet engine oil contaminants and designed a jet engine bleed air simulator (BAS) to replicate smoke/fume incidents caused by pyrolysis of jet engine oil. Field emission scanning electron microscopy (FESEM) with X-ray energy dispersive spectroscopy (EDS) and neutron activation analysis (NAA) were used for elemental analysis of filters, and gas chromatography interfaced with mass spectrometry (GC/MS) was used to analyze used filters to determine TCP isomers. The filter analysis study involved 110 used and 74 incident filters. Clean air filter samples exposed to different bleed air conditions simulating cabin air contamination incidents were also analyzed by FESEM/EDS, NAA, and GC/MS. Experiments were conducted on a BAS at various bleed air conditions typical of an operating jet engine so that the effects of temperature and pressure variations on jet engine oil aerosol formation could be determined. The GC/MS analysis of both used and incident filters characterized tri-*m*-cresyl phosphate (TmCP) and tri-*p*-cresyl phosphate (TpCP) by a base peak of an m/z = 368, with corresponding retention times of 21.9 and 23.4 minutes. The hydrocarbons in jet oil were characterized in the filters by a base peak pattern of an m/z = 85, 113. Using retention times and hydrocarbon thermal conductivity peak (TCP) pattern obtained from jet engine oil standards, five out of 110 used filters tested had oil markers. Meanwhile 22 out of 74 incident filters tested positive for oil fingerprints. Probit analysis of jet engine oil aerosols obtained from BAS tests by optical particle counter (OPC) revealed lognormal distributions with the mean (range) of geometric mass mean diameter (GMMD) = 0.41 (0.39, 0.45) μm and geometric standard deviation (GSD), σ_g = 1.92 (1.87, 1.98). FESEM/EDS and NAA techniques found a wide range of elements on filters, and further investigations of used filters are recommended using these techniques. The protocols for air and filter sampling and GC/MS analysis used in this study will increase the options available for detecting jet engine oil on cabin air filters. Such criteria could support policy development for compliance with cabin air quality standards during incidents.

INCIDENT-RESPONSE MONITORING TECHNOLOGIES FOR AIRCRAFT-CABIN AIR QUALITY

by

PAUL W. MAGOHA

M.S., Lvov Polytechnic Institute, Ukraine, 1984

A DISSERTATION

submitted in partial fulfillment of the requirements for the degree

DOCTOR OF PHILOSOPHY

Department of Mechanical Engineering
College of Engineering

KANSAS STATE UNIVERSITY
Manhattan, Kansas

2012

Approved by:

Co-Major Professor
Steven J. Eckels

Approved by:

Co-Major Professor
Byron W. Jones

Copyright

Abstract

Poor air quality in commercial aircraft cabins can be caused by volatile organophosphorus (OP) compounds emitted from the jet engine bleed air system during smoke/fume incidents. Tri-cresyl phosphate (TCP), a common anti-wear additive in turbine engine oils, is an important component in today's global aircraft operations. However, exposure to TCP increases risks of certain adverse health effects. This research analyzed used aircraft cabin air filters for jet engine oil contaminants and designed a jet engine bleed air simulator (BAS) to replicate smoke/fume incidents caused by pyrolysis of jet engine oil. Field emission scanning electron microscopy (FESEM) with X-ray energy dispersive spectroscopy (EDS) and neutron activation analysis (NAA) were used for elemental analysis of filters, and gas chromatography interfaced with mass spectrometry (GC/MS) was used to analyze used filters to determine TCP isomers. The filter analysis study involved 110 used and 90 incident filters. Clean air filter samples exposed to different bleed air conditions simulating cabin air contamination incidents were also analyzed by FESEM/EDS, NAA, and GC/MS. Experiments were conducted on a BAS at various bleed air conditions typical of an operating jet engine so that the effects of temperature and pressure variations on jet engine oil aerosol formation could be determined. The GC/MS analysis of both used and incident filters characterized tri-m-cresyl phosphate (TmCP) and tri-p-cresyl phosphate (TpCP) by a base peak of an m/z = 368, with corresponding retention times of 21.9 and 23.4 minutes. The hydrocarbons in jet oil were characterized in the filters by a base peak pattern of an m/z = 85, 113. Using retention times and hydrocarbon thermal conductivity peak (TCP) pattern obtained from jet engine oil standards, five out of 110 used filters tested had oil markers. Meanwhile 22 out of 77 incident filters tested positive for oil fingerprints. Probit analysis of jet engine oil aerosols obtained from BAS tests by optical particle counter (OPC) revealed lognormal distributions with the mean (range) of geometric mass mean diameter (GMMD) = 0.41 (0.39, 0.45) μm and geometric standard deviation (GSD), σ_g = 1.92 (1.87, 1.98). FESEM/EDS and NAA techniques found a wide range of elements on filters, and further investigations of used filters are recommended using these techniques. The protocols for air and filter sampling and GC/MS analysis used in this study will increase the options available for detecting jet engine oil on cabin air filters. Such criteria could support policy development for compliance with cabin air quality standards during incidents.

Table of Contents

List of Figures

List of Tables

Acknowledgements

I would like to express my sincere appreciation to my supervisors, Professor Steven J. Eckels and Professor Byron W. Jones of Mechanical Engineering at Kansas State University, for their guidance, encouragement, and advice in the course of my studies and the preparation of this dissertation. I would like to thank also all the examiners: Professor B. Terry Beck, and Professor Ronaldo G. Maghirang for their time and effort in serving on the advisory committee and for helpful discussions that led to various suggestions and amendments to the dissertation. I am also grateful to Professor Oliver L. Weaver, for kindly agreeing to be the outside chair. I wish also to acknowledge the assistance from Professor Clifford Weisel with GC/MS analysis, Dr. Dan Boyle for assisting with FESEM/EDS analysis and Dr. Jeffrey Geuther for assisting with NAA analysis, and Professor James Higgins for advising on interpretation of statistics. Finally, I wish to thank my family and friends for their support and encouragement throughout the years of study. I gratefully acknowledge the Federal Aviation Administration (FAA) of USA for their financial support of this work which was made possible through a grant number 04-ACE-KSU. Although the FAA sponsored this study, it neither endorses nor rejects the findings of this research.

Dedication

To my grandson Mikel Braden Magoha

Preface

During the last five decades, unprecedented global demand for travel and international business requirements and ever expanding manufacture of different aircraft models have created the modern global civil aviation industry. On the cusp of this century's second decade, the global civil aviation finds itself balancing efficiency and availability while safety demands and energy costs increase. In particular, in response to growing demands for a more controlled aircraft cabin environment, scientific research on aircraft cabin air supply have gained ground over the past decade. Looking ahead to the next 10 years, aircraft manufacturers will emerge as leaders that augment airlines' business alignment and performance while implementing technologies and services that reduce costs by improving design, management, and operating efficiency, including cabin air quality. While many nations worldwide still rely on aircrafts with bleed air technology, new solutions are emerging that will deliver significant improvements in cabin air quality supply operations. The use of aircraft cabin air quality monitoring technologies combined with filter analysis techniques in a strategic blended implementation could help airlines address many of their objectives including aircraft environmental control system performance, compliance and safety. This study presents some critical technological trends that will drive improvements in aircraft cabin air quality in the next decade and beyond. The research focuses on presenting analytical techniques that may improve understanding of cabin air quality by analyzing used cabin air-recirculating filters. The aim is to find technological solutions in aircraft cabin air supply operations; an airline's success may thus depend on implementing effective technological changes whilst, at the same time, avoiding significant harmful side effects to humankind.

Acronyms

AChE	Acetylcholinesterase
ACGIH	American Conference of Governmental Industrial Hygienists
ANSI	American National Standards Institute
APU	Auxiliary Power Unit
ASHRAE	American Society of Heating, Refrigerating and Air-Conditioning Engineers
ASME	American Society of Mechanical Engineers
BAe	British Aerospace
BALPA	British Airline Pilot Association
BAS	Bleed Air Simulator
BChE	Butyrlcholiesterase
BEI	Biological Exposure Indices
BSE	Back Scattered Electron
Bq	Becquerel
CASA	Australian Civil Aviation Safety Authority
CEN	European Comite de Normalization
Ci	Curie
CO_2	Carbon dioxide
CO	Carbon monoxide
COT	Committee on toxicity
^oC	degrees Celsius
cm^3	cubic centimeter(s)
CFM	cubic foot per min.
cm	centimeter(s)
CNS	Central Nervous System
DBPP	Dibutyl phenyl phosphate
DOP	Di-octyl phthalate
DOT	U.S. Department of Transportation
DSA	Digital Spectrum Analyzer
^oF	degrees Fahrenheit

EASA	European Aviation Safety Agency
EDS	Electron dispersive spectroscopy
EOHSI	Environmental and Occupational Health Sciences Institute
EPA	US Environmental Protection Agency
EPAAQ	Expert Panel on Aircraft Air Quality
ECS	Environmental Control System
FAA	US Federal Aviation Administration
FESEM	Field emission scanning electron microscopy
FWHM	Full width at half maximum
GC/MS	Gas Chromatography-Mass Spectrometry
g	gram(s)
GSD	Geometric Standard Deviation
HEPA	High Efficiency Particulate Air (Filter)
HPGe	High Purity Germanium
ICAO	International Civil Aviation Organization
IER	Institute of Environmental Research
IEST	US Institute of Environmental Science and Technology
in.	inches
IPCS	International Programme on Chemical Safety
kcps	Kilocounts per second
kN	Kilonewton(s)
LabVIEW	Laboratory Virtual Instrumentation Engineering Workbench
lbf	Pound-force
L	Liter(s)
m	meter(s)
MAK	Maximale Arbeitsplatz-Konzentration (German Maximum Workplace Concentrations)
µg	microgram(s)
µm	micrometer(s)
mm^2	Square millimeter(s)
m^3	cubic meter(s)

mbar	millibar
min.	minute(s)
μCi/mg	Micro-Curie per milligram
$\mu g/m^3$	Microgram per cubic meter
MMAD	Mass Median Aerodynamic Diameter
MERV	Minimum Efficiency Reporting Value
MIL-STD	Military Standard
mL	milliliter(s)
MPPS	Most Penetrating Particle Size
mR/hr	milliRontgen per hour
MSDS	Material Safety Data Sheet
nA	nanoamperes
NAA	Irradiation Neutron Activation Analysis
NASA	US National Aeronautics and Space Administration
nm	nanometer
NRC	US National Research Council
OP	Organophosphates
OPC	Optical Particle Counter
OPICN	Organophosphate ester induced chronic neurotoxicity
OSHA	US Occupational Safety and Health Administration
O_3	Ozone
Pa	Pascal
PAN	N-phenyl-1-naphthylamine
pg	Picograms
PEL	Permissible exposure limits
ppm	parts per million
ppb	parts per billion
PSD	Particle size distribution
psi	pounds per square inch
PSID	Pounds per square inch differential
RSP	Respirable suspended particulates

s	Second(s)
SAS	Statistical application software
SAE	Society of Automotive Engineers
SBO	Smoke and burning odor
SCFH	Standard cubic foot per hour
SDD	Silicon drift detector
SIM	Single Ion Monitoring
SVOC	Semi Volatile Organic Compounds
TBP	Tri-butyl phosphate
TCP	Tricresyl phosphate
TMPP	Trimethylyolpropane phosphate
TMPE	Trimethylyolpropane ester
TmCP	Tri-*meta*-cresyl phosphate
ToCP	Tri-*ortho*-cresyl phosphate
TpCP	Tri-*para*-cresyl phosphate
TPP	Tri-phenyl phosphate
TVOC	Total volatile organic compounds
TLVs	Threshold limit values
TWA	Time weighted average
ULPA	Ultra low penetration air
VOC	Volatile organic compounds
WHO	World Health Organization

Notations

C_m = Mass concentration (mg/m^3)

m = Net mass increase of the filter after sampling (mg)

Q = Flow rate (m^3/s)

Q_s = Sampling rate of each filter (m^3/s)

R = Gas constant (Pa·m^3/kg·K)

t = Sampling period (s)

Nu = Nusselt number

Re = Reynolds number

Pr = Prandtl number

T_1 = Absolute temperature of air (K)

γ = Specific heat ratio

D = Tube diameter (m)

A = Surface area (m^2)

L = Length of the tube reactor (m)

h = Heat transfer coefficient (W/m^2 ·K)

c_p = Specific heat capacity of the fluid J/(kg·K)$^{-1}$

k = Thermal conductivity of the fluid (W/m·K)

R = kJ(kmol K)$^{-1}$

$\dot{q}$ = Wall heat flux (W/m^2)

$\dot{m}_{air}$ = Flow rate of air (kg/s)

$C_j(\mu_x)$ = Total number of counts under the peak associated with gamma ray energy E_j from radionuclide I (counts)

N_a = Avogadro's number (mol^{-1})

$\overline{\sigma}_a$ = Average thermal absorption cross section of precursor isotope í (cm^2)

ϕ = Thermal flux density (cm^{-2} s^{-1})

m = Sample mass (micrograms)

μ_x = Weight fraction of element x in the sample

$p_{i'}$ = Abundance of precursor isotope i in the element of interest

f_j = Branching ratio of the gamma j in the radioisotope of interest

η_j = Overall detection efficiency, including intrinsic efficiency and geometry

A_x = Atomic mass of the element x

λ_i = Decay constant of the isotope of interest (s^{-1})

t_o = Irradiation time (s)

t_w = Waiting time between the end of irradiation and the start of counting (s)

t_c = Counting time of the detector (s)

CHAPTER 1 - INTRODUCTION

1.1 Background

Modern commercial aircraft display impressive technology that highlights advances in global air transportation. That success ensures safe and efficient air travel. However, scrutiny of the air quality in commercial aircraft reveals some technical challenges that must still be overcome. The quality of aircraft cabin air depends both on the quality of the bleed air, sources outside the cabin and the strength and nature of the emissions from cabin sources. Without effective ventilation systems in aircraft cabins, passengers and crew may suffer from the effects of poor air quality. In fact, concerns about the potential hazards of cabin air have motivated most studies performed to date on the quality of the air being supplied to aircraft cabins. These studies have led to technologies that have minimized the impact of air pollution in aircraft cabins. The air-filtration and air-cleaning systems used in aircraft reduce the effects of pollutants in the cabin by removing the air contaminants from the cabin air supply. The contaminants emanating within the cabin that are of greatest concern and most need to be controlled include human body odors, microbial aerosols, volatile organic compounds (VOCs), carbon dioxide (CO_2), and carbon monoxide (CO). The large quantity of outside airflow supplied to the cabin helps maintain low levels of gaseous and VOCs not removed by the filtration system (Hunt and Space, 1994). Historically, air quality standards for commercial aircraft cabins have been met by complying with reasonable safety and health requirements established by codes and guidelines. These regulations typically address the threats associated with emissions from cabin sources, fire, and weather changes, but not aircraft cabin air quality incidents.

1.1.1 Defining aircraft cabin air quality incidents

An aircraft cabin air quality incident, which is often referred to as cabin air contamination event or simply as a smoke/fume incident, is a very complex phenomenon, whose symptoms often mimic smoke generation in a closed environment. A smoke/fume incident is also sometimes called an incident-occurrence or simply an incident or episodic event (ANSI/ASHRAE Standard 161-2007, 2007). The BALPA report submitted to the COT committee refers to a smoke/fume incident as a contaminated air event (BALPA, 2006). An “incident” is not a technical term. Rather it is an informal way of referring to a potentially

serious process that occurs in the aircraft bleed air system and culminates in contaminating the cabin's air supply. An incident poses a serious threat to safety of aircraft cabin occupants. The smell resulting from smoke/fume incidents is based on the perceptions and experiences of airline crew and maintenance staff across the airline industry. Different words have been used worldwide to describe the odor coming from incidents, but the most commonly used words are "dirty socks" or "oil smell."

1.2 Literature Review

1.2.1 Commercial aircraft environmental control system (ECS)

The conditions in the aircraft cabin, including the temperature, relative humidity (RH), cabin pressure, and cabin air quality, all affect the comfort, productivity, and well-being of cabin occupants. The type of ECS design as well as the air-exchange rate determines the quality and quantity of air supplied to aircraft cabins. Air is supplied and exhausted from the cabin continuously. The outside air supplied to the cabin is provided by the engine compressors and cooled by air-conditioning packs. The conditioned air from the packs flows into a common mix manifold, where it is mixed with recirculated cabin air. The mixed air is then supplied to the passenger cabin. The air enters the passenger cabin from overhead distribution outlets that run the length of the cabin. These outlets are designed to create carefully controlled circular airflow patterns in the cabin. The exhaust air is extracted from the cabin through return air grilles in the sidewalls near the floor, running the length of the cabin on both sides.

In most airplanes, the cabin exhaust passes into the "cheek" area below the cabin floor alongside the cargo hold. Recirculation fans may draw air from this area; one or more outflow valves, which control the cabin pressure, also draw air from this area. Approximately 20 CFM of a mixture of fresh and recirculated air is provided per passenger. This leads to a complete cabin air exchange every two to three minutes: 20 to 30 air changes per hour (Hunt and Space, 1994). On a typical passenger jet, the ratio of fresh to recycled air is about 50-50 (ASHRAE, 1999). But, depending on the design requirements, all modern commercial aircrafts recirculate from 10 to 50 percent of the cabin air. According to Hocking (2000), outside air provided to aircraft passengers is at least close to the 7.0 – 9.4 L/s (15 – 20 cfm) per person. Figure 1.1 shows the various components of a typical aircraft air-conditioning system in a modern airplane (ASHRAE, 1999). Figure 1.2 shows the pattern of air circulation inside aircraft cabins.

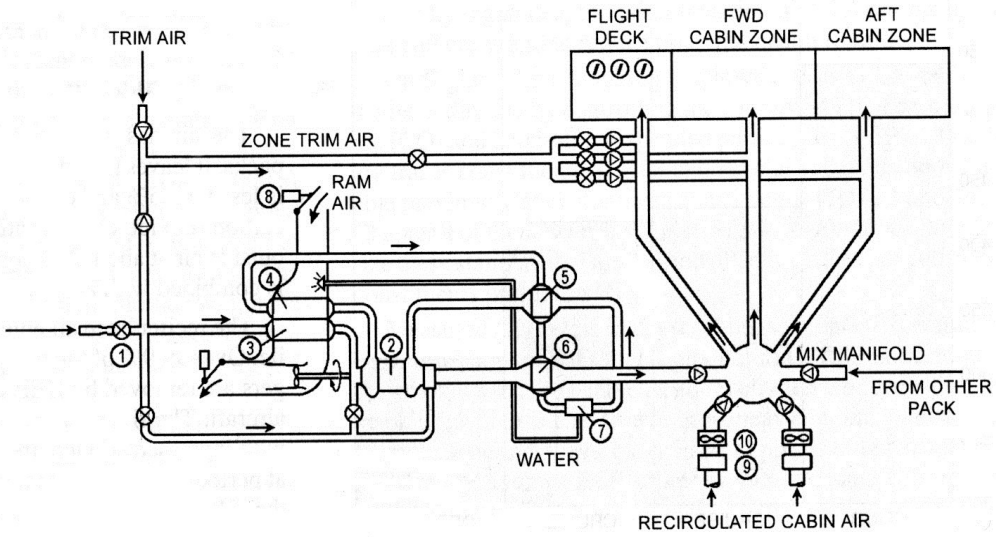


Figure 1.1 A schematic of typical aircraft air-conditioning system

Source: ASHRAE Handbook, 1999, ©ASHRAE, www.ashrae.org

1. Flow control valve
2. Air cycle machine
3. Primary heat exchanger
4. Secondary heat exchanger
5. Reheater
6. Condenser
7. Water collector
8. Ram air
9. Recirculating filter
10. Recirculating fan

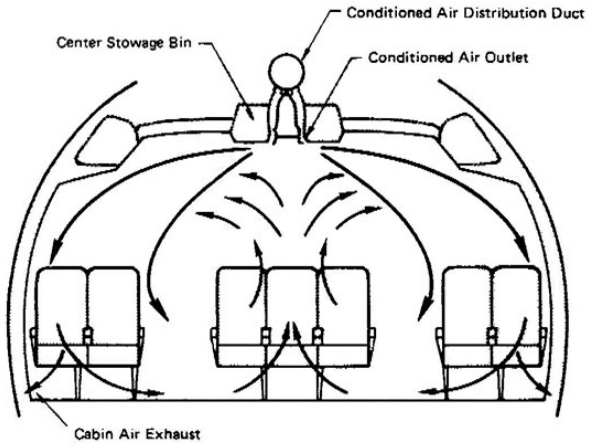


Figure 1.2 Pattern of air circulation inside aircraft cabin

(Source: The Committee on Airliner Cabin Air Quality, 1986).

In modern building environmental control systems, the recirculation systems are commonly designed and operated with up to 90 percent recirculated air with the flow rates of

outside air provided at about 0.5 kg/min. (1.1 lb/min) (ASHRAE 1999). Meanwhile, in modern aircrafts, the amount of outside air used for ventilation varies from one model to another, ranging from 10 to 50 percent of the total air supply (ASHRAE, 1999). The high air exchange rate controls temperature gradients, prevents stagnant hot or cold areas, maintains air quality, and dissipates odors in the cabin. The outside airflow maintains cabin pressurization within the pressure hull of the aircraft, a critical function of the environmental control system. Moreover, this fresh air supply should have acceptable quality and should not contain pollutants in quantities that would be considered harmful if introduced to the cabin. Besides exchanging air between the inside and outside of the cabin, the ventilation system decreases cabin air pollutant concentrations by diluting cabin airborne pollutants, thereby improving cabin air quality.

1.2.2 Air filtration in commercial aircraft cabins

The aircraft's ventilation system and cabin air recirculation filters are both very important safety components. The aircraft's ventilation system is designed to remove particles in the recirculated air and reduce bio-effluent levels including toxic gases, VOCs, and any hazardous chemical substances present in cabin environment. HEPA filters are important to the ECS and help maintain a healthy environment in the cabin. The HEPA filters are used for two important reasons: to prevent the spread of pathogens through the cabin with recirculated air and to protect ECS components, fans in particular, from dust and lint.

1.2.3 Aircraft cabin air quality and standards

Previous studies by Spengler et al. (1997) and Nagda and Rector (2003) reported a wide range of VOCs and SVOCs in aircraft cabin air during aircraft operations. These studies could not conclusively trace VOCs to specific sources. However, potential sources for these pollutants are hydraulic fluid, engine and APU lubricants, jet fuels, de-icing fluids, pesticides (in aircraft flying from mosquito-infected parts of the world), cleaning chemicals and disinfectants, perfume worn by cabin occupants (air fresheners and cosmetics), outgassing of cabin materials and furnishings, in-flight catering (particularly vapors from distilled spirits), and human bio-effluents coming from human metabolic processes. The bio-burden in an aircraft cabin depends primarily on the amount of ventilation per person and not on the occupant density. Viable and non-viable particulates on passengers' clothing, may also contribute to contamination of cabin air although the total air volume on airplanes is exchanged every two to three minutes, far more frequently

than the exchange rate in a typical air-conditioned building (Walkinshaw, 2010). The recirculated air poses little or no threat to the health of the cabin occupants as long as the aircraft is equipped with a HEPA filter. In an aircraft ECS, air filtration has been a key process guaranteeing desirable air quality and is vital in meeting air quality standards in the aircraft cabin environment.

1.2.3.1 Aircraft cabin air quality standards

The U.S. FAA has issued several guidelines and regulations for air in aircraft cabins. However, these guidelines are not specific. Nonetheless, since 1943, the Society of Automotive Engineers (SAE) International has been developing and updating standards on air quality and safety within commercial aircrafts; each standard has a primary feature. The first SAE standard publication released in 1943 contained general requirements for control of air temperature, cabin air pressure, and humidity. An approach to air purity-dilution with outside or recirculated air was also included (SAE ARP85E, 1943). In 1978, SAE published an updated diagram of the typical bleed air system and considerations addressing bleed air duct sizing, materials, acoustics, failure protocols, and proof and burst test conditions (SAE ARP1796A, 1978). The SAE International publication, ARP1539B, issued in 1981 and reaffirmed in 2003, was the first document to provide information on aircraft ECS particulate contamination (SAE ARP1539B, 1981). The SAE ARP4418A published in 1995 provided a table of marker compounds to be sampled for and analyzed during bleed air quality tests. It used prN4618 limits as reference limits for all constituents except particulates, which use a NIOSH limit. Testing techniques were also identified in the publication. The standard defined engine-generated concentrations as measurements of engine bleed air minus air supply inlet (SAE ARP4418A, 1995).

Historically, the first aircraft air quality standards originated because of military safety and health specifications (Fox, 2009). The ASHRAE review process for air quality within commercial aircraft has evolved over the past two decades. The actual development of the ASHRAE standard for airliners started in June 1994, when ASHRAE TC 9.3, Transportation Air-conditioning, made a formal recommendation to ASHRAE to form a Standards Project Committee (SPC) with a charter to derive air quality standards specific to commercial aircrafts. The result was the formation of ASHRAE SPC 161, Air Quality within Commercial Aircraft, which began developing a new standard. In 2007 ASHRAE Standard 161-2007 was issued and approved by ANSI in May 2008. In addition to continuing to update the standard, the committee

is developing a companion guideline, Guideline 28, which provides additional detail, background information, and additional recommendations on the standard. A draft version of the guideline was released for public review and comments, but the final guideline has not yet been published. The ASHRAE Standard 161 (2007) provides minimum criteria for air quality in commercial aircraft. It defines the requirements for air quality in an airliner and specifies methods for measuring and testing for compliance. Further, the standard addresses the unique characteristics of an aircraft cabin environment: the high occupant density, occupant activity levels that range from completely sedentary (passengers) to very active (flight attendants), classification as a public place (passengers) and a workplace (crew), and comparatively low pressure and relative humidity. The standard also covers the chemical, physical, and biological contaminants that may affect air quality as well as the physical cabin environment parameters, such as the temperature, relative humidity, and pressure, and measures to address these parameters (ANSI/ASHRAE Standard 161-2007). The document lays a solid groundwork for upcoming standards on establishing and operating air quality programs in commercial airplanes. Although the standard serves as a reference guideline for airline operators, it is a work in progress. The research presented in this dissertation is a part of that progress. The European Aviation Safety Agency (EASA, 2009); World Health Organization (WHO, 1990), and International Civil Aviation Organization (ICAO, 2001) have also published standards or codes for operating commercial aircraft.

Past studies of cabin air quality standards have focused largely on prevention and establishing rules and regulations based on experience. This conventional approach to establishing standards and codes for air quality within commercial aircraft uses a prescriptive approach. The major drawback to the prescriptive approach is the assumption that all air entering the aircraft ECS is pristine at high altitude (Fox, 2009). While many aspects of ANSI/ASHRAE Standard 161-2007 apply to the operational characteristics of commercial aircraft air quality, it does not cover bleed air quality monitoring in detail or have protocols for monitoring bleed air system operations.

Modern airplanes have technological innovations that allow room for improvement and replacement of individual components or systems. However, since scientific innovations in commercial aerospace industry have been driven by business mindset, standards do not have regulatory force in aircraft manufacturing. Airlines are beginning to assume more responsibility

as good stewards, in part due to public awareness and in part to research. In future, standards may become mandatory for the aircraft cabin environment. At present, an aggressive profile of a commercial jet operation reveals high performance characteristics, including an ECS that will adjust itself to perfectly adapt to changing flight conditions. This means that an ECS in a modern jetliner operates in continually and rapidly evolving environmental conditions in which air quality provision is given a high priority.

1.2.4 Commercial aircraft bleed air system

Aircraft engine bleed air is defined as the air extracted from compressor stages of gas turbine propulsion engines and auxiliary power units (ANSI/ASHRAE Standard 161-2007; Shang et al., 2010). Aircraft cabin air recirculation systems with bleed air technology were first developed in the wake of studies conducted by the National Aeronautics and Space Administration (NASA) and McDonnell Douglas Corporation. Those studies indicated that substantial fuel savings could be realized without compromising cabin air quality by using a bleed air system, and, today, most modern aircraft use this technology. Bleed air technology has been used in commercial aircraft engines since 1963. Its use has marked a significant turnaround for aircraft operations. Bleed air applications include ECS use, fuel tank pressurization, anti-icing systems, aerodynamic blowing, and driving compressors and suction pumps (Evans, 1991). As a primary source of air for the ECS, the bleed air system provides high pressure, high temperature air bled from the engines and routed throughout the airframe to secondary systems responsible for air conditioning in the aircraft cabin and keeps critical parts of the aircraft, like the leading edge of the wing, ice-free (SAE ARP 1796, 2007).

Bleed air is bled from the engine into a complex system that conditions the air before it is delivered into the cabin. Typically, the bleed air supply to the aircraft cabin environment is drawn from certain compressor stages of the jet propulsion engines at high pressure and temperatures ranging from 170^{o}C (340^{o}F) during ground operations to as high as 350^{o}C (670^{o}F) at take-off depending on the mode of operation, the stage of the compressor used for the extraction, and the speed of the engine (NRC Report, 2002). The outside air enters the engine compressor at atmospheric conditions and is compressed in several stages, raising its pressure up to 650 kPa (100 psi) (about five times atmospheric pressure) with higher temperatures usually topping 310^{o}C (590^{o}F) during top climb (NRC Report, 2002). A small portion of this air is then

extracted from the engine through one or more bleed port openings on the "dry" side of the engine, cooled, compressed, cooled again, expanded for further cooling, and then routed into the passenger compartment. Turbine jet engines also have a "wet" side that comes in contact with engine oil. While the dry side of the engine is intended to remain oil free, in certain conditions it can be contaminated with engine oil.

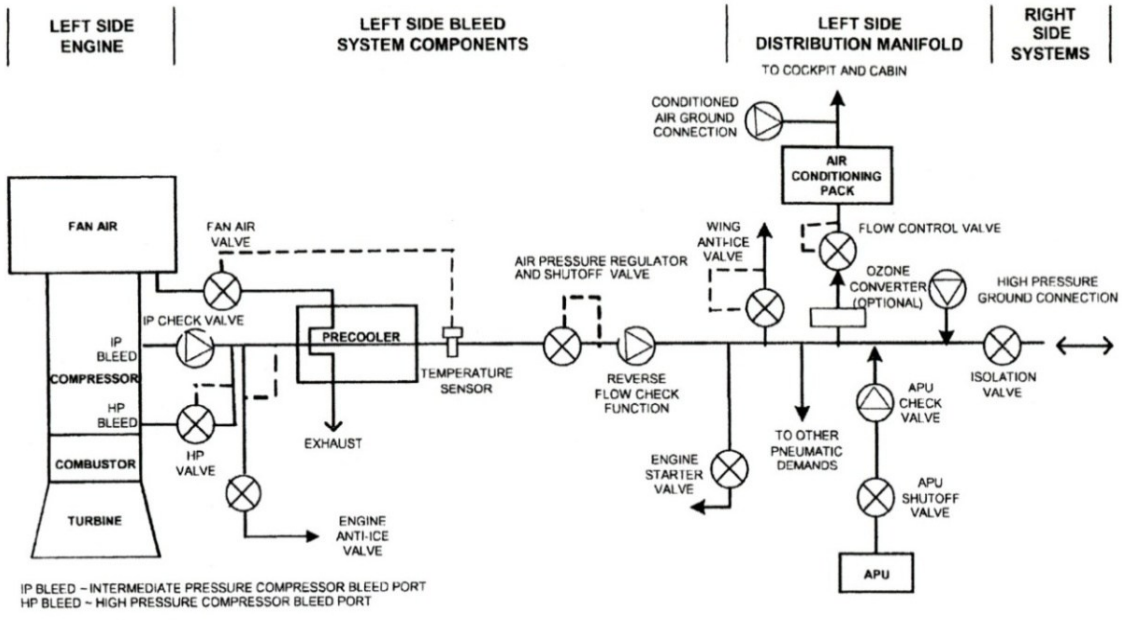


Figure 1.3 Schematic of typical commercial aircraft bleed air system
(Source: Standards ARP 1796, SAE International, 1987)

Figure 1.3 shows a schematic of a typical commercial aircraft bleed air system (Standards ARP 1796, SAE International, 1987). Most engines have two bleed air ports: high pressure and low pressure. The pressure at a given location within the compressor depends primarily on the power level at which the engine is operating. The bleed air systems automatically switch between the high and low ports choosing the low pressure port whenever pressure is adequate and switching to the high pressure port when the engine is operating at lower power levels and, consequently, generating lower pressures in the compressor. The hot, high-pressure air coming from the engine compressor is cooled by the pre-cooler to safer temperatures before it is distributed through the ducts to pneumatic aircraft systems. The pre-cooler automatically discharges excess energy back into the atmosphere as waste heat. The pre-cooler ensures that the

temperature of the pneumatic duct line is always well below the ignition temperature of fuel and/or below the critical level for surrounding equipment. The air is then ducted into the aircraft air-conditioning packs, where it is mixed with recirculated air before going to the cabin. In addition to the engines, the auxiliary power unit (APU) on the aircraft provides bleed air for use on the ground and, for some aircraft, in flight usually until just after take-off and just before landing. Table 1.1 shows typical conditions for the bleed air from a jet engine.

Table 1-1 Typical temperatures and pressures of an operating aircraft engine

Mode of Operation	**Temperature ^{o}C (^{o}F)**	**Absolute Pressure kPa (PSI)**	**Extraction Stage**
Top of climb	310 (590)	690 (100)	Low pressure
Cruise	250 (490)	340 (50)	Low pressure
Initial descent from cruise	185 (365)	200 (29)	High pressure
End of descent (ground level)	230 (445)	460 (67)	High pressure
High pressure to low pressure switch-over	280 (535)	80 (70)	High pressure
Ground operations	170 (340)	-	APU

(Source: NRC, 2002)

The bleed air, which is tapped from a compressor stage of the aircraft engines, is used to pressurize aircraft cabins. The air tapped from an engine increases the fuel consumption of the engine since the tapped air is no longer available to the engine to generate thrust; consequently, the engine compressor must be larger than what is actually required to generate thrust alone (Evans, 1991). To reduce the requirement for bleed air, a certain proportion of the siphoned air is cooled, conditioned to comfortable levels, and mixed with recirculated filtered cabin air before it is introduced to the passenger cabin, instead of having outside air produced from bleed air supplied constantly to the passenger cabin (Markwart, 2009).

With this design, a balance between recirculated air and fresh air is achieved so that a high level of cabin air quality is maintained, fuel efficiency is improved, and the environment is less affected (ANSHI/ASHRAE 2007, Ensign and Gallman 2006, NRC 2002). The use of bleed

air from the jet engines may account for the largest operating cost in providing necessary secondary power and environmental control functions for the aircraft (US Patent 5956960, 1999). Figure 1.4 shows a bleed air duct used in most of commercial transport aircraft manufactured by Airbus Industries.

Figure 1.4 Typical bleed air system in commercial transport aircraft

(Source: http://www.liebherr.com/AE/en-GB/products_ae.wfw/id-160-0)

1.2.5 Mobil Jet Oil II: A synthetic jet engine lubricating oil

Jet engine lubricating oils are specialized synthetic oils with a formulation designed specifically for use in high-performance jet engines. The oils have unique physical and chemical properties for lubricating jet engines. According to Winder and Balouet (2002), in jet oil, TCP is used in the formulation of lubricants as an anti-wear additive to enhance load bearing properties and improve tolerance to increasing speed of rotating or sliding motion. It also has flame-retardant properties. Their high performance as lubricants in gas turbine propelled aircrafts

means they offer remarkable advantages over petroleum-based lubricating oils. The multifaceted functions of the jet engine oils have contributed to their popularity in the market. This study focused on Mobil Jet Oil II, which has a molecular weight of 368.37 and a maximum viscosity of 380 cSt at 50°C (Streicher, 1994). Its melting point is 11°C and boiling point 410°C at 1.20 g/mL. Mobil Jet Oil II has a vapor density of 1.1 kg/m^3 at 15ºC and a flash point of 270°C (518°F) (Streicher, 1994: MSDS, 2010). The important features and benefits Mobil Jet Oil II as a jet engine lubricant are summarized in Table 1-2.

Table 1-2 Key features and benefits of jet engine lubricating oils

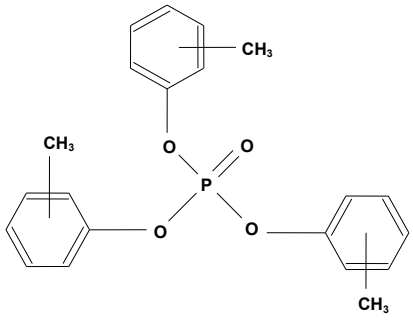
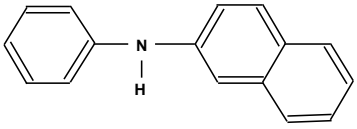
Feature	Advantages and Potential Benefits
Excellent thermal and oxidation stability	Reduces the formation of carbon and sludge deposits; Maintains engine efficiency and extends engine life; Reduces bulk oil oxidation and increases deposit control by 50^oF
Excellent wear and corrosion protection	Extends seal, gear and bearing life; Reduces engine maintenance
Viscosity and shear stability across wide temperature range	Provides effective lubrication at high operating temperatures
Chemically stable at high operating temperature	Reduces evaporation losses and oil consumption
Excellent resistance to foaming	Maintains film strength under rigorous operating conditions
Good low temperature	Permits start-up and ensures effective lubrication of critical components at temperatures as low as – 40^oF

(Source: MSD. http://www.exxonmobil.com/UKEnglish/Aviation/PDS/GLXXENAVIEMMobil_Jet_Oil_II.asp)

The jet engine oils are a combination of a highly stable synthetic base fluid and a unique chemical additive package, providing outstanding thermal and oxidative stability that resists deterioration and deposit formation in both the liquid and vapor phases as well as excellent resistance to foaming. The load-carrying ability of the oil comes from its synthetic base stock viscosity and, therefore, is not subject to loss from viscosity index additive shear (Rudnick, 2003). Additionally, jet engine oils are formulated to meet the demanding requirements of aircraft with gas turbine engines that must perform well over a wide range of severe operating conditions. The closely controlled, low-temperature viscosity of the oil, along with its low pour point, ensure good low-temperature fluidity to permit an effective operating range between – 40^oC (– 49^oF) and 204^oC (400^oF). The product has a high specific heat to ensure good heat

transfer from oil-cooled engine parts. Laboratory testing and in-flight performance have shown that the oil has excellent bulk oil stability at temperatures up to 204°C (400°F) for extended periods. The evaporative rate at this temperature is low enough to prevent excessive loss of volume. The ingredients that have been commonly added to jet engine lubricating oils are listed in Table 1-3.

Table 1-3 Additives to jet engine oils and possible health effects on exposure to humans

Ingredients	Concentration (% by weight)	Effects of exposure on human health
Tricresyl phosphate (TCP) $(CH_3C_6H_4O)_3P=O$ 	1 – 5.0%	Neurotoxin
N-Phenyl-1-Naphthylamine (PAN) $C_{16}H_{13}N$) 	0.1 – 1.0%	Skin sensitizer
Akylated-diphenylamines	< 2.0%	None

(Source: ACGIH 2001; MSDS, 2010)

Jet engine lubricating oils are supplied in many (intermediate) grades classified by viscosity. Type II oils are required for the main engines, while Type I oils are recommended for APU use by some engine manufacturers for its cold-start properties. One of the constituents of interest in jet engine oils in this study are TCP isomers because they are organophosphates and known to have adverse effects on human health. The TCP isomers could as well serve as oil markers on filters. TCP exists in ten isomeric forms, but three isomers, ortho-, meta- and para-, are the most common forms. The ortho-isomer is highly toxic; its presence should be minimized as much as possible. The meta- and para-isomers of TCP are relatively inactive (Winder and

Balouet, 2002). The TCP boiling point is about 200^{o}C, so that under typical domestic conditions it would not vaporize (Holt, 2011). Jet turbine lubricating oils are formulated to operate efficiently at higher temperature conditions and allow longer operation. Jet engines require oils with a lower pour point, or better viscosity temperature characteristics, and a higher degree of resistance to oxidation or thermal decomposition than petroleum derived oils. Therefore, synthetic lubricants are not made from natural crude oils, which would breakdown under high temperatures. They are made from a highly stable polyol ester basestock and can handle high temperatures without breaking down or forming carbonaceous deposits. The presence of polyol ester base stock in jet engine oil implies that in any chemical analysis of oil, the substance could also serve as oil marker on used filters. Because of the high temperatures that develop in turbine engines, the synthetic lubricating oils are formulated to dissipate heat quickly and provide a cushioning effect. In addition to being able to handle high temperatures, lubricants for modern jet engines must be able to handle extreme speed and structural stress conditions without breaking down or forming deposits. Thus, the addition of TCPs to jet engine oils might be viewed as a "potentially fatal poison or as unpleasant but necessary economic benefits."

1.3 Problem Identification and Description

During a flight, the aircraft engine experiences a wide range of temperatures and pressures. These changes depend strongly on flight conditions (weather, including wind speeds), payload, and length of the flight. Most of these variations are non-critical and may be simply described as aircraft system reactions to flight conditions. At lower temperatures, the formation of jet engine oil mist in the bleed air may result in an incident. Additionally pyrolysis of jet engine oil can also result in incidents. Addressing the pollutant emissions from a rare event such as smoke/fume incident caused by pyrolysis of lubricating jet engine oil has been a really significant challenge. The unpredictability of smoke/fume incidents is compounded by the constantly changing temperatures associated with processes occurring in the aircraft engine.

During pyrolysis, the jet engine lubricating oil, and specifically some of the synthetic anti-wear oil additives, which include the toxic organophosphate TCP, can undergo thermal decomposition into a range of substances: VOCs of low molecular weight; organic acids; esters; ketones; TCP isomers, including neurotoxin ToCP; and carbon monoxide (CO) (van Netten, 2000; MSDS, 2008). Therefore, even though jet engine oils are excellent for lubricating aircraft

engine parts, they can degrade cabin air quality. The AAIB bulletin describes how jet engine oil leaks into an aircraft's ECS: The engine lubrication system supplies pressurized oil to the main shaft bearings. Various devices are in place to ensure that the air pressure external to the bearing chambers exceeds the local oil pressure to prevent engine oil from escaping and contaminating the compressor airflow. The forward bearing on the low pressure shaft uses a continuous cast iron seal ring as part of its sealing arrangement. Its purpose is to ensure that a positive air pressure gradient is maintained to prevent oil from escaping from the bearing housing.

However, when the bearing floating seal ring fails or is worn out, the engine fuel or lubricant fumes and gases can leak into the compressor airflow path and be ingested into the bleed air system. The quality of the provided air to the cabin air conditioning system becomes degraded (van Netten and Leung, 2000; AAIB Bulletin, 2009). When this happens, an incident is said to have occurred. Such seal failures have occurred in Boeing 757-204 powered by Rolls-Royce engine model RB211-535E4-37 (AAIB Bulletin, 2009). According to an AAIB report, the cause of the malfunctioning of a compressor seal for a known and investigated case of a smoke/fume incident was tensile fracture, with a possible fatigue mechanism as the origin. In this case, the compressor seal fracture may have been caused by the drag between the static seal ring carrier plates and the rotating lower pressure shaft. Another cause of smoke/fume incidents problem is the overfilling of jet engine lubricating oil (maintenance irregularities) by the aircraft's maintenance staff (Harrison et al. 2008; Murawski and Hecker, 2011).

The frequency and intensity of smoke/fume incidents are, in fact unknown. Every smoke/fume incident is different, but there is a growing scientific awareness that all of these disparate incidents have a common result: the occasional contamination of cabin air supply while the aircraft is in flight. Consequently, incidents are potential problems for airlines' crews and air travelers. Incidents can create high anxiety among cabin occupants, disrupt the comfort of air travelers during flight, and threaten their health and safety. For the cockpit crew, an incident can escalate into a crisis threatening the crews' ability to control an aircraft. Generally, smoke/fume incidents can tarnish an airliner's reputation as a safe mode of travel by risking the lives of passengers and crew. Besides smoke/fume incidents, electrical arching has caused fire and smoke in aircrafts. Modern large transport aircraft have more than 500,000 ft. of wire, and electrical arching has caused fire and smoke in airliners (Cox, 2006). Therefore, burning wire

insulation is also a potential source of smoke/fume in aircraft cabin environment. This study did not address this issue.

1.4 Justification for the Study

Following the introduction of bleed air technology, the overall aircraft engine efficiency improved, but the technology also introduced the possibility of engine oil contaminants (gases and particulates) leaking into the cabin air supply. This means that although the bleed air system conserves energy in the aircraft, it cannot provide the level of safety required for critical ECS applications during smoke/fume incidents. According to BALPA report (2006) submitted to COT Secretariat, acute and chronic illnesses may be induced in pilots and cabin crew who inhale smoke/fumes from engine oil and hydraulic fluid, additives present in these products, and pyrolysis products that may be emitted from the engines and auxiliary power unit (APU) into the air conditioning system of certain aircraft types during air contamination incidents (BALPA Report, 2006). The air supplied to the cabin occupants include recirculated air which has passed through cabin air filters. In the face of the risks associated with the human intake of airborne particulates formed during smoke/fume incidents, analyses of used and incident filters and monitoring simulated bleed air, is an important step in a strategy to address smoke/fume incidents problem. This implies that the recirculation filters can be an effective sampling mechanism for assessing cabin air quality and investigating air quality incidents.

The primary purpose of the cabin air recirculation filter is to remove particulate matter from recirculation air system. The impact of the filter on air quality may, however, extend far beyond just removing particulate matter. After many hours of operation, the filter media becomes highly loaded with a variety of matter and may actually serve as a source of some contaminants. Since approximately 50% of air supplied to the cabin passes through these filters, out-gassing from this matter in the filter may result in contaminants being introduced into the supply air stream, which may adversely affect air quality. Also, the heavily loaded filter media can serve as a reactive bed where particulate contaminants, both solid and liquid, have collected; gasses passing through the filter media may react with them. In this way, secondary contaminants may then be introduced into the cabin supply air.

Tens of thousands of liters of air pass through cabin air recirculation filters on a typical flight. In fact, what is collected on the filters is not really a sample, but effectively a global

collection of the suspended particulate matter in the cabin air during the flight. Because large quantities of air pass through recirculation filters in the ECS, the filters may also serve as a useful diagnostic tool for assessing the air quality in general and smoke/fume incidents in particular through analysis of materials collected on the filters. This large sampling volume is both an advantage and a challenge in using cabin air recirculation filters for diagnostic purposes. The large and comprehensive sample of air passing through the filter means that whatever particulate matter which was in the air will show up on the filters and in large quantities, compared to that which can be collected with air sampling devices. However, aircraft HEPA cabin air recirculation filters are non-specific and will have not only an integrated sample for the entire flight but also the material collected from many other flights as well. Thus, pinpointing which sample came from a particular contamination event may be difficult. While HEPA cabin air recirculation filters may be useful diagnostic tools, the most useful results come when they are used in conjunction with other sampling methods.

The concentration levels of some airborne aerosol particulates and gases from aircraft engine bleed air during normal operations have been reported in the scientific literature (Crump et al. 2011; De Nola et al. 2011). Scientists have yet, however, to investigate both the fate of aerosols with different pressure and temperature in an aircraft's bleed air system and how varied conditions in the bleed air system alter aerosol formation during pyrolysis of jet engine oils. While much research has focused on the toxicology of TCP and its isomers in workplaces, relatively few studies have examined how these pollutant emissions are generated in an aircraft bleed air system and transported in the aircraft environmental control systems (ECS). The dangers posed by smoke/fume incidents are hard to measure, and practical ways to remove contaminants generated by smoke/fumes incidents when they occur are lacking. The toxicity levels of the constituents or degradation products of jet engine oils and the relationships between exposures and reported health effects on cabin crews have not been established. Scientists have compiled information about toxicity levels for the amounts of TCPs and ToCP found in workplaces. But much still remains unknown about the effect of TCPs in aircraft cabin environment.

Both animal studies and those conducted in workplaces have shown that high levels of ToCP are hazardous to human health. In particular, ToCP has been linked to cancer (Winder and Balouet, 2002). Somkuti et al. (1988) and Baron et al. (1962) have shown that ToCP is a

powerfully neuropathic substance. The risks of cabin fume exposure include both short-term health problems and long-term illness, disease and disability (Vakas, 2007). According to the Occupational Safety and Health Administration (OSHA) the lethal human oral dose of ToCP is about 1 g/kg and doses of 6 to 7 mg/kg have produced serious paralysis (OSHA, 1978, Kelso et al. 1988; MSDS, 2011). The American Conference of Governmental Industrial Hygienists' (ACGIH) standard for ToCP is 0.1 mg/m^3 of air averaged over an eight-hour work shift (ACGIH, 2001). Some evidence links exposure to smoke/fumes produced during incident-occurrences to serious health risks to passengers and crew (van Netten, 1998; Michaelis, 2003; Bobb, 2003; Swedish Statens Haverkommission, 2003; Mangili and Gendreau, 2005).

Additional evidence exists of some significant flight safety concerns, indicated by incidents reported by United Kingdom Civil Aviation Authority (CAA) (BALPA Report, 2005), and by an investigation of the Swedish Board of Accidents into a 1999 incident in which pilots became incapacitated (Swedish Statens Haverkommission, 2003). The NRC Committee has also described a number of case studies and anecdotal reports that available from other reporting systems (NRC Report, 2002). A definitive understanding of bleed air composition during smoke/fume incidents can only be achieved by a scientific study that facilitates real-time monitoring of the quality of the air passing through the bleed air system. Jet engine lubricating oils have not been exhaustively studied and their use remains largely unregulated. The amount of smoke/fumes from jet engine oil needed to pose a risk has not been quantified because the exact amount of airborne aerosol particulates released during various incidents remains unknown. Scientists have yet to establish acceptable limits for the amount of aerosol particles emitted during smoke/fume incidents: that is the concentration levels of TCP isomers that would be considered a safe threshold. So far, no study has made any attempt at quantifying the particulate size distribution of these compounds from aircraft bleed air systems either. Yet the bleed air system is a conduit for air going into the aircraft cabin.

Reference criteria, such as OSHA's permissible exposure limits (PELs), the ACGIH's threshold limit values (TLVs), and MAK's for the TCP isomers in an aircraft cabin environment have not been developed. The existing industrial exposure standards for TCP and ToCP were not developed for aircraft cabins (Rayman, 2002; and Fox, 2000), and little is known about the health effects of exposures to mixtures of airborne particulate contaminants from jet engine lubricating oil. This makes providing proper aircraft cabin air quality an occupational health and

safety issue. Airborne byproducts of the pyrolysis of jet engine oils in the aircraft bleed air system are not covered by the standards currently applied to pollutant emissions in cabin air.

Furthermore, airborne Mobil Jet Oil II aerosol particulate emissions from the aircraft bleed air system during incidents have not been characterized. The characteristic differences in the size and composition of aerosol particles formed in bleed air systems during smoke/fume incidents have yet to be scientifically examined. Considerably more monitoring of bleed air systems is necessary to establish the factual information needed to make these determinations. Currently, automated real-time data acquisition systems that can generate these data are not available. Nor do means of forewarning of smoke/fume incidents in commercial aircrafts exist. Yet passengers and crew may suffer discomfort and adverse health effects if the quality of air from engine bleed air is poor. In addition to the chemical constituents of pyrolyzed jet engine oil, contaminated bleed air may also contain CO as a byproduct of incomplete combustion of phosphate esters. Acute exposure to CO may cause nausea, headaches, dizziness, and drowsiness. Moreover, chronic neurological sequelae have been reported after acute high-level exposure to CO (Prockop and Chichkova, 2007). Although a better understanding of the levels of TCP and other contaminants during incidents is necessary, methodologies do not currently exist for sampling, analyzing, and displaying instantaneous readings of both particulate and gaseous concentration levels of these compounds in aircraft engine bleed air systems, particularly during smoke/fume incidents.

To begin to explain the relationship between exposure to particulates and health problems, used aircraft cabin air filters and sampling simulated bleed air could be analyzed. Developing testing protocols for monitoring engine bleed air in commercial transport aircrafts will pave the way for risk control and for helping maintain cabins as safe working environments. Performance-based regulations in conjunction with monitoring bleed air system parameters can ensure that the health, safety, and comfort objectives in the aircraft cabin are met. Whether based or expressed on the basis of the number of flights or the number of hours flown, a study by expert panel on aircraft air quality (EPAAQ) established by the Australian Civil Aviation Safety Authority (CASA) reported that fume events are quite rare (CASA Report, 2009). Although considered rare, smoke/fume incidents are shrouded in uncertainty and have become a public health issue in international air travel. No matter how rare these events are, human safety is at stake during such incidents, and the risks of exposure to aerosols from aircraft bleed air during

smoke/fume incidents must be understood better (U.S. GAO, 2004). Even the magnitude of the problem is not known, yet global air travel may be affected. The level of impact of bleed air emissions on cabin air quality is also not known. According Winder and Balouet, immune-suppression is one of the health symptoms of long-term exposure to smoke/fume incidents (Winder and Balouet, 2001). Therefore, learning how aerosol emissions from jet engine oils containing TCPs can affect the most vulnerable is necessary, particularly for travelers with underlying medical conditions such as diabetes, lung disease or heart disease, as well as young children, the elderly, pregnant women, and those with weakened immune systems, who are at highest risk.

1.5 Objectives of the Study

The objective of this study was to determine if aircraft cabin air recirculation filters can be analyzed to determine the source contaminants involved in air quality incidents. Specifically, the study examined aircraft cabin filters by various methods to determine whether jet engine lubricating oil is the source of contaminants in an air quality incident. The focus was on finding markers for the presence of engine oil on used and incident filters using three analytical techniques: FESEM/EDS, GC/MS, and NAA. The analyses of incident and used filters by these methods allowed assessment of whether or not jet engine lubricating oil marker(s) can be detected and quantified in used and incident cabin air recirculation filters. FESEM/EDS analysis identified filters contaminant elements from jet oil, and GC/MS was performed to specifically investigate filters for TCPs and other compounds found in jet engine oils. This study was undertaken to identify acceptable best practices for investigating cabin air quality in commercial aircraft through analysis of cabin air recirculation filters and the development of aircraft bleed air simulator (BAS). The research delivers unique perspectives and advice to airlines on how they can leverage novel analytical techniques to identify smoke/fume incidents to solve air quality problems in aircraft cabins.

Consequently, this research aimed to provide the most effective and meaningful metrics and tools for investigating cabin air quality in commercial aircraft during smoke/fume incidents. Using cabin air recirculation filters as a diagnostic tool for cabin air quality assessment was critical, and the goal was to determine the ability of the analytical methods to establish fingerprints of aircraft engine lubricating oil on dirty and incident filters. The study established a

firm specific link (tracer) between smoke/fume incident and possible detection method and used the outcome to develop practical tools for examining aerosol particulates in cabin air recirculation filters. Another objective of this study was to develop the BAS system.

The specific objectives of the study were:

- To develop techniques for analyzing used cabin air recirculation filters. This included developing procedures for sampling HEPA cabin air recirculation filters.
- To develop an aircraft BAS system to simulate bleed air during different flight phases and investigate air quality breaches in those simulated flight conditions. This involved conducting real-time monitoring of aerosol particles formed during pyrolysis of engine oil at micron levels. The experimental work also included sampling simulated bleed air and loading it onto clean cut samples of cabin air recirculation filter media with known concentrations of engine oil aerosols generated by BAS.
- To measure gaseous products, in particular, CO, as a characteristic determinant or marker for the incident-occurrence process.

With the above objectives in mind, the study expects (a) to advance the understanding of air quality science and the challenges and opportunities in identifying the contaminant so that the source can be eliminated and (b) to develop the best engineering practices for implementing an experimental setup for investigating air quality breaches in the aircraft bleed air system. The aim of developing the BAS was to provide a way to create simulated oil contamination under controlled conditions over a range of temperatures, pressures, and transit times in typical bleed air systems. The practical demonstration of the applied engineering techniques used to arrive at the results was also a strategic goal in this study.

1.6 Research Methodology

FESEM/EDS, GC/MS, and NAA were used to assess whether or not jet oil marker(s) can be detected and quantified in used and incident cabin air recirculation filters. This research was designed to analyze used and incident filters and develop an aircraft bleed air simulator. The study implemented experimental protocols for monitoring simulated bleed air and profiles clean, used, and incident HEPA cabin air recirculation filters to model responses to aircraft bleed air contamination events. Filter samples from the used and incident filters were collected both prior to and following exposure to known concentrations of engine oil contaminants. Detailed

chemical and elemental analysis of the filter samples were conducted using FESEM/EDS, GC/MS, and NAA. In addition to filter analyses, the bleed air simulator (BAS) was developed to model smoke/fume incidents to determine the feasibility of using both analytical techniques and to detect sampled air of aerosols of Mobil Jet Oil II. BAS development also allowed us to determine the size distribution and composition of aerosols in a simulated bleed air. Practical studies and statistical models were used to evaluate data from used and incident filters.

1.7 Scope of the Study

The scope of this study is confined to examining used HEPA filters from commercial aircraft ventilation and air conditioning systems. The methods and procedures used for analyzing TCPs and elements on the filter surface are focused on determining jet engine oil contamination on filters. The BAS was developed and used to simulate smoke/fume incidents caused by jet engine lubricating oil.

1.8 References

AAIB Bulletin 6/2009, (2009). G-BYAO EW/C2006/10/108. http://www.aaib.gov.uk/cms_resources.cfm?file=/Bulletin%206-2009.pdf (Cited May 5th, 2010).

ACGIH, 2001. Threshold Limit Values and Biological Exposure Indices (TLVs and BEIs). Cincinnati: American Conference of Governmental Industrial Hygienists. ISBN: 1-882417-40-2, pp. 58.

ASHRAE, (1999). ASHRAE Handbook – HVAC Applications, Chapter 9, Aircraft. American Society of Heating, Refrigerating and Air-Conditioning. Atlanta, GA.

ASHRAE, (2007). ANSI/ASHRAE Standard 161-2007, Air Quality within Commercial Aircrafts. 20 pp. Product code: 86493. ISBN: 1041-2336. Atlanta, GA: American Society of Heating, Refrigerating and Air-conditioning Engineers, Inc.

ASHRAE, (1999). ANSI/ASHRAE Standard 52.2-1999. Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size. Atlanta, GA: American Society of Heating, Refrigerating and Air-conditioning Engineers, Inc.

Australian Civil Aviation Safety Authority (CASA). Expert Panel on Aircraft Air Quality (EPAAQ), Contamination of aircraft cabin air by bleed air – a review of the evidence. September 2009. http://www.casa.gov.au/wcmswr/_assets/main/cabin/epaaq/epaaq-entire-report.pdf

Baron, R. L., Bennett, D. R. and Casida, J. E., (1962). Neurotoxic syndrome produced in chickens by a cyclic phosphate metabolite of Tri-o-cresyl phosphate – A clinical and pathological study. Brit. J. Pharmacol. (1962), 18, 465 – 473).

British Airline Pilot Association (BALPA) Report, (2005). U.K. Civil Aviation Authority (CAA). http://www.rsc.org/images/balpa_tcm18-99526.pdf (Cited: January 7, 2012).

British Airline Pilot Association (BALPA) Report, (2006). U.K. Civil Aviation Authority (CAA). http://cot.food.gov.uk/pdfs/cot-laystatementbalpa200706.pdf (Cited: November 20th, 2011).

Bobb, A. J., (2003). Known harmful effects of constituents of jet oil smoke. TOXDET-03-04. Ohio: U.S. Naval Health Research Center Detachment (Toxicology), 2003.

Cox, J. M., (2006). Reducing the Risk of Smoke, fire and Fumes in transport Aircraft. Past History, Current Risks and Recommended Mitigations. Cockpit Smoke Solution Report. http://www.safeopsys.com/docs/SOS_SAFITA.pdf (Cited: Nov. 20th, 2010).

Crump, D., Harrison, P. and Walton, C., (2011). Aircraft Cabin Air Sampling Study; Part 2 of the Final Report, Institute of Environment and Health, Cranfield University, April 2011. https://dspace.lib.cranfield.ac.uk/handle/1826/5306 (Cited: November 24th, 2011).

De Nola, G., Hanhela, P. J. and Mazurek, W. (2011). Determination of Tricresyl Phosphate Air Contamination in Aircraft. Ann. Occup. Hyg. Vol. 55. No. 7, pp. 710-722, 2011. Oxford University Press on behalf of the British Occupational Hygiene Society doi:10.109/annhyg/mer040.

European Aviation Safety Agency (EASA). http://www.easa.eu.int/rulemaking/technical-publications.php.

Evans, A. B. (1991). The Effects of Compressor Seventh-Stage Bleed Air Extraction on Performance of the F100-PW-200 Afterburning Turbofan Engine. NASA Contract Report 179447. February 1991.

Ensign, T. R. and Gallman, J. W., (2006). Energy optimized equipment systems for general Aviation Jets. 44th AIAA Aerospace Sciences Meeting and Exhibit. Reno: 9 – 12 January 2006, Nevada.

Fox, R. B., (2009). A US Perspective on Cabin Air Quality Standard Development. ICE International Aviation Conference. Munich, 9-10 March 2009.

Harrison, R., Murawski, J., McNeely, E., Guerriero, J., Milton, D., (2008). Bleed-Air Contaminant Exposure Management Guide. Management of Exposure to Aircraft Bleed-air Contaminants among Airline Workers: A guide for health care providers. August 2008.

Hocking, M. B., (2000). Passenger aircraft cabin air quality: trends, effects, societal costs, proposals. Chemosphere 41 (2000) 603 – 615. Pergamon Press.

Holt, G. C., (2011). A conference most revealing: aircraft cabin air quality. *Journal of Biological Physics and Chemistry* 11 (2011) 216–220 © 2011. Collegium Basilea & AMSI doi: 10.4024/22HO11A.jbpc.11.04.

Hunt, E. H. and Space, D. R., (1994). The Airplane Cabin Environment: Issues Pertaining to Flight Attendant Comfort. International In-flight Service Management Organization Conference, Montreal, Canada, November 1994.

ICAO, (2001). Aircraft disinfection practices survey. FALP/3-IP/1 International Civil Aviation Organization, Montreal, Canada.

Kelso, A. G., Charlesworth, J. M. Mcvea, G. G., (1988). Contamination of Environmental Control Systems in Hercules Aircraft. Australian Government Department of Defence Materials Research Laboratory. Report MRL-R-1116.

Liebherr Aerospace Product. http://www.liebherr.com/AE/en-GB/products_ae.wfw/id-160-0. (Cited: May. 15th, 2011).

Mangili, A. and Gendreau, M. A., (2005). Transmission of infectious disease during commercial air travel. Lancet 2005, 365: 989 – 996.

Markwart, M., (2009). System For Improving Air Quality In An Aircraft Pressure Cabin. Patent application number: 20090277445. AIRBUS DEUTSCHLAND GMBH\ CINCINNATI, OH US IPC8 Class: AA61M1600FI. USPC Class: 12820312.

Material Safety Data Sheet (MSDS) for Tricresyl Phosphate. Issued: 05/18/2008. http://mobiljet2.com/msds.pdf

Michaelis, S., (2003). A survey of health symptoms in BALPA Boeing 757 pilots. J. Occup Health Safety - Aust NZ 2003, 19(3): 253 – 261.

Murawski, J. and Hecker, S., (2011). Exposure to oil fumes on aircraft: necessary to regulate? Occupational Health & Safety, Australian & New Zealand Journal of Health, Safety and Environment 2011 Volume 27(2).

Nagda, N. L. and Rector, H. E., (2003). A critical review of reported air concentrations of organic compounds in aircraft cabins. Indoor Air 2003; 13: 292 – 301. Copyright Blackwell Munksgaard. ISSN 0905-6947.

National Research Council (NRC) Report, (2002). The Airliner Cabin Environment and the Health of Passengers and Crew Committee on Air Quality in Passenger Cabins of Commercial Aircraft., Washington DC: National Academy Press. ISBN 0-309-17023-0 e-pub.

OSHA, (1978). Occupational Health Guideline for Tri-ortho-cresyl Phosphate. Occupational Safety and Health Administration, U.S. Department of Labor, September 1978.

Prockop, L. D. and Chichkova, R. I., (2007). Carbon monoxide intoxication: an updated review. J. Neurol. Sci. 262(1-2):122 – 30.

Rudnick, L. R., (2003). Lubricant Additives: Chemistry and Applications. CRC Press ISBN: 978-0-8247-0857-3.

Ryman, R. B., (2002). Cabin air quality: an overview. Aviat Space Environ Med, 73(3): 211-5.

SAE ARP-85E, (1943). Reaffirmed 1991. Air Conditioning Systems for Subsonic Airplanes Society of Automotive Engineers International, Warrendale, PA.

SAE ARP-1539B, (1981). Aerospace Recommended Practice: Environmental Control System Contamination. Society of Automotive Engineers International, Warrendale, PA.

SAE ARP-1796A, (1978). Engine Bleed Air System for Aircraft. Society of Automotive Engineers International, Warrendale, PA.

SAE ARP-4418A, (1995). Procedures for Sampling and Measurements of Engine and APU Generated Contaminants in Bleed Air Supplies from Aircraft Engines. Society of Automotive Engineers International, Warrendale, PA.

SAE ARP 1976, (2007). Aerospace Recommended Practice: Engine bleed air system for aircraft. Society of Automotive Engineers International, Warrendale, PA.

Shang, L., Liu, G., Hodal, P. (2010). Development of High Performance Aircraft Bleed Air Temperature Control System With Reduced Ram Air Usage, IEEE Transactions on Control Systems Technology, Vol. 18, No. 2, March 2010.

Somkuti, S. G., Tilson, H. A., Brown, H. R., Campbell, G. A., Lapadula, D. M. Abou-Donia, M. B., (1988). Lack of Delayed Neurotoxic Effect after Tri-o-cresyl Phosphate Treatment in Male Fischer 344 Rats: Biochemical, Neurobehavioral and Neuropathological Studies. Fundam. Appl. Toxicol. 10, 199 – 205.

Spengler, J., Burge, H., Dumyahn, T., Muilenberg, M. and Forester, D., (1997). Environmental Survey on Aircraft and Ground-Based Commercial Transportation Vehicles. Prepared by Department of Environmental Health, Harvard University School of Public Health, Boston, MA, for Commercial Airplane Group, The Boeing Company, Seattle, WA. May 31, 1997.

Streicher, R. P., (1994). NIOSH/DPPSE. NIOSH Manual of Analytical Methods (NMAM) 4th edition. 1994.

Swedish Statens Haverkommission (Swedish Board of Accident Investigation). Incident onboard aircraft SE-DRE during flight between Stockholm and Malmo M County, Sweden on 12 November 1999, Report RL 2001:41E. Stockholm: Statens Haverkommission, 2003.

The Committee on Airliner Cabin Air Quality, (1986). The Airliner Cabin Environment: Air Quality and safety. The National Academies Press 1986. Copyright National Academy of Sciences.

U.S. GAO, (2004). AVIATION SAFETY More research needed on the effects of air quality on airliner cabin occupants. U.S. General Accounting Office. Report to the ranking Democratic Member, Subcommittee on Aviation Committee on Transportation and Infrastructure, House of Representatives January, 2004.

US Patent 5956960, (1999). Multiple mode environmental control system for pressurized aircraft cabin

Vakas, N., (2007). Interests and the shaping of an occupational health and safety controversy: the BAe 146 case, Ph.D. Thesis, University of Wollongong, 2007.

van Netten, C., (1998). Air quality and health effects associated with the operation of the BAe 146-200 aircraft. Appl Occup Environ Hyg 1998, 13(10): 733-739.

van Netten, C., (2000). Analysis of two jet engine lubricating oils and a hydraulic fluid: their pyrolytic breakdown products and their implication on aircraft air quality In: Nagda, NL (eds). Air Quality and Comfort In Airliner Cabins. pp. 61-75 ASTM STP 1393. American Society for Testing and Materials, West Conshohocken, PA

van Netten, C, Leung, V., (2000). Comparison of the constituents of two jet engine lubricating oils and their volatile pyrolytic degradation products. Applied Occupational and Environmental Hygiene (2000). Volume: 15, Issue: 3, Pages: 277 – 283

Walkinshaw, D. S., (2010). Germs flying and the truth. ASHRAE Journal. Volume 52. April 2010.

Winder, C. and Balouet, J. C., (2002). The Toxicity of Commercial Jet Oils. Environmental Research Section A. Vol. 89. No. 2: 146 – 164. Publisher Academic Press.

Winder, C., and Balouet, J. C., (2001). Aircrew Exposure to Chemicals in Aircraft: Symptoms of Irritation and Toxicity. Journal of Occupational Health and Safety – Australia and New Zealand 17: 471 – 483, 2001.

WHO, (1990). Tricresyl phosphate. (Environmental health criteria; 110) ISBN 92 4 157110 1. http://www.inchem.org/documents/ehc/ehc/ehc110.htm

CHAPTER 2 - ANALYSIS OF USED AIRCRAFT CABIN AIR FILTERS BY FIELD EMISSION SCANNING ELECTRON MICROSCOPY (FESEM) WITH ENERGY DISPERSIVE X-RAY SPECTROSCOPY (EDS)

2.1 Abstract

Most jet turbine engine oils contain the additive tricresyl phosphate (TCP), an organophosphorus (OP) compound; it offers excellent lubricating properties but is hazardous to human health. Rising concern about the toxicity of TCPs is the principal motivation for smoke/fume incidents research. The objective of the study was to identify jet engine oil markers on used aircraft cabin air recirculation filters that could point to jet engine oil as the source contaminant in bleed air incidents. The Nova^{TM} Nano field emission scanning electron microscopy (FESEM) model 430 with energy dispersive X-ray spectroscopy (EDS) equipped with 80mm^2 X-Max silicon drift detector (SDD) was used to determine the composition of elements on the surface of used filters. The filter analysis study involved 99 *used*, non-incident filters and 34 *incident* filters. The term "used" filter refers to filters that were removed from aircraft during normal servicing, normally at the end of a service period. While detailed records were not available for these aircraft for the service period of the filters, they were not reported as problem aircraft. "Incident" filters refer to filters that were removed from aircraft that had air quality issues. The nature of the issues was not reported. In at least some cases, filters were removed for analysis before their normal service period of replacement. Clean, *unused* filters were also examined as controls. The analysis identified phosphorus (P), sulfur (S), and bromine (Br) elements as potential markers for jet engine oil contamination in used filters. The mean (range) atomic weight % of P concentrations for used filters was 0.052 (0.007, 0.144) and for incident filters 0.032 (0.005, 0.080). The statistical analysis suggest a normal distribution as a good fit model for P on used filters (p-values for normality test are greater than 0.05). Statistical analysis also suggests that P is correlated to S ($r = 0.6$; p-value = 0.0001). The analysis of variance of means of P for used filters obtained from different aircraft types revealed that p-values of pair-wise comparisons of aircraft models with Bonferroni adjustment at $\alpha = 0.05$ were statistically significantly different for A320-B777 ($p = 0.0298$) and B737-747 ($p = 0.0002$) but not significant for other pair-wise

comparisons. The electron micrographs and associated elemental maps revealed a diverse morphology of particulate deposition on used filter surfaces. Phosphorus, sulfur, and bromine were found on nearly all filters. In the second approach of analysis where every point was considered, no strong correlation between the amounts was found, so the substantial difference between the ratios of these elements found on filters and in oil-spiked filter samples, and lack of differences in patterns between used and incident filters, leads to the conclusion that non-oil sources of these elements are ubiquitous in aircraft cabins and, thus, they might not be used as unique indicators of the presence of jet engine oil in the cabin air.

2.2 Introduction

Commercial aircraft are the workhorses of global air transportation. Because of increased air travel and challenging environmental regulations, aircrafts must operate at their best. Efficiency must be maximized across the entire spectrum of an aircraft's operation, and cabin air quality must be maintained at all times during flight. Technology must be leveraged to the highest degree possible in every aspect of aircraft operation, including aircraft cabin air quality to respond to changing human health requirements. In any built environment meant for human occupation, clean air supply is necessary to health. Aircraft cabin occupants need a continuous air supply that does not pose hazards to safety, comfort, and health. Providing good air quality in aircraft cabins, however, requires accurate and effective control of a variety of contaminants within the cabin and from outside air. These contaminants include volatile organic compounds (VOCs) and gaseous byproducts from reactions taking place in aircraft engine bleed air system during smoke/fume incidents. The major sources of air pollution from the cabin include bio-effluents, disinfectants, carpets, paints, and furnishings treated with flame-retardant chemicals, such as upholstery, drapes, and curtains. According to Pall Corporation, there is no definite time interval for replacing a cabin air filter element. Airlines often choose to replace cabin air filter elements at regular intervals to fit in with routine scheduled maintenance periods, such as a C-check. The definition of a C-check varies between aircraft models and operators (Pall Corporation).

During past decades, smoke/fume incidents may have been underreported, so these incidents may not have received the attention they deserve. Shortfalls in accounting for incidents have been reported in Britain and Australia. The expert panel on aircraft air quality (EPAAQ)

established by the Australian Civil Aviation Safety Authority (CASA) reported that throughout the world there is no consistency in the collection of data on contaminated cabin air events. According to Winder and Michaelis, the Australian Senate inquiry into the BAe 146 cabin air quality and the UK CAA database on Boeing 757 incident reports over the same period showed cases of underreporting (Winder and Michaelis, 2005, Michaelis, 2007). Recent reports from U.S. FAA indicate that US airlines have reported significant increases in smoke/fume incidents. Such incidents have been reported fleet-wide across a wide range of aircraft types (Murawski and Supplee, 2008). From January to December 2010, US Airways documented 87 air supply contamination events that involved engine oil or hydraulic fluids (ISP, CWA, AFL-CIO, 2011). An October 2010 circular released to airline operators states that more than 900 cases of smoke/fume incidents occur annually (U.S. DOT FAA InFO 10019, 2010). Increases in reporting of incidents suggest that airlines are becoming more responsive to incident-occurrences. Additionally, airlines may now be recognizing that smoke/fume incidents are challenges worth tackling. In addition, the increased number of incident reports puts new pressure on airlines to provide appropriate safety and security on aircraft without discouraging passengers and crew.

Rising concern about the toxicity of TCPs as well as public concern about aircraft air quality has motivated research into smoke/fumes incidents. Commensurately, advances in these scientific studies have also created increased public awareness of airborne contaminants in aircraft and in particular the adverse health effects of airborne pollutants on humans. In addition, technological advances have also made available a range of innovative tools for testing cabin air quality. Whenever a smoke/fume incident occurs, it significantly undermines an airline's efforts to provide quality air to the passengers and crew because of airborne particulates (BALPA Report, 2005). As a result, an incident can disturb cabin occupants, both passengers and crew, which can adversely affect cabin crew morale and their motivation to work. The substances of interest are jet engine oils, hydraulic fluids and deicing fluids (NRC, 2002; Solbu et al. 2007; De Nola et al. 2008). In the case of jet engine oils, the airborne aerosols produced from either mists of oil or the pyrolyzed products of jet engine oil can cause a range of health problems for cabin occupants (Michaelis, 2003; Winder and Michaelis, 2005).

According to various scientific reports, a wide variety of chemical compounds have been found in aircraft cabin air (Hunt and Space, 1994; Spengler et al. 1997). While studies have shown chemical pollutants in aircraft cabin air, only recently have a few studies identified TCPs

in cabin air during normal aircraft operations. Crump et al. (2011) and De Nola et al. (2011) both identified ToCP and CO in the cabin air supply during normal operations. Van Netten and Leung (2000) also identified TCPs and CO in cabin air during normal aircraft operations. In the civil aviation industry, synthetic jet engine oils contain additives that offer the best lubrication properties for jet engines. However, the usage of these oils may pose potential safety and health risks to air passengers and cabin crew.

2.2.1 Aircraft cabin air recirculation filters

Technological advances in air filtration materials and design have ensured that aircraft cabin air recirculation filters maintain desirable air quality in aircraft cabins. Regardless, air passengers and crew are still exposed to many cabin contaminants and probably other unknown contaminants. An aircraft cabin air filter helps mitigate the health effects of airborne particulate pollutants by eliminating particulate pollutants from the recirculation air returned to the cabin environment, thereby improve the air quality in the cabin. According to Molhave (1991), exposure to VOCs, even at very low concentrations has been linked to a number of health problems, including upper respiratory irritation, neurological symptoms, and cancer. Thus, in aircraft cabins, air filtration reduces the environmental burden caused by airborne pollutant emissions from the cabin and outside air supply. To make sure the air supply in the aircraft cabin is safe, every filter is tested and rated when manufactured according to strict specifications. Aircraft cabin air filters remove bacteria and viruses at an efficiency greater than 99.999% (Harding, 1994). This means that the filters can protect the passengers and crew against the spread of microbes and viruses during flight. It also means that air purity, particularly for particulates, is high when air is supplied to cabin occupants.

The aircraft cabin air recirculation filters generally are made of fibrous materials, usually randomly arranged synthetic glass fibers that capture particulate matter or respirable aerosols using a combination of four filtration mechanisms, namely, inertial impaction, diffusion, interception, and sieving (Cooper and Alley, 2002; Michaelis and Loraine, 2005). The filters are manufactured in a variety of sizes and shapes to fit aircraft's ECS retrofit needs. Figure 2.1 shows some typical cabin air recirculation filters and the aircraft frame model in which they are used. Donaldson's HEPA cabin air recirculation filter for the Boeing 767-300 series has a label

containing important technical information including (a) a maximum resistance of 250 Pa (1.20 in. W.G) at 1500 CFM and (b) a maximum penetration of 0.10 % at 1500 CFM.

Figure 2.1 Some HEPA cabin air recirculation filters approved by FAA for installation on various commercial aircrafts

(a) Airbus: A318/A319/A320/A321 (b) Boeing 777-200, 777-300, 777-300ER (c) Boeing 737 and Boeing 757 models. (d) Boeing 767 models (e) Boeing 747-400 and (f) Charcoal filter: Boeing 767-model.

The filter medium is constructed from ultra-fine glass fibers intertwined to form a mesh structure held together with an organic binder. The filters are pleated to increase the surface area available for capturing particulates and to reduce the face velocity. The characteristics of the pleating are the length of pleat, distance between two pleats, and filtration area. Corrugated separators strengthen the filter pack and prevent the media from collapsing. The filter media is sealed to a rigid aluminum frame using an adhesive.

2.2.2 The standards for aircraft cabin air filters

The performance of HEPA filters or their ability to reduce exposure to airborne particulate matter is defined by their efficiency. Every aircraft cabin air recirculation filter is tested and rated, so it delivers certifiable performance according to certain air quality standards. The Military Standard-282 Method 102.9.1 (1965) was the initial standard efficiency specification adopted by HEPA filter manufacturers for commercial aircraft, requiring the filters to capture 99.97% of 0.3 μm particles. HEPA filters are also usually rated at 99.99% sodium flame test efficiency or the equivalent efficiency of 99.97% DOP (di-octyl phthalate) efficiency (Bull, 2008). The criterion that aerosol penetration for the HEPA filters should not exceed 0.03% (0.0003) for 0.3 μm diameter particles represents the most difficult particle size to capture, i.e., the most penetrating particle size (MPPS) for a HEPA filter (Hinds, 2000). The diameter specification of 0.3 μm corresponds to the MPPS. For aircraft cabin air recirculation filters, ASHRAE Standard 161 (2007) recommends a HEPA filter that meets or exceeds the requirements of Institute of Environmental Science and Technology IEST-RP-CC001.5 Filter Type “A”, with a minimum efficiency of at least 99.97% on 0.30 μm size particles. ASHRAE Standard 52.2-2007 recommends evaluating HEPA filters according to a minimum efficiency reporting value (MERV). A MERV is a rating for describing filter performance. For example, a filter MERV rating of 17 has an efficiency of nearly 100% when particles of 0.3 μm size are considered. The European Comite de Normalization (CEN) has developed Standard EN 1822.1 (2009) for the classification and testing of HEPA and ultra-low penetration air (ULPA) filters, based on particle counting at the MPPS, which provides a minimum of 99.95% penetration efficiency for 0.4 μm particles. To meet the U.S. EPA definition, HEPA cabin air recirculation filters must be 99.97% effective in capturing dust, vapors, bacteria, fungi and some viruses. A

study by Korves et al. (2011) has demonstrated that analysis of filters could characterize viruses in aircraft cabin air.

Filter manufacturers use HEPA filtration technology because of high air quality, capacity, and ability to satisfy aircraft cabin air supply requirements. However, stricter legislation has increased the demand for techniques to monitor bleed air. The concerns stem in part from unknown threshold levels of airborne particulate emissions formed from jet engine lubricating oils during smoke/fume incidents. These threats loom while regulations, standards, and procedures to manage them remain unspecific. Currently, the airline industry worldwide is actively seeking to develop innovative air quality monitoring techniques that would minimize the burden of smoke/fume incidents on cabin air quality. In fact, the impact of bleed air on cabin air quality depends on many variables: namely the conditions that promote incidents and the amount of aerosol emissions produced from the process. This means airlines need air quality monitoring solutions that meet stricter requirements of the air quality in cabin environment. To implement requirements for safety measures that can reduce the risk of smoke/fume incidents and enhance the level of protection for cabin occupants, it is necessary to understand the threshold levels for jet engine oil contaminants in cabin air supply. Screening techniques like analysis of cabin air recirculation filters could be indispensable in detecting jet engine oil contaminants in cabin air if they can produce reliable results. Currently, no standard method exists for assessing cabin air quality using analysis of cabin air filters installed in aircrafts, and no information has been published on the effectiveness of such analysis in detecting sources of air contamination. With cabin air recirculation filters as the only air-cleaning device fitted to an aircraft's ECS, these filters are therefore the focus for investigation of air quality in airplane cabins. Analyses of used cabin recirculation filters may answer questions about how the cabin air quality parameters change during smoke/fume incidents.

In this study, samples of clean and used cabin air recirculation filters were characterized by FESEM, Nova^{TM} NanoSEM model 430 equipped with EDS, Oxford Instruments INCA 350 with 80 mm^2 X-Max SDD detector. The FESEM/EDS is a high powered microscope with an emission spectrometer, both of which are useful for an investigation of surface phenomena (Nadeau and Herguth, 2004). The FESEM/EDS technique can also provide high-quality morphological images showing the features of contaminants and the spectra of the elemental constituents present on the surface of a sample (Stellmack, 2010). In this study, used and incident

aircraft cabin air recirculation filters were examined to determine if jet engine oil contamination signatures could be identified. The study also addressed effective filter analytical options for monitoring incidents by testing clean cabin filters exposed to Mobil Jet Oil II. Mobil Jet Oil II was used in the laboratory tests because it is the most widely used jet engine oil (B. W. Jones, personal communication). The aim was to determine whether elements in jet engine lubricating oil and deposits on used filters could be linked.

2.3 Materials and Methods

2.3.1 Filter sampling

Filter sample preparation was a very important step in analyzing aircraft cabin air recirculation filters because it could affect the accuracy of the data gathered during analysis. All the necessary steps for the preparation of the filter samples were conducted in the clean room at the KSU Institute for Environmental Research (IER). The air circulation system for this room is fitted with both HEPA and electrostatic filters that keep concentrations of airborne particulate to below 2648 counts/m^3. Before the filter sample preparation began, the air-circulation system in the room was turned on and left running for about 10 minutes to reach a steady state. The boxes containing the filters were moved from the closet into the clean room one at a time. After a box containing a filter was moved into the clean room, it was cut open to remove a filter, which was always wrapped in a plastic bag. The filter was then placed on a table covered with aluminum foil. At this point, the person performing the sampling put on sterilized plastic gloves and a dust mask. All the tools used in disassembling the filters and cutting out specimens were wiped with isopropyl alcohol. This sterilization step was included because filter specimens were also collected for biological analysis (Korves et al. 2011). The outer aluminum casing was cut with a sheet metal snip to separate it from the filter. The use of the clean room and sterilized equipment throughout the sampling process ensured that cross-contamination was highly unlikely. The sequence of operations used for preparing filter samples by FESEM/EDS analysis is shown in Figure 2.2 below. For the FESEM/EDS measurements, approximately two 2.5 cm square samples were cut from each filter and placed in a zip-lock plastic bag measuring 18 × 24 in. Each zip-lock bag was labeled with a filter ID for future identification.

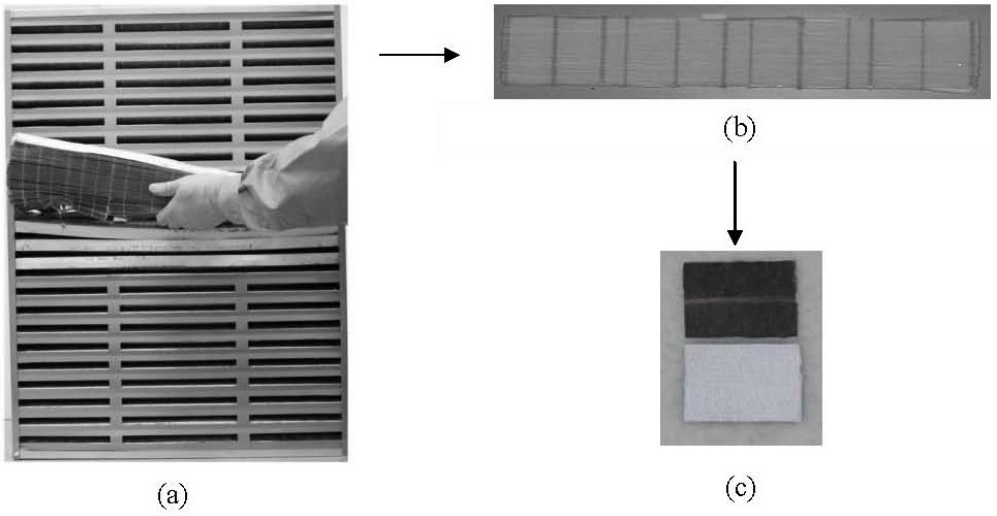


Figure 2.2 (a) Filter sampling process (b) Filter panel (c) Filter sample for FESEM/EDS analysis

The zip-lock bags containing the filter samples were then shipped for FESEM/EDS analysis. Samples from clean filters and clean filter samples spiked with Mobil Jet Oil II were also analyzed with the FESEM/EDS method and their spectra examined. The clean filters used in the study were acquired from three major aircraft cabin air recirculation filter manufacturers: Keddeg, Pall, and Donaldson. The study used aircraft cabin air recirculation filters came from several major US airlines and were collected over two years. Some of the filters were provided directly by airlines, and some were received via third parties without the source airline being identified. In total, 110 used and 90 incident filters were analyzed.

2.3.2 Experimental protocol

From each specimen, a 2.0-mm diameter trephine was used to cut filter samples, which were then placed on an aluminum stub with carbon adhesive to hold samples on the stage and help ground them. A Nova^{TM} NanoSEM model 430 from FEI Company, FESEM equipped with an Oxford X-Max large area analytical EDS silicon drift detector (SDD) 80 mm^2 was used to determine the elemental composition of filter samples. Standardized operating conditions were set at 18 kV accelerating voltage, spot size 4.5 (0.74 nA beam current), 5.0 – 6.5 mm working distance, and the sample chamber under vacuum (10^{-4} – 10^{-5} tort). Quant optimization was performed on the EDS system using copper (Cu) as standard. These parameters were determined to produce accuracy of quantification of lighter and heavier elements of interest. In addition,

these parameters did not require extensive sample preparation or preparatory procedures that might have damaged the sample or altered the spectra.

The area to be analyzed had a horizontal field width (HFW) = 149 μm square fields (22,201 μm^2) at ×1000 magnification. Standard operating conditions produced X-ray count rates between 1–3 kcps and dead times less than 3%. The scanning duration was 2 minutes. The FESEM/EDS was also used to investigate the changes induced in clean filter surfaces by sampling air containing pyrolyzed Mobil Jet Oil II using a bleed air simulator. Clean filters spiked with Mobil Jet Oil II and dried under vacuum at 40^oC (to possibly make volatile components evaporate) were also subjected to detailed FESEM/EDS analysis to identify contaminants from jet oil. The filter surface microstructure and microelement analysis of clean, dirty, and incident aircraft HEPA cabin air recirculation filters also were all analyzed by this methodology. The filter surface characterization, quantitative results were obtained using virtual pack standards supplied with the INCA 350 software. A spectrum of the energy versus relative counts of the detected X-rays was obtained and evaluated for qualitative and quantitative determinations of the elements present on the sample.

The phasemap tool in the INCA 350 software system was used to identify elemental phases with ternary element plots of specific pixel information from montaged X-ray maps. The procedure for element map acquisition involved the use of so-called ternary phase diagrams. The software generated elemental maps of relative concentrations for the elements specified by the user. The element information embedded in each image pixel was rearranged so that regions of similar (ternary) composition could be determined in the phase diagram. Superposition of images obtained from different ternary phase diagrams were represented as a false color map that yielded a phase map. Thus, a realistic reconstruction of elemental distribution in the cross-sectioned sample could be achieved, and the obtained elemental map was mixed into the scanning electron image. Each filter was given a unique, specific identification. The images of the surface characteristics of used filters with magnifications of 500, 1000, and 4000 were acquired by FESEM for comparative analysis. Figure 2.3 shows a picture of Nova^{TM} NanoSEM model 430 used in this study.

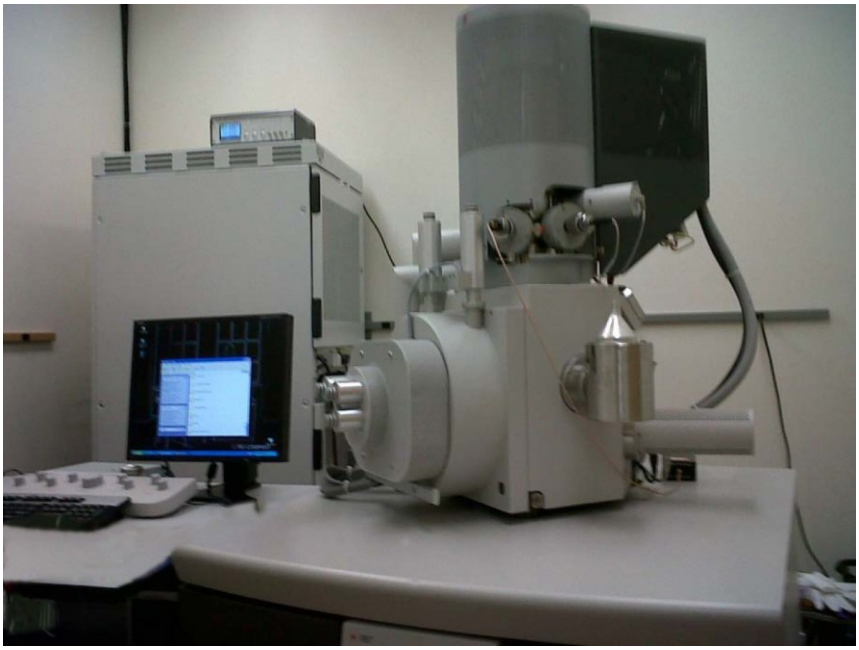


Figure 2.3 Nova^{TM} NanoSEM model 430 FESEM/EDS System

Aside from obtaining atomic weight percentages and elemental distributions, filter samples were also viewed under the FESEM at 500x, 1000x, and 5000x magnifications. Excel software was used to calculate the mean atomic weight percentage levels by averaging the values obtained from six different square fields (22,201 μm^2) analyzed.

2.3.3 Statistical procedures used in data analysis to identify filter contaminant elements

The data obtained from analyzing both used and incident filters were subjected to statistical analysis using SAS Procedures. All analyses were done with the SAS system for Windows (release 9.2; SAS Institute, Cary, NC). This study analyzed data from a total of 200 cabin air recirculation filters considered a representative sample of HEPA filters used in commercial aircrafts. The analysis considered 99 used and 34 incident filters. Using various SAS codes, descriptive statistics of identified jet engine oil contaminant elements on both groups of filters were calculated with PROC UNIVARIATE and PROC CORR procedures. The PROC TTEST procedure was used to test for the difference between the two categories of filters. Meanwhile, both PROC GLM and PROC MIXED procedures were used for analysis of variance (ANOVA). The study analyzed samples from used and incident filters that fit seven different aircraft models as shown in Table 2-1.

Table 2-1 Distribution of used and incident filters by manufacturer and type of aircraft

Filter manufacturer	Used filters							
	Type of aircraft							
	A320	MD-80	A340	B737	B767	B777	B747	Total
Donaldson	0	0	0	0	0	10	9	110
Keddeg	12	0	0	8	1	17	2	
Pall	0	0	0	4	7	21	2	
Puralator	0	0	0	0	0	17	0	
Filter manufacturer	Incident filters							
	Type of aircraft							
	A320	MD-80	A330	B737	B767	B777	B747	Total
Donaldson	0	0	0	0	0	3	0	90
Keddeg	28	0	0	15	0	0	0	
Pall	2	4	2	16	16	4	0	
Puralator	0	0	0	0	0	0	0	

N.B. Only 133 filters tabulated in appendix A4 (pp. 228 – 231): SAS output were considered in this study.

2.4 Analysis, Results and Discussion

2.4.1 Data analysis

The analysis of the FESEM/EDS data involved examining distribution patterns of jet engine oil contaminant elements and analyzing photomicrographs to determine the unique features caused by jet engine oil contamination on filters. The EDS analysis provided results in units of weight percent for the atomic elements present on the surface of filter debris. The data in appendices A1 and A2 include the atomic percentage values of elements detected by EDS analysis for every spot analyzed on used and incident the filters. In both the used and incident filters, more than 20 elements were present in a wide variety of atomic weight percentage levels. The PROC UNIVARIATE procedure was used to test normality for distribution of jet engine oil contaminant elements in used and incident filters. The SAS PROC UNIVARIATE code used to

determine both the descriptive statistics and distribution of phosphorus (P) was written as follows:

```
data pdata;
 label conc = 'Phosphorus % atomic weight';
 input conc @@;
 Phosphorus = log(conc);
 datalines;

(data arranged in 9 rows and 11 columns)
;
run;
title 'Distribution of Phosphorus in Used Aircraft Filters';
proc univariate data=pdata normal cbasic alpha = 0.05;
  var Phosphorus;
  probplot Phosphorus;
    Histogram / Normal (COLOR=red FILL)
                vaxis = axis1
                name = 'phist';
    inset n mean(5.3) std = 'Std Dev' (5.3) skewness(5.3)
           / pos = ne header = 'Summary Statistics';
    axis label = (a=90 r=0);
run;
```

The phosphorus data were converted to log by program command on the fourth line in the above program. The p-values for the four methods (Shapiro-Wilk, Kolmogorov-Smirnov, Cramer-von Mises, and Anderson-Darling) were calculated by the program. Meanwhile the distributions of S and Br were determined without log conversion.

The SAS PROC CORR procedure (Pearson Correlation) tested for the probability of observing a correlation coefficient or one more extreme under the null hypothesis so that the correlation (rho) is 0. The SAS code for the correlation of jet engine oil contaminant elements on filters was written as follows with the appropriate data for used and incident filters:

```
data corrpsb;
input Phosphorus Sulfur Bromine;
datalines;
(data arranged in columns)
;
run;
title 'Calculation and Test of Correlations, 95% CI for Used Filters';
ods output FisherPearsonCorr=corr;
proc corr data=corrpsb Fisher (biasadj=no);
var Phosphorus Sulfur Bromine;
run;
ods html;
ods graphics on;
proc corr data=corrpsb plots=scatter(alpha=.2 0.3);
var Phosphorus Sulfur Bromine;
run;
```

```
ods graphics off;
ods html close;
```

The PROC TTEST procedure was used to test for the equality of means of two sets of the same variable from used and incident filters.

```
Options nodate;
data filter (drop=Used);
input Category$ @;
do used=1 to 99;
input Phosphorus @;
output;
end;
datalines;
.......
;
run;
proc ttest data=filter Alpha=.05;
  class category;
  var Phosphorus;
run;
```

The PROC GML and PROC MIXED procedures were used for the analysis of variance (ANOVA) of mean values of identified contaminant elements from jet engine oil. The PROC GML procedure tested whether the set of data subjected to analysis had the same variability, i.e., whether the variance in the observation was the same. The PROC MIXED procedure was used with a repeated statement so that separate variance for each aircraft model could be calculated. The procedure included a Satterthwaite denominator degree of freedom adjustment. Appropriate SAS procedures were also used to graphically represent variances and spread of the data by box plots and scatter plots.

```
options nodate;
data filter;
input Filter_ID $ Aircraft $ Phosphorus Sulfur Bromine Category $;
datalines;
. . . . .(data in appendix A1)
;
run;
proc print data=filter;
run;
proc sort data=filter;
  by category aircraft;
proc boxplot data=filter;
  by category;
  plot Phosphorus*aircraft;
  run;
  proc boxplot data=filter;
```

```
  by category;
  plot Sulfur*aircraft;
run;
proc boxplot data=filter;
  by category;
  plot Bromine*aircraft;
run;
proc sort;
  by category;
run;
*Comparison of Used vs Incident;
proc glm data=filter;
   class category;
   model Phosphorus Sulfur Bromine = category/solution ss3;
   lsmeans category/pdiff stderr cl adjust=bon;
run;
quit;
proc sort data=filter;
  by category;
run;
proc glm data=filter;
  by category;
  class aircraft;
  model Phosphorus Sulfur Bromine = Aircraft/solution ss3;
  means aircraft/hovtest=bartlett hovtest=levene(type=abs)
           hovtest=BF hovtest=obrien(w=0.5) Welch;
  lsmeans Aircraft/pdiff stderr cl adjust=bon;
run;
quit;
symbol color=red value=circle;
symbol2 color=black;

*scatterplots to visualize variability of aircraft;
proc gplot data=filter;
  plot Phosphorus*aircraft=category;
run;
proc gplot data=filter;
  plot Sulfur*aircraft=category;
run;
proc gplot data=filter;
  plot Bromine*aircraft=category;
      run;
proc MIXED data=filter;
  by category;
  class aircraft;
  model Phosphorus = Aircraft/ddfm=satterth;
  repeated/group=aircraft;
  lsmeans aircraft/pdiff cl adjust=bon;
run;
quit;
proc MIXED data=filter;
  by category;
  class aircraft;
  model Sulfur = Aircraft/ddfm=satterth;
  repeated/group=aircraft;
  lsmeans aircraft/pdiff cl adjust=bon;
run;
```

```
quit;
proc MIXED data=filter;
   by category;
   class aircraft;
   model Bromine = Aircraft/ddfm=satterth;
   repeated/group=aircraft;
   lsmeans aircraft/pdiff cl adjust=bon;
run;
quit;
```

The following statement in the SAS code PROC GLM procedure:

```
model Phosphorus Sulfur Bromine = Aircraft/solution ss3;
means aircraft/hovtest=bartlett hovtest=levene(type=abs)
            hovtest=BF hovtest=obrien(w=0.5) Welch;
```

enables the program to perform four tests of homogeneity for each identified contaminant element: Levene's, O'Brien's, Brown and Forsythe's, Bartlett's and Welch's tests. The procedure tested for equal variances, i.e., whether the variances of means of one type of contaminant in different aircrafts were equal. In pairwise comparisons, the "adjust=bon" in the code accounted for the differences in sample sizes and produced Bonferroni adjusted p-values (Adj P).

The statement "`model Phosphorus=Aircraft/ddfm=satterth; model Phosphorus = Aircraft/ddfm=satterth;`" in PROC MIXED procedure allowed the program to calculate lsmeans and standard error for each aircraft model and adjusted for unequal variances. This approach averaged data points obtained from each filter and focused mainly on three identified contaminants: phosphorous, bromine, and sulfur.

2.4.2 Results and discussion

2.4.2.1 EDS assessment

The data revealed that all of the filters, regardless of manufacturer, clean, spiked with oil, or only used had common elements in different proportions. Each filter set produced different results, and the analyses of spots yielded different results with varying atomic weight of elements. The common elements are oxygen (O_2), sodium (Na), magnesium (Mg), aluminum (Al), silicon (Si), chlorine (Cl), potassium (K), calcium (Ca), zinc (Zn), and barium (Ba). The identified elements in clean, clean oil-spiked, used, and incident filters are listed in Tables 2.3, 2.4, 2.5, and 2.6 and as a combined used and incident filter listing in Appendix A1. The units are given in percentage of atomic weight values for each element. Although more than 20 elements

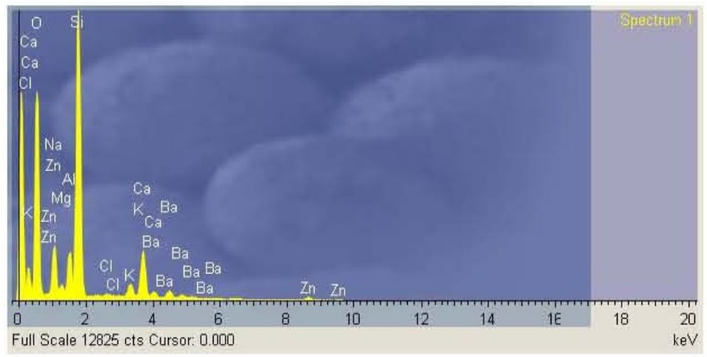
were identified in both used and incident filters, only three were identified as markers for jet engine oil contamination analysis after comparison with elements obtained from clean filters.

2.4.2.1.1 ***Distribution of elements in clean filters***

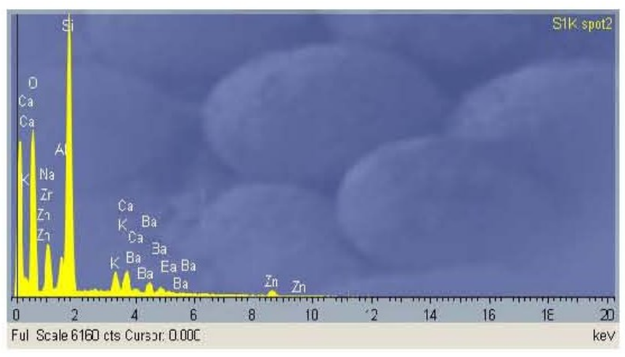
Table 2-2 shows variation of mean, standard variation of elements in clean filters samples from three filter manufacturers. The elemental composition of clean filters was computed from six different observations or spots analyzed from two samples obtained from a clean filter set. The elements observed in different proportions were O_2, Na, Mg, Al, Si, Cl, K, Ca, Zn, and Ba. The top row in Figure 2.4 shows elements present in the clean filters from Pall Aerospace Co., Keddeg Co., and Donaldson, and the bottom row shows corresponding elemental distributions. From Figure 2.4 it is evident that the EDS and qualitative analyses of clean filters had higher percentages of O_2 and Si, respectively. The EDS results are convincing evidence that Si and O_2 are the main elements in clean filters. The finding suggests that clean filters are mainly manufactured from silica (SiO_2). The spectra data show high oxygen content, which is most likely from SiO_2.

Table 2-2 Elements identified in clean filter samples from (a) Pall Aerospace Inc., (b) Keddeg Co. and (c) Donaldson Co.

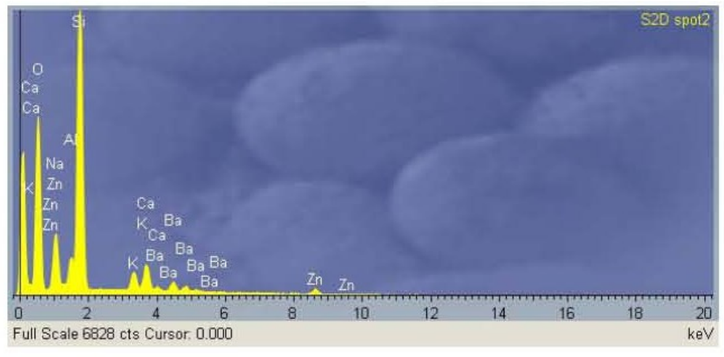
(a) Filter from Pall Aerospace Corporation					
Element	Number of observations	Mean atomic Weight %	Std. Dev.	Minimum	Maximum
Oxygen	6	69.9467	1.0550	67.8900	70.9300
Sodium	6	5.2400	0.6490	4.3800	5.9200
Magnesium	6	0.6750	0.0675	0.6200	0.7900
Aluminum	6	2.18500	0.2236	1.9600	2.5200
Silica	6	17.1750	0.4547	16.5400	17.8200
Chlorine	6	0.0750	0.0867	0.0000	0.2000
Potassium	6	0.8900	0.0919	0.7900	1.0500
Calcium	6	2.4083	0.5222	1.7700	2.9600
Zinc	6	0.8567	0.3058	0.6300	1.4700
Barium	6	0.5500	0.1101	0.4700	0.7700
(b) Filter from Keddeg Company					
Element	Number of observations	Mean atomic Weight %	Std. Dev	Minimum	Maximum
Oxygen	6	68.2000	0.6348	67.3800	69.3100
Sodium	6	5.6917	0.3394	5.1200	6.0300
Magnesium	6	0.0767	0.1878	0.0000	0.4600
Aluminum	6	2.2917	0.1619	2.1200	2.5400
Silica	6	19.0167	0.5260	18.1800	19.5900
Potassium	6	1.1133	0.1021	0.9700	1.2300
Calcium	6	1.6650	0.3473	1.3500	2.2100
Zinc	6	1.2083	0.1292	1.0300	1.3300
Barium	6	0.7350	0.0950	0.6300	0.8600
(c) Filter from Donaldson Company					
Element	Number of observations	Mean atomic Weight %	Std. Dev.	Minimum	Maximum
Oxygen	6	68.2217	1.4584	65.9400	70.1200
Sodium	6	5.8433	0.2041	5.6400	6.1600
Aluminum	6	2.2917	0.1270	2.1100	2.4700
Silica	6	18.9033	0.9346	17.7600	20.4000
Potassium	6	1.1717	0.1470	0.9800	1.4000
Calcium	6	1.5633	0.1711	1.3600	1.7800
Zinc	6	1.2283	0.2038	0.9900	1.5700
Barium	6	0.7767	0.1011	0.6700	0.9300



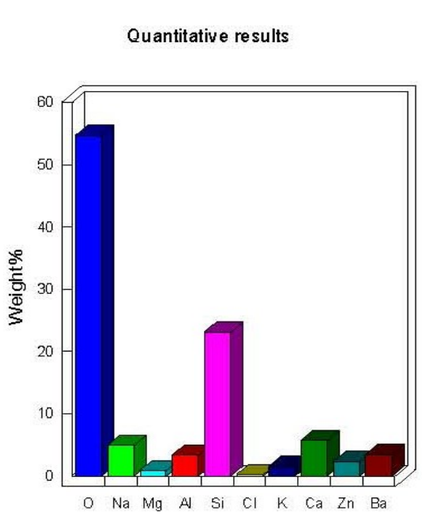
(a)



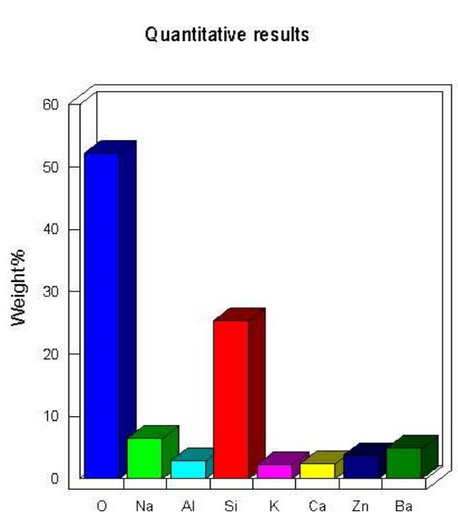
(b)



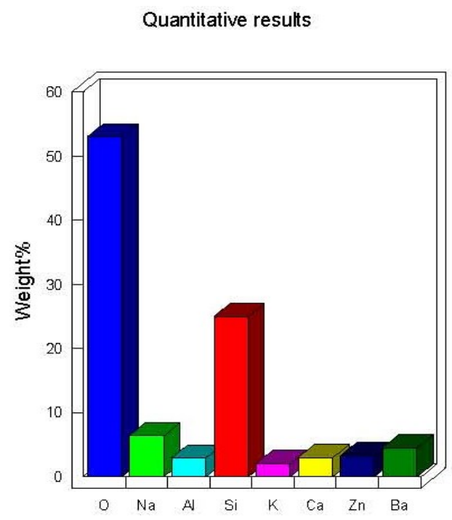
(c)



(d)



(e)



(f)

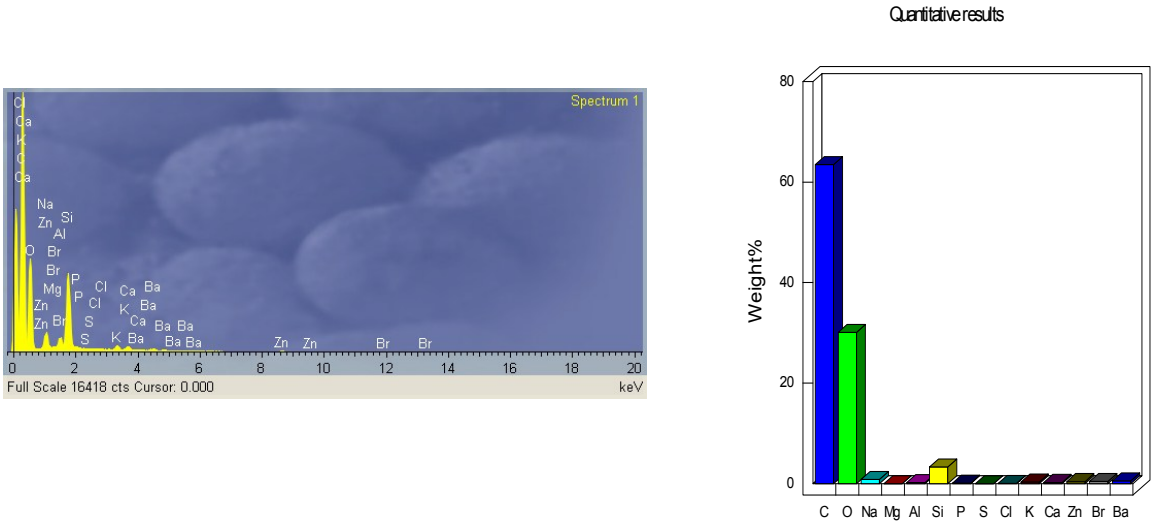
Figure 2.4 Top row – Atomic adsorption spectrum (EDS) of clean HEPA filter media manufactured by (a) Pall Aerospace Co., (b) Keddeg Co., and (c) Donaldson and bottom row – their corresponding qualitative composition of elements shown as (d), (e) and (f) respectively

2.4.2.1.2 ***Distribution of elements in clean filters spiked with Mobil Jet Oil II***

An analysis of the clean filter spiked with Mobil Jet Oil II showed that carbon (C), sulfur (S), phosphorus (P), and bromine (Br) were introduced by adding oil to the filter. The mean atomic weight percentage values for other elements decreased compared to clean filters. The elemental distribution in clean filter spiked with jet engine oil indicates that the elements were present in both the filter and Mobil Jet Oil II. The new elements that altered the elemental distribution are P, S, and Br. Table 2-3 shows the distribution of elements in clean filters spiked with Mobil Jet Oil II. When the clean filter and spiked filter samples are compared, the trails left by Mobil Jet Oil II on cabin air filters are clear and consists of C, P, S, and Br. Carbon with a mean atomic weight percentage value of 60.4% is the main constituent element in the clean filter samples that were spiked with jet oil.

Table 2-3 Elements identified in clean filter media spiked with Mobil Jet Oil II

Element	Number of observations	Mean atomic weight %	Std. Dev.	Minimum	Maximum
Carbon	6	60.4233	7.9906	44.8400	65.3700
Oxygen	6	33.7533	5.5572	30.0500	44.5400
Sodium	6	1.0283	0.4372	0.6800	1.8500
Aluminum	6	0.3600	0.1728	0.1900	0.6700
Silica	6	3.5117	1.4797	2.5200	6.3900
Phosphorus	6	0.0467	0.0121	0.0300	0.0600
Sulfur	6	0.0150	0.0084	0.0100	0.0300
Potassium	6	0.2200	0.0121	0.1500	0.3900
Calcium	6	0.2650	0.1537	0.1300	0.1500
Zinc	6	0.1783	0.0924	0.1000	0.5300
Bromine	6	0.0850	0.0517	0.0000	0.1500
Barium	6	0.1233	0.0532	0.0800	0.2200



(a) (b)

Figure 2.5 (a) EDS spectrum (b) Elemental distribution of clean filter spiked with Mobil Jet Oil II

2.4.2.1.3 ***The distribution of elements in used and incident filters***

Based on the above results, C, P, S, and Br are potential markers for oil on the cabin filters. Carbon was not considered further because it is known to have multiple, significant sources otherwise present on aircraft filters (e.g., lint, human skin flakes, etc.). This leaves P, S, and Br as potential markers. Based on the investigation of the 110 used filters across seven aircraft models, the study showed that 100 percent of filters had traces of these three elements. Likewise, nearly 100 percent of the incident filters also have these elements present. The mean (range) atomic weight percent of P concentrations for used filters was 0.052 (0.007, 0.144) and for incident filters 0.032 (0.005, 0.080). Figures 2.6 and 2.7 depict the variability of filter contaminant elements from jet engine oil. In contrast, the average P levels were slightly lower in incident filters. The differences in variability could be due to the short periods that incident filters might have remained installed in the aircraft because incident filters were removed from the aircraft soon after an incident was suspected to have occurred.

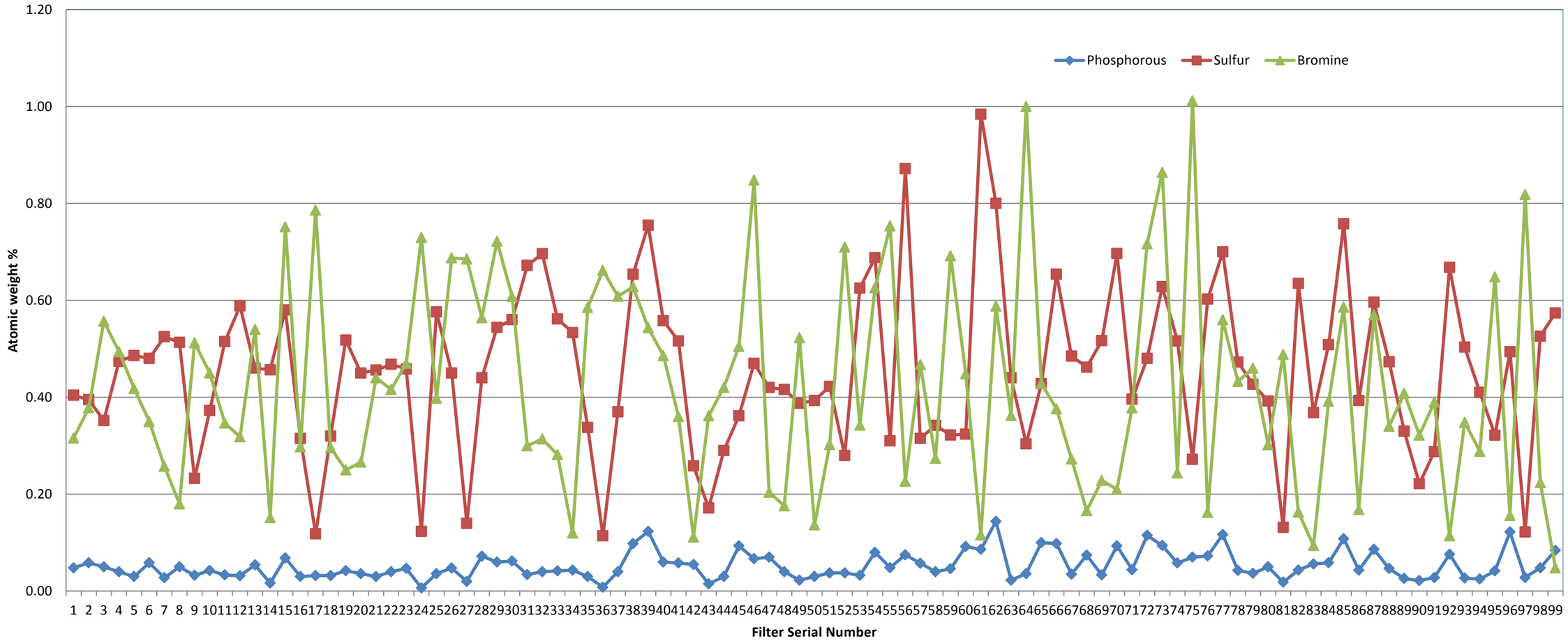


Figure 2.6 Variability of phosphorus, sulfur and bromine in used filters

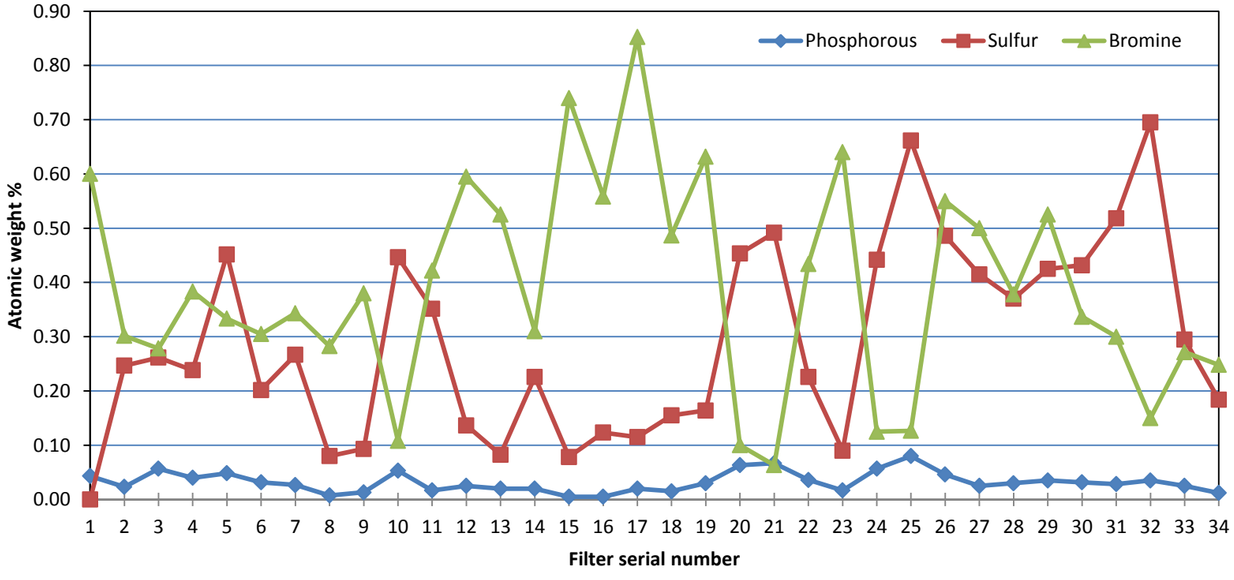
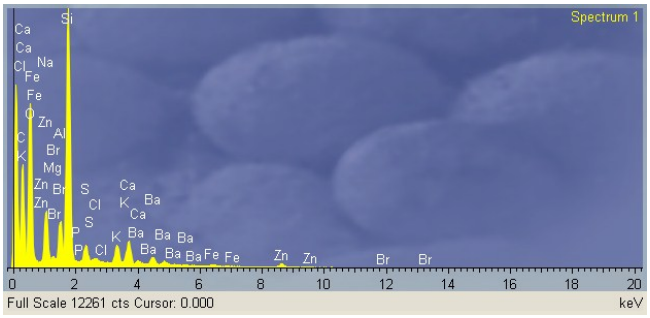
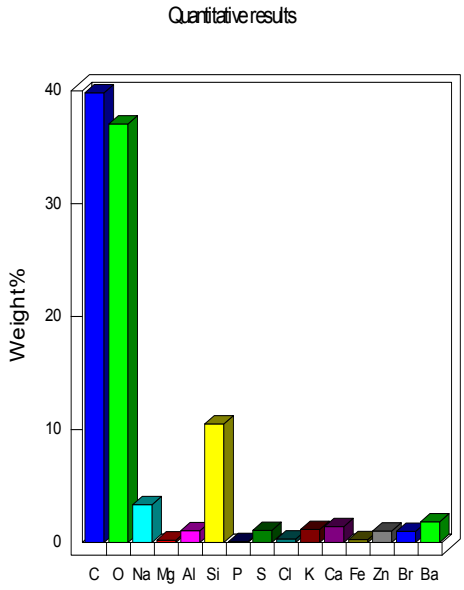


Figure 2.7 Variability of phosphorus, sulfur and bromine in incident filters





(a) (b)

Figure 2.8 (a) EDS Spectrum and (b) elemental composition of used filter ID-9RZMC2

Figures 2.8 (a) and (b) above and the data in appendices A1 and A2 show that C and O_2 make up more than 94.0% of the elements present in the used and incident filters. Of the 99 used filters investigated, one filter had traces of arsenic. Other elements that showed up as traces in some filters included: cesium, titanium, lead, and chromium. However, data sets for the clean, spiked, used, and incident filters clearly identified P, S, and Br as potential markers for jet engine oil contamination and showed that their levels were detectable.

2.4.2.1.4 ***Statistical analysis of identified contaminant elements in used and incident filters: Results of first approach***

Table 2-4 Summarized descriptive statistics of normality test results for elemental contaminants from Mobil Jet Oil II identified in used and incident filters

Used Filters (99)						
Element	Method of Test for Normality	p-value	Mean weight %	Std. Dev.	Maximum	Minimum
Phosphorus	Shapiro-Wilk	0.5193	–3.0885 (0.0524)	0.5517 (0.02778)	(0.0067)	(0.1440)
	Kolmogorov-Smirnov	> 0.1500				
	Cramer-von Mises	0.2500				
	Anderson-Darling	0.2500				
Sulfur	Shapiro-Wilk	0.2933	0.4564	0.1663	0.1140	0.9840
	Kolmogorov-Smirnov	> 0.1500				
	Cramer-von Mises	0.2500				
	Anderson-Darling	0.2500				
Bromine	Shapiro-Wilk	0.0246	0.4253	0.2127	0.4800	1.0120
	Kolmogorov-Smirnov	0.1500				
	Cramer-von Mises	0.0792				
	Anderson-Darling	0.0628				
Incident Filters (34)						
Phosphorus	Shapiro-Wilk	0.0936	–1.3921 (0.0320)	0.6580 (0.0184)	(0.0500)	(0.0800)
	Kolmogorov-Smirnov	0.1500				
	Cramer-von Mises	0.2500				
	Anderson-Darling	0.2118				
Sulfur	Shapiro-Wilk	0.1129	0.2913	0.1777	0.0000	0.6950
	Kolmogorov-Smirnov	> 0.1500				
	Cramer-von Mises	0.0985				
	Anderson-Darling	0.0948				
Bromine	Shapiro-Wilk	0.5309	0.3878	0.1924	0.0633	0.8525
	Kolmogorov-Smirnov	0.5309				
	Cramer-von Mises	>0.1500				
	Anderson-Darling	>0.2500				

N.B: Minus numbers are $\log_{10}$ of values of P.

The p-values for normality test from the SAS code PROC UNIVARIATE were used to determine the distribution of P on used and incident filters as shown in Table 2-4. All the p-values for normality tests are greater than 0.05. There was no significant evidence for rejecting the assumption of normality. Therefore, the computed test statistic for distribution of P supported the hypothesis of normality. However two outliers in data distribution were omitted.

The output of PROC CORR procedure:

Calculation and Test of Correlations, 95% CI for Used Filters

The CORR Procedure

Pearson Correlation Coefficients, N = 99

Prob > |r| under H0: Rho=0

	Phosphorus	Sulfur	Bromine
Phosphorus	1.00000	0.58591	0.07262
		<.0001	0.4750
Sulfur	0.58591	1.00000	-0.28531
	<.0001		0.0042
Bromine	0.07262	-0.28531	1.00000
	0.4750	0.0042	

Calculation and Test of Correlations, 95% CI for Incident Filters

The CORR Procedure

Pearson Correlation Coefficients, N = 34

Prob > |r| under H0: Rho=0

	Phosphorus	Sulfur	Bromine
Phosphorus	1.00000	0.65239	-0.56459
		<.0001	0.0005
Sulfur	0.65239	1.00000	-0.62509
	<.0001		<.0001
Bromine	-0.56459	-0.62509	1.00000
	0.0005	<.0001	

The Pearson correlation procedure was used to calculate the correlation coefficients and prints the entire correlation matrix, which includes p-values as well as descriptive statistics. The p-values obtained by running SAS code PROC CORR procedure for used filters showed some significant levels of correlation between potential marker elements. They were as follows: P versus S is significant ($r = 0.65239$; p-value < 0.0001); S versus Br is significant ($r = 0.63509$; p-value <0.0001). But the correlation for P versus Br was not significant ($r = – 0.56459$, and p-value <0.0005). On the other hand, for incident filters, P versus S was significant ($r = 0.58591$, and p-value < 0.0001), and S versus Br was significantly correlated ($r = – 0.28531$, and p-value = 0.0042). However, P versus Br was not significantly correlated ($r = 0.07262$, and p-value = 0.4750). A comparison of the p-values for used and incident filters suggested that contaminant elements in the used filters were more highly correlated than were in the incident filters.

The output of the PROC TTEST procedure is shown below:

Variable: Phosphorus

Category	N	Mean	Std Dev	Std Err	Minimum	Maximum
Incident	34	0.0320	0.0184	0.00315	0.00500	0.0800
Used	99	0.0524	0.0278	0.00280	0.00670	0.1440
Diff (1-2)		-0.0204	0.0258	0.00512		

Category	Method	Mean	95% CL Mean		Std Dev	95% CL Std Dev	
Incident		0.0320	0.0256	0.0384	0.0184	0.0148	0.0242
Used		0.0524	0.0469	0.0579	0.0278	0.0244	0.0323
Diff (1-2)	Pooled	-0.0204	-0.0305	-0.0103	0.0258	0.0230	0.0293
Diff (1-2)	Satterthwaite	-0.0204	-0.0288	-0.0120			

Method	Variances	DF	t Value	Pr > |t|
Pooled	Equal	131	-3.98	0.0001
Satterthwaite	Unequal	87.29	-4.84	<.0001

Equality of Variances

Method	Num DF	Den DF	F Value	Pr > F
Folded F	98	33	2.30	0.0080

The SAS code for PROC TTEST procedure above shows that the means of used and incident filters are not equal (p-value = 0.0001). Therefore, the Satterthwaite method for testing of inequality was considered. The Folded F test had a p-value = 0.0080, suggesting that the inequality of variances in means for the used and incident filters is statistically significant at the 10% level. The PROC GLM procedure was used to perform ANOVA by using a pairwise comparison of means, standard deviations, and confidence intervals of phosphorus data from used and incident filters.

Table 2-5 shows the homogeneity tests. The homogeneity tests for all p-values were less than 0.1, indicating that unequal variances for P and Br were statistically significant. For S, all p-values were greater than 0.1, suggesting than the variability of means of S was not significant in used filters. For incident filters, the p-values for all the tests of homogeneity for P and S were greater than 0.1, suggesting that the unequal variances were not statistically significant, whereas for Br, unequal variance was statistically significant.

Table 2-5 ANOVA – Test for homogeneity of jet engine oil contaminants variance in used and incident filters

ANOVA for jet engine oil contaminant elements in used filters			
Test method	p-value for P	p-value for S	p-value for Br
Levene's test	0.0026	0.3062	0.0066
O'Brien's test	0.0810	0.4683	0.0192
Brown and Forsythe's test	0.0192	0.3214	0.0100
Bartlett's test	0.0002	0.2079	0.0106
Welch's test	0.0006	0.0478	0.0626
ANOVA for jet engine oil contaminant elements in incident filters			
Levene's test	0.1311	0.0833	0.0169
O'Brien's test	0.3384	0.4007	0.0535
Brown and Forsythe's test	0.1400	0.2132	0.0154
Bartlett's test	0.2548	0.0892	0.0349
Welch's test	0.4063	0.0075	0.0065

----------Category=Used ----------

The Mixed Procedure

Type 3 Tests of Fixed Effects (Response = P)

Effect	Num DF	Den DF	F Value	Pr > F
Aircraft	4	15.8	3.18	0.0003

Least Squares Means

Effect	Aircraft	Estimate	Standard Error	DF	t Value	Pr > |t|	Alpha	Lower	Upper
Aircraft	A320	0.03964	0.004042	10	9.81	<.0001	0.05	0.03063	0.04864
Aircraft	B737	0.05534	0.009072	10	6.10	0.0001	0.05	0.03512	0.07555
Aircraft	B747	0.03263	0.002634	10	2.39	<.0001	0.05	0.02676	0.03850
Aircraft	B767	0.04792	0.008214	5	5.83	0.0021	0.05	0.02680	0.06903
Aircraft	B777	0.05828	0.003899	59	14.95	<.0001	0.05	0.05047	0.06608

Differences of Least Squares Means

Effect	Aircraft-Aircraft	Estimate	Standard Error	DF	t Value	Pr > |t|	Adjustment	Adj P
Aircraft	A320 B737	-0.01570	0.009932	13.8	-1.58	0.1365	Bonferroni	1.0000
Aircraft	A320 B747	0.007009	0.004825	17.2	1.45	0.1643	Bonferroni	1.0000
Aircraft	A320 B767	-0.00828	0.009155	7.5	-0.90	0.3939	Bonferroni	1.0000

Aircraft	A320	B777	-0.01864	0.005616	32.5	-3.32	0.0022	Bonferroni	0.0298
Aircraft	B737	B747	0.02271	0.009447	11.7	2.40	0.0338	Bonferroni	0.2465
Aircraft	B737	B767	0.007420	0.01224	14.1	0.61	0.5540	Bonferroni	1.0000
Aircraft	B737	B777	-0.00294	0.009874	14	-0.30	0.7704	Bonferroni	1.0000
Aircraft	B747	B767	-0.01529	0.008626	6.05	-1.77	0.1263	Bonferroni	0.8953
Aircraft	B747	B777	-0.02565	0.004705	56.1	-5.45	<.0001	Bonferroni	0.0002
Aircraft	B767	B777	-0.01036	0.009092	7.47	-1.14	0.2898	Bonferroni	1.0000

The results for the PROC MIXED procedure for used filters suggests that the pair-wise comparison between the means of A320 versus B777 and B747 versus B777 were statistically significantly different ($p = 0.0298$ and 0.0002, respectively). This could be due to disproportionately high filter sample size for the affected aircrafts (Refer to Table 2.1). Otherwise, the overall p-values of pair-wise comparisons of aircraft models with Bonferroni adjustment at $\alpha = 0.05$ were not significant for other pairwise comparisons, suggesting that aircraft model has no role in P concentrations.

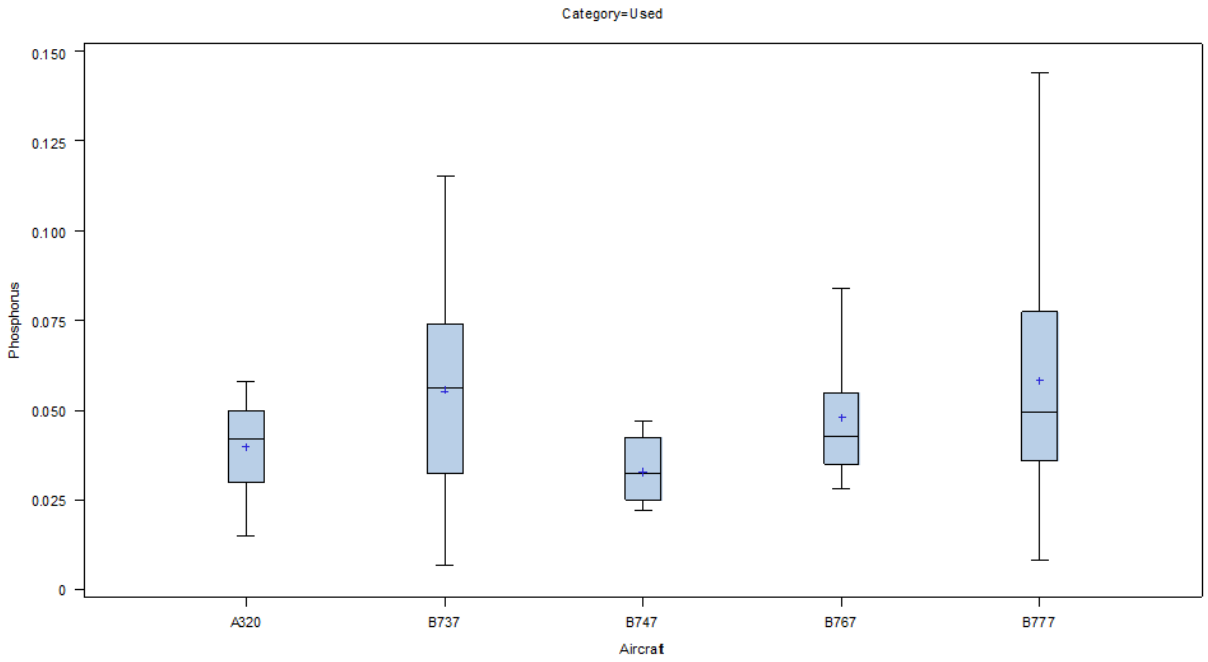
---------- Category=Incident ----------

The Mixed Procedure

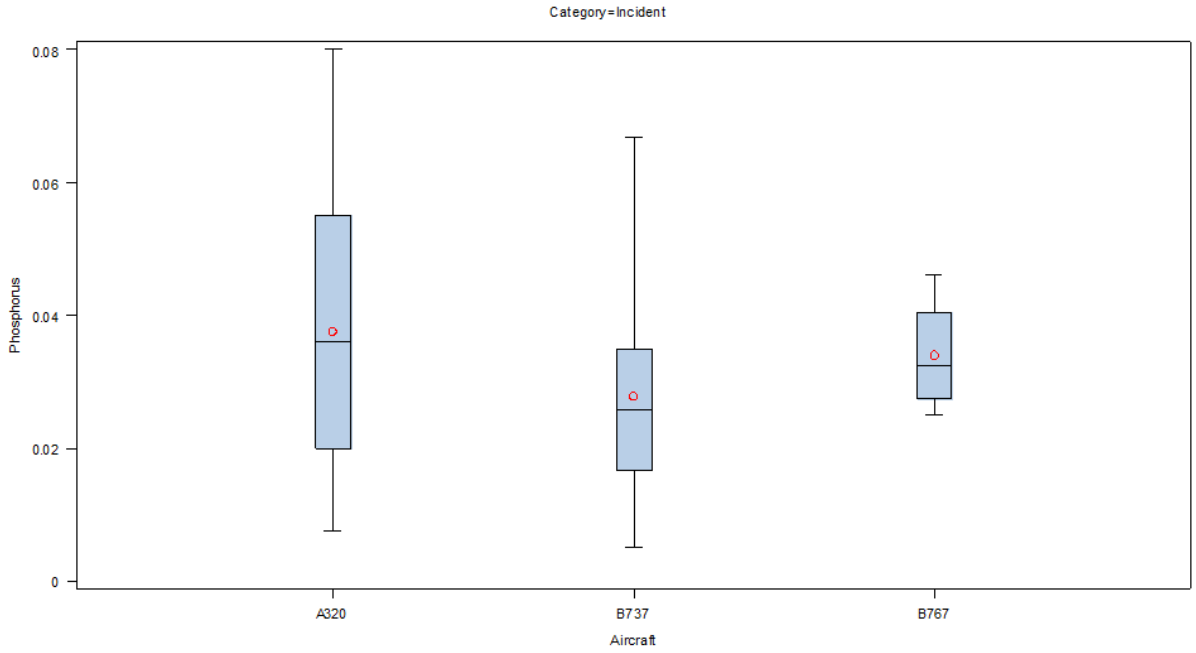
Type 3 Tests of Fixed Effects (Response = P)

Effect	Num DF	Den DF	F Value	Pr > F
Aircraft	2	13.6	1.02	0.3865

The output of PROC MIXED procedure for incident filters had p-value = 0.3865, suggesting that the aircraft type has no effect on phosphorus concentration. The effect of aircraft model was not significant in average concentration levels of phosphorus found in filters. Figures 2.9 (a) and (b); 2.10 (a) and (b); and 2.11 (a) and (b) show the box plots of mean percent atomic weights of P, S, and Br in both used and incident filters for different aircraft frame models covered by the study. Meanwhile, Figures 2.12 through 2.14 show the scatter plots for P, S, and Br in different aircrafts. These scatter plots show the spread of mean atomic weight percent of P, S, and Br and the outliers.

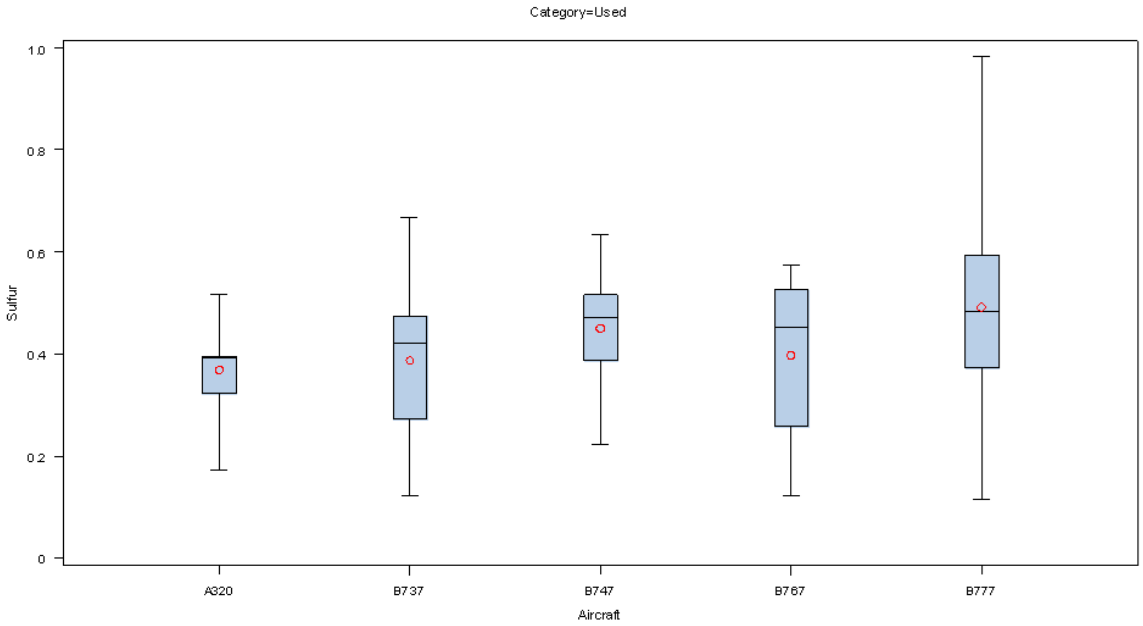


(a)

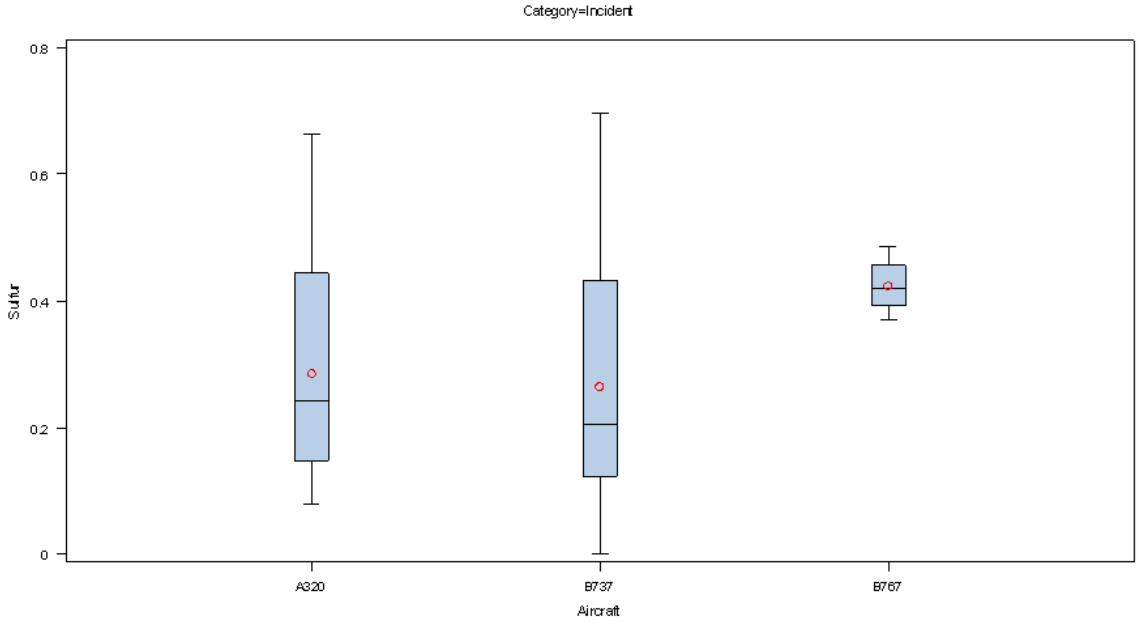


(b)

Figure 2.9 Box plots showing variability of mean atomic weight percent of phosphorus in (a) used and (b) incident filters from different aircraft types

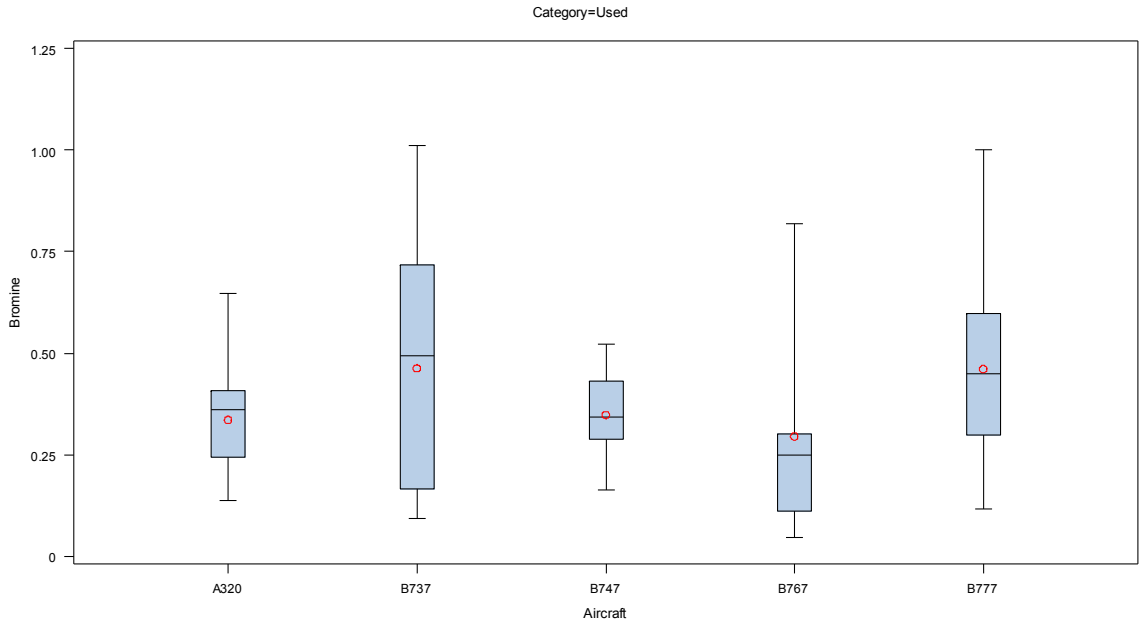


(a)

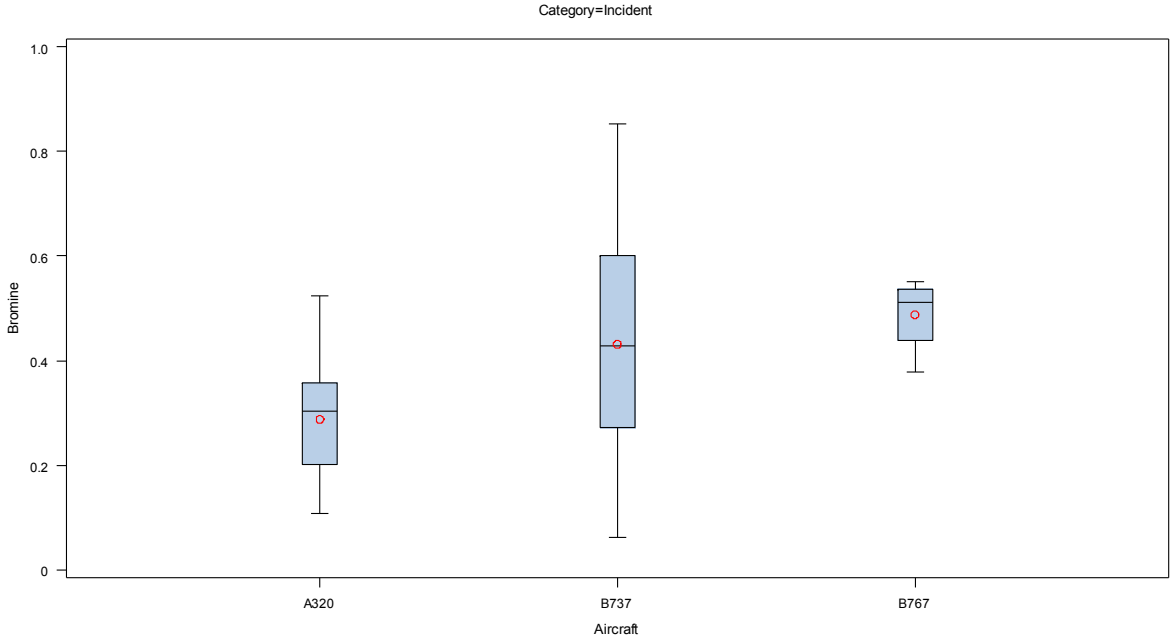


(b)

Figure 2.10 Box plots showing variability of mean atomic weight percent of sulfur in (a) used and (b) incident filters from different aircraft types



(a)



(b)

Figure 2.11 Box plots showing variability of mean atomic weight percent of bromine in (a) used and (b) incident filters from different aircraft types

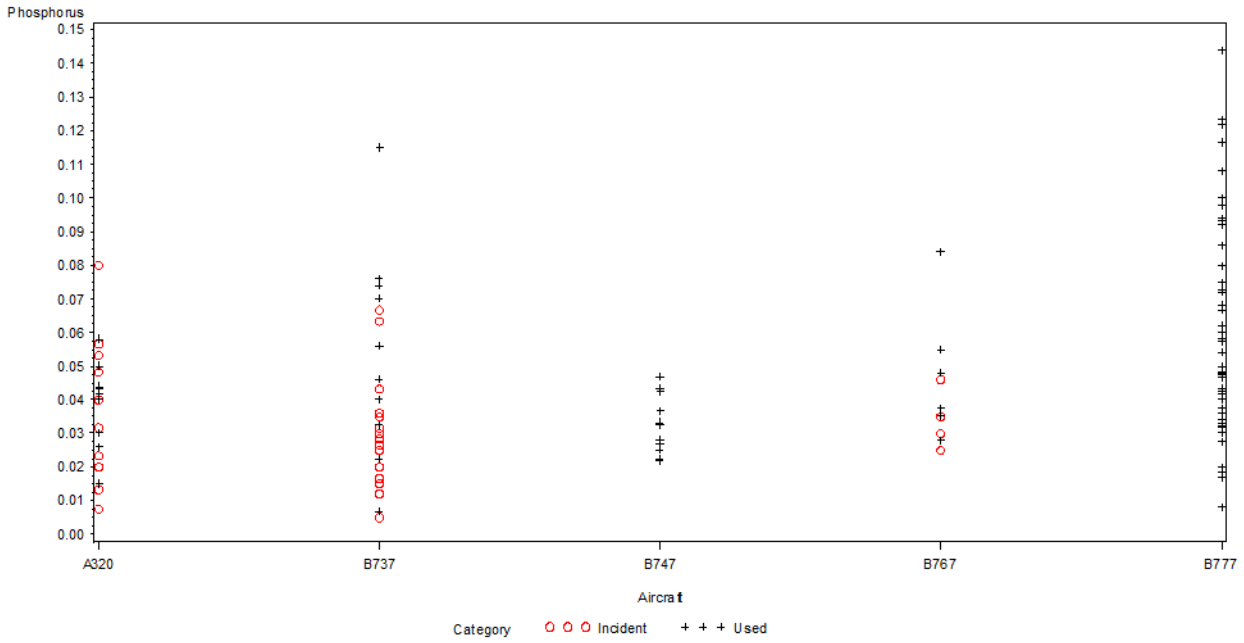


Figure 2.12 Scatter plots of mean atomic weight percent of phosphorus in used and incident filters from different aircraft types

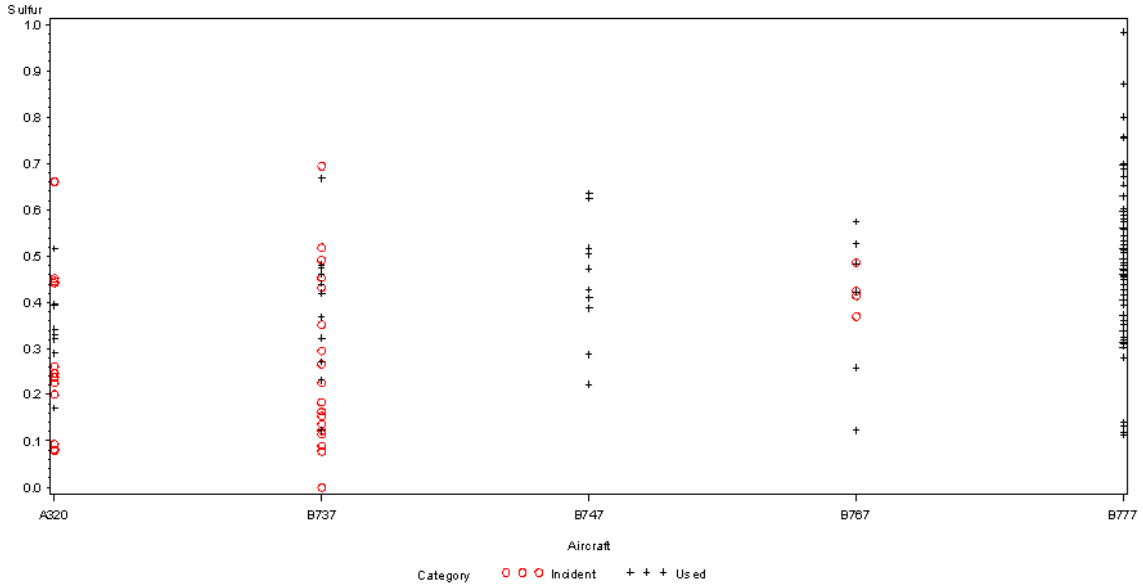


Figure 2.13 Scatter plots of mean atomic weight percent of sulfur in used and incident filters from different aircraft types

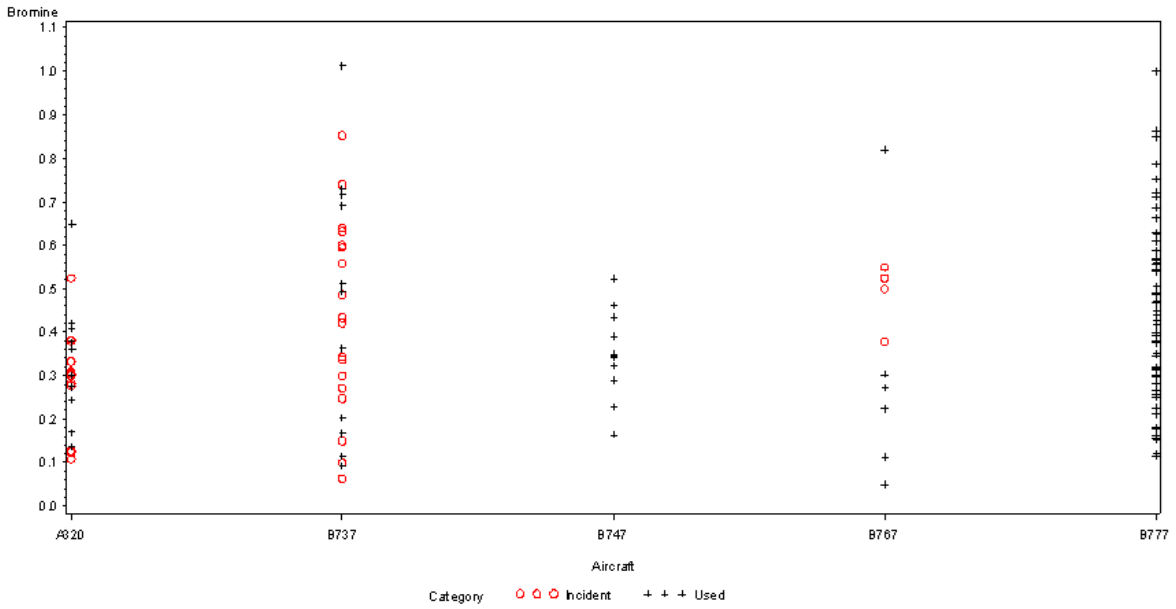


Figure 2.14 Scatter plots of mean atomic weight percent of bromine in used and incident filters from different aircraft types

2.4.2.2 Further assessment of P, S, and Br as markers for jet engine oil on aircraft filters

In additional analyses, all filters and every measured data point (not averaged spot values) were used in Excel to compute the correlations of P, Br, S, C, O_2, and Si. The nearly ubiquitous presence of P, S, and Br on used filters made it difficult to attribute their presence uniquely to oil. While the statistical analysis indicated some significant correlations, the strength of the correlations also was not enough to make a convincing argument that the presence of these elements was uniquely due to jet engine oil. To better understand the nature of these deposits, the individual specimen data presented in Appendices A.1 and A.2 were plotted in pair-wise combinations in Figures 2.15 through 20. Consistent with the statistical analysis, P and S were correlated suggesting some commonality of source, but the wide scatter indicates multiple, independent sources as well. Bromine shows no or negative correlation with P and S, again consistent with the statistical analysis, which indicates no commonality of source.

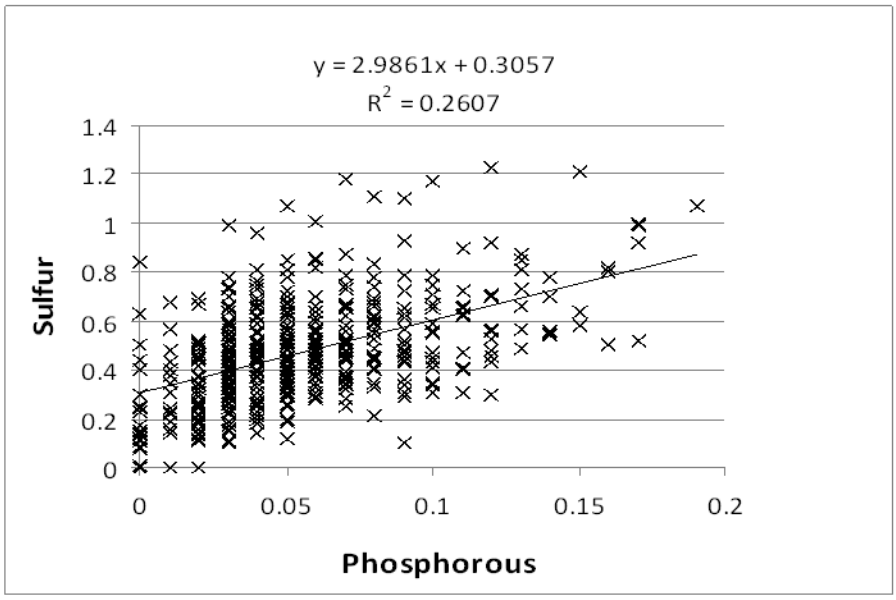


Figure 2.15 Comparison of Sulfur and phosphorus in used filters

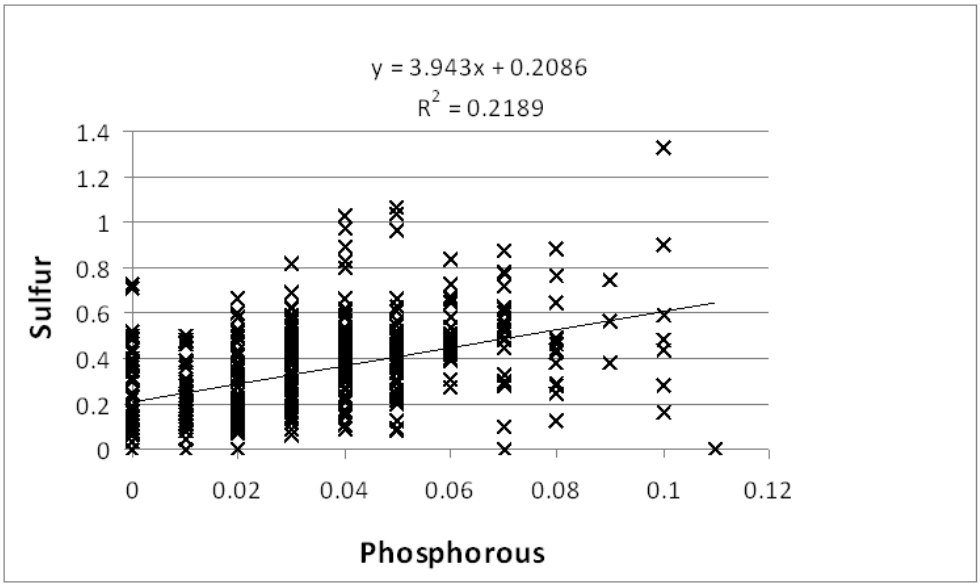


Figure 2.16 Comparison of sulfur and phosphorus in incident filters

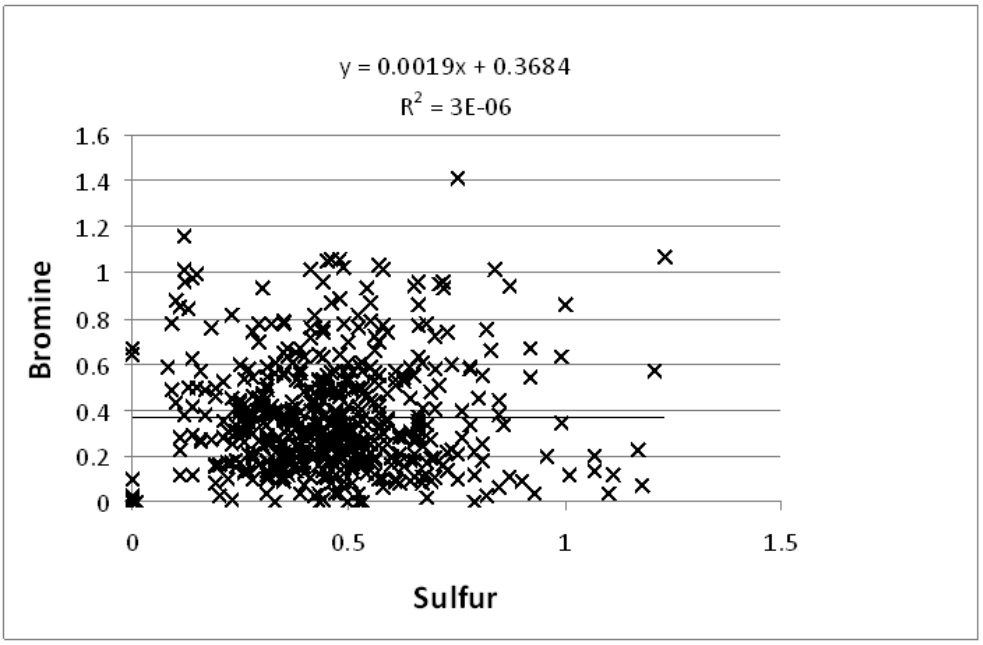


Figure 2.17 Comparison of bromine and sulfur in used filters

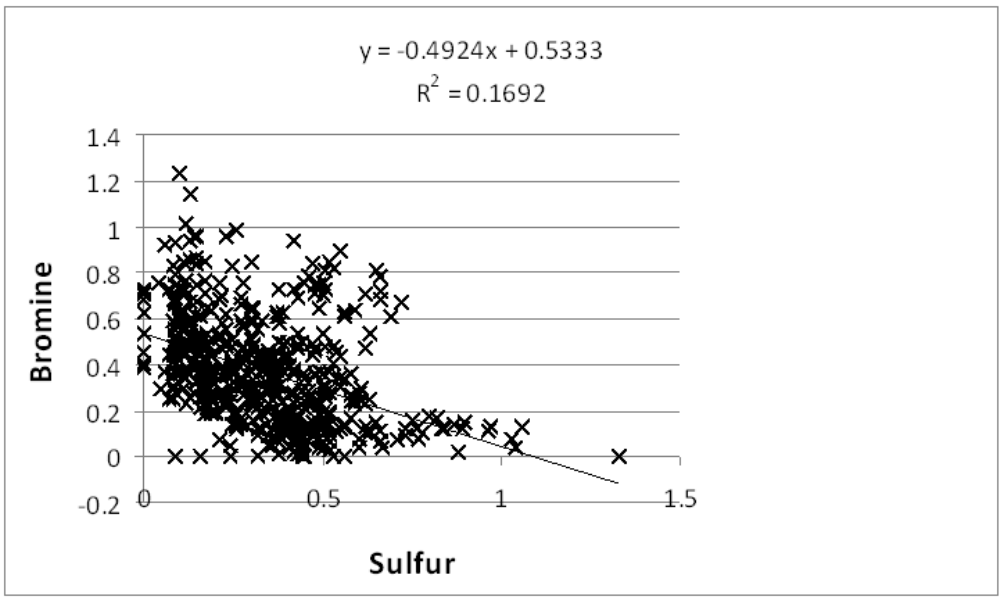


Figure 2.18 Comparison of bromine and sulfur in incident filters

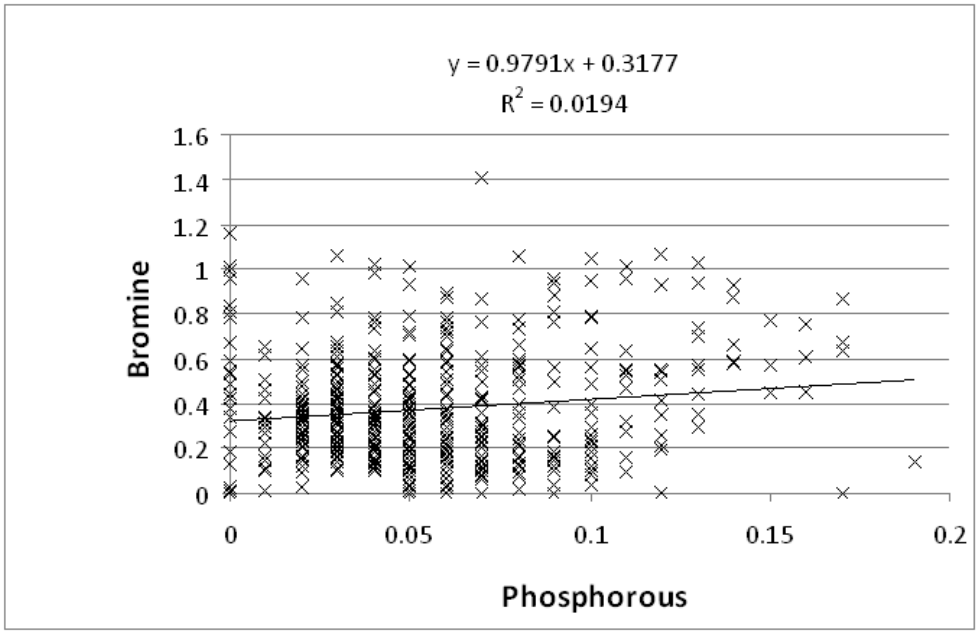


Figure 2.19 Comparison of bromine and phosphorus in used filters

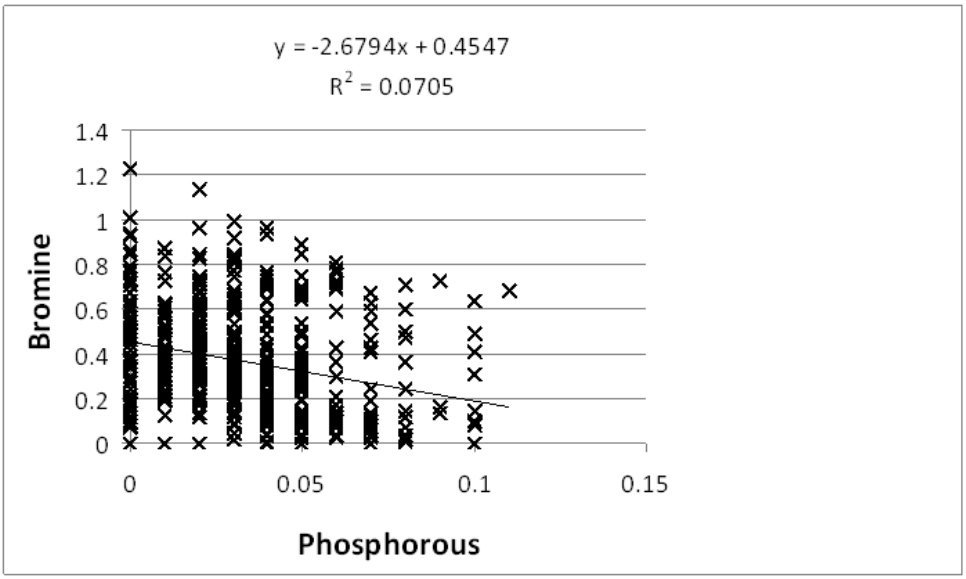


Figure 2.20 Comparison of bromine and phosphorus in incident filters

In examining the data, it is important to note that FESEM/EDS results were provided in percent of elements measured. The data are not absolute values. Since the FESEM/EDS method only examines the surface, these numbers are roughly a percent of the surface area, ignoring the fact that FESEM/EDS technique does not detect all elements. It is also important to remember

that FESEM/EDS looks at an area that is small compared to the surface texture of filter media. Thus, some measurement locations may look deeper into the filter than others.

Carbon was not expected to be a useful indicator of oil because it is present on filters in other forms. However, it is useful to look at the nature of carbon deposits on filters to understand how other results may be affected. Since results are in percent of total "atomic weight," a large amount of carbon will necessarily decrease the amount of the other elements seen. Figures 2.21 and 2.22 show how carbon deposits relate to silicon and oxygen. The clusters of points in the scatter plots roughly appear to form a straight line, suggesting that a linear relationship exists between carbon and silicon, and oxygen respectively. For brevity, only the used filter results are presented, but the results for the incident filters are nearly identical. The very strong negative correlations seem quite surprising. However, the filter media may be composed primarily of silicon oxide (glass). The strong negative correlation results from the carbon deposits covering up the media, the silicon oxide. Finally, the relationships of P, S, and Br to carbon on the filters are shown in Figures 2.23 through 2.25. P and S occur pretty much randomly with carbon, but Br has a clear negative correlation with carbon. These results indicate that P and S are deposited along with the carbon on the filter. That is, carbon does not simply cover up the P and S when it is deposited. Bromine, on the other hand, tends to be covered up by the carbon deposits. Bromine deposits are thus different from the S and P deposits, indicating that much of the Br comes from sources other than those for P and S.

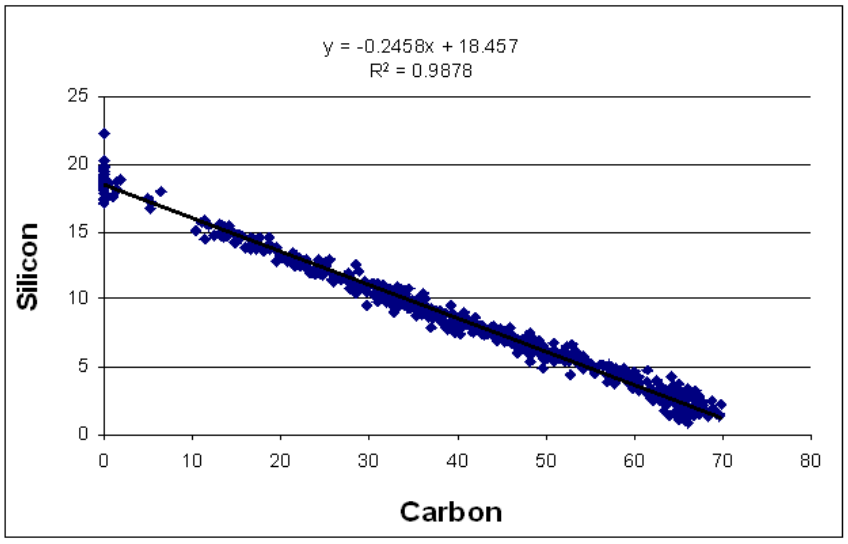


Figure 2.21 Decrease in silicon with increasing carbon in used filters

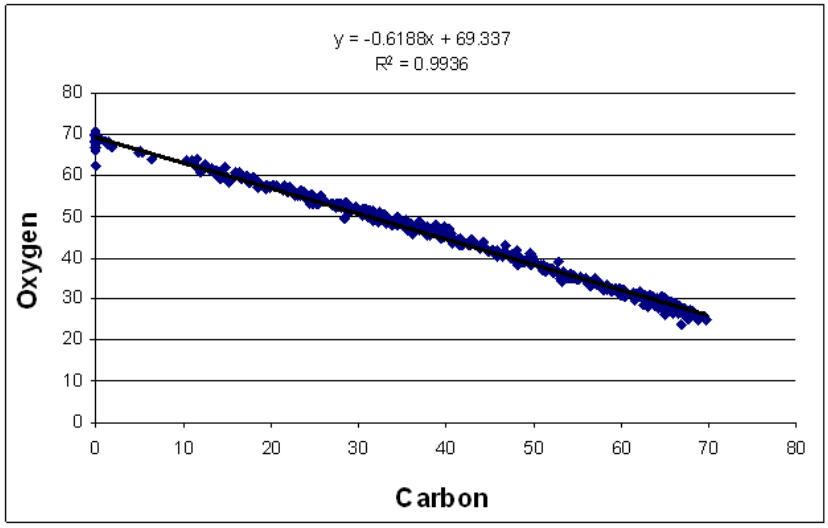


Figure 2.22 Decrease in oxygen with increasing carbon in used filters

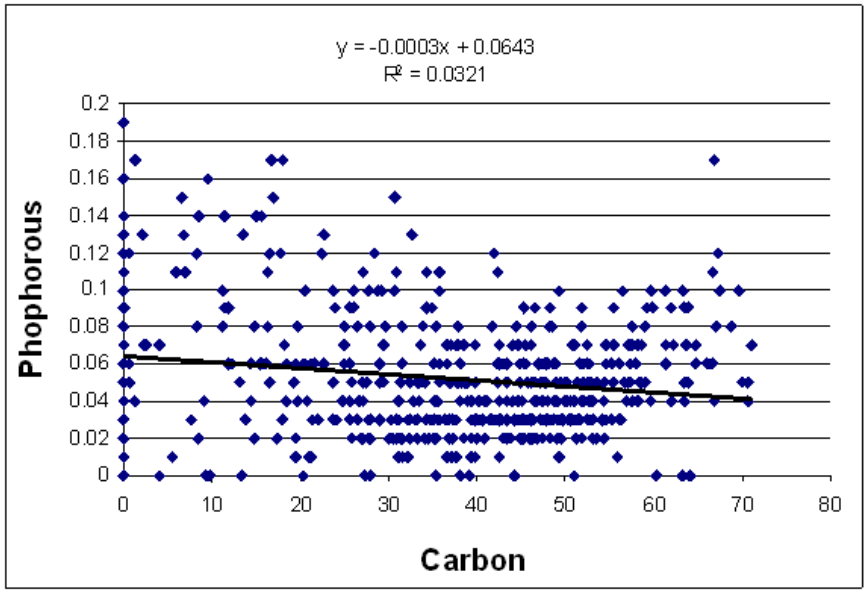


Figure 2.23 Relationship of phosphorus with carbon in used filters

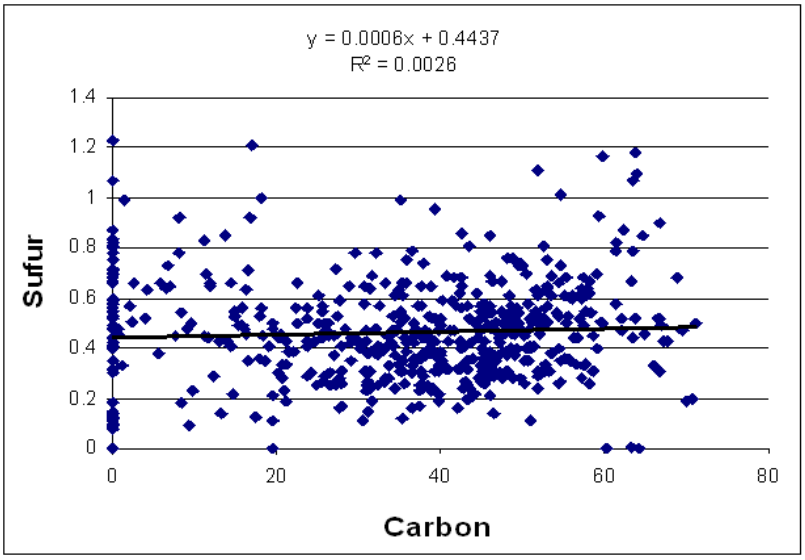


Figure 2.24 Relationship of sulfur with carbon in used filters

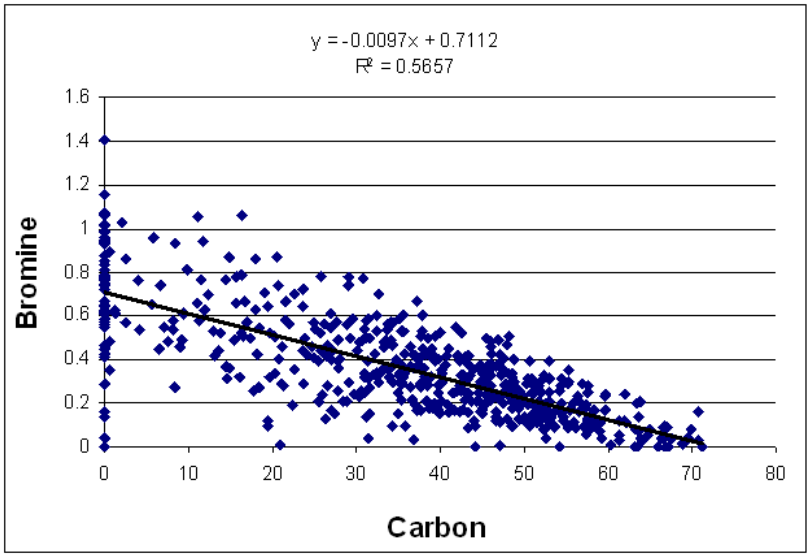


Figure 2.25 Relationship of bromine with carbon in used filters

Flame retardants, which are included in many cabin materials, including carpets, upholstery, and plastics, contain Br and generally do not contain S or P. Gerecke (2007) found high concentrations of polybrominated diphenyl ethers (PBDEs) in a sample of settled airplane dust. It should be no surprise then that bromine is present on most, if not all, filters and, that its presence would be different than P and S. Exactly why it tends to be covered up by carbon, while P and S do not, is unknown at this point but is not a factor in excluding it as an effective marker for oil using FESEM/EDS.

2.4.2.2.1 ***Microscopic analysis of clean, used and incident filters***

In addition to clean filter elemental composition, the morphology of the clean fibers was also of interest, because these elements fuse to form non-crystalline fibers due to high temperature exposure during the molding and extrusion of glass fibers and subsequent rapid cooling. Figure 2.32 shows a scanning electron micrograph of a sample from a clean filter manufactured by Keddeg Company.

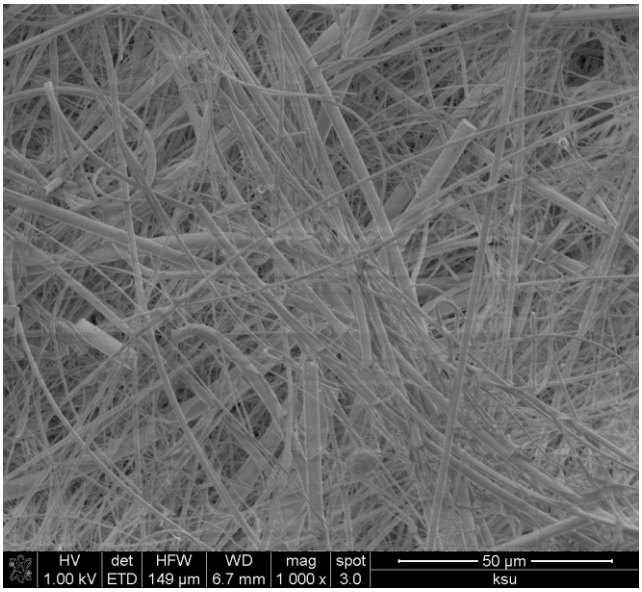


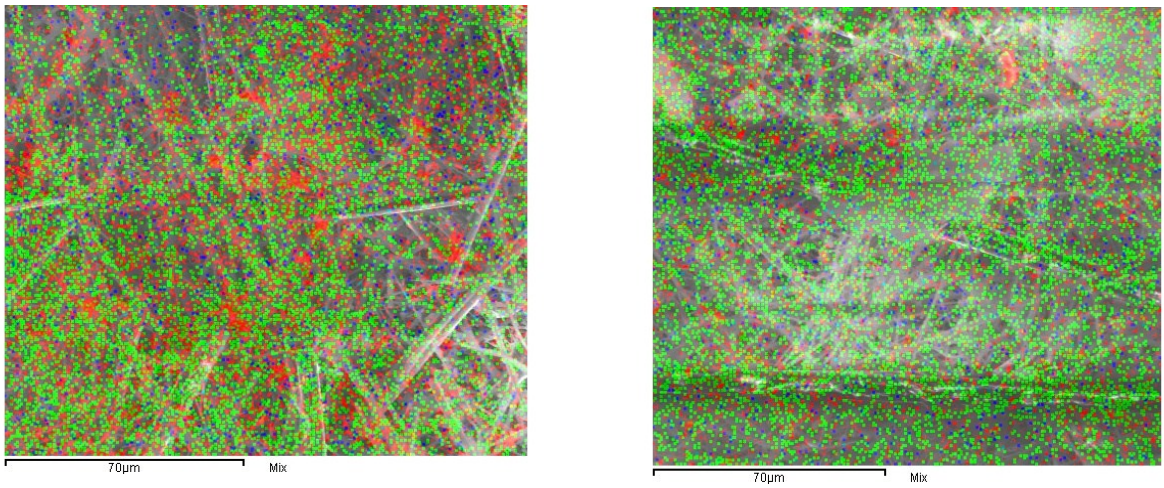
Figure 2.26 Electron micrograph of clean HEPA filter manufactured by Keddeg Co.

Microscopic examination of the clean filter samples from three filter manufacturers showed that fibers consisted of high-purity, ultra-long intertwined glass fibers. The filter fibers were very clearly preserved and show precise long string like structures. As shown in Figure 2.32, the micrographs indicate that each clean filter fiber had a uniform diameter along its entire length and most glass fibers had smooth surfaces. The high magnification observations also showed that the glass fibers exhibited a single crystalline nature without apparent lattice defects. The binder, a blue coating, is clearly visible between the glass fibers.

2.4.2.2.2 ***Mixed maps***

Mixed maps were obtained from photos taken by FESEM as it skimmed over the filter surface; voltages ranged from 1 to 18 kV during the analysis. This study mapped the surface of the aircraft cabin air filters to a resolution fine enough to determine particulates deposited on the

surface. The mixed maps in Figure 2.33 show the morphological features of elements deposited on used filter surfaces. Only three elements could be represented at a time. Under the experimental conditions, no clear differences between used and incident filters could be found. However, when used and incident filters were compared to clean filters, there was evidence of P, S, and Br pigmentation in the used and incident filters.



(a) Filter ID DAW454 (b) Filter ID FTRT75

Key: Green = Phosphorous, Red = Sulfur and Blue = Bromine

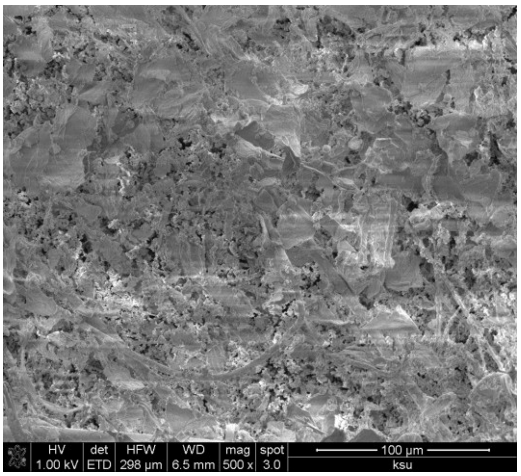
Figure 2.27 Mixed elemental maps for P, S and Br in used filter samples

Carbon was abundant in both the used and incident filters. Some possible sources of carbon could be soot and dead skin cells from human bodies. The elemental maps produced in the FESEM/EDS study provide important information on micro-textural and structural characteristics of contaminants deposited on used filter materials.

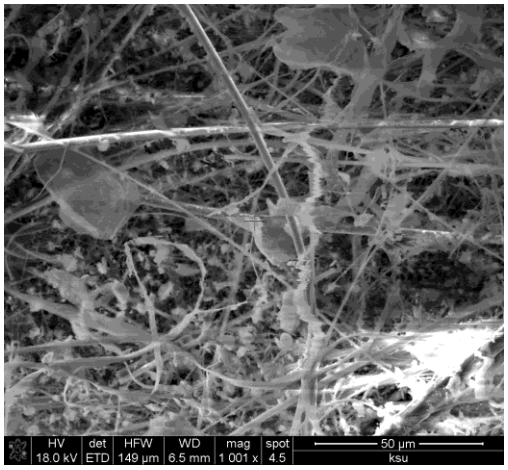
2.4.2.2.3 ***Photomicrographs of used and incident filters***

Irregularly-shaped particles were deposited on the surface of the fiber material. An analysis of the dispersed particles indicated new elements not present in clean filters. The thickness of the fibers in both used and incident filters increased because of the particulate deposition on the fibers. In some photomicrographs, the fibers are barely visible and have significant amorphous outer layers. However, the particles could not be described by their origin or formation mechanism, chemical composition, and physical properties. Figures 2.34 (a) and (b)

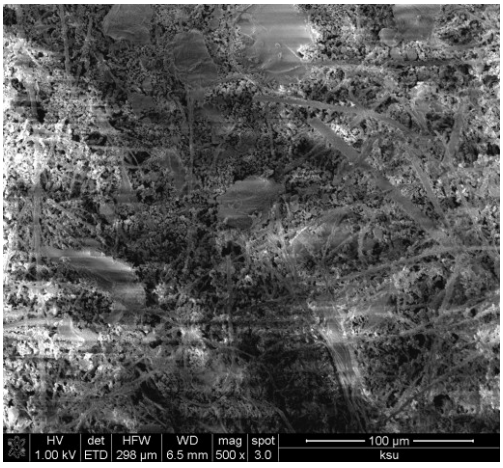
show high-magnification FESEM images of used filters. Figures 2.34 (c) and (d) show the same images for incident filters. Images produced from different filters and at different points during the analysis can be placed side by side. As seen under FESEM in Figure 2.34, the filter depositions vary from small particulates to large irregularly shaped particulates, with images ranging from fibers to spongy amorphous structures with no distinctive shape.



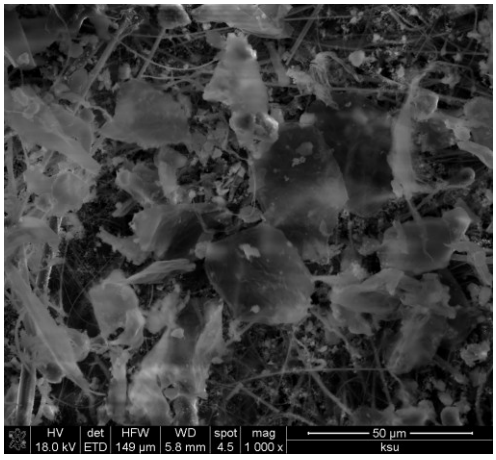
(a) Filter ID 3Q5J9L



(b) Filter ID 9RZMC2



(c) Filter ID 163B4J



(d) Filter ID 23937

Figure 2.28 Composite image of electron micrographs for (a) used filters ID 3Q5J9L and 9RZMC2 and (b) incident filters ID 163B4J and 23937

To a casual observer, both used and incident filters look the same with a few variations suggesting gradations of dirtiness in used filters. With FESEM, more information can be derived,

and the used and incident filters can be compared. These filter deposits could also be important indicators of jet engine oil contamination. The microphotographs are representative images of the filter deposition, and their varying natures indicate the wide range of deposits in the cabin filters. The images essentially physically characterize the deposits on the filter surface. However, the chemical nature of these deposits remains unknown to scientists seeking clues about cumulative aircraft cabin air quality from filter analysis.

This study has provided a glimpse into the nature of filter deposition, a reflection of the composition of cumulative air passing through the aircraft cabin. When used and incident filters were compared, used filters had more contaminants with higher mean concentrations than the incident filters. This result is likely because used filters were used longer and were removed during routine maintenance at the end of their expected service life. Incident filters may have been removed much sooner. Each analysis produced slightly different results. In both groups of filters, the first batch of analyses showed more consistent results than the second. The presence of all three contaminants indicates the presence of jet engine oil on filters. While it was hoped that P, S, or Br or some combination of these elements could be used as a clear marker for jet engine oil, the ubiquitous presence of these elements on nearly all filters, the lack of strong correlations between the elements, and other known sources of Br inevitably led to the conclusion that these elements alone or in combination cannot be used to identify the presence of jet engine oil on filters. This result is nevertheless important because the objective of the study was to determine whether or not FESEM/EDS can be used to identify the presence of jet engine lubricating oil on filters and, thus, identify the contaminant source for an air quality incident. Apparently, it is not a suitable technique. Even so, this study provides new information about the concentrations of elements in used filters.

2.4.2.3 Possible sources of contaminant elements deposited on used filters from aircraft cabins

Many sources may contribute to the wide range of elements found in used filters. According to Winder and Balouet (2001), jet engine oils and hydraulic fluids used in aviation industry contain a range of ingredients: organophosphate compounds, including tricresyl phosphates (TCP), tributylphosphates (TBP), triphenyl phosphates (TPP) and their derivatives, from 3 to 25 percent in content; toxic inorganic molecules, such as naphthylamines, amines and esters; organometallic additives; zinc dialkyl dithiophosphates, calcium alkyl phenates, magnesium sulphonates, molybdenum, and barium containing additives. If these materials leak

into the bleed air system, then they could contribute significantly to cabin air supply contamination. Such contamination could be a source of S, Ba, Ca, Mg, Zn, and P. Sulfur dioxide (SO_2) is a well-known component of diesel emissions from trucks often used at airports. Other vehicles at airports also emit such pollutants. Therefore, when an aircraft sits at the airport terminal, the composition of the air being supplied to the cabin differs from the air supplied to the cabin during flight; that may as well influence filter elemental deposition.

In-cabin emission processes include products of metabolic processes from cabin occupants, dust carried into the cabin by passengers. Every aircraft model is unique, and the cumulative cabin air quality may be determined even by passenger seating arrangements. Some aircrafts have a single aisle, others two or three aisles and business and first class compartments. All these arrangements can determine the intensity of metabolic processes in the aircraft cabin. Differences in jet engine characteristics could also influence the quantity of bleed air and type of pollutants deposited on the filters (De Nola et al. 2008). Although aircraft usually fly at high altitudes where the air is considered pristine, events like volcanic eruptions can pollute air even at these altitudes. The ever-changing aircraft routes or flight paths of aircraft can also affect filter deposition levels. More information is needed on the effects of the size of the aircraft, routes, and different cabin and engine maintenance practices unique to airlines.

Traces of a few toxic elements like arsenic (As), lead (Pb), chromium (Cr), and cerium (Ce) have been detected in both used and incident filters. Identifying the source of these elements in the aircraft cabin was outside the scope of this study. The most likely source of these trace elements is the air supplied to the aircraft cabin. The medical ramifications of the presence of these toxic trace elements in aircraft cabin air are not known. After being replaced during scheduled maintenance checks (C-checks), used aircraft cabin air recirculation filters should not be dumped but used for enhanced data mining as part of an emerging air quality management model that views used cabin filters not as the last stop but as temporary storage for recoverable cabin air quality information. This study has demonstrated how the FESEM/EDS system can obtain information from used cabin air recirculation filter samples. These findings have added new knowledge about aircraft cabin air quality. While falling short of being able to fully and accurately detect smoke/fume incidents, the study results should spur scientific debate about the origin of the P and S detected on the filters. The P could possibly be from TCPs in jet engine oils additives or from hydraulic fluids but could very well be from some other unknown source.

No scientific evidence currently establishes a definite link between the elements present in jet engine oil and those deposited in air filters. No studies have shown conclusively how jet engine oils contaminate cabin air filters. FESEM/EDS, however, offers insight in characterizing cabin air quality because all airborne particulates from the cabin environment pass through the cabin air recirculation filters. The FESEM/EDS technique in aircraft filter analysis has the potential to help the airline industry improve air quality. FESEM/EDS is non-destructive and requires very little sample preparation; it can be configured to handle any sample size from large surfaces to ones as small as a few microns. Its multi-element capability means that the FESEM/EDS technique is well suited to analyze elements deposited on cabin air filters.

This study presents, for the first time, using the FESEM/EDS technique, a benchmark for evaluating elemental species on used filters. The FESEM/EDS technique can offer a wide variety of micro-contamination solutions and provides an excellent source of technical information on aircraft cabin air quality. This study's new test protocol for inspecting aircraft's incident filters will enable scientists to recreate a vivid and detailed picture of deposits on cabin air recirculation filters and correlate the elemental deposits to past cumulative cabin air quality.

2.5 Conclusions

In this study, the FESEM/EDS technique was used to identify P, S, and Br as potential markers for jet engine oil contamination of aircraft filters. These contaminants are present in both used and incident filters in a wide range of atomic weight percentages. This study also provided a new methodology to support analysis and characterization of elements deposited on used aircraft cabin air filters. However, P, S, and Br were present on nearly every filter evaluated, whether used or incident, so the lack of strong correlation between these potential markers on the filters and a known non-oil source for Br result in the conclusion that P, S, or Br either singularly or in any combination cannot provide an indication of oil contamination. It appears that FESEM/EDS methods may not be used to identify a unique marker for jet engine oil contamination on aircraft cabin filters.

Nevertheless, this research has provided researchers with new information about used HEPA filter deposition, which reflects the cumulative air quality passing through the aircraft cabin during flight. The study has shown how used filters can be used to assess aircraft cabin air quality. Finally, the study suggests that routine filter screening for P would be a viable option for

detecting cabin air quality incidents. Such screening might help airlines make informed decisions about whether an incident occurred. Nonetheless, this study did not identify the reason for variability of identified contaminant elements from jet engine oil, and how they affect cabin air supply has not been answered by this study.

2.6 References

Abou-Donia, M., (2005). Proceedings of the Contaminated Air Protection Conference Proceedings of the BALPA Air Safety and Cabin Air Quality International Aero Industry Conference. Held at Imperial College, London, 20–21 April 2005.

Australian Civil Aviation Safety Authority (CASA). Expert Panel on Aircraft Air Quality (EPAAQ), Contamination of aircraft cabin air by bleed air – a review of the evidence. September 2009. http://www.casa.gov.au/wcmswr/_assets/main/cabin/epaaq/epaaq-entire-report.pdf

ASHRAE (1999). ANSI/ASHRAE Standard 52.2-1999. Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size. Atlanta, GA: American Society of Heating, Refrigerating and Air-conditioning Engineers, Inc.

ANSI/ASHRAE (2007). ANSI/ASHRAE Standard 161-2007, Air Quality within Commercial Aircrafts. 20 pp. Product code: 86493. ISBN: 1041-2336. Atlanta, GA: American Society of Heating, Refrigerating and Air-conditioning Engineers, Inc.

British Airline Pilot Association (BALPA) Report (2006). U.K. Civil Aviation Authority (CAA) http://cot.food.gov.uk/pdfs/cot-laystatementbalpa200706.pdf (Cited: November 20th, 2011).

Bull, K., (2008). Cabin air filtration: Helping protect occupants from infectious diseases. Travel Medicine and Infectious Disease (2008). Vol. 6, Issue 3, May 2008, pp. 142–144.

CEN EN-1822-1: (2009). European Standard for High Efficiency Air Filters (HEPA and ULPA) Part 1: Classification, Performance Testing, Markings. CEN Central Secretariat: rue de Strassart, 36, B-1050 Brussels.

Cooper, C. D. and Alley, F. C., (2002). Air Pollution Control: A Design Approach. 2nd ed., pp. 696. Prospect Heights: Illinois, Waveland Press, Inc.

De Nola, G., Hanhela, P. J. Mazurek, W., (2011). Determination of Tricresyl Phosphate Air Contamination in Aircraft. Ann. Occup. Hyg. Vol. 55. No. 7, pp. 710–722, 2011. Oxford University Press on behalf of the British Occupational Hygiene Society doi:10.109/annhyg/mer040.

Gerecke, A. C., (2007). Brominated flame retardants in settled dust of a commercial aircraft. http://www.bfr2010.com/abstract-download/2007/P074.pdf (cited March 15th, 2012).

Harding, R., (1994). Cabin air quality in aircraft. BMJ British Medical Journal. Volume: 308, Issue: 6926, Publisher: BMJ Group, Pages: 427 – 428.

Hinds, C. W., (1999). Aerosol Technology, Properties Behavior and Measurements of Airborne Particles. 2nd ed. ISBN 0-471-19410-7.

Hunt, E. H. and Space, D. R., (1994). The Airplane Cabin Environment: Issues Pertaining to Flight Attendant Comfort. International In-flight Service Management Organization Conference, Montreal, Canada, November 1994.

IEST-RP-CC001.5: Institute of Environmental Science and Technology, Recommended Practice for Efficiency Test Method for HEPA and ULPA Filters, 940 East North-west Highway, Mt. Prospect, IL 60056.

Inflight Safety Professionals (ISP), CWA, AFL-CIO, (2011). http://msnbcmedia.msn.com/i/MSNBC/Sections/NEWS/z_Personal/Gold/AFA%20letter%20to%20FAA%20re.%20SDR%20violations%20and%20need%20for%20regs%20August%202011.pdf (Cited: Jan. 20, 2012).

Korves, T. M., Johnson, D., Jones, B. W., Watson, J., Wolk, D. M. Hwang, G. M., (2011). Detection of respiratory viruses on air filters from aircraft. Letters in Applied Microbiology 53, 306 – 312. The Society for Applied Microbiology. doi:10.1111/j.1472-765X.2011.03107.x.

Michaelis, S., (2003). A survey of health symptoms in BALPA Boeing 757 pilots. J. Occup Health Safety – Aust. NZ 2003, 19(3): 253 – 261.

Michaelis, S., (2007). Frequency of events and underreporting in Aviation Contaminated Air Reference Manual, pp. 211 – 248, ISBN 9780955567209, London, England.

Michaelis, S., and Loraine, T. (2005). Aircraft Cabin Air Filtration and Related Technologies: Requirements, Present and Prospects. Handbook of Environmental Chemistry Vol. 4, Part H (2005): 267 – 289. Copyright Springler-Verlag Berlin Heidelberg 2005.

MIL-STD-282 Method 102.9.1. (1956). US Government Printing Office Washington, DC pp. 33 – 38.

Molhave, L., (1991). Volatile organic compounds. Indoor air quality and health. Indoor Air. 1991; 4: 357 – 376.

Murawski, J. T. L., Supplee, D. S., (2008). An Attempt to Characterize the Frequency, Health Impact, and Operational Costs of Oil in the Cabin and Flight Deck Supply Air on U.S. Commercial Aircraft. Journal of ASTM International, Vol. 5, No. 5. Paper ID JAI101640. Available online at www.astm.org

Nadeau, G., Herguth, W. R., (2004). Applying SEM/EDS to Practical Tribology Problems. Practical Oil Analysis, July 2004.

National Research Council (NRC) Report, (2002). The Airliner Cabin Environment and the Health of Passengers and Crew Committee on Air Quality in Passenger Cabins of Commercial Aircraft. Washington DC: National Academy Press.

Pall Corporation, (2012). http://www.pall.com/main/Aerospace-Defense-Marine/Literature-Library-Details.page?id=46181 (Cited: June 20th, 2012).

Solbu, K., Thorud, S., Hersson, M., Øvrebø, S., Ellingsen, D. G., Lundanes, E., Molander, P., (2007). Determination of airborne trialkyl and triaryl organophosphates originating from hydraulic fluids by gas chromatography–mass spectrometry Development of methodology for combined aerosol and vapor sampling. Journal of Chromatography A, 1161 (2007) 275 – 283.

Spengler, J., Burge, H., Dumyahn, T., Muilenberg, M., Forester, D., (1997). Environmental Survey on Aircraft and Ground-Based Commercial Transportation Vehicles. Prepared by Department of Environmental Health, Harvard University School of Public Health, Boston, MA, for Commercial Airplane Group, The Boeing Company, Seattle, WA. May 31, 1997.

Stellmack, M., (2010). Microanalytical Techniques for Identifying Nonprotein Contaminants in Biologics. BioProcess International, Vol. 8, No. 2, February 2010, pp. 36 – 39.

U.S. DOT FAA InFO 10019 (2010). U.S. Department of Transportation. http://www.faa.gov/other_visit/aviation_industry/airline_operators/airline_safety/info/all_infos/media/2010/Info10019.pdf (Cited: 01/4/2012).

Winder, C. and Balouet, J. C., (2001). Aircrew Exposure to Chemicals in Aircraft: Symptoms of Irritation and Toxicity. Journal of Occupational Health and Safety – Australia and New Zealand 17: 471 – 483, 2001.

Winder, C. and Michaelis, S., (2005). Aircraft Air Quality Malfunction Incidents: Causation, Regulatory, Reporting and Rates. In: Hocking, M. B., (ed.). Air Quality in Airplane Cabins and Similar Enclosed Spaces. Handbook of Environmental Chemistry Vol. 4, Part H (2005): 211-228. DOI 10.1007/b107245. Springler-Verlag Berlin Heidelberg, 2005.

CHAPTER 3 - USING GAS CHROMATOGRAPHY AND MASS SPECTROMETRY TO DETERMINE JET ENGINE OIL MARKERS IN AIRCRAFT CABIN AIR FILTERS

3.1 Abstract

The air that is used to pressurize and ventilate an aircraft cabin is the bleed air that comes from the propulsion engine compressor. Under certain conditions, lubricating oil from the compressor bearings can contaminate the bleed air. When this contamination occurs, it has the potential for creating serious air quality issues for the cabin. Of particular concern is tricresyl phosphate (TCP) compound, an additive in synthetic jet engine lubricating oils. The potential for TCP contamination in aircraft engine bleed air has spurred concerns about the risks smoke/fume incidents pose to aircraft cabin occupants. Unfortunately, there are no onboard sensors that can determine the source air quality problems and it is particularly difficult to identify sources after the fact, especially when the problem is intermittent. However, most commercial aircraft are equipped with high efficiency particulate air (HEPA) filters that clean the air that is recirculated in the cabin. These filters capture liquid droplets and solid particulate matter that may be in the cabin air. It is believed that, in the case of oil contamination of the bleed air, this contamination will be present on the cabin filters. The objective of this research was to determine if gas chromatography interfaced with mass spectrometry (GC/MS) can be used to detect the presence of oil or markers of oil in commercial aircraft cabin air recirculation filters when an incident occurs. The actual chemical analysis was conducted by the Environmental and Occupational Health Sciences Institute (EOHSI) at the University of Medicine and Dentistry of New Jersey (UMDNJ). An Agilent series 6890 GC with a 5973 MSD was used to analyze 184 filters removed from a variety of commercial aircraft divided into two groups. The first group consisted of 110 filters that were collected from the aircraft during routine servicing at the end of the normal filter life and are referred to as “used” filters. The second group consisted of 74 filters that were collected from aircraft that were identified as having air quality problems or complaints. They are referred to as “incident” filters. In addition to being a contaminant of health concern, the study hypothesized that TCP in jet engine lubricating oil would be deposited as a contaminant on used aircraft cabin filters and serve as a unique marker of engine oil

contamination. The jet engine oil signatures were identified by matching retention times in chromatograms of the analyzed samples to retention times in mass spectra against standard mass spectra of jet engine oil. The TCP isomers: tri-*m*-cresyl phosphate (TmCP) and tri-*p*-cresyl phosphate (TpCP) were characterized by an m/z = 368 base peak with corresponding retention times of 21.9 and 23.4 minutes. Using retention times, m/z, and hydrocarbon peak pattern as jet oil fingerprints, five out of 110 used filters tested had oil markers. Meanwhile, 22 out of 74 incident filters tested positive for oil markers. It is concluded that the method can detect and quantify TCP isomers present on aircraft cabin air recirculation filters and use this information to identify lubricating oil as the source of the contamination in some cases. The study demonstrates a new experimental methodology that could have a positive impact on aircraft cabin air quality. Identifying the source of aircraft cabin air quality problems by analyzing recirculation filters could help airlines maintain air quality in line with the needs and goals of the business.

3.2 Introduction

Studies by Brown et al. (2001) found that much is already known about many aspects of aircraft cabin air quality however, there are concerns about the potential contamination of aircraft cabin air with engine lubricating oils. The introduction of contaminants such as tricresyl phosphates (TCPs) into aircraft cabin air supply can have damaging in-cabin repercussions and negative consequences for cabin occupants' health. That is why it is critically important that contamination levels of TCPs in aircraft cabin air be correctly identified and controlled. But because of the complexity of the nature of TCPs, detecting them can be a difficult analysis without the proper tools. Most jet engine lubricating oils used in the aviation industry contain TCPs, which are used as a high temperature vapor phase lubricant. Thus, TCP use involves the delivery of lubricant in a gaseous carrier, e.g., air, to the contacting surfaces (Harrison et al. 2008).

TCPs can be absorbed cutaneously, ingested, inhaled, or injected (Yurumez, et al. 2007). The TCP cresols also known as toluols can exhibit up to ten structural isomers. But it usually occurs mainly in the form of three structural isomers: tri-*o*-cresyl phosphate (ToCP), tri-*m*-cresyl phosphate (TmCP), and tri-*p*-cresyl phosphate (TpCP). Figure 3.1 shows the chemical structure of TCP and its three isomers. Many published scientific reports have demonstrated the risks associated with exposure to TCPs. Studies conducted by Abou-Donia (2005) on animals have

shown that dermal exposure to each of the three TCP isomers; ToCP, TmCP, and TpCP, can cause sensorimotor deficits in rats and neuropathological lesions in the brain.

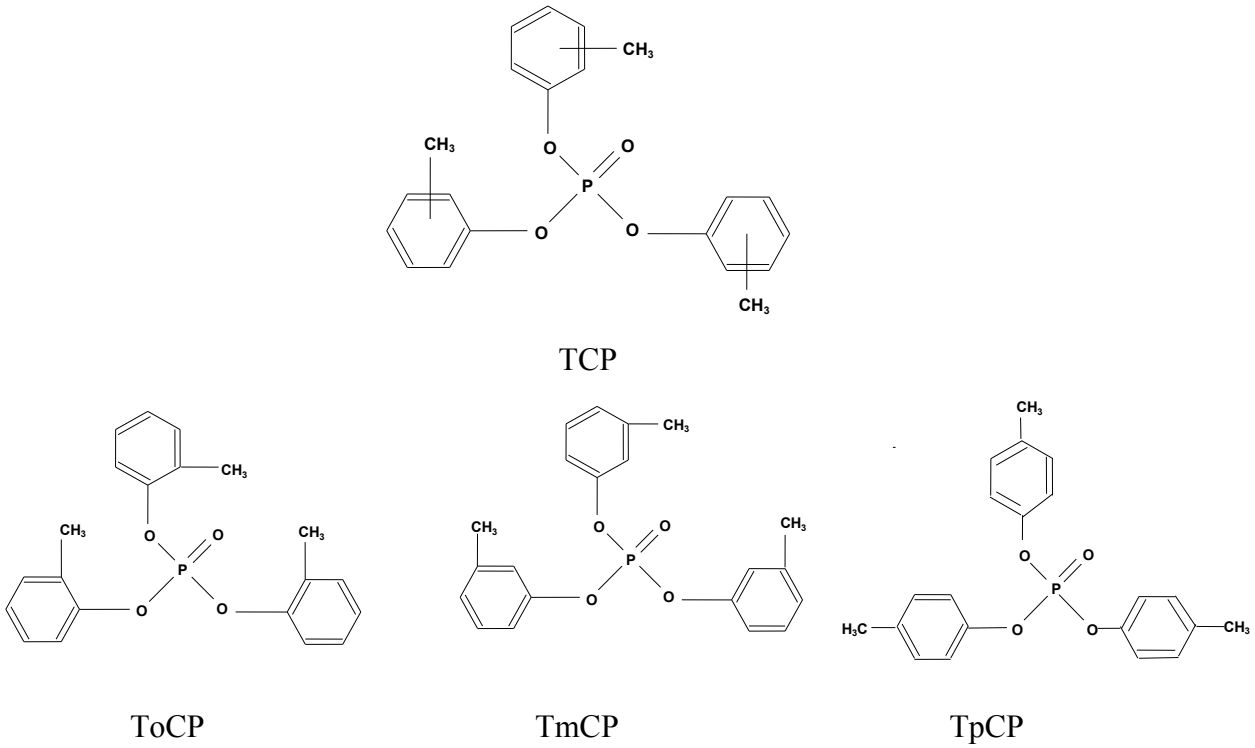


Figure 3.1 The chemical structure of TCP and its three main isomers

According to Yurumez et al. (2007), humans exposed to organophosphates (OPs), including TCPs, may rapidly become symptomatic; the onset and severity of symptoms depend on the specific compound, amount, route of exposure, and rate of metabolic degradation. A concentration of TCP isomers of 100 μg/m^3 is currently considered as the standard safe limit but some isomers will cause enzyme damage and limit the production of dopamine in the brain at 10 μg/m^3 (Holt, 2011). The main route by which the general population takes in TCPs is inhalation, i.e. ingestion through the lungs is the easiest method to absorb quantities of OPs. The liver then metabolizes the various isomers in TCP to a cyclic phosphate, which is a known neurotoxin more potent than the most potent TCP isomers. This then binds to the enzyme that enables the production of various neurotransmitters in the brain (Holt, 2011). Studies by Mars et al. (1994) and Somkuti et al. (1988) demonstrated that OP compounds can cause delayed polyneuropathy,

whereas ToCP has weak or absent anticholinesterase effects but can be powerfully neuropathic. A study by Mackenzie et al. (2006) on the possible health implications for pilots breathing contaminated aircraft cabin air has linked certain neurological and respiratory ill health to exposure of contaminated bleed air on commercial and military aircrafts.

TCPs belong to OP triesters, which comprise a broad class of chemical neurotoxins targeting important enzymes such as cholinesterases and various neurotoxic esterases (Viveros et al. 2006). In general, OPs, including TCP irreversibly inhibit the activity of enzymes such as carboxyl ester hydrolases and acetylcholinesterase (AChE) (Pope 1999; Karalliedde 1999). In an attempt to find a bio-marker, Liyasova et al. (2011), analyzed blood from 12 jet airplane passengers and found that butyrylcholinesterase (BChE), an enzyme found in human plasma cholinesterase (primarily in the liver), reacts with ToCP to form phosphorylated BChE. According to Expert Panel on Aircraft Air Quality (EPAAQ) (CASA Report, 2009), tests based on measuring TCP metabolites in blood and/or urine may not be sufficiently sensitive, or able to discriminate exposures to the more neurotoxic compounds (TOCP, DOCP, MOCP and TMPP). The CASA report also noted that that exposure to other potentially toxic components of contaminated cabin air (e.g. O_3, CO, CO_2, hydrocarbons) or hypoxia (lack of sufficient O_2) might be overlooked if the focus was solely on bio-monitoring of OPs. TPC also induces an organophosphorous-induced delayed neuropathy (OPIDN) (Abou-Donia et al. 1990; Hatch 1988; Rosenstock et al. 1991). The constituent product within TCP family that appears to cause most concern is the ToCP isomer, a neurotoxicant that is ten times more toxic than the para- and meta-isomers (Henschler, 1958, Winder and Balouet 2002).

According to an International Programme on Chemical Safety (IPCS) report, the ToCP has significant toxicity and therefore subject to control by regulation (IPCS report, 1990). Thus concerns about TCP toxicity largely focus on the ToCP isomer content (De Nola et al. 2008, Select Committee on Science and Technology, 2000, Craig and Barth, 1999). That is because health problems related to ToCP are more severe than other isomers or esters present in jet engine oils. In spite of the health risks related to TCP, quantitative data on its application in aircraft operations is sparse (Denola et al. 2011). Moreover, in a study intended to present a method to assess exposure to airborne trialkyl and triaryl OPs, Solbu et al. (2007) found that the neurotoxin trimethylolpropane phosphate (TMPP) is also present in jet engine lubricant formulations containing TCP and trimethylolpropane ester (TMPE).

During the past decade, studies have confirmed the presence of TCP in aircraft cabin air. Van Netten and Leung (2002) conducted pyrolysis experiments on jet engine lubricating oil and reported the release of TCPs. They recommended that cabin filters be analyzed for TCP derivatives released during pyrolysis of jet engine oil and hydraulic fluids to determine air quality after incidents. Using thermal-desorption gas chromatography-mass spectrometry (TD/GC/MS), a research group at Cranfield University, UK, has analyzed bleed air samples collected by a portable pump onto sorbent tubes from five different aircraft types in operation and found ToCP, other TCPs, and TBP (Crump et al. 2011). Denola et al. (2011) have also detected ToCP in aircraft cabin air. Solbu et al. (2011) have found OPs in aircraft cabin and cockpit air. The presence of TCPs in the aircraft cabin air supply represents a significant and growing part of the problem of aircraft cabin air quality. Past scientific studies have also detected other VOCs in aircraft cabins. Vapors from organic compounds accumulate in the cabin atmosphere by evaporation from parent substances like oils, paints, adhesives, furnishings, pesticides, disinfectants, cleaning agents, foods, and alcoholic drinks. These VOCs are distributed throughout the aircraft cabin via ECS and in cabin sources. Typical VOCs found in aircrafts cabins include isopropanol, ethanol, propylene glycol, acetone, acetonitrile and insecticides. (Spengler et al. 1997). However, measured concentrations of VOCs in aircraft cabins are generally low (Nagda and Rector, 2003).

When smoke/fume incidents occur they disrupt the performance of critical applications of an aircraft's ECS. As a result, cabin air quality may change, and cabin occupant safety may be at risk. Airborne pollutant emissions during smoke/fume incidents are widely perceived as a main culprit in cabin air contamination and have been implicated in a range of health problems in immune, endocrine, nervous, and reproductive systems of animals and humans. These problems are generally associated with TCP in jet engine oils or hydraulic fluids. The health complications associated with smoke/fume incidents tend to vary. The possible critical health effects of human exposure have been classified as short-term or long-term depending on the length of exposure and the intensity of the smoke/fume incident. Table 3-1 lists some of the reported health symptoms of exposure to smoke/fume incidents (Winder and Balouet, 2001; Michaelis, 2003; Abou-Donia, 1990; Nisse et al. 1998).

Table 3-1 Health symptoms of long and short-term exposure to smoke/fume incidents

A. Symptoms from short-term exposure
1. Neurotoxic symptoms: blurred or tunnel vision, nystagmus, disorientation, shaking and tremors, loss of balance and vertigo, seizures, loss of consciousness, parathesias;
2. Neuropsychological symptoms: memory impairment, headache, light-headedness, dizziness, confusion and feeling intoxicated;
3. Gastro-intestinal symptoms: nausea, vomiting;
4. Respiratory symptoms: cough, breathing difficulties (shortness of breath), tightness in chest, respiratory failure requiring oxygen;
5. Cardiovascular symptoms: increased heart rate and palpitations;
6. Irritation of eyes, nose, and upper airways.
B. Symptoms from long-term exposure
1. Neurotoxic symptoms: numbness (fingers, lips, limbs), parathesias;
2. Neuropsychological symptoms: memory impairment, forgetfulness, lack of co-ordination, severe headaches, dizziness, sleep disorders;
3. Gastro-intestinal symptoms: salivation, nausea, vomiting, diarrhea;
4. Respiratory symptoms: breathing difficulties (shortness of breath), tightness in chest, respiratory failure, susceptibility to upper respiratory tract infections;
5. Cardiovascular symptoms: chest pain, increased heart rate, and palpitations;
6. Skin symptoms: skin itching and rashes, skin blisters (on uncovered body parts), hair loss;
7. Irritation of eyes, nose, and upper airways;
8. Sensitivity: signs of immuno-supression, chemical sensitivity leading to acquired or multiple chemical sensitivity.

(Source: Winder and Balouet, 2001; Michaelis, 2003; Abou-Donia, 1990; Nisse et al. 1998; Holt, 2011).

There has been consistent evidence that aircrew experience a variety of specific medical conditions both acute and chronic associated with work in the airline industry. However, according to CASA report (2009), the evidence for the existence of an 'Aerotoxic Syndrome' related to smoke/fume events is still based almost entirely on case-series reviews, remains self-reported and should be categorized epidemiologically as inadequate or insufficient evidence to determine whether an association exists. The panel that compiled the CASA report further noted

that “this view is based on the lack of adequately designed studies and the difficulties inherent in undertaking such studies rather than on the presence of evidence of no association.” In spite of the advanced science and technology that supports the civil aviation industry smoke/fume incidents are still not fully understood. Much uncertainty revolves around how much harm can be done by smoke/fume generated during incidents. While it is not clear exactly how much can cause adverse reactions, it is known that smoke/fumes from incidents contain TCPs, which can affect human health adversely. Human health effects related to exposure to TCP and its isomers in workplaces have been investigated. The standards that specify the emission limit of exposure to TCPs emitted from industrial processes have been specified. However, how airborne particulates and TCPs formed in aircraft bleed air system during smoke/fume incidents affect cabin air quality still needs to be understood. In short, the threshold at which TCP aerosols in cabin air will cause undesirable effects on human health still needs to be determined. The risks related to smoke/fume incidents need to be identified, managed, and communicated. Consequently, the ability to monitor cabin air quality needs to be improved.

Even though the potential safety issues of exposure to smoke/fumes from jet engine oils are generally known, airlines still use jet engine oils with TCP additives because of their wide spectrum of activity and ready availability at a low cost. Moreover, no other additive has been found to match TCP's anti-wear and load carrying performance (Select Committee on Science and Technology, 2000), making it still appealing even though a study by Winder and Balouet (2002) confirmed that it contains at least two ingredients hazardous to human health: TCPs and *N*-phenyl-1-naphthylamine. Mobil Jet Oil II, the most popular jet engine oil used in commercial and military airplanes was used as representative jet engine oil for this study. The purpose of this study was to provide a method for determining jet engine oil markers or signatures on aircraft cabin air recirculation filters using GC/MS analysis. This part of study focused on identifying three TCP structural isomers (ortho-, para-, and meta-) and their concentrations in used and incident aircraft filters using GC/MS.

3.3 Materials and Methods

3.3.1 Filter sampling

For filter sample preparation, the general procedure described in Chapter 2 was adopted for preparing filter samples for analysis using GC/MS. The clean room at the IER is about 97%

efficient at collecting airborne particulate matter. The air circulation system to the room is fitted with both HEPA and electrostatic filters that keep airborne particulates down to 2648 counts/m^3. The air-circulation system in the room was turned on and ran for about 10 minutes to reach a steady state. The boxes containing the filters were moved one at a time from the closet to the clean room and sampled. Once the boxes were cut open, they were immediately removed from the clean room. The filters, wrapped in a plastic bag, were placed on a table covered with aluminum foil. At this point, the person performing the sampling put on sterilized plastic gloves and a dust mask. All the tools used in disassembling filters and cutting out specimens were wiped with isopropyl alcohol. A sheet metal snip was used to cut the outer aluminum casing and separate it from the filter. A whole panel of filter, as shown in Figure 3.2 (b), was cut and placed in an 18 × 24 in. zip-locked plastic bag and shipped for GC/MS analysis.

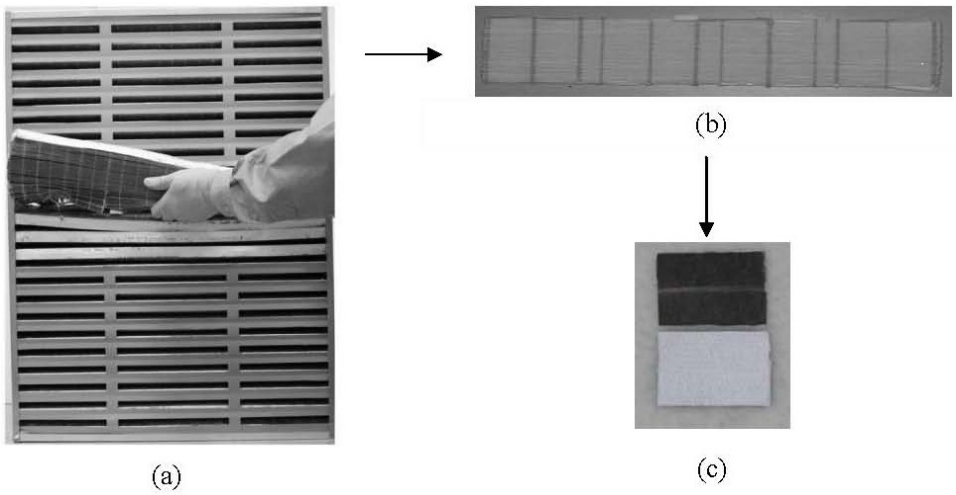


Figure 3.2 (a) Filter sampling process (b) Filter panel (c) Filter sample for GC/MS analysis

The filter was then returned to a plastic bag which it came from and shut, taped and returned to the storage cabinet. Samples of Mobil Jet Oil II aviation jet turbine lubricating oil were also analyzed using the GC/MS method and the spectra examined. Clean filters used in the study were acquired from three well-known major aircraft cabin air recirculation filter manufacturers: Keddeg Company, Pall Aerospace Incorporation, and Donaldson Company Incorporation. A total of 90 incident filters were analyzed. All tested filters were supplied anonymously by four U.S. airline companies.

3.3.1 Principle operation of GC/MS

The GC/MS instrument separates chemical mixtures and identifies the components at a molecular level. The GC works on the principle that a mixture will separate into individual chemical compounds when heated. The heated gases are carried through a column with an inert gas (such as helium). As the separated substances emerge from the column opening, they flow into the MS where the chemical compounds in the mixture are identified by the mass of the analyte molecule. A library of known mass spectra, covering several thousand chemical compounds stored on a computer is used for comparison with spectral information against the unknowns using retention times and mass ion ratio to achieve accurate identification.

3.3.1 Analysis of used aircraft filters by Agilent Series 6890 GC with 5973 MSD

An Agilent series 6890 GC with a 5973 MSD was used to investigate used and incident filter samples extracted from cabin air recirculation filters. Figure 3.3 below shows the picture of 6890 GC/MS model with 5973 MSD.

Figure 3.3 Hewlett Packard (HP) Agilent series 6890 GC/MS system with 5973 MSD
Source: American Laboratory and Trading (AHT, 2012).

The Agilent GC/MS has an Agilent 6890 network gas chromatography system with split/splitless inlet is configurable with; Agilent 5973 inert mass selective detector with electron

impact (EI) Source; Agilent 7683 series autosampler; and Agilent 7683 series injector; Agilent 59864B ionization gauge controller; Edwards 1.5 vacuum pump, and cables, mouse, keyboard, monitor, computer preloaded with software (AHT, 2012). The 6890 Plus delivers high levels of performance with electronic pneumatic controls of all gas flow and pressures. Built-in sensors automatically compensate for ambient changes in temperature and barometric pressure differences to reach more accurate and reproducible results. (AHT, 2012).

3.3.2 Procedures for preparation of standard solution for GC/MS analysis

The GC/MS is a qualitative chemical analysis of VOCs on filters. GC/MS successfully focused on analyzing multiple chemical compounds on used filters to detect concentrations ranges of jet engine oil footprints. With GC/MS analysis, the investigation focused on the concentration of well-known ingredients from Mobil Jet Oil II. Therefore, an entire panel of filter was placed in a solvent, and the extract analyzed. In GC/MS analysis, selecting appropriate sample preparation techniques allows reproducibility, accuracy, and simplicity.

Concentration of standard was injected in the low nanogram per microliter range. Recovery was determined by spiking clean filters with 2.0 µg/mL of each standard analyte. The standard was then used to identify and quantify the peaks of the compounds present in the spiked clean filters. The recovery levels were as follows: Pure samples were injected in amounts of 1.0 µL to the GC/MS. The column was 30 m long, 0.25 mm (0.01 in.) in diameter and was filled with helium carrier gas. The carrier gas flow rate was set at 1.5 mL min^{-1}, and the temperature was regulated to 100^{o}C for 10 minutes and then to –20^{o}C to 250^{o}C for 10 minutes.

First, a 50 cm^2 sample was cut out from the filter. Specimens were placed in 40 mL vials, and 10 mL methylene chloride (CH_2Cl_2) solvent was added to each vial. The mixture was then sonicated for 20 minutes. During sonication, the solvent extracted the organic substances deposited on the filter sample. The extract was filtered using a 13/25 mm (0.2/0.45 µL) syringe filter. The extract was then evaporated to 0.5 mL. A 1.0 µL aliquot was injected into the gas chromatograph port of the GC/MS instrument operated in the electron impaction mode and run in the SIM mode at 368 amu, which is sensitive to TCP. The chromatography used was a 30 m × 0.25 mm × 250 µm column with helium as the carrier gas flowing at 1.5 mL/min. The second injection was done with the GC/MS instrument operated in the SCAN mode to confirm the peak identification of the TCP and the synthetic hydrocarbon analysis, key constituents of the Mobil

Jet Oil II. Quantitation was performed with a calibration curve made from standards of target compounds (1-20 ng/μL) run under similar conditions. The compounds of interest (jet engine oil signatures) were identified by matching of retention times in chromatograms of the analyzed samples to retention times in mass spectra against a standard. Quantitation used a calibration curve made using standards of target compounds (1-20 ng/μL) run under similar conditions. Co-elution of other congeners could not be excluded, so identification and quantification, especially of congeners present in small amounts, remains to be confirmed. Microsoft Excel was used to compute descriptive statistics and concentrations of identified TCPs in used and exposed filters.

3.4 Analysis, Results and Discussion

3.4.1 Data analysis

The concentration levels of known ingredients used in formulating Mobil Jet Oil II were investigated by analyzing concentrations levels of TCP and its isomers in incident filters. Comparisons of incident filter data and spectra were made with data and spectra obtained from Mobil Jet Oil II and clean filter samples. Mass spectral libraries (databases) of validated chemical compounds were used to compare spectra and compound identification information against the unknowns to achieve accurate results. GC/MS is a relative technique; measured sample values are compared to a previously conducted calibration. Therefore, the quality of GC/MS measurements depends upon the reference materials and the stability of the entire system. To ensure that stability, the procedure management software delivers quality control and qualification of the GC/MS analyses with the highest levels of stability, accuracy, and user-friendliness. Positive identifications were made by matching retention times as well as mass spectra against a library. Quantification was done using a calibration curve made from standards of target compounds run under similar conditions. A pattern of key peaks similar to Mobil Jet Oil II were observed. The compounds are TMP phosphate, TmCP, TpCP, and unknown isomers. Microsoft Excel was used to calculate descriptive statistics for TmCP concentrations (ng/cm^2) in used and incident filters.

3.4.2 Results and discussion

Good separations of the standards were obtained. The match of mass spectra to library mass spectra was quite evident. From the standard, the peak identification codes and retention times of 22.4, 21.9 and 23.4 min. for o-TCP, m-TCP and p-TCP respectively were observed. Blank filters (clean filter recovery study): The unused filters had no detectable levels of cresyl phosphate and no other forms of TCP or jet oil related compounds were found. The peaks and background present were hydrocarbons expected from glue used to hold filter paper together.

The TCP peaks and the hydrocarbon were evaluated as potential markers for jet engine lubricating oil on the filter as follows: TCP was first examined in the jet engine oil sample. Four peaks were present at nominal retention times of 21.5, 22.4 and 23.4 min. for the GC conditions used in the study. These peaks correspond to hydrocarbon TMP, m-TCP, p-TCP. Peaks were identified by matching retention times and ion fragment pattern, particularly the presence of ions at 107, 165, 184 and 198. Other compounds do co-elute with these peaks, including the 368 amu ion, so a spectrum subtraction was done to confirm each peak and each mass spectrum reviewed. Synthetic hydrocarbons were present in the jet engine oil sample with 8 peaks present in jet oil from KSU starting at retention times in 20.5-minute range for the conditions used. The mass spectra pattern for the hydrocarbons typically had a base peak at 85amu and strong ion fragments at 113 and 91, as well as additional ions at 127 and 156, without the classic fragmentation patterns associated with the cleavage of CH_2 groups.

To mark a filter as having TCP present, (marked as “yes”) at least two of the three TCP isomers had to be identified in the chromatogram. If two or all three were present in relatively high concentrations then clearly they were from jet engine oil and. The TmCP isomer was present in most samples (but not in the blanks), but that isomer can come from sources other than jet engine oil. Thus, even a high concentration was not sufficient to conclude that jet engine oil was the source. If two isomers were present at very different concentrations the filter was marked ‘maybe’. A peak at 22.4 minute was considered likely to be from jet engine oil when it was very large and accompanied by later eluting peaks with mass spectra consistent with TCPs. The GC runs were stopped at 30 minutes, so evaluating the data for the presence of later eluting compounds was not possible. Some chromatograms were obtained from used filters; tables showing TCP isomers’ concentrations in used and some incident are shown in Appendix B: Tables B.1 and B.2 respectively.

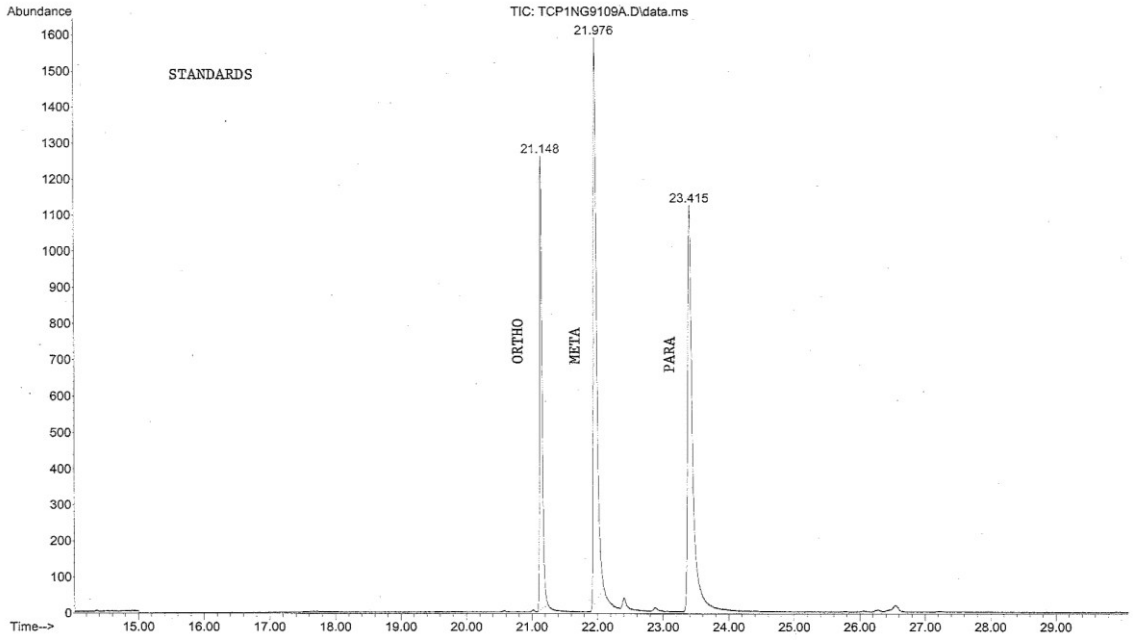
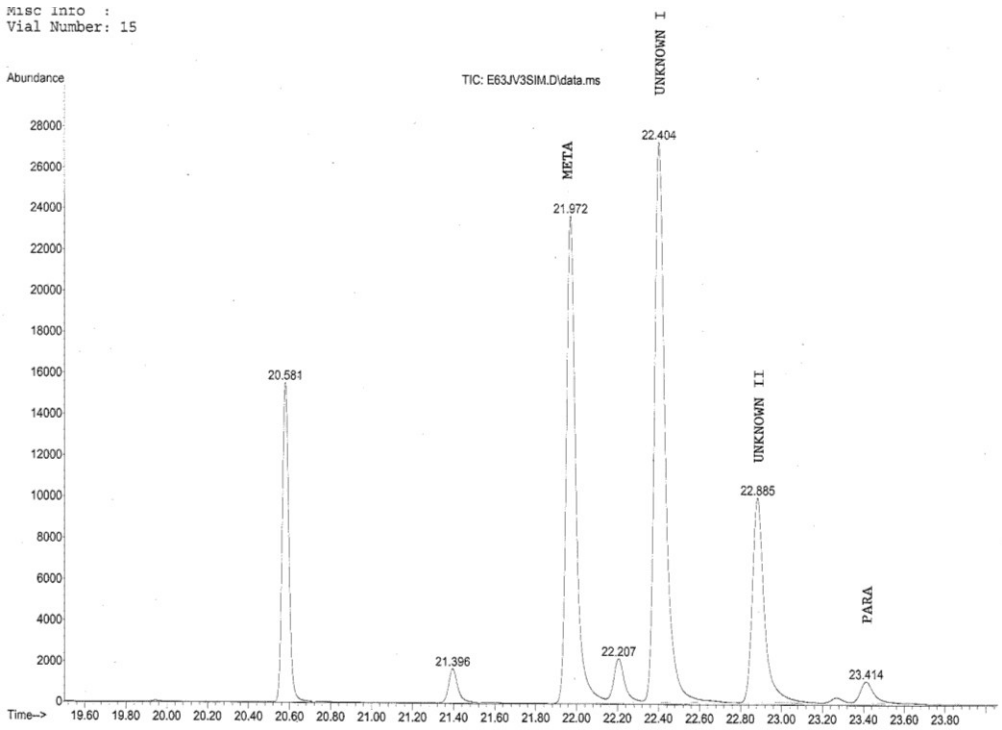
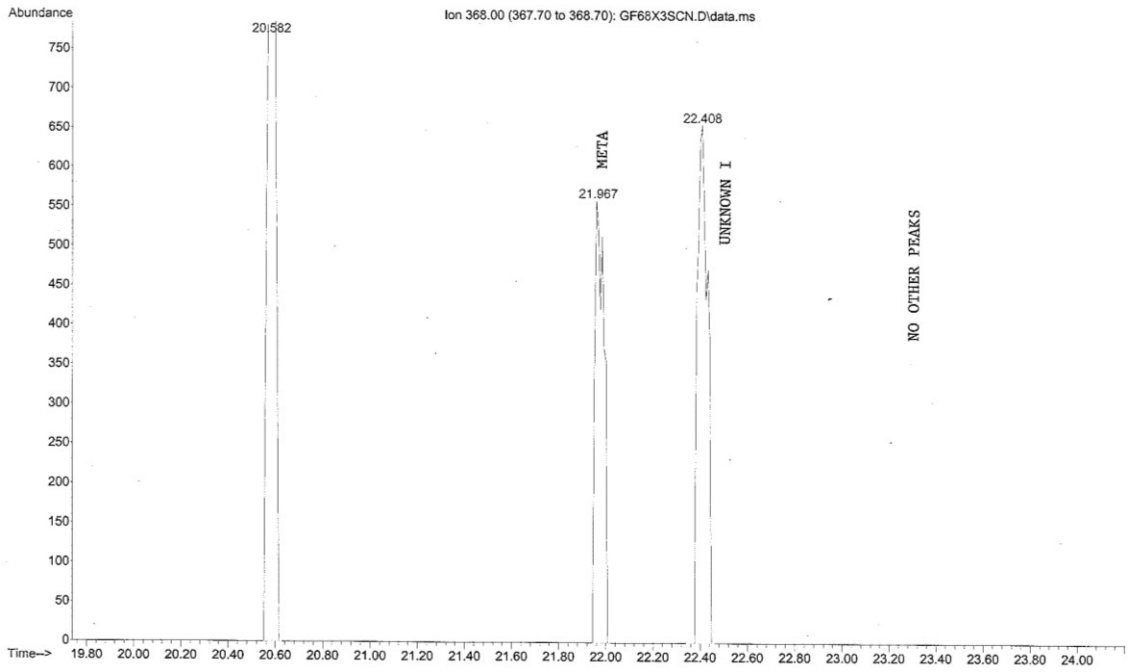


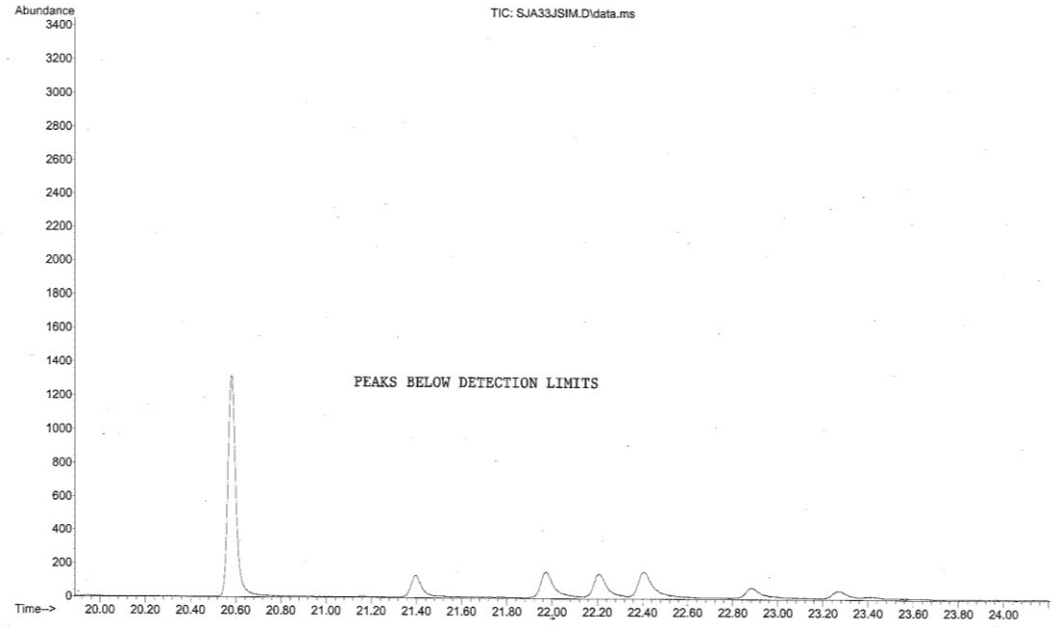
Figure 3.4 GC/MS spectrum of standard solution



(a) Used filter ID E63JV3

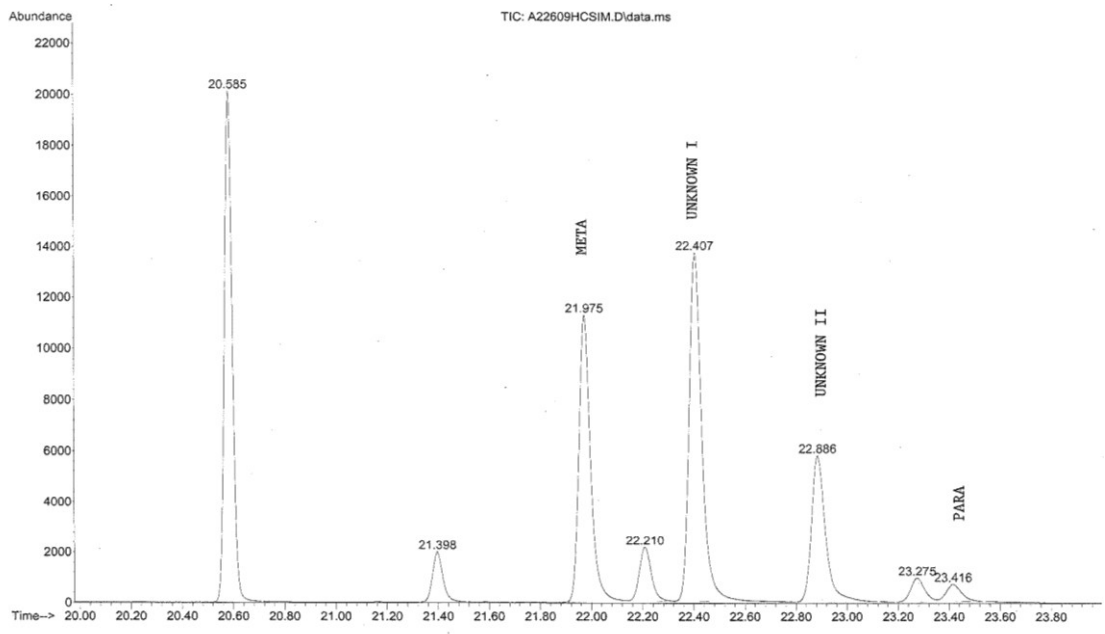


(b) Used filter ID GF68X3

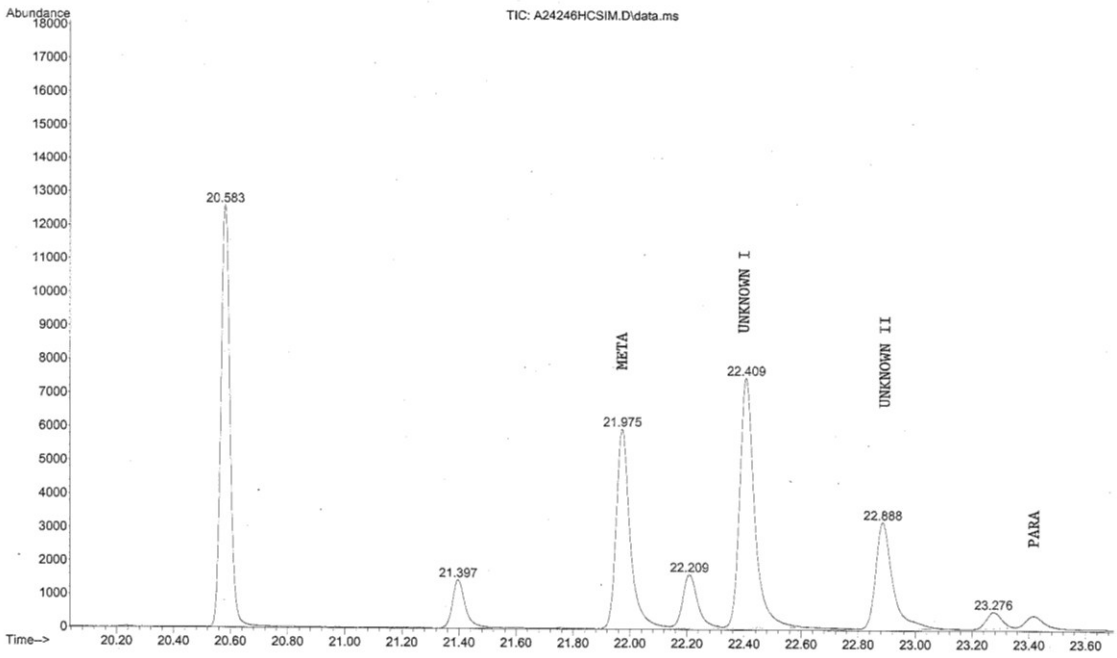


(c) Used filter ID SJA33J

Figure 3.5 Spectra of used filters: (a) ID E63JVE (b) **ID GF68X3 and (c) ID SJA33J with peaks below detection levels**



(a) Incident Filter ID A22609HC



(b) Incident filter ID A24246HC

Figure 3.6 Spectra of incident filters (a) ID A22609HC and (b) A24246HC

Table 3-2 Descriptive statistics for TmCP and TpCP in used and incident filters

Filter Category	TCP Isomer	Sample Size (N)	Arith. mean	Geom. Mean	Median	Range	Std. Deviation	Coeff. of variation	Std. error of mean	95% conf. inter.	Upper 95% conf. limit	Lower 95% conf. limit.
Used	TmCP	108	10.82	14.50	5.86	251.70	26.33	2.43	2.52	5.02	15.85	5.80
	TpCP	108	0.69	0.00	0.00	26.80	2.87	4.17	0.28	0.55	1.24	0.14
Incident	TmCP	66	25.82	19.60	11.20	366.40	52.26	2.02	6.43	12.85	38.67	12.97
	TpCP	66	1.61	0.00	0.00	25.20	3.96	2.46	0.49	0.97	2.8	0.63

Descriptive statistics parameters for TmCP and TpCP in both categories of filters are different.

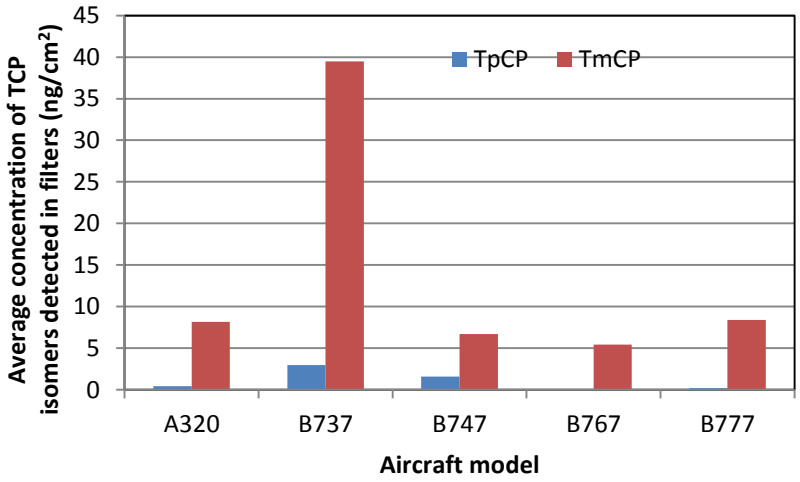


Figure 3.7 Histograms of mean concentration of TCP isomers detected in used filters

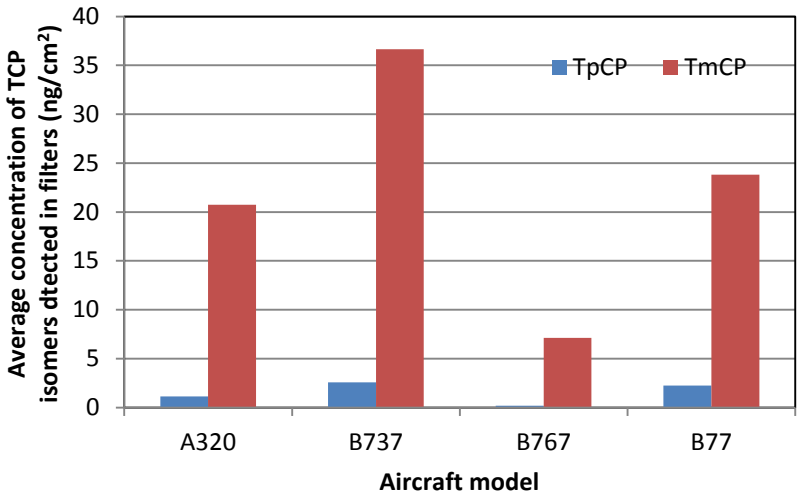


Figure 3.8 Histograms of mean concentrations of TCP isomers detected in incident filters

3.4.2.1 Discussion

Comparing of chromatograms and data obtained from Mobil Jet Oil II with those from incidents and used filters indicate that GC/MS is an effective technique for detecting TCP isomers on airline cabin air filters. Overall, GC/MS analysis results suggest that not all analyzed used filters showed the presence of TCP isomers. Without doubt, jet engine oils with additives ensure that the jet engines function efficiently, but those additives are not friendly to human health. The economics of using jet engine lubricating oil are significant: the consequences are catastrophic if engine failure occurs. However, all known facts about TCP toxicity, means the use of jet engine lubricating oil in aircraft operations must be reinvented; the status quo is unsustainable. The study has established a firm link between incident-occurrences and detection method: GC/MS. The investigation has offered a riveting demonstration of the presence of TCP isomers on used aircraft filters which implies that these compounds are airborne and can only reach the filters through cabin air supply originating from the bleed air. Currently, the performance of aircraft engine types cannot be linked to concentration of TCPs. The identifying, managing and communicating any performance factor linked to cabin air quality incidents could help establish if correlations exist between aircraft engine operation conditions and smoke/fume incidents.

Specifically identifying each isomer of TCP using GC-MS is difficult as it is necessary to have a standard specimen of each pure isomer to properly calibrate the instrument used for the measurements. In practical applications, these standard specimens are not likely to be readily available (B. W Jones, personal communication). Additionally, the exact formulation of TCP in jet oil may vary over time and amongst oil brands. Thus, the characteristic composition for jet oil used in this study is not necessarily accurate for a future application. For these reasons in future applications of this method, a specimen of jet oil from the potential source should always be analyzed along with filter specimens if TCP is to be used as a marker for oil. This oil then effectively becomes a "standard." That is, it is not necessary to associate each TCP peak in the chromatograph with a specific isomer. Rather, the important consideration is that the TCP peaks seen on the filter correspond to the peaks seen for the jet oil and that the concentration ratios seen on the filters correspond to the concentration ratios seen in the oil. The peaks and concentration ratios identified in this study are not necessarily the ones that would apply in a given application.

3.4.3 Recommendations

Since the TCPs detected on the filters must have been airborne and carried by the cabin air supply to the filters, further studies are recommended to create a database that would help in developing TCPs standards for aircraft cabin environment. With such a database, airlines can reliably assess air quality parameters associated with incidents. Further studies should screen for the presence of other isomers not identified by this study.

3.5 Conclusions

The GC/MS procedure has been developed to determine the presence of jet oil markers in used aircraft filters. Of those 177 filters analyzed, 32 incident and 14 used filters showed the presence of TCPs and hydrocarbon compounds. The findings do support the possible use of cabin air recirculation filter analysis to determine a jet engine oil marker for air contamination by airborne particulates generated during smoke/fume events. The method can be used to monitor incidents by analyzing filters that have been exposed to smoke/fume incidents. The technique could also be useful in investigating oil contamination in a variety of aircraft components. This study will also help increase the understanding of the nature of other volatile hazardous chemical compounds that exist in the bleed air system so that appropriate regulations governing air quality in aircraft cabins can be enacted.

3.6 References

Abou-Donia, M., (2005). Proceedings of the Contaminated Air Protection Conference Proceedings of the BALPA Air Safety and Cabin Air Quality International Aero Industry Conference. Held at Imperial College, London, 20-21 April 2005.

Abou-Donia, M. B., Lapadula, D. M., (1990). Ann. Rev. Pharmacol. Toxicol., 30, 405 (1990).

American Laboratory and Trading. ALT Inc © 2011 (2012). http://www.usedlabequipment.com/lab_equipment/HP+Agilent+6890+GC+MS+System+w+5973+MSD_17953.php. (Cited: 4th May, 2012).

Brown, T. P., Shuker, L. K., Rushton, L., Warren, F. and Stevens, J., (2001). The possible effects on health, comfort and safety of aircraft cabin environments. The Journal of The Royal Society for the Promotion of Health. September 2001, 121 (3), pp. 177–184. http://rsh.sagepub.com/content/121/3/177.full.pdf (Cited: April 15th, 2012)

Bull, K., and Roux, P., (2010). Cabin Air Filtration Systems – Novel technological solutions for commercial aircraft. 40th International Conference on Environmental Systems. American Institute of Aeronautics and Astronautics. AIAA 2010-6291.

Australian Civil Aviation Safety Authority (CASA). Expert Panel on Aircraft Air Quality (EPAAQ) (2009). Contamination of aircraft cabin air by bleed air – a review of the evidence. http://www.casa.gov.au/wcmswr/_assets/main/cabin/epaaq/epaaq-entire-report.pdf

Craig, P. H., and Barth, M. L., (1999). Evaluation of the hazards of industrial exposure to tricresyl phosphates: A review and interpretation of the literature. Journal of toxicology and Environmental Health, Part B, Critical reviews. Vol. 2 (4) pp. 281-300.

Crump, D., Harrison, P. and Walton, C., (2011). Aircraft Cabin Air Sampling Study; Part 2 of the Final Report, Institute of Environment and Health, Cranfield University, April 2011. https://dspace.lib.cranfield.ac.uk/handle/1826/5306 (Cited: November 24th, 2011).

De Nola, G., Kibby, J. and Mazurek, W., (2008). Determination of *ortho*-cresyl phosphate isomers of tri-cresyl phosphate used in aircraft turbine engine oils by gas chromatography and mass spectrometry. Journal of Chromatography A, 1200 (2008) 211 – 216.

De Nola, G., Hanhela, P. J. and Mazurek, W., (2011). Determination of Tricresyl phosphate Air Contamination in Aircraft. Ann. Occup. Hyg. Vol. 55. No. 7, pp. 710-722, 2011. Oxford University Press on behalf of the British Occupational Hygiene Society. doi:10.109/annhyg/mer040.

Hanhela, P. J., Kibby, J., DeNola, G., and Mazurek, W., (2005). Organophosphate and Amine Contamination of Cockpit Air in the Hawk, F-111 and Hercules C-130 Aircraft. Australian Government Department of Defence. Published by DSTO Defence Science and Technology Organisation, Victoria 3207 Australia.

Hatch R. C. (1988). Poisons causing nervous stimulation or depression. In N.H. Booth and L.E. McDonald (Eds.), Veterinary Pharmacology and Therapeutics, Iowa State University Press, Ames, IA, pp. 1053 (1988).

Henschler, D., (1958). Tricresylphosphate poisoning; experimental clarification of problems of etiology and pathogenesis. Klin Wochenschr 1958; 36:663-74.

Holt, G. C. (2011). A conference most revealing: aircraft cabin air quality. *Journal of Biological Physics and Chemistry* 11 (2011) 216–220 © 2011 Collegium Basilea & AMSI doi: 10.4024/22HO11A.jbpc.11.04.

International Programme on Chemical Safety (IPCS) Report on Environmental Health Criteria 110:Tricresyl Phosphate. (1990). http://www.inchem.org/documents/ehc/ehc/ehc110.htm#PartNumber:2. (Cited: August 20th, 2010).

Karalliedde, L., (1999). Organophosphorus poisoning and anaesthesia. 54: 1073 – 1088.

Liyasova, M., Li, B., Schopfer, L. M., Florian Nacho, F., Masson, P., Furlong, C. E., Lockridge, O., (2011). Exposure to tri-o-cresyl phosphate detected in jet airplane passengers. Toxicology and Applied Pharmacology. 256 (2011) 337-347.

Michaelis, S. (2003). A survey of health symptoms in BALPA Boeing 757 pilots. Journal of Occupational Health and Safety - Australia and New Zealand 19(3): 253 – 261.

Nagda, N. L. and Rector, H. E., (2003). A critical review of reported air concentrations of organic compounds in aircraft cabins. Indoor Air 2003; 13: 292 – 301. ISSN 0905-6947.

Nisse, P., Forceville, X., Cezard, C. C., Ameri, A., Mathieu-Nolf, M., (1998). Intermediate syndrome with delayed distal polyneuropathy from ethyl parathiol poisoning. Veterinary and Human Toxicology, 40: 349 – 52.

Pope, C. N., (1999). Organophosphorous pesticide: do they have the same mechanism of toxicology? *J. Toxicol. Environ. Health,* 2:161 – 181.

Rosenstock, L., Keifer, M., Daniell, W. E., McConnell, R. and Claypoole, K., (1991). Lancet, 338, 223 (1991).

Spengler, J., Burge, H., Dumyahn, T., Muilenberg, M. and Forester, D., (1997). Environmental Survey on Aircraft and Ground-Based Commercial Transportation Vehicles. Prepared by Department of Environmental Health, Harvard University School of Public Health, Boston, MA, for Commercial Airplane Group, The Boeing Company, Seattle, WA. May 31, 1997.

Solbu, K., Thorud, S., Hersson, M., Ovrebø, S., Ellingsen, D. G., Lundanes, E. and Molander, P., (2007). Determination of airborne trialkyl and triaryl organophosphates originating from hydraulic fluids by gas chromatography-mass spectrometry. Development of methodology for combined aerosol and vapor sampling. *J. Chromatogr A,* 1161 (1-2): 275 – 83. Epub 2007 Jun 2.

Solbu, K., Daae, H, L., Olsen, R., Thorud, S., Ellingsen, D. G., Lindgren, T., Bakke, B., Lundanes, E. and Molander, P., (2011). Organophosphates in aircraft cabin and cockpit air – method development and measurements of contaminants. *J. of Environ. Monit*., 2011, 13, 1393 – 1403. www.rsc.org/jem

Select Committee on Science and Technology (2000). Science and Technology - Fifth Report. House of Lords, UK. http://www.publications.parliament.uk/pa/ld199900/ldselect/ldsctech/121/12107.htm. (Cited 01/07/2012).

Van Netten, C. and Leung, V., (2000). Comparison of the constituents of two jet engine lubricating oils and their volatile paralytic degradation products Appl. Occup. Environ. Hyg. 15(3): 277 – 283.

Van Netten, C., (1998). Air quality and health effects associated with the operation of BAE 146-200 aircraft. Applied Occupational & Environmental Hygiene, 13(10): 733 – 739.

Viveros, L., Paliwal, S., D. McCrae, D., Wild, J., Simonian, A., (2006). A fluorescence-based biosensor for the detection of organophosphate pesticides and chemical warfare agents. Sensors and Actuators B 115 (2006) 150 – 157.

Winder, C., and Balouet, J. C., (2002). The Toxicity of Commercial Jet Oils. Environmental Research Section A. (89): 146 – 164. Dio:1006/enrs.2002.4346.

Winder, C., and Balouet, J. C., (2001).Aircrew Exposure to Chemicals in Aircraft: Symptoms of Irritation and Toxicity. Journal of Occupational Health and Safety – Australia and New Zealand 17: 471 – 483, 2001.

Yurumez, Y., Durukan, P., Yavuz, Y., (2007). Acute organophosphate poisoning in university hospital emergency room patients. Intern Med. 2007; 46(13):965 – 9.

CHAPTER 4 - NEUTRON ACTIVATION ANALYSIS (NAA) OF COMMERCIAL AIRCRAFT CABIN AIR RECIRCULATION FILTERS

4.1 Abstract

The lack of air quality monitoring in the bleed air systems of civil aircraft means unsuspecting cabin occupants may be exposed to a cabin air supply contaminated with smoke/fumes from jet engine lubricating oil. Jet engine lubricating oil, though necessary for aircraft engine operations, poses certain safety hazards if it contaminates the engine bleed air used for pressurizing and ventilating aircraft. The magnitude of the threat posed by smoke/fumes incidents is not known. Furthermore, scientists are unsure of the scope of the problem. This study focuses on using neutron activation analysis (NAA) for monitoring cabin air quality for jet engine oil contamination by analyzing aircraft cabin air recirculation filters. The objective of this part of the research was to analyze used aircraft cabin air filters to determine if elements from jet engine oils contaminating the filters could be detected. Duplicate samples from 200 cabin filters removed from aircraft and from clean – unused filters were analyzed. One hundred and ten of the filters were removed from aircraft during routine servicing at the end of normal filter service life. These filters were designated as “used” filters in this study and were from aircraft not known to have had air quality incidents or related problems. Ninety of the filters were removed from aircraft identified as having air quality issues and are designated as “incident” filters in this study. All of the filter samples were irradiated in a TRIGA MARK II reactor. The high-purity germanium (HPGe) detector coupled with GENIE 2K software was used to analyze gamma-rays emitted from irradiated filters samples. The jet engine oil was also irradiated, and the results of that investigation compared to used, incident, and clean filters. Data obtained from irradiated used, incident, and clean filters and jet engine oil samples were analyzed by SAS software to determine the elements from jet engine oil that might be considered as contaminants in used and incident filters. The analysis also compared the concentration of isotopes of elements in used and incident filters to determine any differences between them. Based on the analysis of the experimental data, the jet engine oil markers in used aircraft filter could not be determined. However, traces of a wide range of elements were detected, including Ag, Ar, As, Au, Ba, Be,

Bi, Cd, Ce, Cr, Cs, Fe, Ga, Gd, Hf, Hg, In, Ir, K, Kr, La, Lu, Mo, Na, Nb, Nd, Ni, Os, Pa, Pb, Pm, Rb, Re, Ru, Sb, Sc, Se, Sn, Sr, Ta, Tb, Tc, Tb, Tc, Te, Th, W, Xe, Yb, and Zr. Statistical analysis by one way ANOVA using SAS code PROC GML revealed statistically significant differences in the concentrations of some isotopes from the used and incident filters. Therefore, further investigation should verify the findings to ascertain the suitability of this technique for detecting jet engine oil on aircraft cabin filters. Background isotopes must be clearly determined to remove them from the analysis.

4.2 Introduction

Commercial air transportation during the past 50 years has improved in large part because of modern aircraft design. Part of the new technology involves air quality. Civil aviation technology advances and diverse scientific methods have converged in different ways to shape and transform air quality in commercial aircraft. The jetliner's environmental control system (ECS) has been painstakingly designed to meet demanding quality standards for the air supplied to the cabin. Air quality safety standards have always been designed into the aircraft's ECS. But past studies on aircraft cabin air quality have mainly focused on contaminant threats originating from within the cabin, including cigarette smoke (Nagda and Rector, 2003). Meanwhile a modern aircraft's infrastructure has changed significantly; consequently, it has not kept pace with the demands for quality air supply for the cabin. Disruptions arising from smoke/fume incidents are unusual but can cause dangerous situations in an aircraft cabin. Airborne volatile chemical substances emissions from the aircraft bleed air system during smoke/fume incidents have not been studied even though the fumes raise many health concerns, in particular the impact of TCPs additives in jet engine lubricating oils on aircraft cabin occupants. Continuing cabin air quality incidents drive air quality studies in airplanes, particularly studies of hazardous airborne substances released into aircraft cabins during incidents.

Deterioration in air quality during smoke/fume incidents may also hurt airline commerce in addition to having a negative impact on health, particularly the health of frequent fliers like aircrew. In fact smoke/fume incidents may have unfavorable lingering long-term health effects. Furthermore, incidents can create significant emotional strain for aircraft cabin occupants, and the level of concern is even higher amongst flight attendants and pilots. Air quality needs to be maintained at all times during flight, but the FAA rules and regulations governing air quality

provision in aircraft cabins do not cover smoke/fume incidents (ASHRAE, 2007). Essentially all commercial aircraft already have bleed air systems. Too much remains unknown about smoke/fume incidents, in part because a smoke/fume incident is hard to quantify because commercial aircrafts do not have air quality monitoring systems on board. Additionally, because the air quality during smoke/fume incidents cannot be measured, the quality of the air supply for cabin occupants during incidents cannot be adequately judged, and determining how to handle incidents is nearly impossible. In the interest of stakeholders in airline industry, the effects of these incidents must be explored more fully, so the best remedy can be chosen.

In a modern aircraft's ECS, HEPA cabin air recirculation filters remove airborne particulates from the air and are an integral part of air quality control system. Smoke/fume incidents contaminate the air supply in the cabin. Thus, smoke/fume events in aircraft engine bleed air system cause emissions to enter the ECS; eventually, those contaminants pass through the cabin air recirculation filters, making them a focus of interest among researchers. A study by van Netten (1999), did not find significant concentrations of toxic elements in any of the jet engine lubricating oils and hydraulic fluids analyzed. However, according to Winder and Balouet (2001), toxic metals contaminants in commercial jet engine lubricating oils include; cobalt (Co), Mg, manganese (Mn), vanadium (V) and chromium (Cr). Alemon et al. (2004) have successfully used NAA to characterize airborne suspended particles in air filters. Landsberger et al. (1993) also used NAA to determine concentrations of cadmium in air filter samples. In this study, NAA was used to analyze used and incident cabin air recirculation filters to quantify elemental concentrations of jet engine lubricating oil markers. The study aimed to analyze the concentration levels of isotopes in both irradiated incident and used filter samples on cabin air filters to determine jet engine oil contamination. This study investigated the elements present in Mobil Jet Oil II, clean, used and incident cabin air recirculation filters in an attempt to determine the jet engine oil signature on used and incident filters.

4.2.1 Principles of neutron activation analysis (NAA)

NAA works by irradiating the sample with neutrons in the reactor to induce nuclei of the atoms in the sample to become radioactive. When a sample is irradiated, the stable elements in the sample are transformed into radioactive isotopes by neutron absorption. Each radioactive nucleus emits gamma rays of different and unique energies or wavelengths, whose intensity is

proportional to the concentration of that element in the sample. Gamma ray detection can discriminate between these gamma ray energies, measure their intensities, and determine the concentrations of different elements in the sample (Shultis and Faw, 2007). Figure 4.1 illustrates the irradiation process converting a target material (specimen) into radioactive isotopes (Glascock, 2011). The isotopes decay at a characteristic rate, in most cases, emitting gamma rays of characteristic energies and intensities. As an example, irradiation of iron (Fe) with neutron particle and the resulting to gamma ray energy produced are shown below by Equations (4.1a) and (4.1b). When either prompt gamma rays or delayed gamma rays emitted from the radioactive nucleus are analyzed, elements in the sample can be identified.

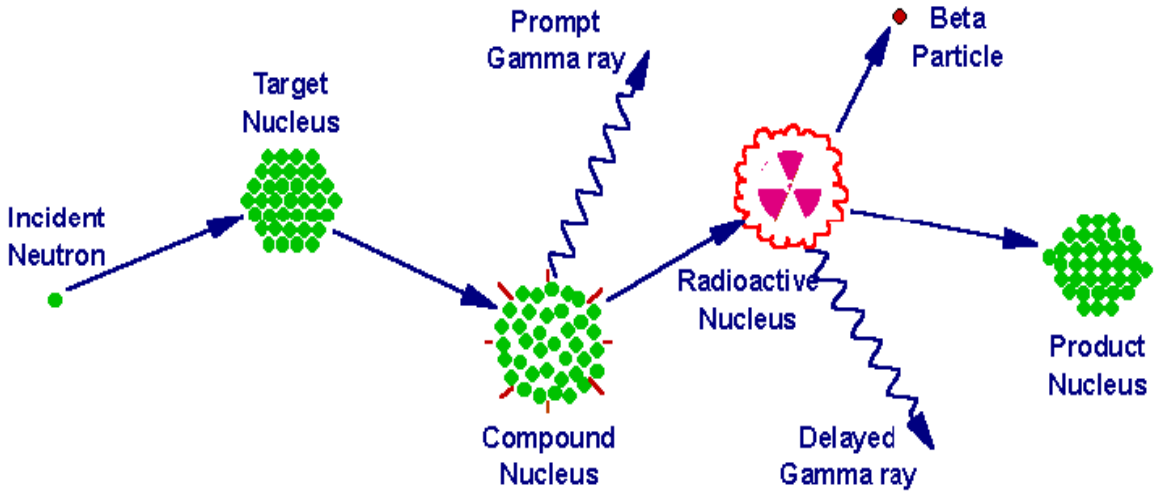


Figure 4.1 Schematic illustrating neutron activation process and emission of gamma rays
(Source: Glascock, 2011)

$$^{58}Fe + {}^{1}n \quad {}^{59}Fe + \text{Beta-} + \text{Gamma rays} \qquad (4.1a)$$

Gamma ray energies = 142.4, 1099.2, 1291.6 keV (4.1b)

When gamma rays deposit their energy into the crystal, it creates a hole and electron pairs in the crystal and a bias voltage is used to collect the charges. The number of pairs created is proportional to the energy of the gamma ray. The weight of a given element in a sample is

usually determined by comparison. In analysis of filter material by NAA, a sample of filter material is analyzed for its elemental and isotopic composition. The process can be qualitative (determining what elements are present), or quantitative (determining how much of each element are present). The intensity of gamma ray emission by the irradiated sample is measured using a high-purity germanium (HPGe) semiconductor detector. A HPGe detector offers high energy resolution as compared to other types of radiation detectors. A high energy resolution allows one to distinguish more accurately the difference between two similar gamma ray energies. The ability to distinguish between different gamma energies allows one to create a detailed energy spectrum.

The mass of a given element in a sample is usually determined as follows: (a) Counts, (b) Specific activity, (Counts/(time × detection efficiency) × mass (mg) = (μCi/mg), (c) Number of radioactive isotope atoms: Activity = λ × n, (d), where λ = decay constant and n = number of isotope atoms. Based on neutron flux, irradiation time, the number of element atoms is calculated (e) Mass of the element. In the analysis of the filter material with NAA, the elemental and isotopic mass of a sample of the material was determined. Gamma ray detection systems have been developed that can themselves discriminate between the gamma ray energies emitted, measure their intensities and hence determine the concentration of the different elements in the sample. The isotopes decay at a characteristic rate, in most cases emitting gamma rays of characteristic energies and intensities. By analyzing either prompt gamma rays or delayed gamma rays emitted from the radioactive nucleus, elements in the sample can be identified. Therefore, the basic process of NAA consists of three steps: irradiate the sample in a reactor; measure the energy spectrum of gamma radiation emitted by the sample, and identify elements based on the energy level of emitted radiation.

4.3 Materials and methods

4.3.1 Filter Sampling

Figure 4.2 shows the steps involved in cutting filter specimen once they are received in the laboratory.

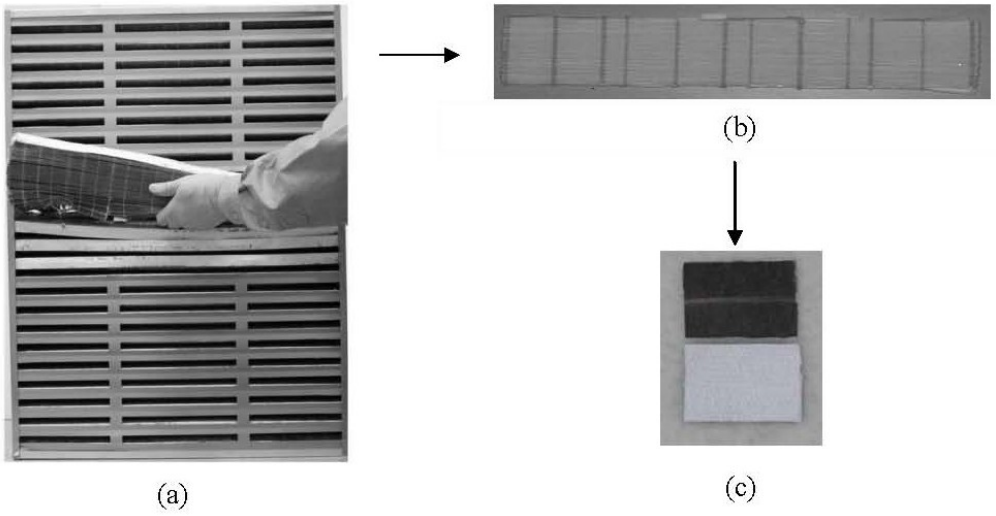


Figure 4.2 Filter sampling preparation for NAA

4.3.2 Preparatory steps for irradiation of filter samples

In the nuclear laboratory, filter samples were cut into 75-150 mg pieces to provide a more uniform sample size, allowing quick comparative analysis of data. Smaller samples also reduced the amount of radioactive waste for disposal. To prepare for the NAA, samples were weighed in a polyethylene bag. To perform a comparative analysis, samples were placed in a second polyethylene bag to prevent activating any trace elements on labels created by marker pens. A self-sealing plastic sleeve/container (handled with clean gloves to prevent contaminating the sample) was placed on an analytic balance, and the tare weight was set to zero. A sample was placed in the plastic container, and the container weighed on the balance; this weight and sample identification numbers were recorded on a second container. The sample container was then placed into the labeled container. This process was repeated for all samples and for samples of pure iron (used to measure the neutron flux to which the samples were exposed, known as flux monitors). All the samples and flux monitors were placed in a heat resistant polyethylene capsule and sealed in a plastic sleeve. For liquid samples, 5.0 mL was sealed in polyethylene containers to prevent the release of contaminants into the reactor tank and to ensure that cross contamination did not occur. Iron standards were packaged and weighed in the same manner as filter samples. The filter samples were assigned iron standards, one iron standard per polyethylene capsule.

4.3.3 Filter irradiation process

Both filter and iron standard samples were placed into sample vials and capped. Sample vials were then placed in 10 specially-machined racks, six samples per vial, and four vials per rack. Therefore, 240 samples could be irradiated at once. Iron wire activation was used to calculate the actual flux. The movable portion of the sample rack was locked in place with aluminum wire. Before irradiation, the sample racks were lowered into the Rotary Specimen Rack (RSR) well, an irradiation site that surrounds the core of the nuclear reactor. The reactor was then operated at a targeted power for a predetermined time and conditions to activate the samples, typically 450-500 kW for eight hours. At the end of a test run, the reactor was shut down.

The target irradiation time and power level was based on an optimization of a number of variables, including trial irradiations, analysis, elements of interest, and the number of samples to be analyzed. Laboratory analysis requires time, and analyzing larger sample sets can cause loss of data from samples counted later in the sequence for radionuclides with short half-lives. Figure 4.3 shows the top view of the research nuclear reactor at Kansas State University.

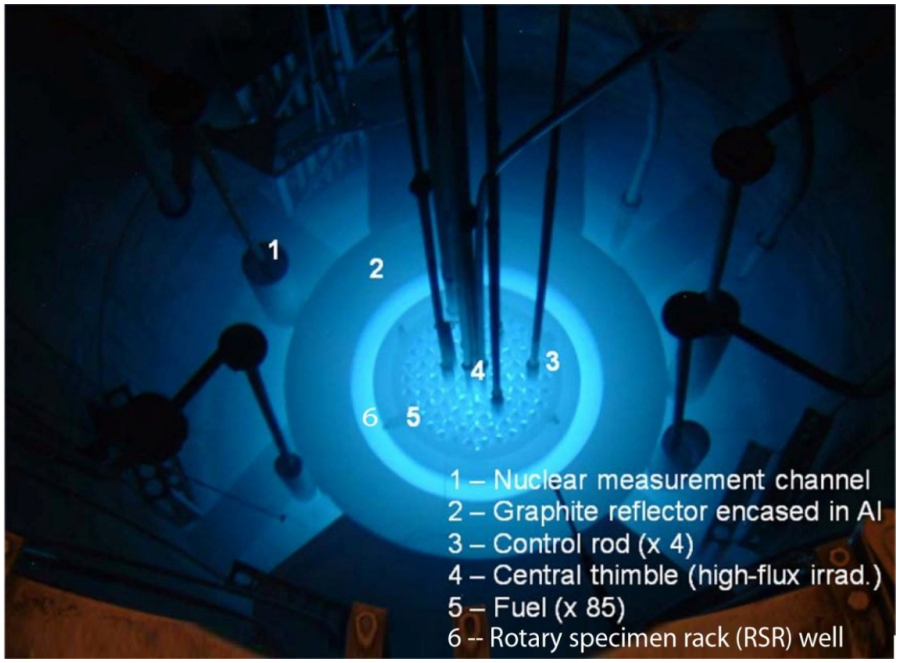


Figure 4.3 Top view of TRIGA MARK II Reactor at Kansas State University

The counting sequences for samples with short-lived radionuclides must be tightly controlled, so detecting short-lived radionuclides demands resources. In general, higher power levels and longer operating times increase sensitivity in detecting radionuclides with long half-lives. For all samples analyzed at the Kansas State reactor, irradiation times of 8 hours accommodates the facility's operating schedule, and power levels of 500 kW were selected as a maximum for continued steady state operation over an 8-hour period. At 500 kW the reactor released 3.0×10^{12} fast neutrons at cm^{-2} s^{-1} and thermal neutron at 3.6×10^{12} cm^{-2} s^{-1}. These parameters were chosen to produce data for the range of elements identified in the trials. If the samples are highly radioactive, detector dead time limits their usefulness; waiting for a sample to cool enough to reduce activity to a threshold where dead time is acceptable may mean some elements, present in small quantities with a short half-life, fall below detection levels due to the shortness of the radioactive process.

4.3.4 Handling procedures to minimize or avoid radioactive contamination spread

Following irradiation, samples were highly radioactive, so they were left in the reactor pool to decay to minimize their radioactivity while they were handled. Meanwhile, the sample racks were removed from the RSR well. Sample vials were removed from racks. Water that leaked into the vials was drained back into the reactor tank. The samples were then removed from the vials and placed in the pit to decay further to acceptable counting levels. A radiation monitor model Victoreen 450 was used to monitor radiation levels before samples were dispatched for counting. A 2-mR/hr radiation level reading was considered safe for counting; otherwise, higher values would saturate the detector and interfere with counting accuracy. New outer bags were prepared and each labeled for sample identification. The bagged samples were weighed, and the sample's iron standards were transferred to the new bags. In case of error or ambiguous results, a portion of the original sample was kept for re-testing. Finally, the samples were transferred to the NAA laboratory, where an analysis was performed using HPGe detector and GENIE 2K software.

To reduce exposure of personnel to radioactivity, the samples were left to decay for a minimum of five to seven days, which would normally be adequate without a significant loss of data due to the shortness of the half-lives. The sample racks were disassembled by cutting the aluminum wire, which was then discarded in accordance to general regulations for radioactive

waste disposal 10CFR20.2001 (1991). At the end of each irradiation, before the samples were removed to new outer bags, they were swiped to verify that they were free from loose surface contamination. The old bags were also disposed of according to 10CFR20.2001 regulations.

4.3.5 Determination of concentration of radioactive atoms within a sample

One method to calculate the concentration of radioactive atoms in a sample is to determine the area under the peak by peak analysis. The peak area refers to the number of photons collected at a specific energy peak. The number of photons collected is proportional to the concentration of the radioactive isotope. The GENIE 2K algorithms calculate the net peak area by subtracting the background continuum (B) from the gross counts (G). The resulting net peak area (S) is displayed in Figure 4.4.

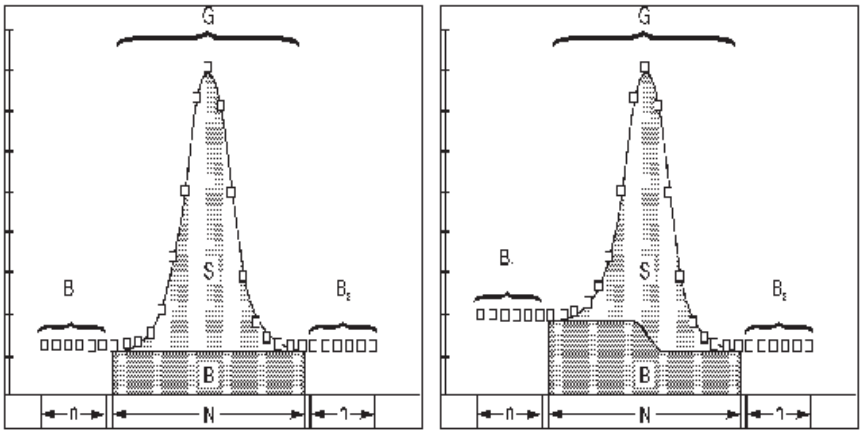


Figure 4.4 Net peak area calculation for different background continuum counts

(Source: Canberra Industries, Inc., 2001).

In order to calculate the concentration of radioactive isotope, it is assumed that there are no initial radioactive atoms. Thus, the radioactive atoms are produced only from the irradiation in the reactor. After the irradiation, the activity will decay exponentially. Equation 4.2 is used to calculate the concentration of radioactive isotope (Shultis and Faw, 2007).

$$\mu_x = \frac{C_j(\mu_x)A_x\lambda_i}{N_a\bar{\sigma}_a\phi m\, p_{i'} f_j \eta_j}\left[1 - e^{-\lambda_i t_o}\right]^{-1} e^{\lambda_i t_w}\left[1 - e^{-\lambda_i t_o}\right]^{-1} \quad (4.2)$$

where:

$C_j(\mu_x)$ = Total number of counts under the peak associated with gamma ray

energy E_j from radionuclide I (counts)

N_a = Avogadro's number (mol^{-1})

$\overline{\sigma}_a$ = Average thermal absorption cross section of precursor isotope í (cm^2)

ϕ = Thermal flux density ($cm^{-2}\ s^{-1}$)

m = Sample mass (micrograms)

μ_x = Weight fraction of element x in the sample

$p_{i'}$ = Abundance of precursor isotope i in the element of interest

f_j = Branching ratio of the gamma j in the radioisotope of interest

η_j = Overall detection efficiency, including intrinsic efficiency and geometry

A_x = Atomic mass of the element x

λ_i = Decay constant of the isotope of interest (s^{-1})

t_o = Irradiation time (s)

t_w = Waiting time between the end of irradiation and the start of counting (s)

t_c = Counting time of the detector (s)

4.3.6 Gamma ray counting

Jet engine oil and clean filters were also irradiated as controls. After irradiation, these samples were left to cool down/decay for 7-10 days, after which gamma rays emitted from the irradiated samples were counted by HPGe detector for one hour. According to Agnello et al. (2009), HPGe detectors have higher energy resolution compared to traditional scintillators like sodium iodide (NaI), and the detectors have enabled significant advances in nuclear spectroscopy. A Canberra multi-channel analyzer (MCA) with Genie 2K software was used to analyze the data from the irradiated samples. The MCA sorted and stored myriad proportional signals coming from the nuclear detector due to gamma ray interaction with the detector. A high energy resolution allowed the difference between two similar gamma ray energies to be distinguished more precisely. This ability to distinguish between different gamma energies facilitated creating a detailed energy spectrum.

4.3.7 Radiation detection and analysis by GENIE 2K software

The GENIE 2K software has built in algorithms used to calculate the activity of an irradiated sample. By entering the sample mass and irradiation time into the program, the

software calculates the specific activity of a sample. The software program contains a database of isotopic information to be used in the specific activity calculations. Also by using an internal clock, GENIE 2K can account for the irradiation time, waiting time, and counting time of the sample. The software algorithms use equations 4.3, 4.4, and 4.5 to calculate specific activity, thermal flux and concentration of isotope, respectively.

GENIE 2K is a Windows-based software package used to analyze gamma ray spectra obtained from any type of gamma detector. It simultaneously receives data and displays/graphs (spectrum) in real time. Its measurement data can be saved as text for export into standard calculation software like Microsoft Excel. The NAA data analysis involved calculating neutron flux based on the standard or flux monitor (iron). In turn, the flux and peak area were used to calculate the mass of the parent element for each of the daughter isotopes. All counts for the samples were performed for 3600 sec. live time, and the GENIE 2K spectral data acquisition software was used to record the spectrum. A computer program that searched each element present in the sample by energy levels was used to compare the energy peaks in the samples to libraries of known gamma ray energies, and the energy spectrum of the sample was thereby obtained. The instrument also counted total and relative errors (–/+ μCi/mg). Before counting the samples, the HPGe detector was calibrated for both energy and efficiency.

4.3.7.1 Energy and efficiency calibration

The HPGe detector was used in conjunction with the GENIE 2K multi-channel analyzer (MCA) software. The MCA from the HPGe detector output data as counts versus channel number. However, the channel number is not useful unless an energy calibration is performed. Therefore, to perform an energy calibration, a radioactive source that contained isotopes with known energies and activities was used. The calibration source comes with a certificate file that can be used to calibrate energy and efficiency. In this study, the calibration source used had a mixed Europium (Eu) source MGS-1. The Eu source had known quantities of radioisotopes: 152, 154, and 155. With the energy of a photo peak known, the channel number was correlated to energy.

The calibration source was centered above the detector. All subsequent samples were counted at the exact same location as the calibration source. The calibration source and samples had to be on the same location, so any uncertainty due to geometric effects would be minimized. The calibration source was typically counted for three hours to ensure that sufficient counts were

collected under the photo-peak. The GENIE 2K software and the MGS-1 certificate file was used, so a linear relationship could be fitted to the calibration data to relate energy to channel number. Energy calibration, which in essence involves plotting peak energy from certificate file versus observed peak at the channel, was obtained as shown in Figure 4.5. In energy calibration, the GENIE software read the channel number corresponding energy based on equation 4.3a.

An output from GENIE software on energy calibration performed on 7/22/2010 at 9:20:35 is shown below in equations 4.3a through 4.3c and Table 4-1. The software reads the channel and converts it to energy according to equation (4.3). Other related equations produced by GENIE as output are full width at half maximum (FWHM) Equation (4.2b) and low tail Equation (4.3c).

$$\text{Energy (keV)} = -0.678 + 0.262 \times \text{ch} + 0.00\text{E}+000 \times (\text{ch})^2 + 0.00\text{E}+000 \times (\text{ch})^3 \quad (4.3a)$$

$$\text{The full width at half maximum (FWHM) equation: } 2.707 + 0.005 \times \text{E}^{½} \quad (4.3b)$$

$$\text{LOW TAIL} = 0.0\text{E}+000 + 0.0\text{E}+0.000\text{E} \quad (4.3c)$$

The energy distribution corresponding to every channel is expected to assume a Gaussian distribution. The full width at half maximum is a parameter used to describe the width of the energy peak corresponding to a channel. For the calibration problem considered the Gaussian distribution obtained had no tails therefore equation (4.3c) shows all zeros. The energy from the certificate file corresponding to each channel and the error ± the centroid error was as tabulated in Table (4.1). The centroid error indicates how far off the identified centroid channel is from the actual channel corresponding to energy obtained. The response measured for the test shows a linear regression on the data obtained from calibration.

Table 4-1 Energy calibration data

Centroid Channel	Centroid error	Energy (keV)
230.11	0.27	60.00
331.60	0.04	86.50
403.28	0.03	105.30
468.88	0.03	121.80
934.14	0.18	244.70
1315.47	0.03	344.30
2259.51	0.10	591.70
2761.20	0.05	723.30
3333.21	0.03	873.20
3834.59	0.06	1004.80
4863.01	0.06	1274.50
5372.37	0.09	1408.00
6090.67	0.23	1596.5

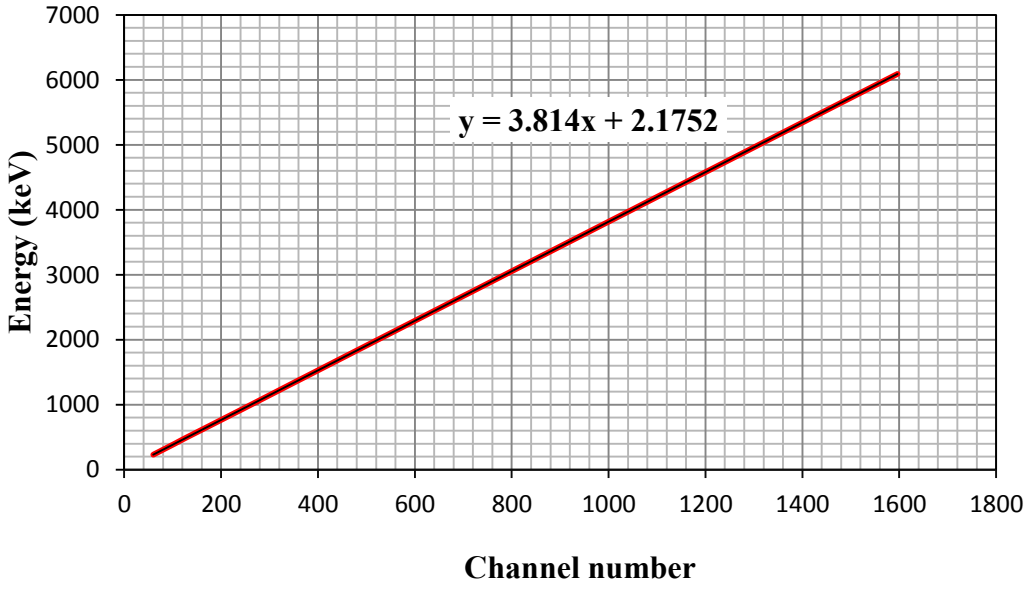


Figure 4.5 Energy calibration using the MGS-1 certificate file

The resulting linear line gives a picture of the relationship between channel number and the corresponding energy output. From the efficiency calibration of October 2010 an energy equation 4.4a was obtained and a non-linear fit was performed to calibrate efficiency versus energy (keV), and a relationship of efficiency versus energy was plotted as shown in Figure 4.6.

$$\ln(\text{Eff.}) = A + B\ln(E) + C\ln(E)^2 + D\ln(E)^3 \quad (4.4a)$$

where Eff. = e^(ln(Eff.)) and E = energy (keV)

Constants: A = –13.1; B = 8.304; C = –1.829 and D = 0.119

Equation 4.4a can be rewritten as follows:

$$\text{Eff} = e^{(A + B\ln(E) + C\ln(E)^2 + D\ln(E)^3)} \quad (4.4b)$$

where Eff = detector calibration efficiency

Using Microsoft Excel, equation 4.4b was used to compute the values shown in Table 4.2. The energy and efficiency values tabulated in Table 4-2 were then used to plot for an efficiency curve that starts at zero, peaks at around 26.4 percent which corresponds to 30 keV, and then decreases as shown in as shown in Figure 4.6.

Table 4-2 Efficiency calibration data

Energy (keV)	Efficiency
5	0.019
10	0.108
15	0.190
20	0.237
25	0.259
28	0.263
30	0.264
40	0.251
45	0.240
50	0.227
100	0.132
250	0.051
500	0.028
750	0.023
1000	0.023
1500	0.026
2000	0.034

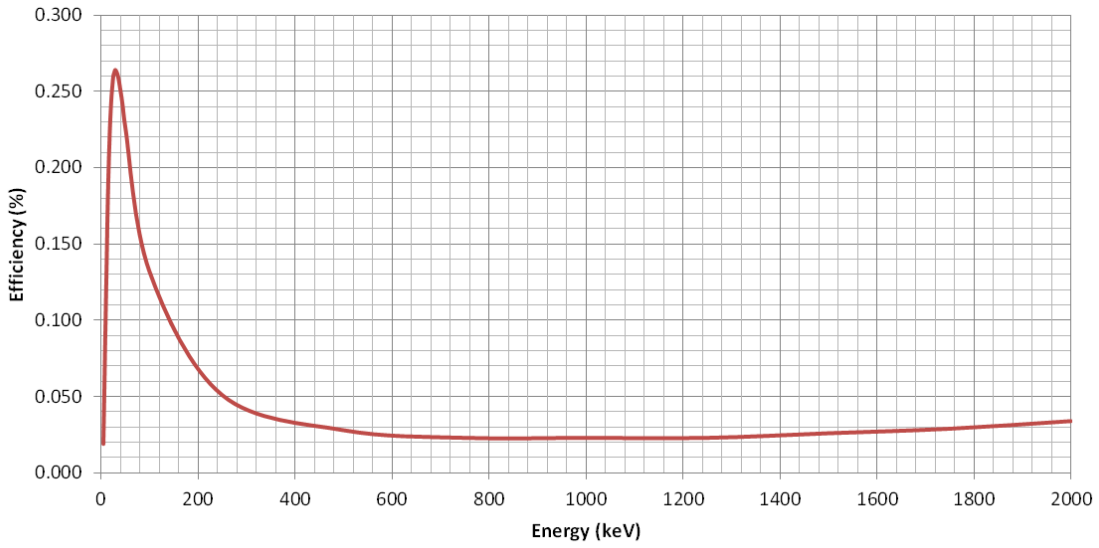


Figure 4.6 Efficiency calibration curve fitting using MGS-1 certificate file

From zero efficiency versus energy have a linear relationship up about 27 percent. Thereafter, energy and efficiency are inversely related: as energy increases, efficiency gets smaller. The line's slope flattens out as it moves the right, suggesting that the rate change of efficiency with energy decreases. The flattened slope indicates that changes in efficiency are less and less sensitive to changes in energy increase. At some point, presumably, there is no further decrease in efficiency and the curve is almost parallel to the x-axis, meaning that efficiency is no longer sensitive to increase in energy.

After the energy and efficiency calibration, irradiated samples could be counted. All samples were counted in the same location as the calibration source so that the solid angle remained unchanged. The sample counting time was adjusted to allow sufficient time for enough counts under the photo peak. Ideally, at least 10,000 counts under the photo peak will keep the statistical error low. Once all samples were counted, the GENIE 2K software generated a report. The filter analysis data were used to identify peak regions of interest. The report contained more information than was needed, but the most useful quantities were the specific activities for each identified isotope. The GENIE 2K software also generated an energy spectrum. The energy spectrum was calibrated to show the identified isotopes next to the associated energy peak.

The radiation detector converts electromagnetic radiation (gamma rays) to an electrical signal on a finite time scale. If the rate of gamma incidence on the detector approaches signal

processing time, the signal from individual radiation events can overlap and degrade the signal. The fraction of time that a detector cannot process an individual radiation event is known as dead time. Activity from short-lived radionuclides generated in an 8-hour operation at 500 kW can cause extremely large dead times. Therefore, sample racks were held in storage to allow short-lived radionuclides to decay before analysis. When the samples approached activity levels for which the dead time was acceptable, the sample racks were removed from storage, and the samples were removed from the capsules. The sample identification and weight information were transferred onto fresh, unirradiated containers. The container with the sample was then removed from the container with the label, and the sample container transferred to the unirradiated, newly labeled container. The sample in the fresh container was then placed close to a HPGe detector.

An analysis software routine applied to the spectral data determined the beginning and end of each region of interest for single gamma energy. The criteria used in this analysis were based on a numerical calculation of the second differential of the intensity function versus energy. The software routine summed the number of times radiation was detected within the determined range and removed the value related to the baseline for the function. Another routine performed an efficiency correction to determine the actual radiation emitted from the sample based on detected radiation. The software used the data collection time (automatically recorded) to determine activity. All of the routines performed statistically based error analyses. Analysis software identified the nuclides associated with specific energies of radiation. This analysis used a library of gamma energies that occur from neutron activated elements and half-life information from the library to calculate the maximum value of mass specific radioactivity for each isotope detected, based on times for start and completion of irradiation (user inputs) and the decay interval before data collection. The digital spectrum analyzer (DSA) is a 16K channel integrated MCA paired with the computer to be a complete spectroscopy workstation. Figure 4.7 shows the data acquisition flow chart.

The identification confidence level reported by GENIE 2K software was confidence in the peak identification. Figure 4.7 summarizes the entire process of NAA of used aircraft filters. The SAS code PROC GML was used to calculate the mass concentration for isotopes; thus, mass concentration = concentration (μCi/mg) multiplied by the mass of the sample. The average mass

concentrations were computed for every filter and the figures obtained were used to analyze differences between used and incident filters. (GENIE 2K Software Manual, 2004)

The radiation that enters the crystal caused electrons to be moved into a conduction band, and a bias across the detector collected the electrons to generate the signal. Larger deposits of energy caused more electrons to mobilize, therefore creating a larger signal. Specific signal magnitudes (pulse heights) were correlated to specific energies. A multichannel analyzer recorded the number of pulses that occurred at specific energies during detection. The aggregation of data was therefore an energy spectrum of the radiation intensity. A spectrum for a reference source was used to accurately determine the energy associated with each channel and the absolute efficiency relating detected radiation to radiation emitted from the source.

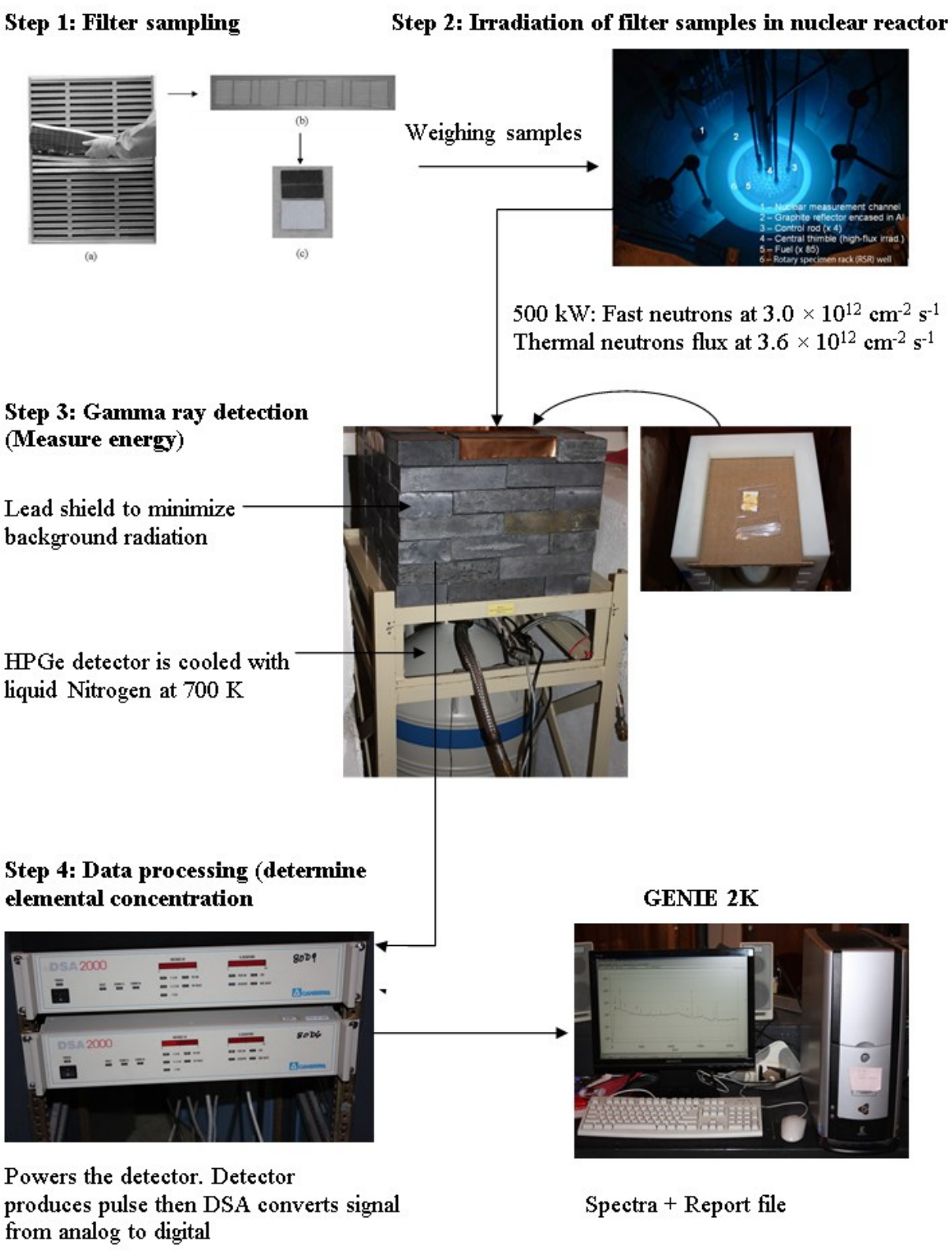


Figure 4.7 Basic steps in gamma ray data acquisition flow chart

4.4 Analysis, Results and Discussion

4.4.1 Data analysis

An analysis of variance (ANOVA) was performed by SAS PROC GML to compare the variability in the means of the mass concentrations (µCi) of isotopes in both used and incident filters. The SAS code was used to compare the two categories of mass concentrations calculated for the isotopes detected in the filters; the results are shown below:

```
options nocenter;
data isotopes;
input Filter$  Spot    Category  AG108m       AG110m AS71    AS76    AS77    AU198   AU198m  BA131
       BA133   BA133m  CD115   CE139   CE141   CE143   CL38    C60     CR51    CS134   Ca47    EU152x
       EU154   FE59    HF175   HF181   HG197   HG203   HO166   IN114m  IR192   IR194   LA140   LU177
       LU177x  MO99    NB94x   ND147   OS185   OS191   PM149   RB86    RE186   RH105   RU103   RU97
       SB122   SB124   SB125   SC46    SE75    SN125x  SR85x   Si32    TA182   TB160   TE121   TE121x
       TE123m  XE127   XE129m  XE133m  YB169   ZN65    ZR95;
cards;
data on mass concentrations of isotopes (µCi)
.
;
proc sort data = Isotopes;
by filter category;
proc means noprint data = isotopes;
by filter category;
var AG108m     AG110m AS71    AS76    AS77    AU198   AU198m  BA131   BA133  BA133m CD115    CE139
       CE141   CE143   CL38    C60     CR51    CS134   Ca47    EU152x  EU154   FE59   HF175   HF181
       HG197   HG203   HO166   IN114m  IR192   IR194   LA140   LU177  LU177x  MO99    NB94x   ND147
       OS185   OS191   PM149   RB86    RE186   RH105   RU103  RU97    SB122   SB124   SB125   SC46
       SE75    SN125x  SR85x   Si32    TA182   TB160   TE121  TE121x  TE123m  XE127   XE129m  XE133m
       YB169   ZN65    ZR95;
output out = spotavg mean = AG108m    AG110m  AS71    AS76    AS77    AU198 AU198m   BA131   BA133
       BA133m  CD115   CE139   CE141   CE143   CL38    C60     CR51    CS134   Ca47    EU152x  EU154
       FE59    HF175   HF181   HG197   HG203   HO166  IN114m  IR192   IR194   LA140   LU177   LU177x
       MO99    NB94x   ND147   OS185   OS191   PM149   RB86    RE186  RH105   RU103   RU97    SB122
       SB124   SB125   SC46    SE75    SN125x  SR85x   Si32    TA182  TB160   TE121   TE121x  TE123m
       XE127   XE129m  XE133m  YB169 ZN65 ZR95;
proc glm data=spotavg;
class  category;
model AG108m   AG110m  AS71    AS76    AS77    AU198   AU198m  BA131   BA133   BA133m  CD115   CE139
       CE141   CE143   CL38    C60     CR51    CS134   Ca47    EU152x  EU154   FE59    HF175   HF181
       HG197   HG203   HO166   IN114m  IR192   IR194   LA140   LU177   LU177x  MO99    NB94x   ND147
       OS185   OS191   PM149   RB86    RE186   RH105   RU103   RU97    SB122   SB124   SB125   SC46
       SE75    SN125x  SR85x   Si32    TA182   TB160   TE121   TE121x  TE123m  XE127   XE129m XE133m
       YB169   ZN65    ZR95 = Category /ss3;
lsmeans Category/stderr pdiff;
run;
quit;
```

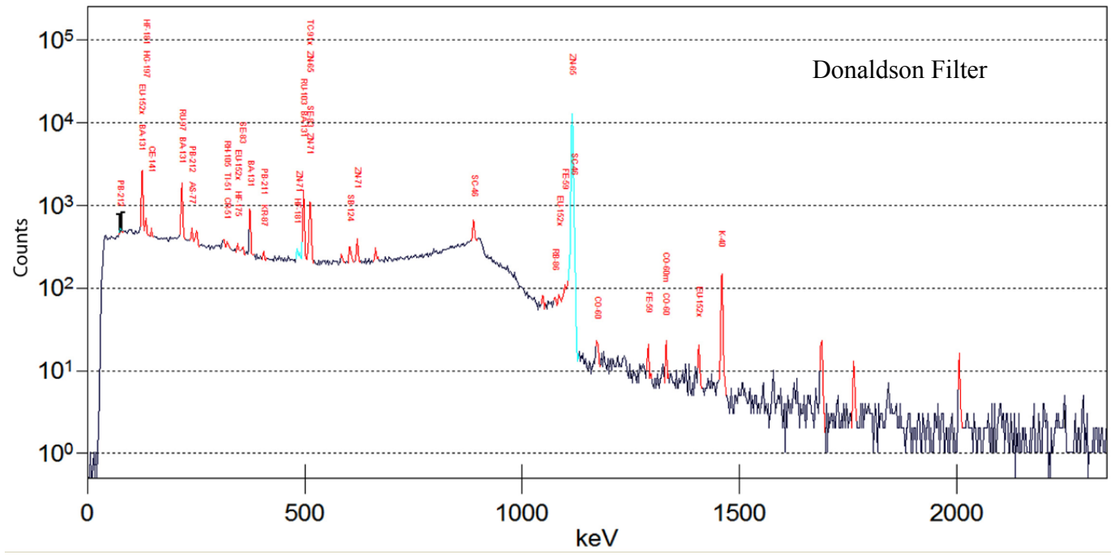
This analysis was done with the SAS system for Windows (release 9.2; SAS Institute, Cary, NC). The confidence level for every peak in the spectrum of the isotope detected is reported by GENIE 2K software. The nuclide identification confidence level reported by the software was the confidence level in the peak identification. All the analyses were performed with the elements in the background radiation included. Based on the energy calibration, background counts of identified isotopes vary from time to time, however further work is recommended to identify background isotopes.

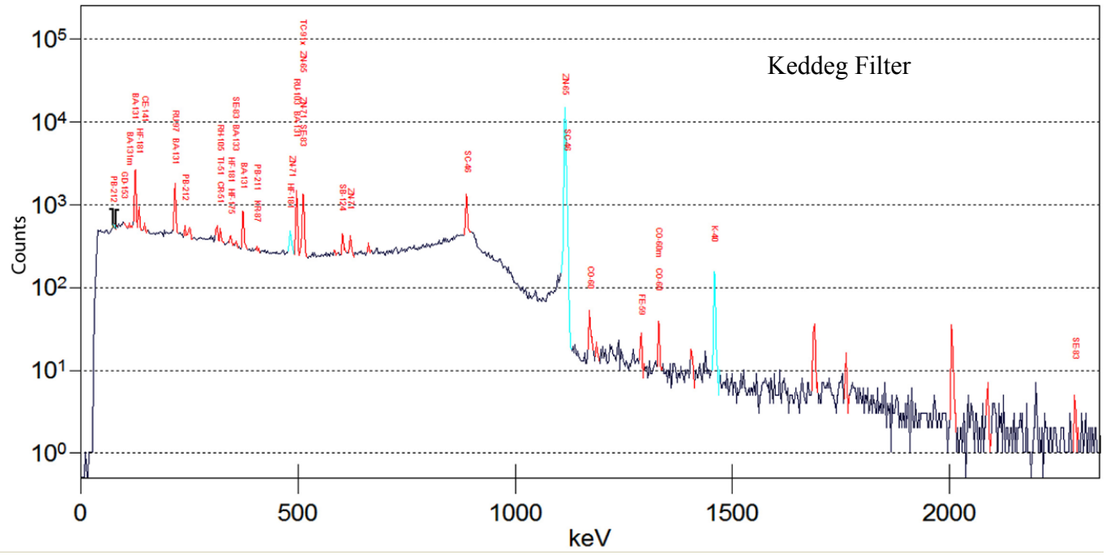
4.4.2 Results and discussion

Table 4-3 Elements detected in background, clean, used, incidents filters and jet engine oil

Source	Elements detected in the samples	# Elements
Background	Ag, As, Au, Bi, Cd, Ce, Co, Cs, Eu, Fe, Hf, Hg, Ho, In, Ir, K, La, Lu, Os, Pa, Pb, Sb, Sc, Sr, Ta, Te, Th, Xe, Yb, Zn, Zr, U	32
Clean Filters	As, Ba, Ce, Cs, Si, Cr, Co, Cs, Fe, Hf, Hg, La, Lu, Os, Rb, Ru, Sb, Sc, Sn, Ti, Te, Xe, Nd, Os, Th, Bi, Kr, Sm, Yb, Ds Gd	30
Used Filters	Ag, Ar, As, Au, Ba, Be, Bi, Cd, Ce, Cr, Cs, Co, Fe, Ga, Gd, Hf, Hg, In, Ir, K, Kr, La, Lu, Mo, Na, Nb, Nd, Ni, Mn, Os, Pa, Pb, Pm, Rb, Re, Ru, Sb, Sc, Se, Sn, Sr, Ta, Tb, Tc, Tb, Tc, Te, Th, W, Xe, Yb, Zr	50
Incident Filters	Ag, Ar, As, Au, Ba, Bi, Br, Cd, Ce, Cr, Cs, Co, Fe, Gd, Hf, Hg, Ho, In, Ir, K, Kr, La, Lu, Mo, Nb, Nd, Mn, Os, Pa, Pb, Pm, Rb, Re, Ru, Sb, Sc, Se, Sn, Sr, TA, Tb, Tc, Te, Th, Xe, Yb, Zr	55
Mobil Jet Oil II	Na, K, Br, Cd, Co, Fe, Mn, Te, Hf, Os, Sb, Sc, Xe, Pm, Au, Pa, Th, Ru	17

During the experiments, some lower mass isotopes occasionally appeared; these may have come from background radiation. The elements suspected to originate from the background are listed in Table 4-3 and were not eliminated from statistical analysis because FESEM/EDS analysis also showed that some of these elements were present in the filters. For example, Fe, Ba, Zn, Fe, Cl, K, Mn, Ce, Ni, As, Cr, Pb, and Br were detected by FESEM/EDS analysis. To assume that the isotopes from these elements were definitely from background radiation would be inaccurate. Bromine appeared in three filters in the first batch of filters analyzed in 2008. However, Br did not show up in the analysis from 2010. Figures 4.8 through 4.11 show spectra from clean filters from three major filter manufacturers, jet engine oil, and used and incident filters. From these spectra, very few rare earth metals are present in the jet engine oil that are not also in the background.





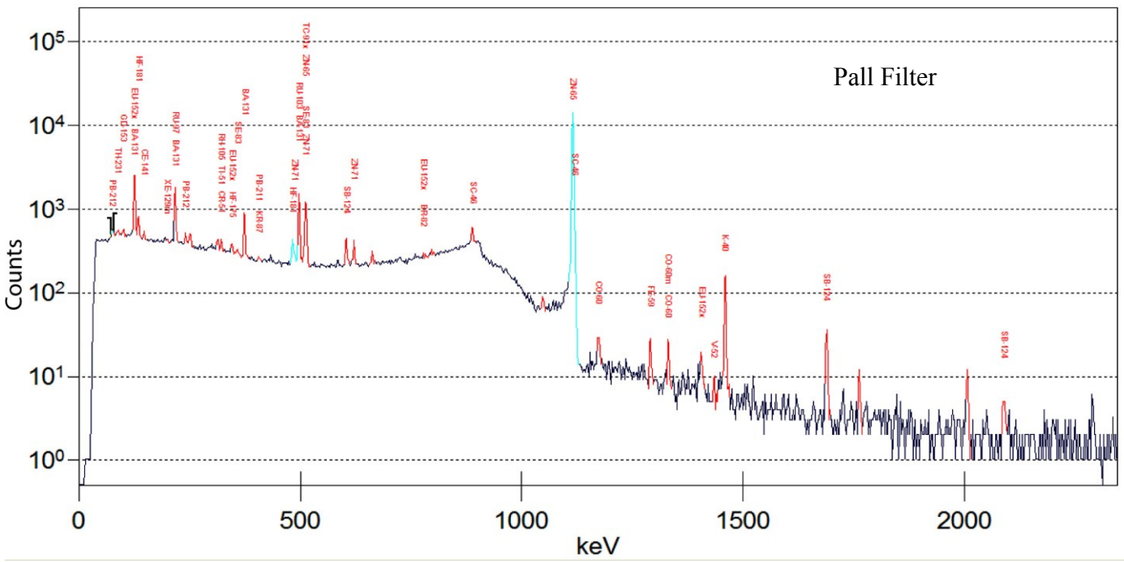


Figure 4.8 Gamma ray spectra showing the elements photo peaks of filter samples from Donaldson, Keddeg and Pall companies irradiated for 8 hours and counted for 1 hour with an HPGe detector after 7-10 days decay time

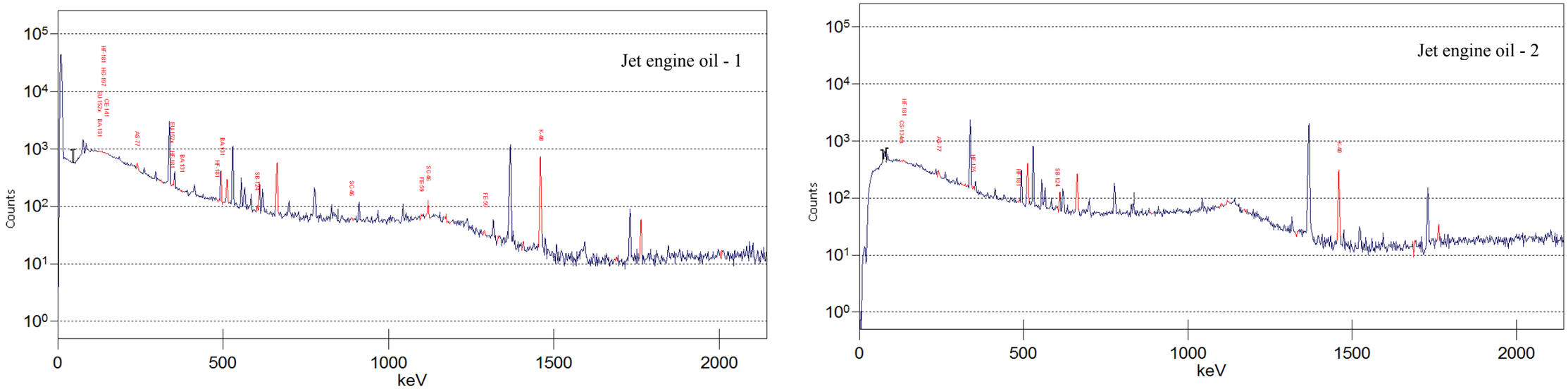
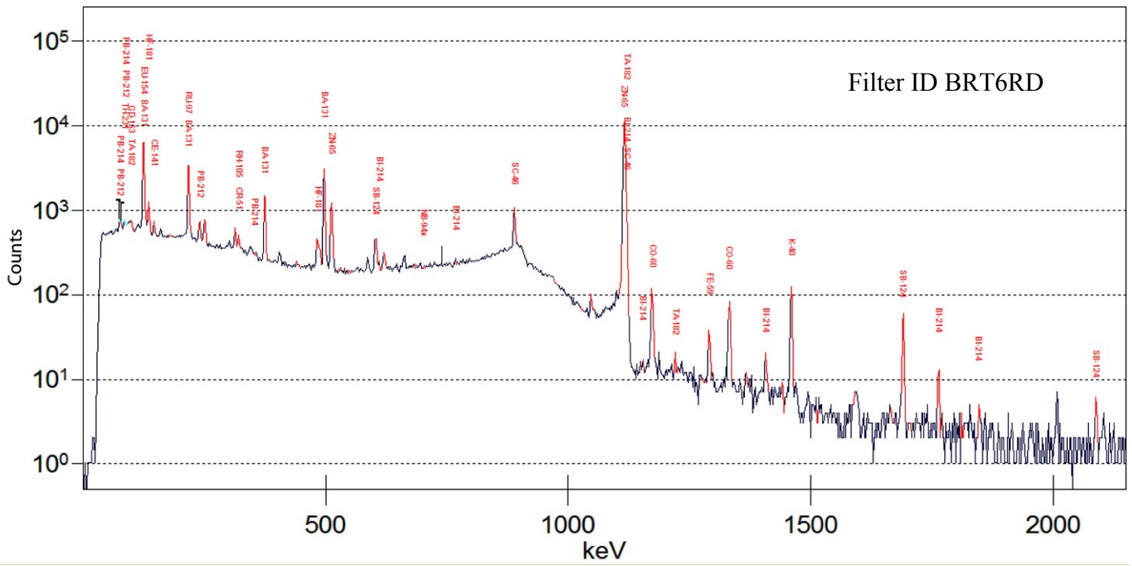
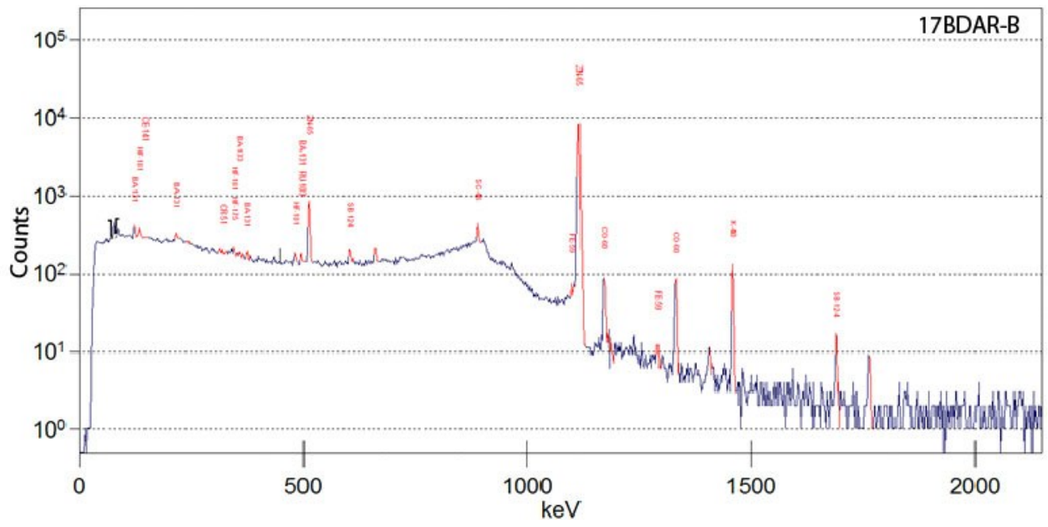
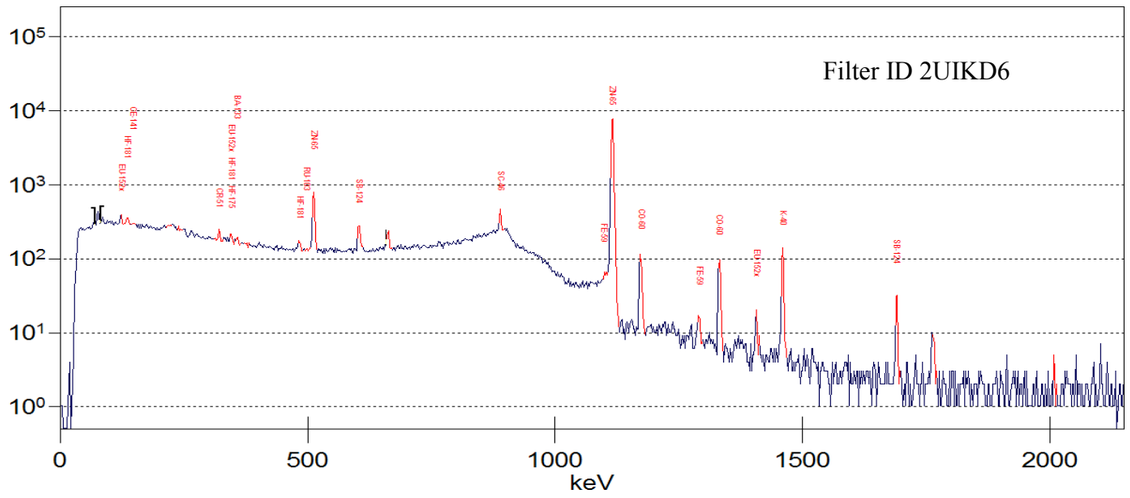


Figure 4.9 Gamma ray spectra showing the elements photo peaks from jet engine oil samples irradiated for 8 hours and counted for 1 hour with an HPGe detector after 7-10 days decay time







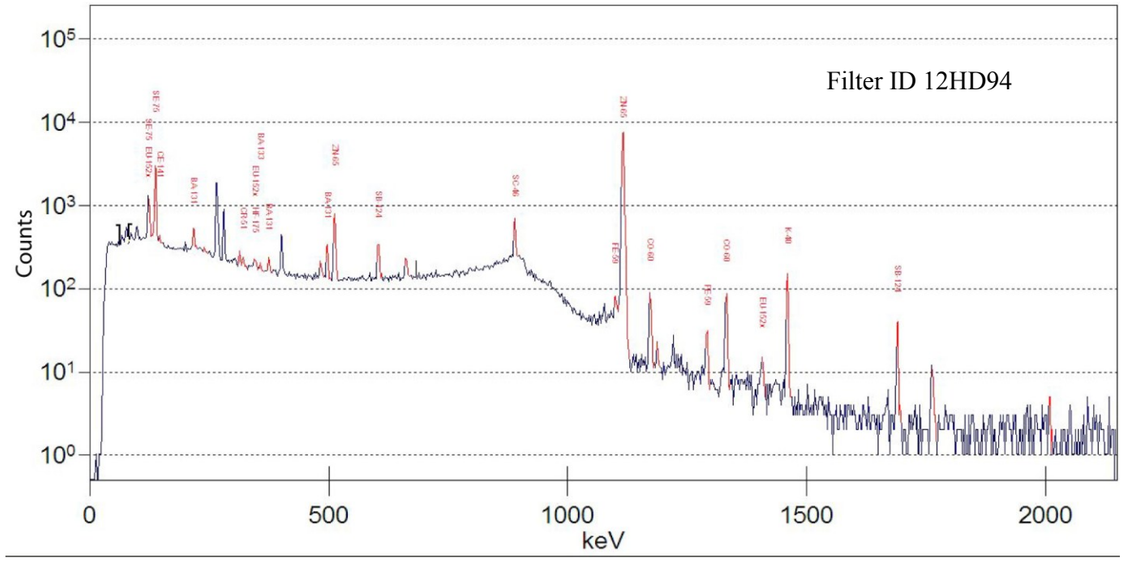
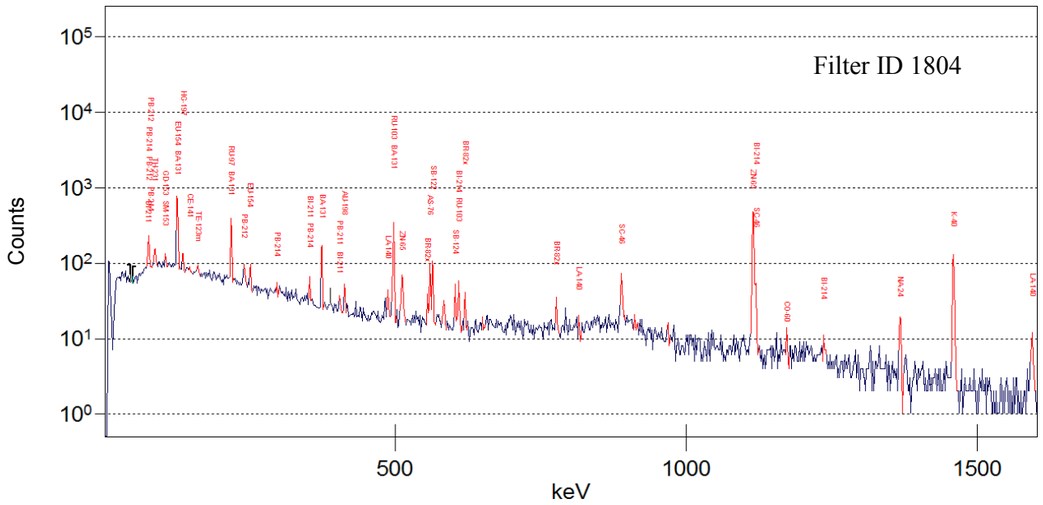
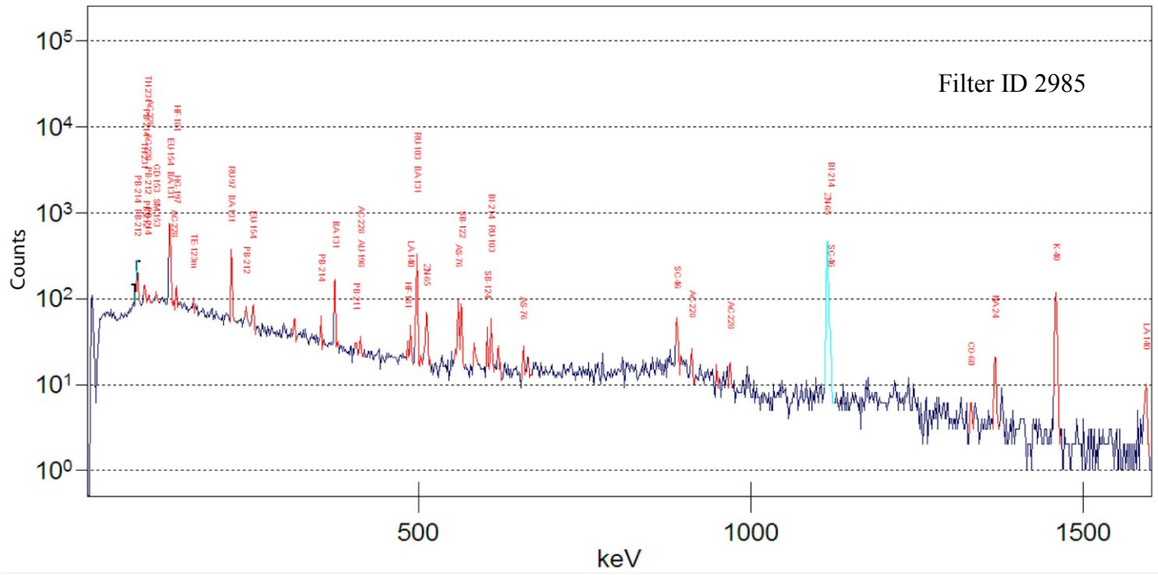
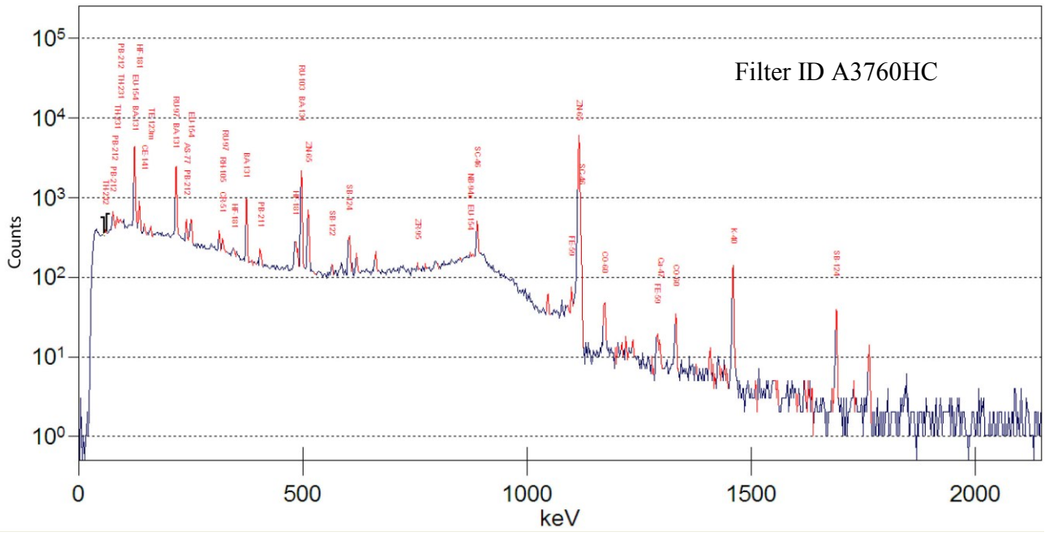


Figure 4.10 Gamma ray spectra showing the elements photo peaks from used filter samples irradiated for 8 hours and counted for 1 hour with an HPGe detector after 7-10 days decay time







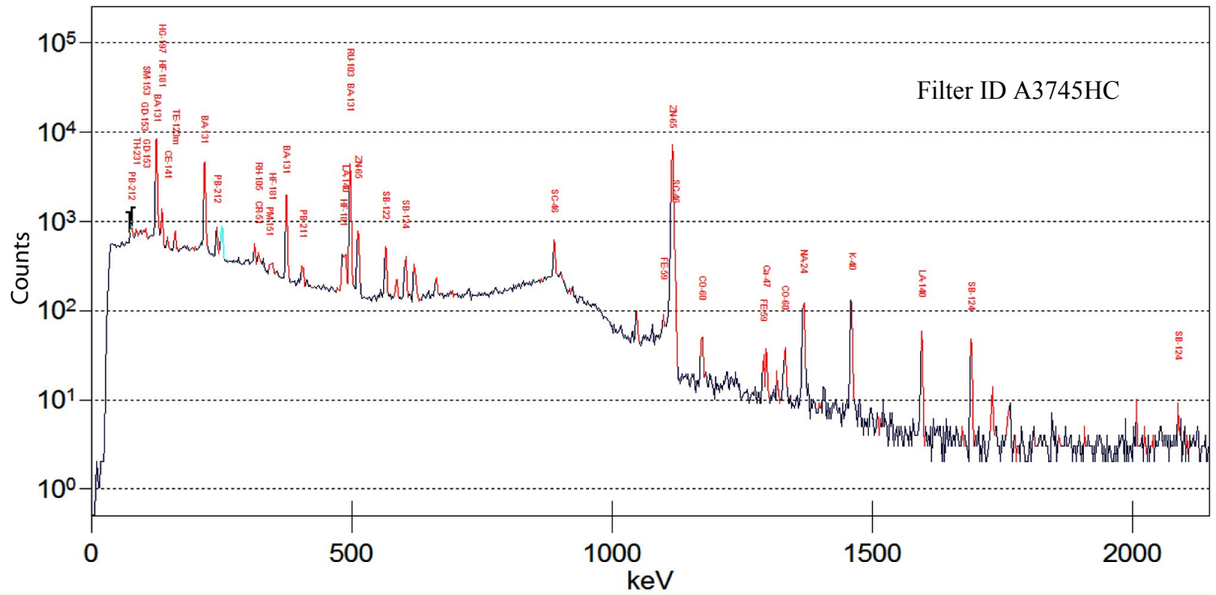


Figure 4.11 Gamma ray spectra showing the elements photo peaks from incident filter samples irradiated for 8 hours and counted for 1 hour with an HPGe detector after 7-10 days decay time

4.5 Recommendations

Before further analysis of used aircraft filters by NAA, elemental analysis of jet engine lubricating oil must ascertain the potential markers present in a typical 1.0-mL or 1.0-gm sample matrix. The time the filters remain installed in the aircraft is also critical in assessing the differences in the mean concentrations of isotopes in different types of used filters. Further studies should also determine the exact background isotopes from the reactor and eliminate background isotopes from statistical analysis aimed at determining the variability of mean concentrations of isotopes.

4.5.1 Statistical analysis

SAS output:

Dependent Variable: Ba-133

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	1	482.73680	482.73680	6.15	0.0143
Error	148	11616.16867	78.48763		
Corrected Total	149	12098.90548			

R-Square	Coeff Var	Root MSE	BA133 Mean
0.039899	187.1169	8.859324	4.734646

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Category	1	482.7368045	482.7368045	6.15	0.0143

Least Squares Means

Category	BA133 LSMEAN	Standard Error	H0:LSMEAN=0 Pr > |t|	H0:LSMean1=LSMean2 Pr > |t|
1	5.94647048	0.87293516	<.0001	0.0143
2	2.07894402	1.29226526	0.1098	

Dependent Variable: Ce-139

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	1	0.04678894	0.04678894	22.66	0.0010
Error	9	0.01858325	0.00206481		
Corrected Total	10	0.06537219			

R-Square	Coeff Var	Root MSE	CE139 Mean
0.715732	68.93147	0.045440	0.065921

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Category	1	0.04678894	0.04678894	22.66	0.0010

Least Squares Means

Category	CE139 LSMEAN	Standard Error	H0:LSMEAN=0 Pr > |t|	H0:LSMean1= LSMean2 Pr > |t|
1	0.15219758	0.02272006	<.0001	0.0010
2	0.01661967	0.01717475	0.3585	

Dependent Variable: Ce-141

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	1	0.00347257	0.00347257	11.49	0.0011
Error	79	0.02388188	0.00030230		
Corrected Total	80	0.02735445			

R-Square	Coeff Var	Root MSE	CE141 Mean
0.126947	135.3049	0.017387	0.012850

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Category	1	0.00347257	0.00347257	11.49	0.0011

Least Squares Means

Category	CE141 LSMEAN	Standard Error	H0:LSMEAN=0 Pr > |t|	H0:LSMean1= LSMean2 Pr > |t|
1	0.01814139	0.00248383	<.0001	0.0011
2	0.00474787	0.00307359	0.1264	

Dependent Variable: Co-60

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	1	0.00018620	0.00018620	9.88	0.0020
Error	160	0.00301442	0.00001884		
Corrected Total	161	0.00320063			

R-Square	Coeff Var	Root MSE	CO60 Mean
0.058177	201.5161	0.004341	0.002154

Source	DF	Type III SS	Mean Square	F Value	Pr > F

```
Category                     1      0.00018620      0.00018620       9.88    0.0020
Least Squares Means
                                                                  H0:LSMean1=
                                  Standard    H0:LSMEAN=0      LSMean2
Category     CO60 LSMEAN             Error       Pr > |t|       Pr > |t|

1             0.00283932      0.00040476         <.0001         0.0020
2             0.00047692      0.00063313         0.4524
```

Dependent Variable: Eu-152x

```
                                    Sum of
Source                       DF         Squares     Mean Square    F Value    Pr > F

Model                         1    2.9401706E-7    2.9401706E-7       8.76    0.0043

Error                        63    2.1145187E-6     3.356379E-8

Corrected Total              64    2.4085358E-6
R-Square     Coeff Var      Root MSE    EU152x Mean

0.122073      147.8497      0.000183       0.000124


Source                       DF     Type III SS     Mean Square    F Value    Pr > F

Category                      1    2.9401706E-7    2.9401706E-7       8.76    0.0043

Least Squares Means
                                                                  H0:LSMean1=
                  EU152x        Standard    H0:LSMEAN=0      LSMean2
Category          LSMEAN             Error       Pr > |t|       Pr > |t|

1             0.00016234      0.00002617         <.0001         0.0043
2             0.00000621      0.00004580         0.8925
```

Dependent Variable: Ru-103

```
                                    Sum of
Source                       DF         Squares     Mean Square    F Value    Pr > F

Model                         1      0.02343193      0.02343193      10.14    0.0019

Error                       105      0.24262258      0.00231069

Corrected Total             106      0.26605452


R-Square     Coeff Var      Root MSE    RU103 Mean

0.088072      322.8119      0.048070      0.014891

Source                       DF     Type III SS     Mean Square    F Value    Pr > F

Category                      1      0.02343193      0.02343193      10.14    0.0019


Least Squares Means
                                                                  H0:LSMean1=
                                  Standard    H0:LSMEAN=0      LSMean2
Category     RU103 LSMEAN            Error       Pr > |t|       Pr > |t|

1             0.00322733      0.00591696         0.5866         0.0019
2             0.03366645      0.00750722         <.0001
```

Dependent Variable: Ru-97

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	1	24.07107757	24.07107757	17.24	0.0003
Error	25	34.91580437	1.39663217		
Corrected Total	26	58.98688193			

R-Square	Coeff Var	Root MSE	RU97 Mean
0.408075	124.5422	1.181792	0.948909

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Category	1	24.07107757	24.07107757	17.24	0.0003

Category	RU97 LSMEAN	Standard Error	H0:LSMEAN=0 Pr > |t|	H0:LSMean1=LSMean2 Pr > |t|
1	2.08766191	0.35632367	<.0001	0.0003
2	0.16601622	0.29544798	0.5792	

Dependent Variable: Sc-46

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	1	0.00016158	0.00016158	28.55	<.0001
Error	53	0.00029997	0.00000566		
Corrected Total	54	0.00046155			

R-Square	Coeff Var	Root MSE	SC46 Mean
0.350073	87.10152	0.002379	0.002731

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Category	1	0.00016158	0.00016158	28.55	<.0001

Least Squares Means

Category	SC46 LSMEAN	Standard Error	H0:LSMEAN=0 Pr > |t|	H0:LSMean1=LSMean2 Pr > |t|
1	0.00423946	0.00042729	<.0001	<.0001
2	0.00078338	0.00048562	0.1127	

Dependent Variable: Zn-65

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	1	310.627973	310.627973	7.90	0.0055
Error	166	6527.566735	39.322691		
Corrected Total	167	6838.194707			

R-Square	Coeff Var	Root MSE	ZN65 Mean
0.045425	183.5421	6.270781	3.416536

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Category	1	310.6279728	310.6279728	7.90	0.0055

Least Squares Means

Category	ZN65 LSMEAN	Standard Error	H0:LSMEAN=0 Pr > |t|	H0:LSMean1= LSMean2 Pr > |t|
1	4.32694839	0.58222738	<.0001	0.0055
2	1.38561498	0.86960083	0.1130	

Table 4-4 Isotopes with statistically significant concentration differences in used and incident filters

Parent Element	Isotope	Filter type	Mean mass concentration (μCi)	p-value
Barium	Ba-133	Used	5.94647048	0.0143
		Incident	2.07894402	
Cerium	Ce-139	Used	0.15219785	0.001
		Incident	0.01661967	
Cerium	Ce-141	Used	0.01814139	0.0011
		Incident	0.00474787	
Cobalt	Co-60	Used	0.00283932	0.002
		Incident	0.00047692	
Europium	Eu-152x	Used	0.00016234	0.0043
		Incident	0.00000621	
Ruthenium	Ru-97	Used	2.08766191	0.0019
		Incident	0.16601622	
Ruthenium	Ru-103	Used	0.00322733	0.0003
		Incident	0.03366645	
Scandium	Sc-46	Used	0.00423946	0.0001
		Incident	0.00078338	
Zinc	Zn-65	Used	0.58222738	0.0055
		Incident	0.86960083	

The concentrations for isotopes of the elements shown in Table 4-4 display marked differences in both the used and incident filters. For example, for Ba-133, the means for the filter type (category), used (1) and incident (2), are 5.946 and 2.079; these means are significantly different at 5% level with a p-value of 0.0134. The values for Ce, Co, Eu, Tu, Sc, and Zn are listed in Table 4.4; mean concentrations of these isotopes are higher in used filters for all the

elements except Ru-103 and Zn-65, which have higher means in incident filters. The used filters were removed at the end of their normal service life while the incident filters were normally removed much sooner. Clearly, the time the filters remain installed in the aircraft is a critical factor when determining the mean concentrations of isotopes from materials that are deposited on the filters and is the likely reason so many of the isotopes have higher concentrations on the used filters.

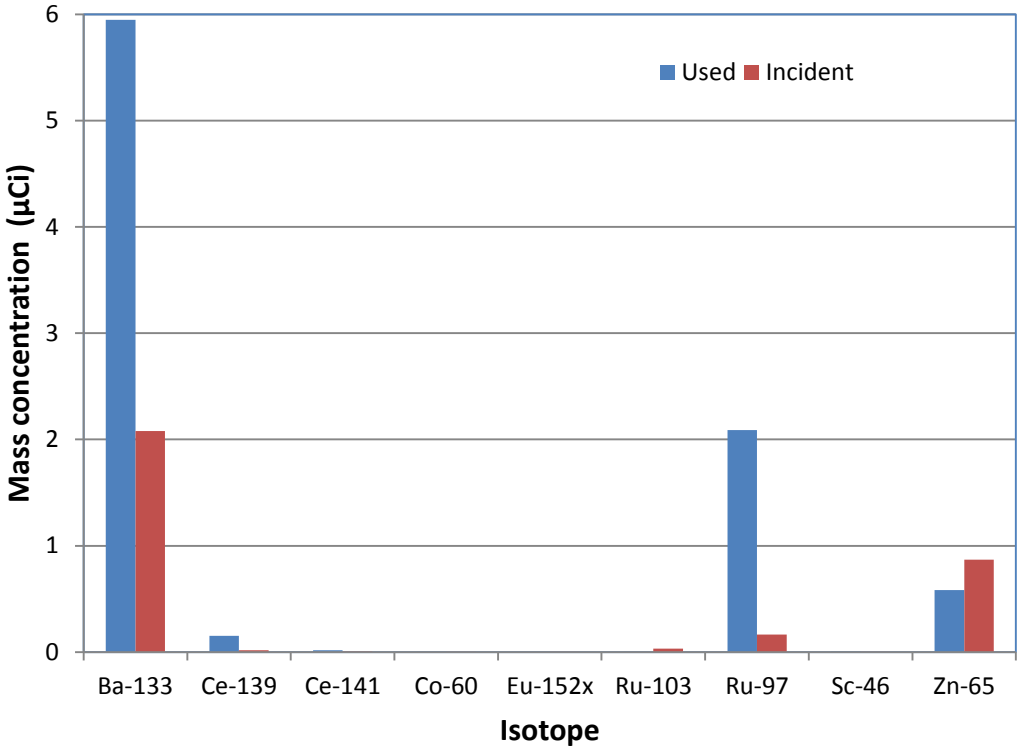


Figure 4.12 Comparison of isotopes with mean concentrations found to be statistically significantly different in used and incident filters

Figure 4.12 shows the isotopes with significant differences in mean concentrations. The cause and effect of the differences, however, was not established. Although the statistical analysis has not identified jet engine oil markers, the increases and decreases in the mean concentrations of the identified isotopes could help explain the effect of jet engine oil contamination on filters if the time the filter stayed in aircraft were known. Therefore, further studies should focus on increases and decreases in mean concentrations of identified isotopes and the time filters remain installed in the aircraft, which should help determine whether mean

concentrations are due to long-term accumulation of contaminants or from smoke/fume incidents.

The SAS program averaged the concentration from the two filter categories and calculated the p-value. A wide range of elements were detected on clean, used, and incident filters. Iron was detected in both used and incident filter samples. Dust brought into the cabin by passengers could be a possible source of iron species in the aircraft cabin. The sensitivity of NAA technique depends on the half-life of isotopes being analyzed, number of particles per decay (yield), and the efficiency of the detector.

According to Weaver (1978), the minimum detectable limits of bromine in a sample is 0.009 μg for 1 hr. of radiation using a neutron flux of 1×10^{13} n/cm^2-sec instrumental analysis with no interfering elements. Bromine was detected in two incident filters, filters ID 1804 and 2985, with the highest ID confidence level being 60.0% and the lowest being 14.5%. A threshold level of 70.0% is generally acceptable as significant. Bromine could be in the filters, and indeed Gerecke (2007) detected bromine in settled dust from commercial aircrafts. With the current experimental design, bromine could not be detected in many filters because high activity from silicon interfered. In addition, bromine has a short-half life (1.47) days, making it still more difficult to detect. Also, bromine is present in many flame retardants widely used in cabin materials so bromine, if found, could not be uniquely associated with engine oil.

A number of factors make NAA gamma spectroscopy a difficult method, especially looking for markers or determinants of jet engine oil contamination. Among them are: The small amounts of radioactive particles and long decay periods for some elements. Fe 58 which is the parent element of Fe 59 has a small amount of radioactive Fe (about 0.28% of elemental iron is contained in Fe 58). It is this small amount of radioactive Fe which is expected to decay in 44 days. The low cross-section is also a factor. The cross-section, which is essentially the probability of neutron capture, is low in the gamma-ray counting technique for some important isotopes. For Fe the cross section for neutron capture is 1.3 barns (thermal neutrons), 1 barn = 1×10^{-24} cm^2). A number of trace elements were found on clean, used, and incident filters. The concentration levels of the isotopes found in the filters are cumulative from many flight hours and may not reflect air quality concerns. Without a doubt, the most useful finding is that elements are present on both used and incident filters. That they can be tested using NAA is

intriguing. For airlines, the findings of this study have implications far beyond health because smoke/fume incidents may also indicate that the aircraft engine is not operating optimally.

One reason smoke/fume incidents have been difficult to understand is that they occur somewhat randomly and there is a low probability of occurrence on any given flight. An incident is difficult to predict. Another reason for the failure to fully grasp the problem is, in part, due to the study approaches that have so far been applied. When it comes to the future of airlines operations nothing is more important than the health and safety of passengers and crew. But, there are different sides to the issues; for the airlines as any other companies they are in business. But they cannot afford to engage in air transportation business and ignore operational consequences which impact negatively on aircraft crew and air travelers. The exploitation of chemical capabilities of Mobil Jet Oil II at the expense of those who are negatively affected is unacceptable. Both of these issues, while mostly different from a technical standpoint, point to the increasing effect of modern society's influence on the environment and often negligence of the cause and effect relationships. It is encouraging that Boeing is currently building a 21st century aircraft system that focuses on prevention of fumes events and promotes cleaner air supply to aircraft cabins.

4.5.1.1 Cost evaluation model for analysis of used aircraft filters by NAA

This study explored the relationship between safety and the benefits of using NAA to analyze cabin air filters used on commercial aircraft. The costs associated with aircraft filter analysis by NAA are high. As depicted in Figures 4.7 and 4.13, filter testing with NAA is complex and requires time and expertise. Although the method could produce positive results with higher efficiency detectors, using an experimental set up the facilities available at Kansas State is too laborious, costly, and time-consuming to become routine for commercial operations.

4.5.1.2 Cost analysis model for used aircraft filters by NAA

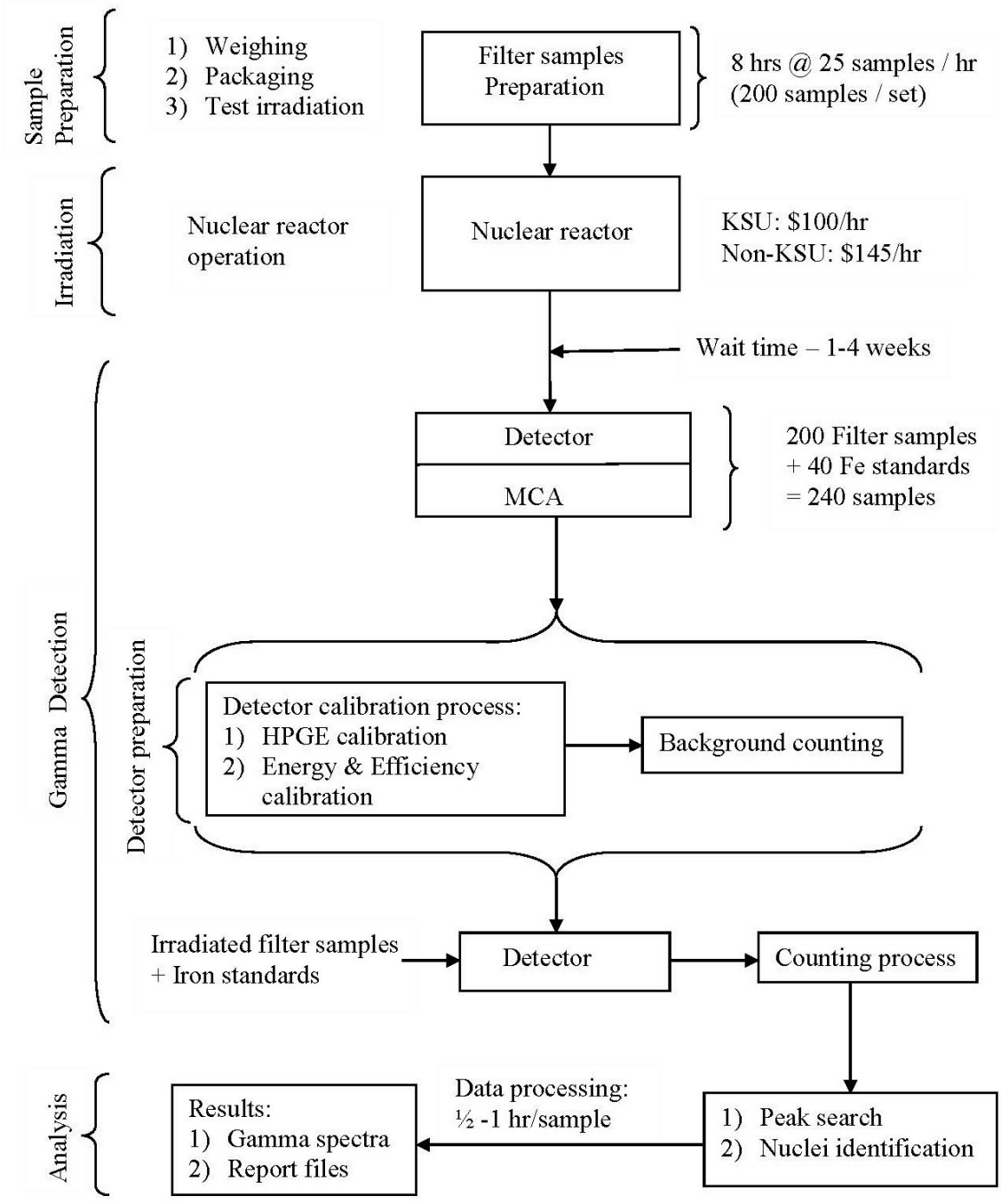


Figure 4.13 Process flow chart of aircraft cabin air filter analysis by NAA

Table 4-5 Cost evaluation chart and comparison guide for analysis of used aircraft cabin air filters by NAA

Process	Process description	Filter samples*	KSU rates/hr.	Non-KSU rates/hr.
Sample Preparation	Sample preparation	200	$25.00	$25.00
Irradiation	Irradiation	200	$100.00	$145.00
Gamma detection	Detector preparation: HPGE calibration Energy and efficiency calibration	240**	$35.00	$51.00
Analysis	Peak search Nuclei identification Data processing	240	$25.00***	$36.00***
TOTAL COST			$15,900.00	$20,190.00
*10 sample sets were analyzed		**TOTAL COST**	**$ 159,000.00**	**$ 201,700.00**

** Irradiation of sample set is independent of sample size, but limited to 200 samples.

*** Sample charge is hourly, averaging 45 minutes per sample.

The rates include staff salary and equipment usage.

4.6 Conclusions

This research could not identify unique elements from jet engine oil observable as contaminants on aircraft cabin filters. However, the study gleaned several interesting facts about NAA as a method for analyzing used aircraft cabin filters. The study found a large variety of trace elements deposited on the surface of used and incident filters. The data obtained from the study could be a starting point for explaining the many mysteries of the aircraft cabin air contamination. This suggests that more is going on in an aircraft's ECS than scientists have previously imagined. Never before has the entire catalog of elements deposited on used aircraft cabin filters been revealed. The data produced by this study will be shared among those searching for appropriate detection methods for aircraft cabin air contamination.

Statistical analysis by one way ANOVA using SAS code PROC GML has revealed statistically significant differences in the means of the concentrations of some isotopes from used and incident filters. The isotopes are from parent elements Ba, Ce, Co, Eu, Ru, Sc, and Zn. The

differences in the means of concentrations of the identified isotopes are certainly pointing at where a search should focus on. Future work should focus on determining the differences in mean concentrations of these isotopes after isolating the background isotopes. The length of the time the filters remain installed in aircraft was also critical to determining whether the differences were due to long-term accumulation of contaminants or smoke/fume incidents. A methodology for gathering data from used and incident filters is by itself a positive contribution. Using this method and a different type of reactor or different irradiation conditions with a different detector might produce expected or different results. However, the long-term future of NAA as a method of aircraft filter analysis will depend on its cost.

4.7 References

Agnello, M., Botta, E., Bressani, T., Bruschi, M., Bufalino, S., DeNapoli, M., Feliciello, A., Fontana, A., Giacobbe, B., Lavezzi, L., Raciti, G., Rapisarda, E., Rotondi, A., Sbarra, C., Sfienti, C., Zoccoli, A., (2009). Study of the performance of HPGe detectors operating in very high magnetic fields. Nuclear Instruments and Methods in Physics Research A.606 (2009) 560 – 568.

Alemon, E., Herrera, L., Ortiz, E., and Longoria, L. C., (2004). Instrumental nuclear activation analysis (INAA) characterization of environmental air filter samples. Appl. Radiat. Isot. 2004 June, 60 (6):815-23.

ANSI/ASHRAE, (2007). ANSI/ASHRAE Standard 161-2007, Air Quality within Commercial Aircrafts. 20 pp. Product code: 86493. ISBN: 1041-2336. Atlanta, GA: American Society of Heating, Refrigerating and Air-conditioning Engineers, Inc.

Canberra (2001) Canberra. Genie 2000 Spectroscopy System Operations Manual (2001). Canberra Industries Incorporation, Meriden, CT (2001).

General regulations for radioactive waste disposal 10CFR20.2001 (1991) http://cfr.regstoday.com/10cfr20.aspx#10_CFR_20p200120.2001 Cited: May 20th 2011.

Gerecke, A. C., (2007). Brominated Flame Retardants in Settled Dust of a Commercial Aircraft. http://www.bfr2010.com/abstract-download/2007/P074.pdf (Cited: March 15th, 2012).

Glascock, M. D., (2011). Overview of Neutron Activation Analysis. University of Missouri – Columbia. http://archaeometry.missouri.edu/naa_overview.html Cited: March 15th 2012.

Landsberger, S., Larson, S., Wu, D., (1993). Determination of cadmium in environmental tobacco smoke by instrumental neutron activation analysis with compton suppression system. Anal. Chem. 1993 June 1: (11) 1506 – 9.

Nagda, N. L. and Rector, H. E., (2003). A critical review of reported air concentrations of organic compounds in aircraft cabins. Indoor Air 2003; 13: 292 – 301. Copyright Blackwell Munksgaard ISSN 0905-6947.

Shultis, J. K. and Faw, R. E., (2007). Fundamentals of Nuclear Science and Engineering 2nd edition. CRC Press 2007.

van Netten, C., (1999). Multi-elemental analysis of jet engine lubricating oils and hydraulic fluids and their implication in aircraft air quality incidents. Sci. Total Environ. 1999 May 7: 229 (1-2): 125-9.

Winder, C. and Balouet, J. C., (2001). Aircrew Exposure to Chemicals in Aircraft: Symptoms of Irritation and Toxicity. Journal of Occupational Health and Safety – Australia and New Zealand 17: 471 – 483, 2001.

CHAPTER 5 - MONITORING SIMULATED COMMERCIAL AIRCRAFT CABIN AIR QUALITY INCIDENTS USING BLEED AIR SIMULATOR (BAS)

5.1 Abstract

During smoke/fume incidents, aircraft cabin occupants may be exposed to toxic organophosphorus (OP) compounds emitted from the bleed air. Exposure to OP compounds, including TCP, is associated with increased risks to health. The objective of this study was to design a simplified version of an aircraft engine bleed air simulator (BAS) for the laboratory to simulate the range of bleed air system operations and create smoke/fume incidents. Experiments were conducted to determine what alters aerosol particulate formation during various simulated incidents using Mobil Jet Oil II as a representative jet engine lubricating oil. The BAS system consisted of a modified ASHRAE Standard 52.2 test rig with a tubular reactor where pyrolysis of jet engine oil occurred. Particulate counts were determined with an optical particle counter (OPC). Samples were also collected onto HEPA filters with a high volume isokinetic sampling system; subsequent laboratory analysis included GC/MS, FESEM/EDS and NAA to determine if elements/compounds linked to the jet engine lubricating oil were present. The exposed filters were also analyzed for TCP isomers and hydrocarbons by GC/MS. The six simulated cabin air quality incident results are also described in this study. Probit analysis of jet engine oil aerosols from BAS tests revealed lognormal distributions with the mean (range) of geometric mass mean diameter (GMMD) = 0.41 (0.39, 0.45) μm and geometric standard deviation (GSD), σ_g = 1.92 (1.87, 1.98). The GC/MS analysis found meta- and para- TCP in clean filters exposed in BAS. The results suggest that BAS and the methodology used in this study can provide a practical air quality of bleed air in commercial aircrafts during incidents. Additionally, BAS could provide insights to help airline regulators in drafting guidelines for compliance requirements to minimize threats and risks posed by aircraft cabin air supply contaminant emissions from the bleed air system during incidents caused by jet engine lubricating oil.

5.2 Introduction

Even though commercial aviation technology has become very advanced, modern airplanes still have inherent design challenges in providing quality air through a bleed air system.

For example, smoke/fume incidents occur in aircraft engines when an oil seal is leaky, a joint is cracked, or too much jet oil is added by maintenance staff (van Netten and Leung, 2000; AAIB Bulletin, 2009). During incidents, misty fumes or the gases and/or smoke/fumes generated when the jet engine oil is pyrolyzed may be introduced into the aircraft's environmental control system (ECS) and eventually enter the aircraft cabin where they may cause discomfort and or adversely affect the health of cabin occupants. The negative impact of an incident-occurrence happens when it alters the gaseous and particulate concentration of the cabin air supply. Jet engine lubricating oils and hydraulic fluids have organophosphate additives that can negatively affect aircraft cabin air supply, particularly in those aircrafts with bleed air systems. Moreover, the aircraft cabin is a high-stress environment, and any additional events like smoke/fume incidents will only heighten stress among passengers and crew. Even more troubling, smoke/fume incidents are infrequent and difficult to predict. Yet, although they are rare, cabin occupants are exposed to the airborne constituents of jet engine lubricating oil when such an incident occurs.

At present, incident-occurrences are not monitored in aircraft fitted with bleed air systems. Providing quantitative measurements of airborne aerosols formed in the bleed air system during smoke/fume incidents and accounting for the suspected burden caused by incidents in the aircraft cabin has been a challenge, and airlines are still struggling to deal with the challenge. The uncertainty about the effect of TCP isomers on cabin air quality is a real concern. Scientists have yet to determine the frequency of incidents and ways to combat the events. Currently, what most concerns scientists and stakeholders in civil aviation is whether the smoke/fumes in cabin environments are enough to cause harm to cabin occupants when incidents occur. Additionally, the lack of real-time monitoring of aerosol emissions from the bleed air system has hindered efforts to understand air quality in aircraft cabins during incidents.

As demand for air travel grows, more attention is being paid to aircraft cabin air quality. Airlines are expected to provide superior air quality to passengers at all times during flight. The business of commercial air transport requires providing not only quality air but comfort and safety as well. The safety features of commercial jets include cabin air that meets quality standards of temperature, relative humidity, and odor (Pierce et al. 1999; Lee et al. 1999; Lindgren and Norback, 2002; Haghighat et al. 1999). Previous studies of aircraft cabin environments have helped determine (TLVs) for well-known potential airborne pollutants in aircraft cabins. Table 5-1, below, lists some commercial aircraft in-cabin air quality parameters

and the recommended levels that ensure the safety of the passengers and crew (Hunt and Space, 1994; Hocking, 1998).

Table 5-1 Air quality parameters measured in commercial airliner cabin environment

Parameter	Average measurements
Carbon dioxide (CO_2)	600 –1,500 ppm
Carbon monoxide (CO)	0.6/0.4 ppm
Respirable Suspended Particulate (RSP)	40/175 ppm
Nitrogen dioxide (NO_2)	Very low
Sulfur dioxide (SO_2)	Very low
Ozone (O_3)	0.02 ppm
Formaldehyde (HCHO)	-
Total Volatile Organic Compounds (TVOC)	1.8 – 3.2 ppm
Temperature	24^{o}C

(Source: Hunt and Space 1994; Hocking, 1998).

All human dwellings and recreational environments today, including enclosed spaces like aircraft cabins, face unprecedented demands that air quality be superior. Excessive airborne particulates and gases in any environment inhabited or occupied by humans can cause health problems. That is why accounting for potential sources of all aerosol particulates in an aircraft cabin environment matters. The design of the ECS in commercial aircraft dictates having precise quantification of air quality information. Studies by Ross et al. (2006) have reported findings that suggest that prolonged exposure to contaminated air on commercial aircraft may cause ill health. Currently, standards do not exist to ensure that the passengers and crew are not exposed to undesirable concentrations of aerosols from TCP produced during smoke/fume incidents. The current OSHA standard for ToCP is 0.1 mg/m^3 of air averaged over an eight-hour work shift. Table 5-2 below lists the standards for the exposure limits of ToCP in workplaces. Exposure to TCP and ToCP can occur through inhalation, ingestion, or eye and skin contact (ACGIH, 2001).

Table 5-2 The OSHA and ACGIH standards for ToCP

Standards	Tri-*ortho* cresyl phosphate
OSHA	PEL: 0.1 mg/m^3 TWA
ACGIH	TLV: 0.1 mg/m^3 TWA

(Source: ACGIH 2001; NIOSH 1994; Cone 2005)

Public information such as labels and material safety data sheet (MSDS) for jet engine oils products ironically grossly understate the hazards of oil ingredients especially ToCP according to Winder and Balouet (2002). The approximate concentration range fraction of TCP ingredient in Mobil Jet Oil II is 2 to 3 percent (De Nola et al. 2008; Winder and Balouet, 2000; Kibby et al. 2005). According to an NRC (2002) report, no quantitative measurements of exposure levels for commercial aircraft engine bleed air are available for the ingredients present in jet engine oils. The 2002 NRC report also points out that phosphate esters and aldehydes found in jet engine oils and their pyrolysis products may cause respiratory and neurological effects, particularly at high concentrations (NRC report, 2002).

The aircraft environment is similar to indoor environments although it differs in how air quality is provided (Strøm-Tejsen, 2006). The quality of the air supply is important for the human body to work optimally, which is why air quality provision in aircraft cabins is regulated by FAA rules. While several FAA regulations govern the quantity and quality of the air supplied to cabin occupants during flight, no current government-mandated or even widely accepted industry standards consider the levels of particulate emissions released from jet engine oils during smoke/fume incidents. The bleed air emissions reporting rules that airlines use at the moment are prescriptive. It would be desirable to move from prescriptive standards to performance standards that rely on measurements. Unfortunately, the inability to capture bleed air system data has delayed developing of the necessary scientific information for effective policy interventions. Currently, airlines need reliable methods and interface control solutions for monitoring aircraft bleed air.

5.2.1 Trends in development of aircraft engine bleed air monitor

Bleed air technology dates back to 1963 when it was first incorporated into the jet engines of the Boeing 727, among the first generation of modern commercial aircraft. At the

same time, the synthetic lubricant jet engine oil was introduced into jet turbine engine operations. Since then, no standard has been developed to limit potential airborne solid particulates and gaseous pollutants emitted from the bleed air system during incident-occurrences. Van Netten and Leung (van Netten, 2000; van Netten and Leung, 2001) provided data from GC/MS measurements of what should be monitored, although conditions associated with the emissions of TCPs remain undetermined.

In 1998, Honeywell reported on its bleed air monitor (BAM), which used catalytic oxidation combined with a CO_2 monitor. The device relies on a catalyst to convert VOCs into CO_2 and water and then measures CO_2 concentration in the bleed air as a surrogate measure of exposure to VOCs associated with combustion of organic materials like oil, hydraulic fluid, and exhaust fumes. Initially intended as a unit for ground operations, it was later modified for integration into aircraft systems for continuous monitoring throughout flight (Air Contamination Monitor, Patent No. 5750999, 1998). Magee Scientific offers a compact, portable, sensitive particle monitor for aerosol black carbon called a micro-aethalometer (Magee Scientific, 2009), which could be integrated into aircraft systems. Van Netten has also developed a personal sampler to monitor cabin air for TCPs in a BAe-300 aircraft (van Netten, 2009).

In 2006, with a grant from the US Air Force (USAF), Owlstone Nanotech in Cambridge, designed a prototype sensor to analyze several airborne contaminants concurrently in the bleed air stream. The goal was to provide real-time information on air supply contamination (e.g. jet oil, hydraulic fluid, exhaust fumes, etc.) in-flight (Koehl et al. 2007). A prototype device was developed, but the USAF did not proceed with this project. Boeing has developed an oil detection kit to identify sources of engine oil leaks or aerosol odors. The kit includes a bleed air sampler and portable infrared spectrometer. Ground crews can connect the air sampler to the 3-inch pneumatic ground cart connector and run the engine or APU bleed air through the sampler for 10 minutes. The spectrometer and a laptop computer analyze the sample. The kit's software alerts the user when the sample matches a known contaminant like oil or hydraulic fluid. In other words, the Boeing sniffer device retrieves an oil signature and compares it with the signature in the bleed air (Holley, 2009).

Similarly, collaborative work from Airsense Analytics GmbH and Lufthansa Technik AG resulted in development of an oil smell detection kit called an aerotracer to identify oil contamination in the aircraft air supply system during ground operations. Aerotracers can

monitor for VOCs, but the device has no trigger point (Airsense Analytics, 2008). Although both the Boeing kit and aerotracer can be used for troubleshooting smoke/fume incidents in the cabin, they are portable devices that are not built into aircraft's architecture and can only be used for ground operations. Additionally, even though the data from portable devices might be accurate, real-time monitoring of bleed air during flight cannot be performed today, presenting a major challenge for the airlines. Furthermore, qualitative measurements from jet bleed air operations simply cannot be made. Quality measurements require large equipment like the BAS. ACER members at Auburn University have developed a portable device for measuring airborne TCP in a gaseous phase. The device converts TCP into cresols by acid hydrolysis. The cresols are then quantified using electrochemical detection techniques (Yang et al. 2011). The ACER members, however, have not indicated if this technology can be used for real-time monitoring on aircraft. Additionally, it is not known how sensitive, expensive, durable, or appropriate the electrochemical detection technique is.

Air travel is the quickest and safest mode of transportation; however, incident-occurrences tend to complicate flight experiences for air travelers and cabin crew. During such incidents, the safety and health of air passengers and crew are at risk. For the cockpit crew, incidents may cause pilots to be unable to function at their best. Diverting the aircraft to the nearest airport to avoid further exposure of cabin occupants is usually the first line of action when smoke/fume events occur, but this is costly. Moreover, such frightening experiences raise legitimate concerns about the suitability of bleed air technology in commercial aircraft operations. A smoke/fume incident is actually a crisis of unknown proportion, disrupting cabin air quality in ways that are difficult to predict. Concerns include how long a smoke/fume incident lasts, and most concerns cannot be addressed because of a lack of research.

At present, modern aircrafts do not have smoke/fume incidents monitoring systems on-board (Ross, 2008). Furthermore, no control system is fitted to the ECS to remove airborne particulates from jet engine bleed air during smoke/fume incidents. Technological solutions for particulate and gaseous contamination from the cabin air supply have been recently suggested (Bull and Roux, 2010), but these solutions have not been evaluated for overall effectiveness. The single most critical element of monitoring cabin air quality is figuring out how to measure airborne aerosols in the aircraft bleed air system. To detect smoke/fume incidents, the aircraft cabin occupants remain the on-board sensors, with airlines relying on human smell to detect

smoke/fume incidents caused by oil (AFL-CIO Report, 2003). One obvious problem with this method of detection is smell is subjective and difficult to assess. The smell changes with time and the person doing the sniffing. Also, the nose can take a long time to detect the smell of oil. The reality is that no human odor threshold exists for any known chemical substance, i.e., human reactions to incidents vary greatly. While an aircraft is in flight, whenever aircrew members smell oil or see visible smoke in the cabin, the cockpit crew usually switches off the ventilation feed from the affected engine (Select Committee on Science and Technology Report to the House of Lords, 2000). In severe incidents, the procedures dictate that the crew redirects the aircraft to the nearest airport. This inconveniences passengers and is expensive for the airline. Pilots need an objective way to identify a source of air contamination. Measurement tools developed from scientific studies and procedures for responses to incidents are therefore critical. Airlines can realize significant efficiency gains in cabin air quality assessment by moving from the human-based process (smell) to one that is fully technology-enabled. Scientists have long sought solutions to smoke/fume incidents but simply monitoring the process has been a challenge. The complexity of the pyrolysis of jet engine oils and the sophisticated patterns of aerosol particulate formation associated with the process make measuring jet engine bleed air quality difficult to do.

The aim of this study was to develop a BAS to determine the concentration levels of compounds and elements in a laboratory-simulated jet engine bleed air system to establish detection limits for different exposure levels. To gain insight into the nature of the aerosol particulate emissions and gaseous byproducts emanating from the bleed air system, an aircraft bleed air simulator (BAS) monitored simulated bleed air in real time. The integrated solution included using an ASHRAE Standard 52.2 test rig, a pyrolysis rector, an air sampling system, and aerosol counting instruments designed to let users continuously monitor smoke/fume incident conditions. The technical challenges of this BAS design are discussed in this study as well. The sampled aerosols were analyzed by FESEM/EDS, GC/MS, and NAA to determine the concentration of compounds and elements deposited on the filter. The overall objective of the study was to facilitate jet engine bleed air monitoring and to aggregate the data to document parameters for aircraft cabin air quality during smoke/fume incidents.

5.3 Materials and Methods

5.3.1 Experimental setup

The schematic diagram of the BAS shown in Figure 5.1, was used aerosol, sample, and measure various parameters associated with each test run. The experimental rig is 3 feet tall, made of rectangular tubes connected in a line (see Figure 5.1). The main duct consists of a series of ducts (air conditioning chambers) with a square cross section measuring 610 × 610 mm (12 × 12 in.), except at the test chamber, which is the largest part of the duct system with a square cross-section configuration of 915 mm × 915 mm (36 × 36 in.). The air conditioning chambers were made of galvanized iron sheets with cross-breaking on all four sides to enhance the crushing strength of the sheet metal. The experimental set up (see Figure 5.1) comprises a duct system simulating a bleed air polluting passageway ventilated with clean outside room air. The duct design conforms to ASHRAE Standard 52.2-1999, which delineates appropriate methodology for testing ventilation particulate air filters and other air cleaning devices (ASHRAE, 1999). The set-up was assembled to meet the aerosol generation, transport, and characterization needs of the study.

The general design criteria related to outside air pre-treatment units, terminal units, air devices, and ductwork are in accordance with ASHARE Standard 52.2 to minimize potential air quality effects. The overall design provides air conditioning and ventilation systems to maintain clean room certification. All joints (sheet metal collar joints) in the duct system were air sealed with mastic in addition to being mechanically fastened. The primary function of the duct system was to provide airflow rates required for the experiment by creating uniform and continuous air flow through the system. The elements that produced controlled airflow rates included a blower to move the air; a canvas connector to reduce vibration transmission from the blower; combined orifice and mixing plate, diffusers; and inlet and exhaust filters to clean incoming and exhaust air.

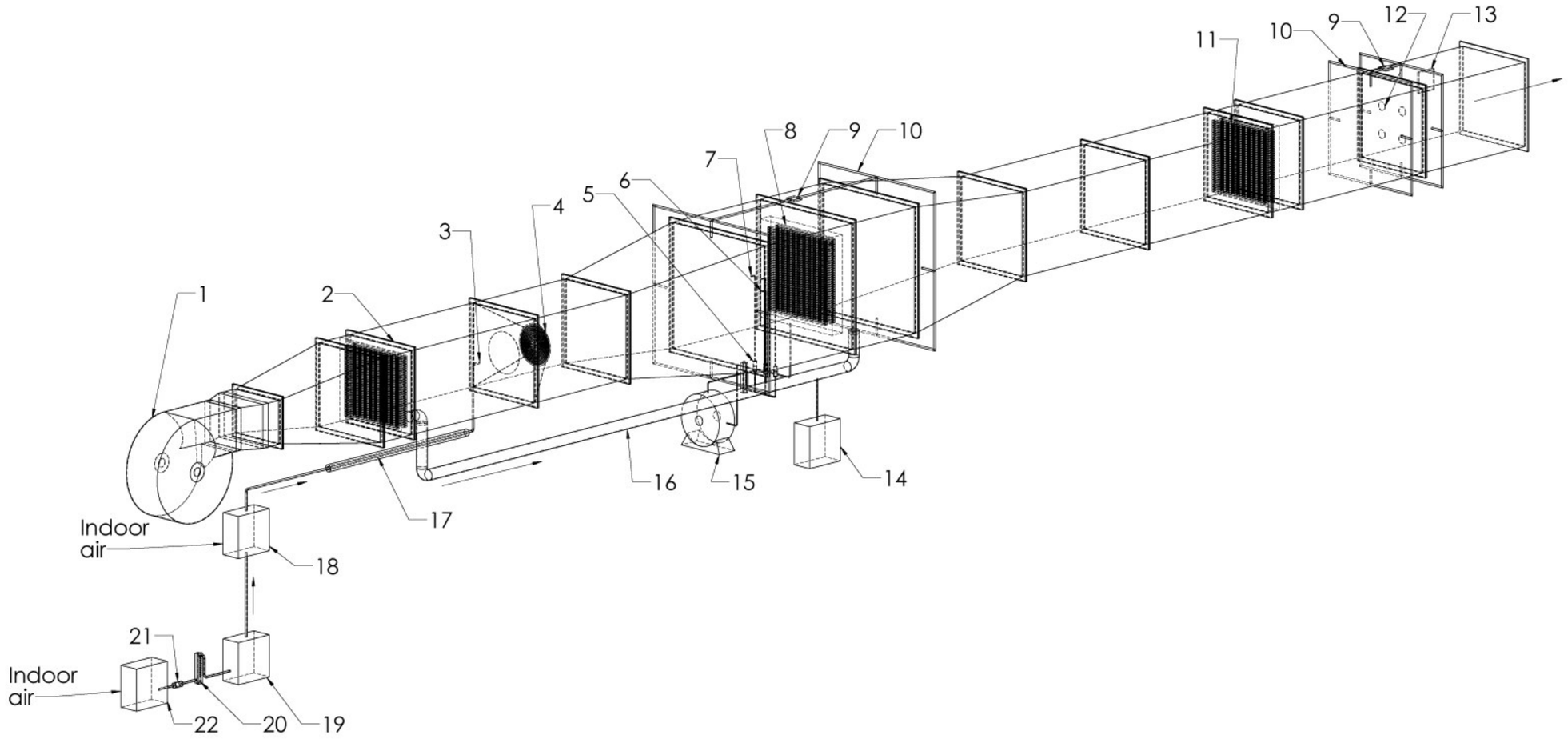


Figure 5.1 Schematic diagram for aircraft bleed air simulation (BAS) system

1. Blower	6. Sampling probe to bypass	11. Outlet filter bank	16. By-pass duct	21. Air filter
2. Inlet filter bank	7. Isokinetic sampler probes	12. ASME nozzle	17. Reactor	22. Main compressor
3. Aerosol injector	8. HEPA filter bank	13. CO sensor	18. Secondary compressor	
4. Mixing orifice and plate	9. Pressure transmitter	14. Optical particle counter	19. Aerosol generator	
5. Filter cassette	10. Pressure ring	15. Air sampling pump	20. Air flow meter	

Other features of the BAS included: aerosol generator, pyrolysis reactor, by-pass duct, aerosol sampling lines for the OPC, flow measurement devices, pressure taps, and instrumentation. The ductwork could withstand internal pressures and contain air so that it was distributed to the various sections of the system. The blower was selected to meet the flow rate, pressure rise, and efficiency requirements for aerosol sampling applications. At the inlet, the test equipment unit was fitted with a variable speed fan (blower) to supply and move air across the inlet HEPA cabin air recirculation filter at a constant face velocity of 0.47 m^3/s (1000 CFM). This air flow rate and a pressure rise of 1000 Pa (4.0 in. H_2O column) were the criteria for choosing a blower. Room air was used as the source. The inlet filter bank was fitted after the blower and arranged to discharge along the centerline of the upstream mixing orifice. The inlet filter bank not only cleaned the room air to ensure that the test results.

The primary function of the duct system was to provide airflow rates required for the experiment by creating uniform and continuous air flow through the system. The elements that produced controlled airflow rates included a blower to move the air; a canvas connector to reduce vibration transmission from the blower; combined orifice and mixing plate, diffusers; and inlet and exhaust filters to clean incoming and exhaust air. Figure 5.1 is schematic diagrams of the apparatus were not biased but dampened any flow fluctuations from the fan (i.e., it caused air to flow uniformly downstream at a constant face velocity). At this point, aerosols from the reactor were injected between the inlet filter bank and upstream mixing plate. The mixing plate distributed the aerosol particulates uniformly in the duct system i.e., it controlled and shaped the flow. It created a turbulent jet inside the duct so that the aerosol particulates mixed uniformly with the air. The small flow area on the mixing plate reduced the cross-sectional area for the flow, resulting in higher turbulence. The perforated plate had 30% open area (Mahindra, 2004).

Just ahead of the mixing orifice, the ductwork system assumes a divergent shape (divergent diffuser) to fit into the bigger test chamber. The diverging section increases the cross section of the duct from 610 × 610 mm to 915 × 915 mm (24 × 24 in. to 36 × 36 in.) over a length of 1.22 m (4 ft.). The divergent diffuser chamber slowly expands along its length, allowing fluid pressure to increase and decrease fluid velocity. Increasing the cross-sectional area helped create a uniform airflow pattern in the test section. The shape and size of the test section chamber, where measurements were made, was largely determined by testing requirements. The section is 610 × 610 mm (36 × 36 in.) in cross section and 1473.2 mm (58 in.)

long and acted as housing for the filter loader. The section has two doors, which allows the user to load the filter and inspect the sampling probes. The aerosol sampling probes and a probe that leads to by-pass duct were installed in the test chamber. The filter in the test section is held in place by a rigid, heavy-duty high strength frame with support members on the entering and exiting sides of the filter. The filter was installed in the chamber to obtain smooth air flow at the outlet of the device section.

Located downstream of the test section is a convergent diffuser, which reduced the cross section of the duct back to 610 × 610 mm) (24 × 24 in.) over a length of 1220 mm (48 in.). The convergent section allows fluid pressure to increase and decrease fluid velocity. The exhaust air was ducted into the room after it passed through the exhaust HEPA filter bank. The inlet and outlet filter banks each consists of a 610 × 610 × 101.6 mm (24 × 24 × 4 in.). Four ASME flow nozzles of 101.6 mm (4.0 in.) diameter designed according to ANSI/ASHRAE Standard 41.2. (1987) were mounted on an aluminum plate inside the last chamber of the ductwork to measure airflow rate through the system. The pressure drop across the ASME nozzles was measured to calculate the flow rate through the test duct. The differential pressure across the nozzles was measured with a pressure transmitter with an accuracy of ±5 percent.

5.3.1.1 Reactor design calculations

The reactor holds air and jet engine oil aerosol mixture securely in a confined space to allow heating to take place. A uniform heat flux was maintained by two electric resistance heaters wrapped around the outer surface of the tube (tube reactor). The tube reactor (pipe) was resistively heated externally to the desired pyrolysis temperature.

Assumptions:

(i) The flow is considered to be steady-state internal turbulent flow;

(ii) Constant fluid properties;

(iii) Uniform heat flux at the surface i.e., tape heater supplying heat at constant heat flux;

(iv) Adiabatic tube surface;

(v) The velocity profiles are fully developed;

(vi) The flow has negligible potential energy (PE) and kinetic energy (KE);

(vii) There is no work transfer across the boundary of control volume;

(viii) The rate at which energy is generated is;

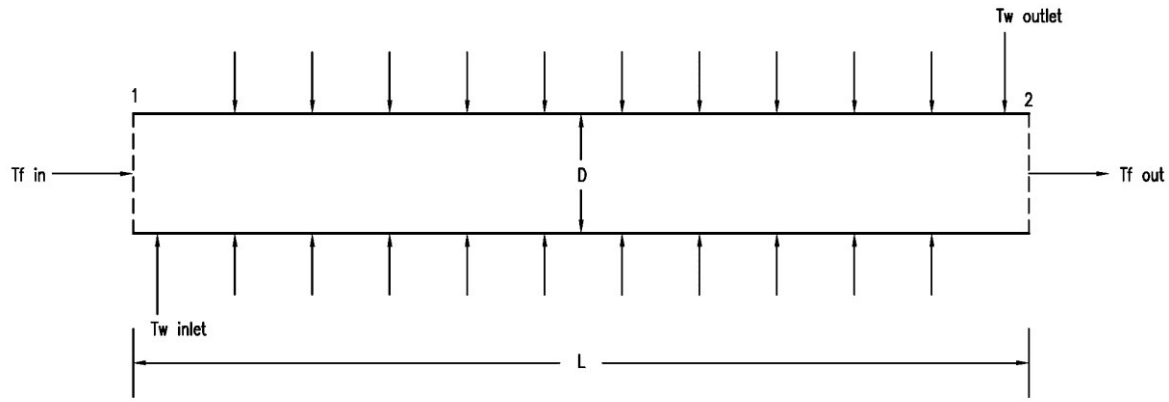


Figure 5.2 Schematic of pyrolytic reactor for jet engine oil

From thermo-physical properties of air at 477.59 K (Incropera and Dewitt, 2002), interpolate between 450 and 500 K to find ρ_{air}, μ_{air}, k and Pr.

Table 5-3 Thermal-physical properties of air at 477.59 K

ρ_{oil}	1.1 kg m^{-3}
μ_{air}	2.613×10^{-5} N.s/m^2
k	39.176×10^{-3} W/m·K
$c_{p\ air}$	1003 J/(kg·K)$^{-1}$
Pr	0.7
R	8.315×10^3 kJ(kmol K)$^{-1}$

These thermal properties of air are read from: Table A.6, (Incropera and DeWitt, 2004).

From the law of conservation of energy: Heat flux, $\dot{q}$ at the internal surface of the tube can be calculated as follows:

$$\dot{q} = h_c\, A\, (T_{wall\ in} - T_{fluid}) \quad (5.1)$$

$$\dot{q} = h_c\, A\, (593\ K - 573\ K)$$

Small ΔT is considered in order not to burn jet engine lubricating oil.

Nusselt number for turbulent flow in pipes is calculated thus:

$$Nu = (h_c \times D)/k \quad (5.2)$$

h_c = heat transfer coefficient

$$\dot{q} = \frac{Nu\ k}{D}\ \pi\ D\ L\ (593\ K - 563\ K)$$

$$\dot{q}\ = Nu\ k\ \pi\ D\ L\ (593\ K - 563\ K)$$

Using Dittus-Boelter (1930) and Colburn (1933) equations: $Nu = 0.023Re^{0.8} \cdot Pr^{n}$, where n = 0.4 for heating, $0.7 < Pr < 160$ and $Re > 10^4$. Since Re is greater than 10^4 and less than10^6, the flow is turbulent.

$$\dot{q}\ = 0.023\ (Re)^{0.8} \cdot (Pr)^{0.4}\ k\ \cdot \pi \cdot\ D \cdot\ L\ (30\ K) \tag{5.3}$$

$$Re\ = \frac{\rho u D}{\mu} \quad \text{and} \quad \dot{m}\ =\ \rho u A \qquad u\ = \frac{4\ \dot{m}}{\rho \pi D^2} \qquad Re\ = \frac{4\ \dot{m}}{\mu \pi D}$$

$$\dot{q}\ = 0.023\ \left(\frac{4\ \dot{m}}{\mu \pi D}\right)^{0.8} \cdot (0.7)^{0.4}\ k\ \cdot \pi \cdot\ D \cdot\ L\ (593\ K - 563\ K)$$

In the above equation there are three unknowns;$\dot{q}$, D and L. For 1 meter length and reactor diameter of 9.246×10^{-3} m (0.5 in.), heat flux, $\dot{q}$

$$\dot{q}\ = 329.1\ W$$

According to Kays and Crawford (2004), heat transfer rate for a tube can be calculated as follows:

$$Q_{conv} = \dot{m}\ \times\ c_{pair}(T_{air\ out} - T_{air\ in}) \tag{5.4}$$

Mass flow rate of air, $\dot{m} = 2.596\ \times 10^{-3}\ kg/s$

Specific heat capacity of air at 477.59K, $c_p = 1003$ J/(kg·K)$^{-1}$

Heat transfer rate, $Q_s = 2.596 \frac{kg}{s}\ \times\ 1003\ \frac{J}{kg.K}\ (30K) = -338.5$ W/m^2

The length of the tube reactor is calculated thus: $L_t = \frac{Q_s}{h_c\ \times \pi \times D \times (\Delta T_{average})}$

$$L_r = \frac{338.5\ W}{275.36 \frac{W}{m^2 K} \times \pi \times 9.246 \times 10{-}3\ m\ \times (30K)}\ \ 1.4\ m \tag{5.5}$$

The reactor was constructed from stainless steel type 316 smooth bore seamless tubing with wall thickness 0.065 in. Table 5.4 summarizes calculated reactor parameters. The length of

the tube reactor was approximately 4.5ft 6 in. The heater specifications are 120 volts and 2.16 amperes.

Table 5-4 Calculated reactor parameters

1.	Pipe size	id = 9.398 mm (0.37in.)
2.	Reynolds Number	Re = 2.461 x 10^4
3.	Convective heat transfer coefficient	h_c = 275.276 W/m^2 K
4.	Heat transfer rate	q = 329.1 W/m^2
5.	Length of reactor tube	L_r = 1.4 m (4.55 ft)
6.	Residence time	R_t = 0.07s
7.	Pressure drop	Δp = 1.589 x 10^3 Pa
8.	Heat flux from tape heater	Q_{tp} = 338.5 W/m^2
9.	Optimum insulation thickness	Optimum insulation = 7/8in.

In the reactor, the sub-micron oil aerosol particles were heated, allowing them to pyrolyze when operated at a sufficiently high temperature. From the reactor, the product of pyrolysis, which in essence is simulated bleed air, was introduced into the duct system as shown in Figure 5.2. This simulated bleed air was injected from the reactor into the duct between inlet filter bank and the mixing orifice. The aerosol concentrations coming from the reactor depend on the compressed air supply, the flow available for consumption by the aerosol generator nozzle, and the temperature and pressure of the reactor. The reactor can be operated at varied temperatures depending on adjustments to the resistance heater.

5.3.1.2 Dilution of sample air

The initial tests on BAS showed that the concentration of aerosol particles was so high that it exceeded the upper limit that could be counted by the OPC. Finding a design for diluting the air to make the OPC register count measurements was one of the first key technical challenges in aerosol sampling. The design aim for the diluter was to dilute test aerosols with clean air to have an appropriate concentration of test particles to measure. Basically, two options are available for diluting air (B. W. Jones, Personal Communication). In option one, all sampled air passes through the OPC. In addition, dilution is bled into a sample line to get the appropriate dilution for the OPC. The second option is to construct a mixing box for sampled air and clean

air, and the OPC pulls its stream from the mixed air. The total flow in this option is independent of the amount of air pumped through the OPC as long as it is more than the flow through the OPC. The basic equation in both cases is the same:

$$C_d = C_{opc}\frac{(Q_1+Q_2)}{Q_1} \tag{5.6}$$

where C_d = the droplet concentration in the duct

C_{opc} = the droplet concentration measured by the OPC

Q_1 = the flow rate of the air extracted from the duct

C_2 = the flow rate of the dilution air

Two critical assumptions are made in the design: the first assumption is that Q_1 in option one is so small that the only useful flow meters are those that would not cause substantial particle drop out. The second assumption is that Q_1 is sufficiently large in option two that using the ASME type flow meter would not result in appreciable drop fall out if the flow is directly measured. If either of these assumptions is incorrect, then option one is probably easier to implement. If both assumptions are correct, then option two should be considered since it offers more accuracy. Equation (5.6) can be used directly used to determine directly the concentration in the duct in option two. Since Q_1 cannot be measured directly in option one, Equation (5.6) can be rewritten as follows to determine the concentration in the duct.

$$C_d = C_{opc}\frac{Q_1}{Q_{t-}Q_2} \tag{5.7}$$

An uncertainty analysis on determination of C_d can be performed for each option to assess the accuracy level. Option two has between 5% and 10% uncertainty in determining C_d whereas option one has between 50% and 100% uncertainty in determining C_d. However, option one is simpler and cheaper to implement.

In this study, the challenge of sample dilution was addressed by constructing a by-pass duct where air sampling could be carried by OPC: essentially option one. Then a series of tests determined the dilution factor. A by-pass consisting of a PVC pipe schedule 40, 76.2 mm (3.0

in.) i.d. and measuring over 4267 mm (14 ft.) long was fitted below the main duct system. The flow enters the by-pass below the main duct at a 90^{o} elbow as shown in Figure 5.1. The by-pass duct changed the airflow rate from 5.66 m^3/s (1115 ft^3/min) in the main duct to 28.2 m^3/s (5548 ft^3/min). A series of controlled dilution tests performed over a range of aerosol concentrations ensured that the concentration used in the tests does not overload the OPC. The 400% dilution was found to be optimal.

The jet engine oil aerosol generated from AG was run through the reactor, and the aerosol particulates produced were counted using an OPC, while the gases were measured using an electrochemical sensor. The air running through the duct system was sampled by isokinetic samplers and measured for contaminants in jet engine oil.

Table 5-5 Calculation of dilution factor

Table 5.4 (a): A 30-minute average aerosol counts with no dilution

Particle Size (µm)	0.3	0.4	0.6	0.55	0.7	1.0	1.3	1.6	2.0	2.2	3.0	4.0	5.0	5.5	7.0	10.0
Air only	1724.8062	681.3953	413.1783	374.031	279.845	149.612	85.27132	48.062	23.25581	17.4419	7.751938	2.325581	0.3876	0.387597	0.3876	0
2 million (2M)	458194.96	372134.5	309058.5	291384.9	243936.4	163064	104450.4	68596.1	41937.21	29766.3	5843.798	989.9225	265.891	135.6589	17.8295	1.16279
4 million (4M)	1331414.7	928014	660382.2	595753.9	440072.5	248047	147501.9	90065.5	51658.53	36739.5	6891.085	1113.178	285.659	144.5736	15.1163	0.77519
6 million (6M)	1284055.4	1034595	844682.6	792067.8	647652.3	416222	259212.8	159645	91553.49	64797.3	11034.11	1714.729	375.194	177.5194	22.4806	0.3876
8 million (8M)	1761500.4	1422202	1158413	1084715	885890.7	560955	343436.8	212984	122706.2	85735.3	15210.47	2410.465	522.093	245.7364	29.0698	0

Table 5.4 (b): A 30-minute average aerosol counts with dilution

Particle Size (µm)	0.3	0.4	0.5	0.55	0.7	1.0	1.3	1.6	2.0	2.2	3.0	4.0	5.0	5.5	7.0	10.0
Air only	1749.2248	516.2791	276.7442	237.5969	156.9767	85.2713	49.22481	30.2326	15.89147	12.4031	4.263566	1.937984	1.16279	0.775194	0.3876	0.3876
2 million (2M)	2575.1938	1644.186	1226.357	1132.171	913.1783	559.302	345.3488	215.504	112.7907	77.5194	18.60465	3.100775	1.93798	1.550388	1.55039	0.77519
4 million (4M)	6537.9845	2945.736	1868.605	1681.008	1256.202	708.915	415.1163	257.364	143.0233	96.124	17.82946	3.875969	1.93798	1.937984	1.55039	1.16279
6 million (6M)	4828.6822	3404.651	2700.388	2534.884	2063.566	1273.26	737.9845	441.86	240.6977	168.217	34.10853	6.20155	2.32558	1.937984	0.77519	0
8 million (8M)	6181.7829	4337.597	3360.465	3120.93	2509.302	1523.64	899.6124	551.55	302.3256	205.814	43.02326	10.07752	3.48837	3.100775	1.93798	1.55039

Table 5.3(c): A 30 minute average dilution factor for different test runs

Particle Size (µm)	0.3	0.4	0.5	0.55	0.7	1.0	1.3	1.6	2.0	2.2	3.0	4.0	5.0	5.5	7.0	10.0
2 million (2M)	552.64805	329.3296	325.0224	325.3068	322.2112	343.678	352.4372	369.987	432.552	456.857	406.9459	849.3333	342.5	174.5	15	3
4 million (4M)	277.66896	381.7036	414.5897	412.4812	400.0934	397.498	402.8972	396.323	406.1555	438.625	507.4	573.2	368	124	12.6667	1
6 million (6M)	416.41447	357.9572	348.3472	344.6212	339.5448	350.234	376.2234	387.721	407.1517	415.751	369.4545	401.6364	322.333	152.3333	57	-1
8 million (8M)	397.01128	371.9975	375.5202	376.0721	376.4831	389.889	403.7589	408.458	428.3112	443.19	392.23	295.8571	224.333	105.5	18.5	0
Mean	410.93569	360.2469	365.8699	364.6203	359.5831	370.325	383.8292	390.622	418.5426	438.606	419.0076	530.0067	314.292	139.0833	25.7917	0.75
Std dev.	112.64446	22.80051	38.48077	38.15462	35.23678	27.2938	24.52271	16.1742	13.84295	17.0925	60.91318	241.6196	62.8158	30.46993	20.9432	1.70783

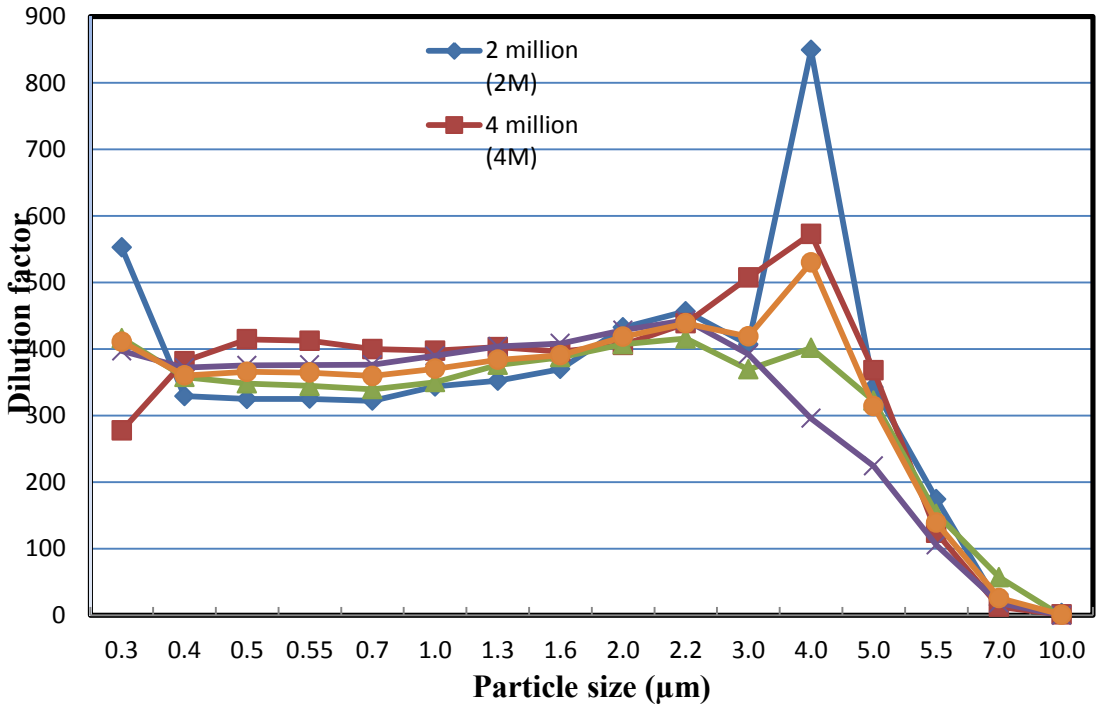


Figure 5.3 Calculation of dilution factor

5.3.1.3 Aerosol sampling calculations

An air sample has three basic ingredients: The amount of pollutant collected during the flow of air through the filter medium and the time run in minutes. The volumetric flow rate of aerosol sampling pump Q in SCFH was calculated according to Equation 5.8 which essentially states the ratio of the flow rates should equal to the ratio of surface which the flow passes:

$$\frac{Q_1}{Q_2} = \frac{A_1}{A_2} \tag{5.8}$$

where Q_1 = Flow rate of air in the duct

Q_2 = Flow rate of air in the sampling cassette

A_1 = Surface area of the filter in the duct

A_2 = Surface area of the small filter in the sampling cassette

Assuming that the volume of an aerosol particle is V_p, then particle sample volume is calculated thus:

$$V_p = \frac{\pi(D_p)^3}{6} \tag{5.9}$$

where D_p is the diameter of the particle

Particle mass flux: $m_p = \rho_p \times V_p$ (5.10)

Assume that the number of particle counts per cubic feet equals n_i

n_i is what the particle counter measures in every sampling period.

Particle mass concentration in the sample is calculated as:

$$m_{ps} = m_p \times \mathrm{n_i} \tag{5.11}$$

where m_{ps} is the mass of particles per volume of air sampled.

Assuming that all particles are accumulated by filter without settling on the cassette, incremental mass flow rate of sampled particles in a given time Δt or total mass of particles in one bin is calculated thus:

$$m_{Fi} = m_{ps} \times \mathrm{Q} \times \Delta\mathrm{t} \tag{5.1.2}$$

Q = 1.34 SCFH (Sample flow rate per filter sampling cassette).

Total mass of particles depositing on the filter media, m_T is equal to the sum of all the incremental mass is a given test run. The total aerosol loading to the filter media were calculated according to equation:

$$m_T = \sum_{i=1}^{16} m_{Fi} \tag{5.13}$$

Figure 3.3 is a LabVIEW function that shows the various steps in calculation of aerosol mass deposited on the filter.

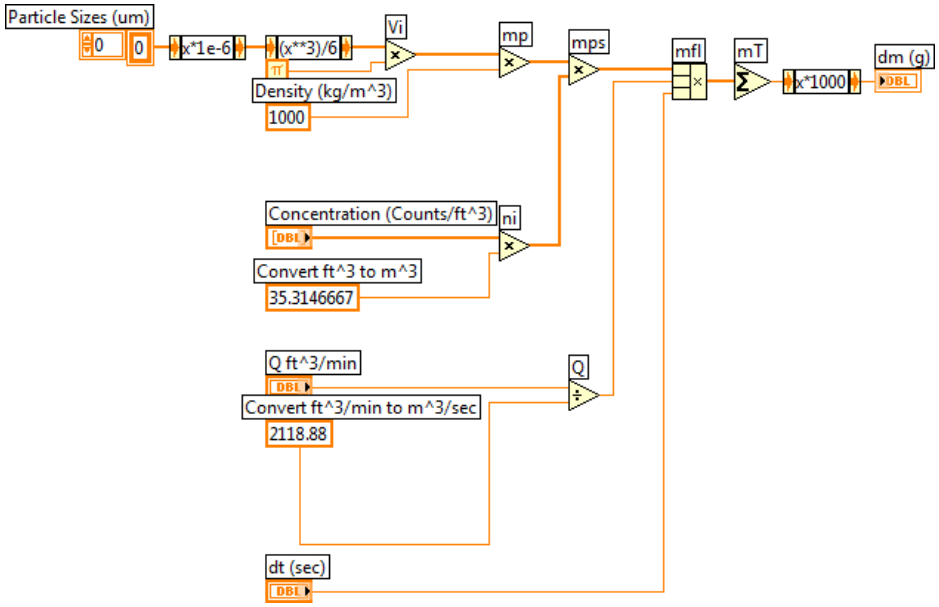


Figure 5.4 LabVIEW function converting counts to mass deposited on filter

The deposition fraction was calculated as the mass deposited on the three small filters divided by the product of the average upstream concentration and the total volume of air passing through the three small filters.

5.3.2 Process control and monitoring

The National Instruments software: Laboratory Virtual Instrumentation Engineering Workbench (LabVIEW) version 8.2 was used to build a control process model to monitor and control the experimental parameters. A program in LabVIEW was designed to communicate with the DAQ system and track different key aerosol production variables at different pyrolysis temperature and pressure ranges. The data acquisition Agilent Model 34970A series and system control were programmed to monitor and capture data from thermocouples, differential pressure transducers, and ASME nozzles. The outputs from the thermocouples and pressure transducers were converted to 0–5 volt electrical signals. The voltages generated at different measurement points of the relays were amplified, and the data transmitted to a microcontroller by an analog to digital converter. A desktop computer with a measurement computing analog-to-digital card was used for data acquisition through a serial cable with an RS-232 communication link. The analog digital data acquisition was programmed to register data points every 7 s. Moreover, special functions of LabVIEW software 8.2 were used to store and synchronically display the obtained data. Appendix D shows the flow chart of LabVIEW program. Figure 5.5 shows a block diagram of the program layout of the control process. The reactor tube was wrapped by two 120 volts, 2.61 ampere heaters and powered by a 1 kW, 120 vdc power supply – variac.

The temperature of the reactor was monitored with K-type thermocouples attached to the outside of the reactor tube. The manufacturer's reported accuracy of the thermocouples is ± 0.15°C. The temperature measurement resolution of the DAQ unit was 0.1^{o}C and 0.000 V.

5.3.3 Data acquisition system

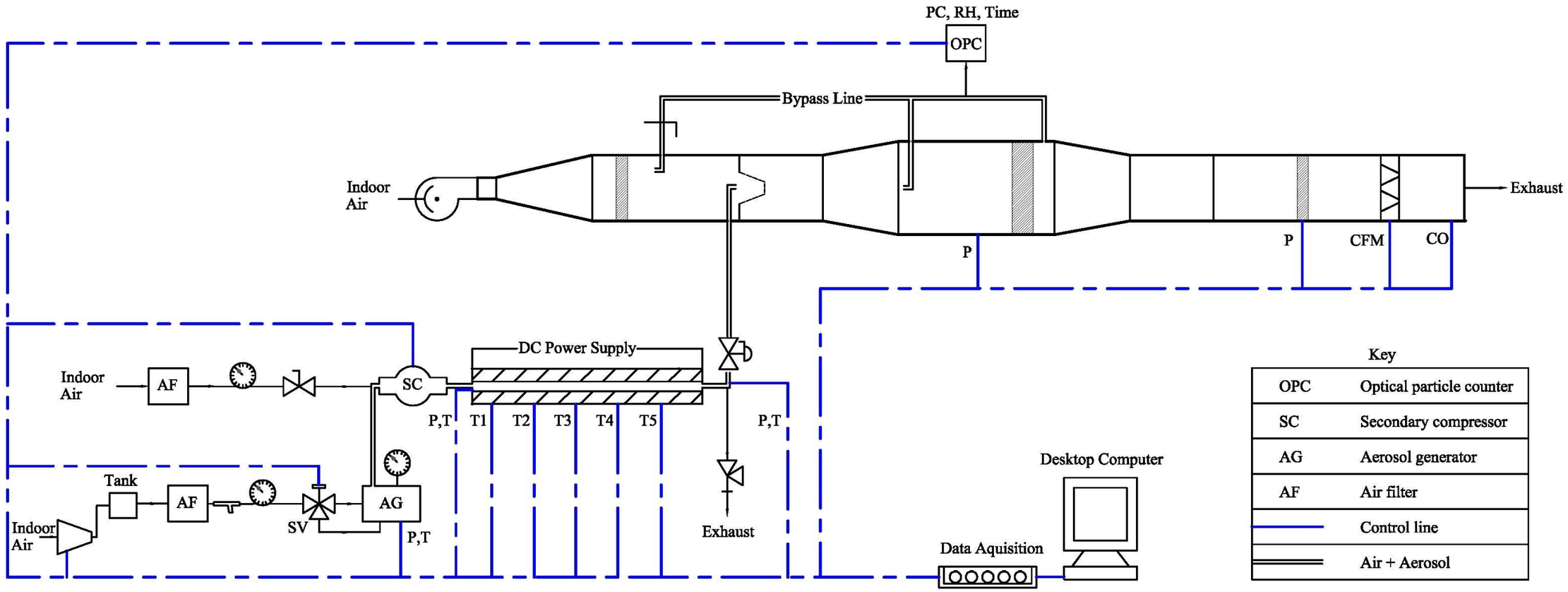


Figure 5.5 Schematic diagram of the BAS and data acquisition system

A pressure transmitter (Omega model PX305-300AI with a 0-300 PSIA range and 0.25 percent full scale accuracy) was fitted at the reactor inlet. The output of this transmitter is a 4-20 mA current loop, which in turn is converted to a 0-5 volts signal to the computer data acquisition system. The On/Off signal from the diaphragm actuated valve sensor interface pressure detector operates a SPDT relay in the control unit. The contact of this relay actuated alarms, indicator lights, or process control equipment. The backpressure regulator at the exit of the reactor tube rated at 350 psig, 350^{o}C. A safety check valve, set to open at 200 PSID, was mounted on a backpressure regulator sitting at the reactor outlet.

During the bleed air simulation experiments, the differential pressure across the filter at the test chamber was measured by the differential pressure gauge. The pressure ring constructed around the duct had a PVC hose connecting the ring to the differential pressure transducers (Model PX653-05D5V, manufactured by OMEGA Engineers Inc., Stamford, CT). The pressure ring opens in the duct through pressure taps, which were built in accordance to the ASHRAE Standard 52.2. The pressure transducers had a measuring range of 0 to 1.25 kPa (0 to 5 in. of H_2O) and output voltage range of 1-5 vdc. The differential pressure transducers were installed in the sampling chamber, because controlled pressure is necessary to maintain ASHRAE Standard 52.2 certification.

The relative humidity (RH) was measured by OPC. The RH was measured to ensure that tests were performed in an RH range that does not affect aerosol light properties. In a moist environment, aerosol particles experience hygroscopic growth; therefore, their optical properties depend strongly on RH. The response of a particle to RH depends mainly on the size and the solubility of the particle (Zieger et al. 2010). Room air was used as the test air source. The temperature of the air at the test device was kept between 50 and 100°F with an RH between 20% and 65%. Carbon monoxide (CO) was measured using electrochemical gas sensor Model 4101-04 series module 4-20 mA (manufactured by Sierra Monitor Corporation, Milpitas, CA). The CO monitor has a detection range of 0-100 ppm and was attached on the inside of the ceiling in the last chamber of the duct system.

The air flow rate in the duct was measured using ASME nozzles. The manufacturer-reported accuracy of the nozzles is ±0.11 m/s or 1.5 percent with starting threshold less than 0.45 m/s. Besides monitoring environmental conditions at the test chamber, the applications also included monitoring reactor temperature profiling, particulate counting, and troubleshooting the

pyrolysis process. The control set-points for temperature, RH, pressure and flow rates were within an acceptable range according to ASHRAE Standard 52.2-1999. Sensor data from connected accessories such as temperature, duct flow rate, pressure, CO concentration, particle diameter, and concentration were displayed on a desktop computer screen. The air distribution in the duct system delivered conditioned air flow and aerosols to the test chamber where sampling occurred. To control the experiment and facilitate data collection, all meters and gauges used in the experiment were set to meet the standards for measurements in clean rooms.

Operational safety procedures: The BAS is a user-friendly system with a series of sensors attached that send real time reports to the system's desktop computer. The system can readjust itself automatically or can be shut down and restarted manually. Alarm and reactor shut down functions are triggered when set temperatures and pressures are exceeded during tests runs. Unusual pressure build up and elevated temperatures in the tube reactor or other unforeseen circumstances are overseen by the electronic control system which kicks in to stop the pyrolysis process; the exhaust by-pass line then opens to vent accumulated gaseous byproducts.

5.3.4 Experimental measurement conditions and procedure

The aerosol generator (AG) (model TDA-4Blite, Air Techniques International (ATI), Owing Mills, MD) generated polydisperse sub-micron of Mobil Jet Oil II aerosols. The AG has three Laskin nozzles adjusted by two control knobs. The two knobs permit the unit to be operated with 1 to 3 nozzles, providing a range of aerosol concentrations (i.e., different nozzle flow rates produce different concentrations of aerosol particles). The AG requires only a supply of clean air to function. From compressor 1, air was supplied to the Laskin nozzle, which rests in Mobil Jet Oil II contained in AG. As the air pressure increases, the oil is forced upwards causing it to be aerosolized. With the help of compressor 2, the aerosols and air mixture are sucked into the reactor under pressure. Finally, before running the tests, the operating air pressure of the Laskin nozzle was adjusted to 20 psig (137.90 kPa) to provide required aerosol particle concentration before it was directed to the reactor.

5.3.4.1 Aerosol sampling procedure

The sampling system filtered particulates in simulated bleed air flowing through the duct to account for airborne Mobil Jet Oil II aerosols in the simulator. The system had three isokinetic probes, clean 25-mm diameter cut from cabin air recirculation filter, three-piece plastic filter

cassettes to hold the filter media in place, and a vacuum air pump (Model Gast, serial number 0677). The sample was drawn into the isokinetic sampling probe by means of the vacuum pump, which could maintain an isokinetic sampling rate while continuously withdrawing a portion of the air through the sampling train. The pump had separate pressure and vacuum gauges and valves, so vacuum and pressure levels could be independently adjusted. The pump was calibrated before running the tests. An air flow meter (model Dwyer series 2000, Dywer Equipment, Inc., MI, USA) was connected to the pump to record the sampled air flow rate. Clear, flexible sample transfer lines made of polyvinyl chloride (PVC) hose were used for connections to the various accessories. The PVC hose connected the probes to the three sampling cassettes and the sampling cassettes with the pump, through a rotameter and back to the main duct in a closed loop system where a calibrated sampling pump pulled a known volume of air through cassettes holding filtration media cut from a clean HEPA cabin air recirculation filter.

To ensure that the sample represented the air and aerosol flow in the duct, sampling had to be isokinetic, that is, the particle–laden air was drawn into the sampling probe at a velocity equal to that of the air in the duct at the sampling point. The isokinetic sampling arrangement is schematically shown in Figures 5.6. Isokinetic sampling probes are widely used for air sampling. For this study, three evenly spaced isokinetic samplers were installed in the test section of the duct system. The samples were collected from a highly charged environment: a duct where simulated bleed air had been introduced. The main body of the sampling probe was made of a 13 mm o.d. stainless steel tube to assure rigidity for handling and positioning. Each probe had a sharp edged inlet diameter of 6.4 mm. (0.25 in.) with a 90° gradual bend (radius of curvature = 57 mm (2.25 in.)). The probes were mounted on the floor of the test chamber in an upright position with the nozzle pointed into the airstream; the opening of the isokinetic probe was aligned to the air movement in the duct. Figure 5.6 shows the entire assembly of the sampling system. The filter media trapped the airborne particulates. Captured aerosol particles on HEPA filters were sent to a laboratory for analysis. Such an arrangement permitted gravity to assist the sample pump in keeping the particulate catch in the filter.

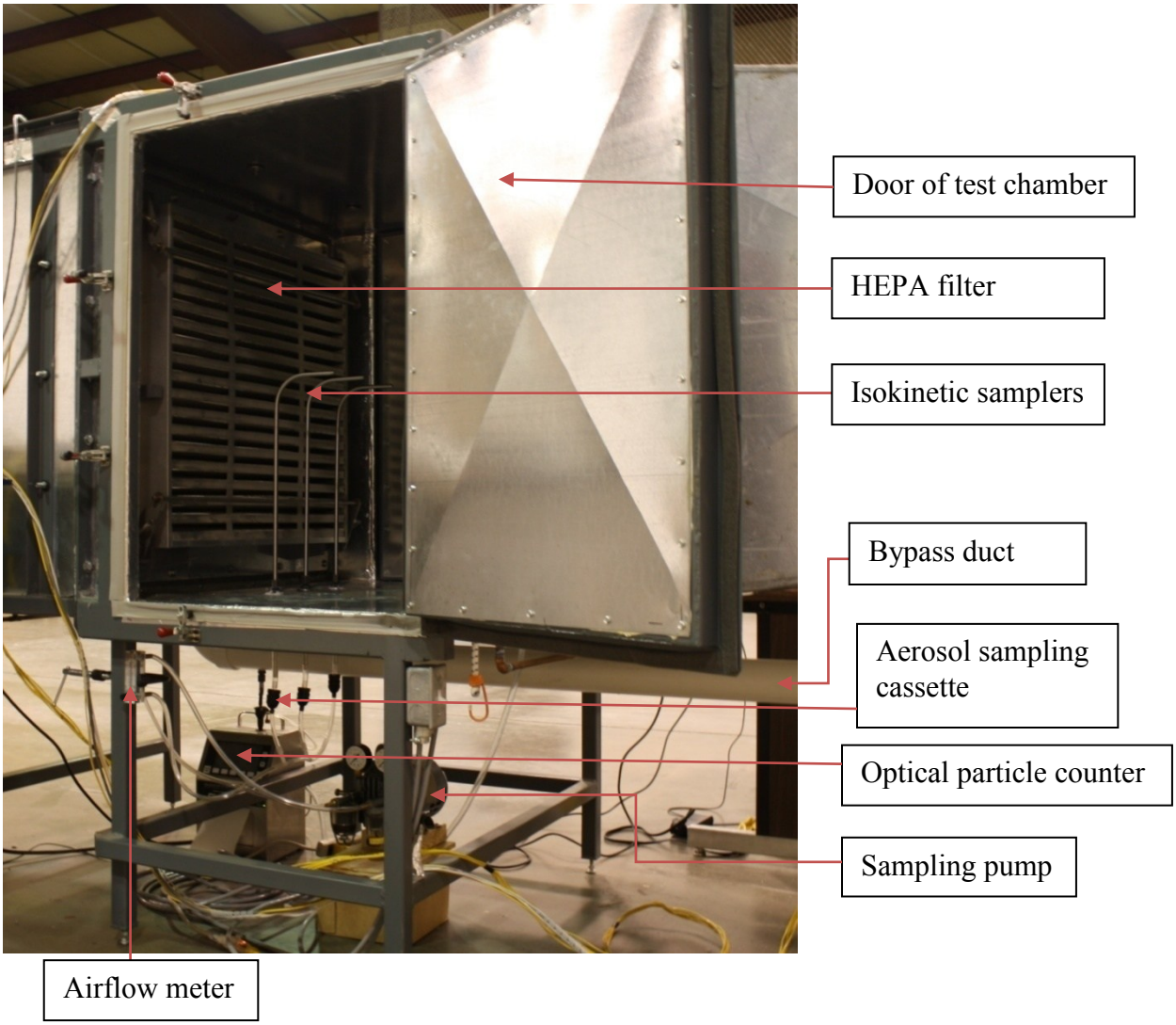


Figure 5.6 Aerosol sampling device assembly

The dimensions of the probes were chosen in accordance with ASHRAE Standard 52.2 guidelines, which require sampling in the duct to be isokinetic. This design helps give an accurate measurement of the particulate level in the system. The isokinetic probe helped reduce counting errors in sample flow velocity and the aerodynamics of small particles. The inlet nozzle of the sample probe(s) was sharp edged to maintain isokinetic sampling within 10 percent at 1000 CFM. The sampling rate was adjusted so that the velocity of the sample, at the mouth of the probe, equaled what it would have been in the absence of the probe. The probe distances from the filter were as defined in the standard ASHRAE 52.2. Very similar designs of isokinetic sampling probes have been used by many other researchers (Hewitt, 1978; Ito et al. 1991).

5.3.4.1 Filter cassette holders

A sampling cassette device for separating the particles contained in the airstream is shown in Figure 5.7. An open-face sampling was performed by removing the end plugs from the three-piece cassette filter holder. The inside diameter of cassette holder varies by only ±5 mm^2 for consistent collection area and minimized error. The filter cassette holders were securely assembled to prevent leakage.

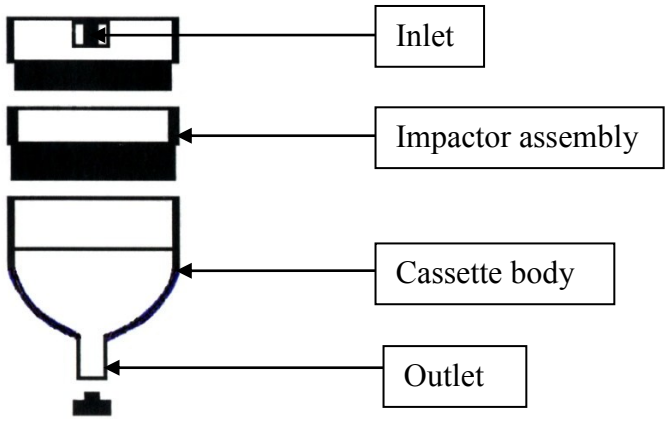


Figure 5.7 A 25-mm Air sampling filter cassette holder

The connection of the sample lines starting from the sampler probes down to the cassettes, the vacuum pump, and the rotameter were carefully considered to avoid particle loss in the sample lines. Particle losses associated with sample lines may include inlet losses due to non-isokinetic sampling; losses to the walls of the sample due to diffusion; electrostatic charging and gravitational settling; and losses in bends, resulting from centrifugal force and eddies (Hanley et al., 1995). Before each test run, all sampling equipment was wet-wiped with 70 percent isopropyl alcohol wipes to sterilize them. The end plugs (caps) at the inlet and outlet of the cassettes filter holders were removed and cut circular 25-mm diameter HEPA filter media with a 0.3 μm pore size were then loaded into cassette holders. After loading the filter media, the cassettes were connected to the sample pump with flexible PVC tubing 15.9 mm (5/8 in.) internal diameter.

Special care was taken to prevent contamination of filter media while loading and unloading the cassettes. The cassette samplers were then connected to an air sampling vacuum pump set to draw air through a sampling media (HEPA filter) at a fixed, predetermined air flow rate of 0.11 m^3/min (4.0 SCFH). The cassettes were used in open-face mode to allow the filter to collect particulates from the air which passes through them. The cassettes have 15.9 mm (5/8 in.)

union fittings on inlet and outlet ends for fastening directly between the pump and the probe sheath. The configuration structure of the filter cassette holder is such that it eliminates bypass and infiltration leakage, ensuring maximum sample collection and accurate results. To ensure that all the connections were leak proof and secure, zip ties (tie wraps) were used around the flexible PVC tubing to tighten the connection with probes and the cassettes. This assured that aerosols being sampled originating from the duct.

Collecting particles from the air sample is most commonly achieved by filtration. A fibrous filter cut from aircraft HEPA filters was fitted to sampling cassettes. All plastic cassettes were secured around the seams to prevent leakage past the filter. Open-face sampling was performed by removing the end plugs from the three-piece cassette and the particulate was thus uniformly deposited on the filters. Deposition occurs when particles impact and are intercepted by the fibers (Hinds, 1998). Thus particulates smaller than the pore size may be efficiently collected. The sampling filter media used in this study had pore sizes of 0.3μm. The efficiency of removing particles from the air depends on the face velocity (i.e., the cross sectional air velocity of the filter holder). For particles less than 1.0 μm, the overall efficiency decreases with increasing face velocity (Liu et al. 1983; Lippmann, 1995).

The experiment was programmed to sample air for 30 min. for every flight condition. For every test run, the above procedure was repeated two times for jet engine oil at different sampling durations, temperatures, and pressures corresponding to various flight conditions. The sampling flow rate was entered every time the experiment was set to run. At the end of each sampling period, the three-piece cassettes containing filter samples were removed from the sampling train assembly, both ends were locked, and cassettes were placed in appropriately labeled zip-locked plastic bag and shipped along with a blank filter to the analytical laboratory for analysis by FESEM/EDS, GC/MS, and NAA. Blank filter media (clean, unexposed cabin air recirculation filter) were included as part of standard laboratory controls.

5.3.4.1 Aerosol particle counting

A laser OPC (Model CI-500 SPECTRO 0.3, Serial number 045455, Climet Instruments Company, Redlands, CA) was fitted to the bypass duct and used to determine particle size distribution. The OPC takes a defined-air sample through a volumetrically controlled pump and measures the airborne particles continuously by scattered light in its laser measuring cell. The

measuring range of particle sizes is from 0.3 – 10 μm in 16 channels. The OPCs 16 channels or bins are set to classify particle size range and counts. The OPC provides single particle count and size classification during sampling period. The sampled air with various size particles is drawn constantly through the flat light beam produced by a focused laser diode. Each scattered signal from a single particle is detected by 90 degree high-speed photo diode so particle color changes can be ignored. Each signal is then counted and classified in 16 different size channels by an integrated pulse height analyzer.

The OPC uses a laser-light illumination source that has a wide collection angle for sensing the scattered light: 50 mW laser diode and wavelength of 780 nm. The OPC determines the size of a sampled particle by the quantity of light scattered by the particle and focused onto a photo detector using a system of mirrors. Since the amount of light scattered from a particle is a strong function of its size, measuring the amplitude of the scattered-light allows the size of the particle to be determined. Particle concentrations are kept low enough within the measuring volume of the counter to ensure only one particle is measured at a time. Particle counters size particles by matching a signal response generated by aerosol particle to an equivalent size of a polystyrene latex sphere. An appropriate optical calibration before installation for use is therefore required for accurate sizing. For this study, the OPC was calibrated by the manufacturer using polystyrene latex spheres. The measured particle size by an OPC depends on a particle's refractive index in addition to its size.

The particle counting by OPC covered the typical ASHRAE 52.2-1999 particle size range of 0.3 – 10.0 μm. This was in accordance with ASHRAE Standard 52.2-1999 procedure which divides the particles in the same size range with each class owning the upper and lower limit and geometric mean size. The OPC unit has an external exhaust system to connect the equipment to the sampled environment. Such an arrangement assures that the pressure is equalized so that the equipment maintains proper flow regulation. During the test, an OPC sampled aerosols from the by-pass. The OPC was operated at volume flow rate specification of 47.20 cm^3/s (0.10 CFM). The maximum particle concentration limit for the selected flow rate was 353.0×10^6 particles/m^3 (10.0×10^6 particles/ft^3).

The OPC was also programmed using LabVIEW to provide a contact closure at the end of each sample period, which consisted of 2 s particle counting followed by a 5 s delay before taking the next sampling to count, i.e., 7 s time resolutions. The precision of the OPC varies

according to size range; it is most precise at the smallest size ranges. The sampling inlet system was designed to ensure a representative sampling by OPC. The different particle size ranges measured by each instrument imposed correspondingly different requirements, and these were taken into account in the design. First, there could be no size bias in the size of particles aspirated into the sampling line over the size range from 0.3-10 μm. Secondly, the flow transport line to OPC was designed to minimize losses for the size range covered by the instrument by making it as short as possible. All the measured data from OPC was acquired and transmitted via the RS-232 serial-interface to a logging desktop computer with analog output: 0 ~ +2.9V. That helped to optimize aerosol production and monitoring efficiency while maintaining safe, reliable operations. Each and every component of the experimental system was selected to provide optimal performance and reliable operation using automated data recording. The OPC spectrometer Climet .3 could not measure particles smaller than 0.3 μm.

5.4 Analysis, Results and Discussion

5.4.1 Data analysis and results

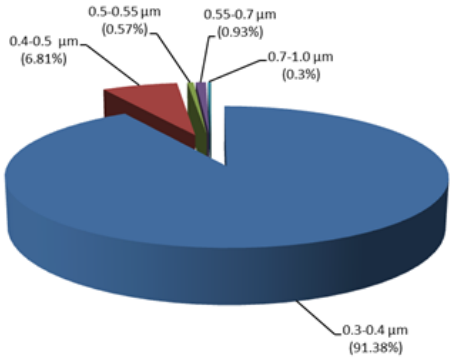
5.4.1.1 Mobil Jet Oil II aerosol particulate distributions in BAS

The average background aerosol counts (air only) for each size range were computed and subtracted out from the counts obtained from the OPC during actual test runs. The remaining counts were then computed for parameters needed. Data pertaining to simulated incidents are in Appendix C.1. The average rate of aerosols produced varied dramatically from one simulated condition to another. The total average aerosol particulate counts ranged from a high of 233,555,417 million counts/ft^3 in ground operations (cold tests) to a low of 163,214,400 million counts/ft^3 in top climb speed conditions. In terms of percentage, the distribution hit a high of 86.98 percent for 0.3 μm aerosols to a low of 0.002 percent for ≥ 0.55 μm size aerosols in top climb (take-off) conditions and 84.1 percent for 0.3 μm aerosols to a low of 16.5 percent in ground operations (cold test). Overall the total test period however, it averaged 37 percent.

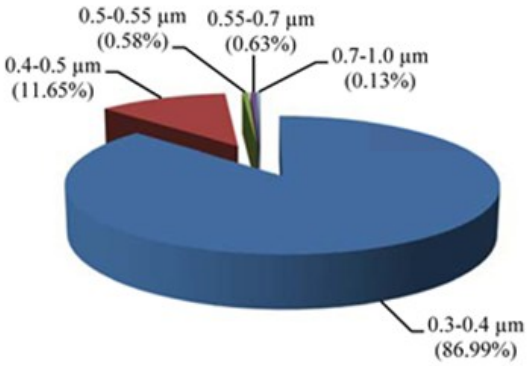
Among the six bleed air operations, 0.3 to 0.4 μm size aerosols are predominant. As evident from Table 5-5 the 0.3 to 0.4 μm particulate size range contributes proportionally more aerosols than any other size range. Ground operations (cold tests conditions) have by far the most widespread total particulate size distribution with have the highest 0.3 to 0.4 μm at about 84

percent and the lowest greater than 1.6 µm at 0.01 percent. Figure 5.8 depicts a pie-chart that illustrates particulate size range distribution for simulated cruise speed test one and take-off test one conditions.

Figure 5.8 Comparison of particulate distribution at cruise test 1 and top climb test 1 conditions



(a) Cruise speed condition test 1



(b) Top climb (take-off) condition test 1

Table 5-6 Distribution of aerosol particulates in percentages from various size ranges at different simulated bleed air operations

Simulated mode of aircraft engine bleed air operation	Test	Percentage distribution in aerosol size range								
		0.3-04 µm	0.4-0.5 µm	0.5-0.55 µm	0.55-0.7 µm	0.7-1.0 µm	1.0-1.3 µm	1.3-1.6 µm	>1.6 µm	Total %
Ground operations (Cold test)	Test 1	84.12	12.33	0.89	1.67	0.88	0.08	0.02	0.01	100
	Test 2	84.07	12.33	0.90	1.67	0.91	0.08	0.03	0.01	100
Top climb (Take-off)	Test 1	86.99	11.65	0.58	0.63	0.13	0.02	0.00	0.00	100
	Test 2	86.54	12.11	0.59	0.63	0.11	0.01	0.00	0.00	100
Cruise	Test 1	91.38	6.81	0.57	0.93	0.30	0.01	0.00	0.00	100
	Test 2	92.00	6.34	0.52	0.85	0.27	0.10	0.00	0.00	100
Initial descent from cruise	Test 1	75.98	19.12	1.59	2.52	0.77	0.02	0.00	0.00	100
	Test 2	76.13	19.04	1.58	2.48	0.75	0.03	0.00	0.00	100
End of descent	Test 1	87.83	9.85	0.76	1.18	0.37	0.01	0.00	0.00	100
	Test 2	87.13	10.62	0.78	1.13	0.33	0.01	0.00	0.00	100
High pressure to low pressure switch-over	Test 1	85.03	12.24	0.93	1.39	0.01	0.00	0.00	0.00	100
	Test 2	86.07	11.42	0.86	1.28	0.37	0.01	0.00	0.00	100

From Table 5-6 and pie charts in Figure 5.8, it is evident that aerosols particulates in the 0.3 to 0.4 µm range are predominant. Suggesting further studies should focus on measuring particulates in less than 0.3 µm size ranges using appropriate equipment.

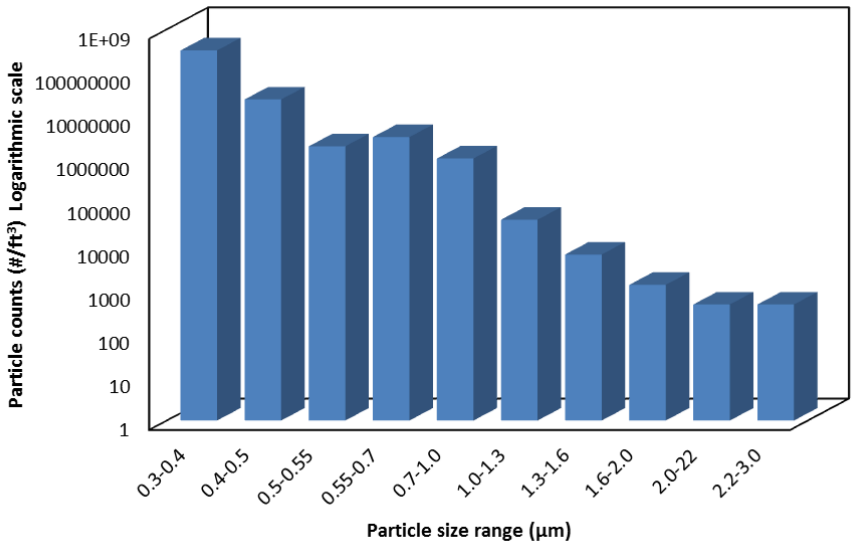


Figure 5.9 Histogram of particle count distribution at simulated ground operations test 1 (14.1 PSI, 170.4°C)

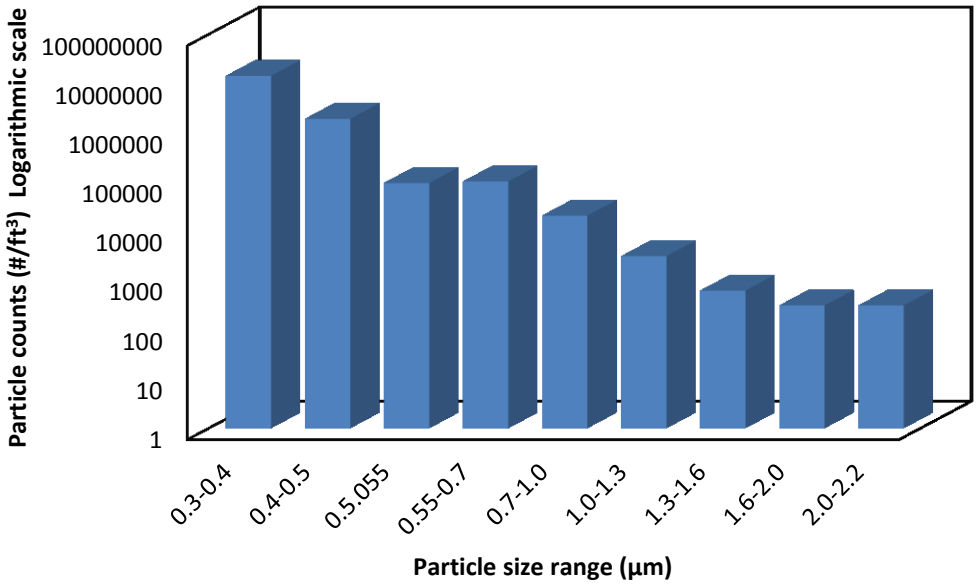


Figure 5.10 Histogram of particle count distribution at top climb (take-off) condition test 1 (103.2 PSI, 308.0°C)

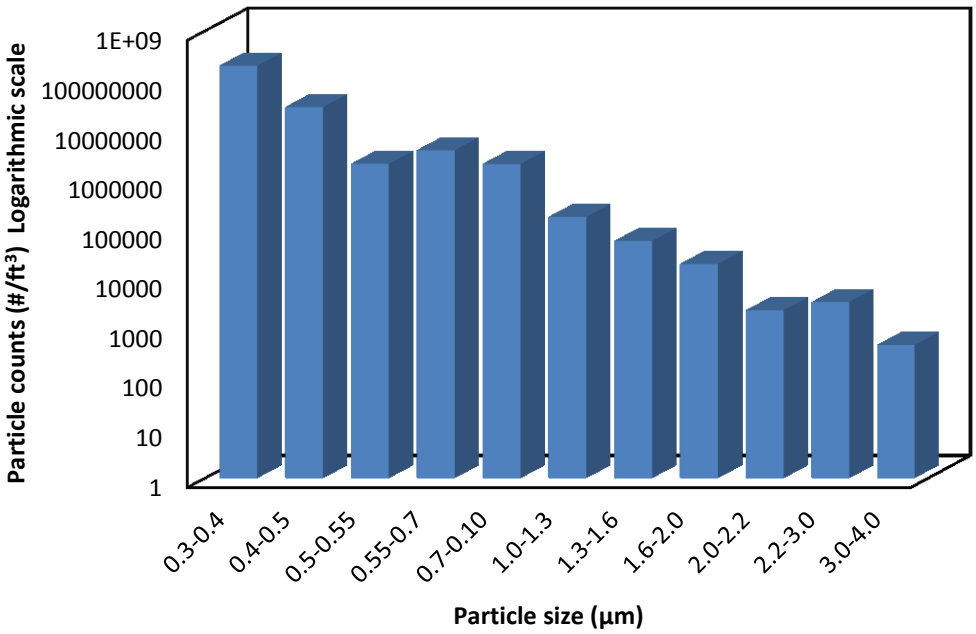


Figure 5.11 Histogram of particle count distribution at simulate cruise speed test 1: (50.7 PSI, 249.7^{o}C)

5.4.1.2 Probit analysis

Raw data in the form of particle counts (number concentrations) per cubic foot of air sampled falling within a specified range of sizes were converted to mass concentration in particle size interval. By dividing by the total mass, the mass concentration values were converted to segments of dF(d[i]) of the cumulative distribution in the intervals around d(i). The segments dF were then used to calculate the cumulative function values, $F(d_p)$. Each $F(d_p)$ was plotted against the particle size value which is the upper limit of each particle size-interval counted. A point value was calculated for each of the cumulative function values using an approximation formula developed by Finney (1947): Probit = $4.9[F^{0.14} - (1 - F)^{0.14}]$. Probit analysis involves fitting a regression model of binomial response variables.

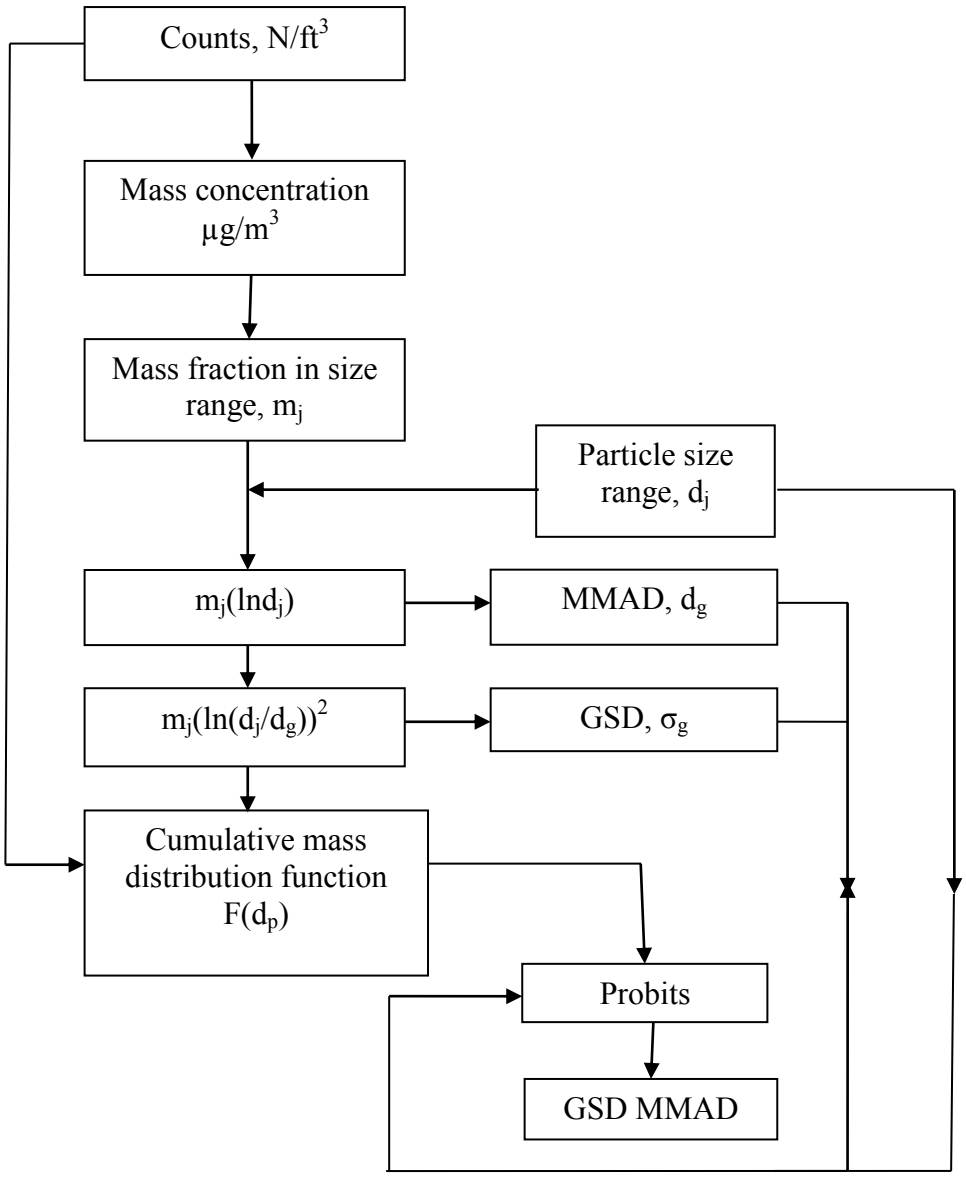


Figure 5.12 Flowchart for calculation of Mobil Jet Oil II aerosol characteristics: Probit analysis

From the concentration of aerosols probits are calculated and finally a graph of probits versus the log of particulate size is constructed. Figure 5.12 shows all the necessary steps required to obtain various aerosol parameters for probit analysis. Table 5-7 contains the values of aerosol characteristics obtained in probit analysis. Probit analysis is the transformation of the OPC acquired data into a linear relation of probit vs particle size.

Table 5-7 Key steps in Probit analysis: Cruise speed (Test 1: 50.7 PSI, 249.7°C)

	0.3 (μm)	0.4 (μm)	0.5 (μm)	0.55 (μm)	0.7 (μm)	1.0 (μm)	1.3 (μm)	1.6 (μm)	2.0 (μm)	2.2 (μm)
Average	163.717431	29.13471215	4.760637	10.382345	6.999339	0.829193	0.355461	0.118341	0.069340	0.092292
Air only	0.386595	0.110657148	0.013039	0.028075	0.017386	0.001645	0.001057	0.000117	0	0
	163.330836	29.02405501	4.747598	10.354269	6.981954	0.827548	0.354404	0.118223	0.069340	0.092292

Particle size range Lower limit (μm)	Particle size range Upper limit (μm)	Mass conc. ($\mu g/m^3$)	Mass fraction in size range m_j	Geom. mean particle size d_i (μm)	$m_j(\ln d_j)$	$m_j(\ln(d_j/d_g))^2$	Cumulative mass distrib. $F(d_p)$	$\ln(d_p)$	Probits
0.3	0.40	163.3308363	0.756509691	0.35	-0.794200611	0.008893472	0.756509691	-0.916290732	0.691552298
0.4	0.50	29.02405501	0.134432538	0.45	-0.107345416	0.002744771	0.89094223	-0.693147181	1.228331308
0.5	0.55	4.747597923	0.021989747	0.525	-0.014169248	0.001940221	0.912931977	-0.597837001	1.356327033
0.55	0.70	10.35426997	0.047958522	0.625	-0.02254068	0.010656962	0.960890499	-0.356674944	1.760163734
0.7	1.00	6.981954314	0.032338756	0.85	-0.00525566	0.019618359	0.993229256	0	2.460418991
1.0	1.30	0.827548471	0.003833008	1.15	0.000535709	0.004480424	0.997062264	0.262364264	2.731685804
1.3	1.60	0.354403673	0.001641514	1.45	0.000609927	0.00282975	0.998703778	0.470003629	2.967270037
1.6	2.00	0.118223114	0.000547581	1.8	0.000321861	0.001280466	0.999251359	0.693147181	3.110552004
2.0	2.20	0.06934019	0.000321167	2.1	0.000238286	0.000910065	0.999572526	0.78845736	3.245752833
2.2	3.00	0.092291787	0.000427474	2.6	0.000408456	0.001538163	1	1.098612289	4.871387651
3.0	4.00	0	0	3.5	0	0	1	1.386294361	
4.0	5.00	0	0	4.5	0	0	1	1.609437912	
5.0	5.50	0	0	5.25	0	0	1	1.704748092	
5.5	7.00	0	0	6.25	0	0	1	1.945910149	
7.0	10.00	0	0	3.5	0	0	1	2.302585093	
	Total	215.9005208	1		-0.941397377	0.054892654			

Mean mass aerodynamic diameter, MMAD = $\exp[m_j(\ln d_j)]$ = 0.39 μm. Geometrical size diameter, GSD, $\sigma_g = \{\exp[m_j(\ln d_j)]\}^{0.5}$ = 1.8674. Figures 5.13 through 5.18 show the distribution of Mobil Jet Oil II aerosol concentrations simulated in BAS for all bleed air operating conditions performed during test 1.

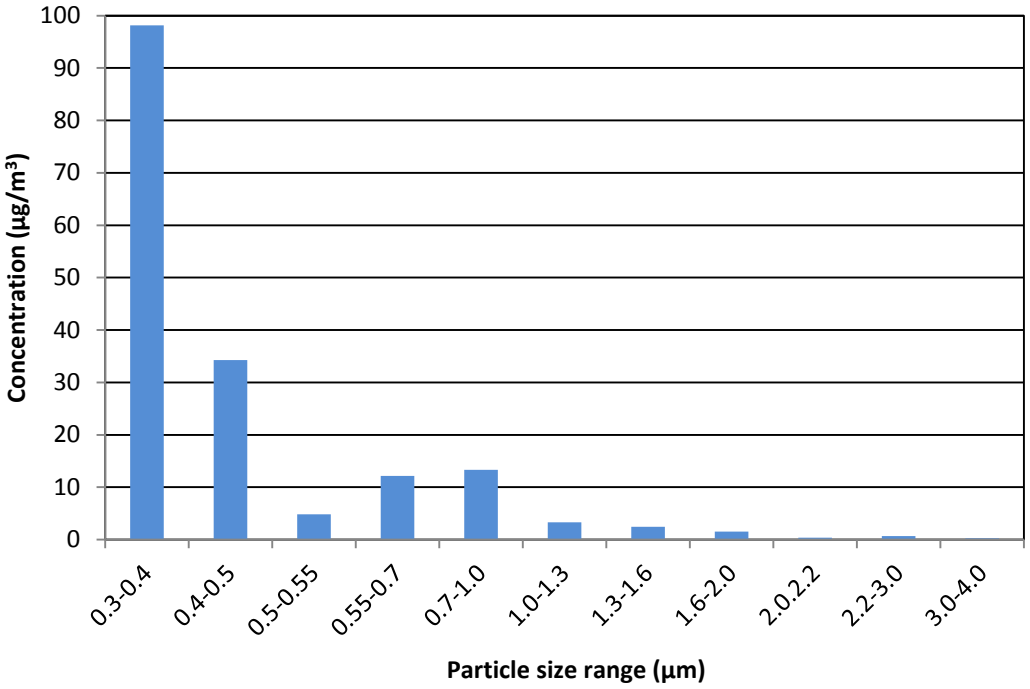


Figure 5.13 Histogram of aerosol concentration distribution at simulated ground operations test 1 (14.1 PSI, 170.4°C)

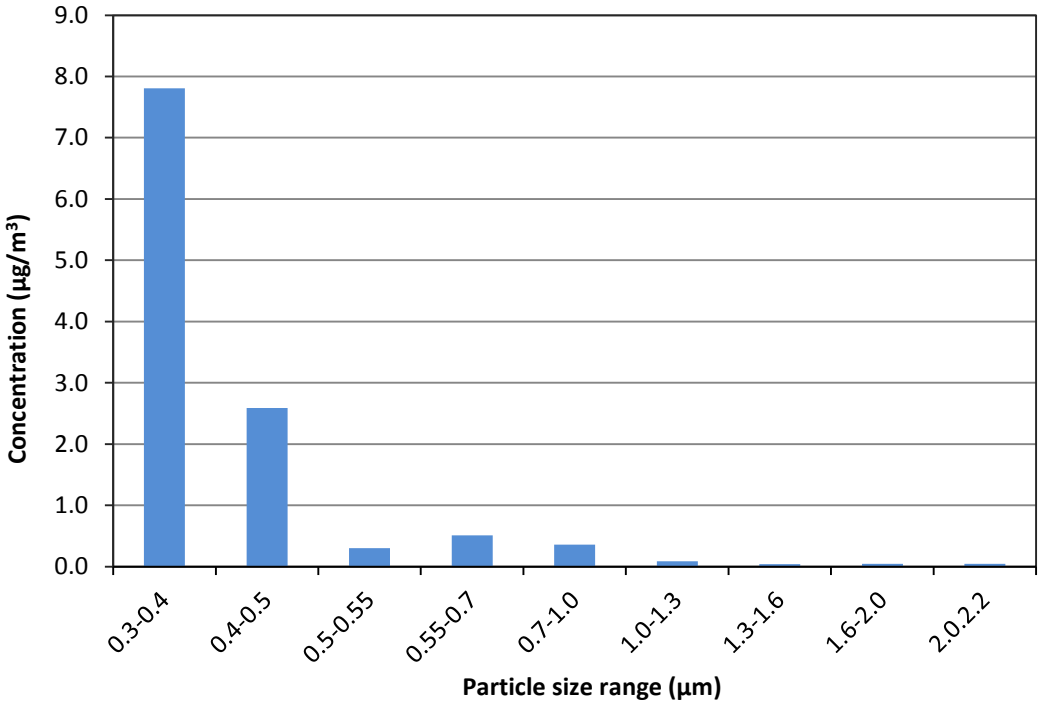


Figure 5.14 Histogram of aerosol concentration distribution at simulated top climb (Hot test 1: 102.2 PSI, 308.0°C)

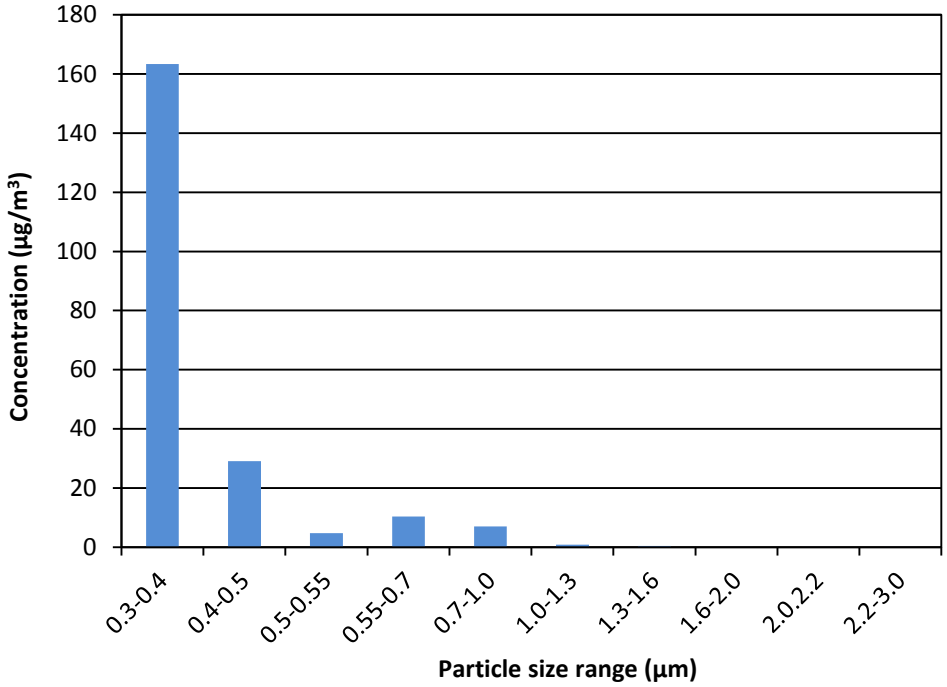


Figure 5.15 Histogram of aerosol concentration distribution at simulated cruise speed conditions test 1 (50.7 PSI, 149.7°C)

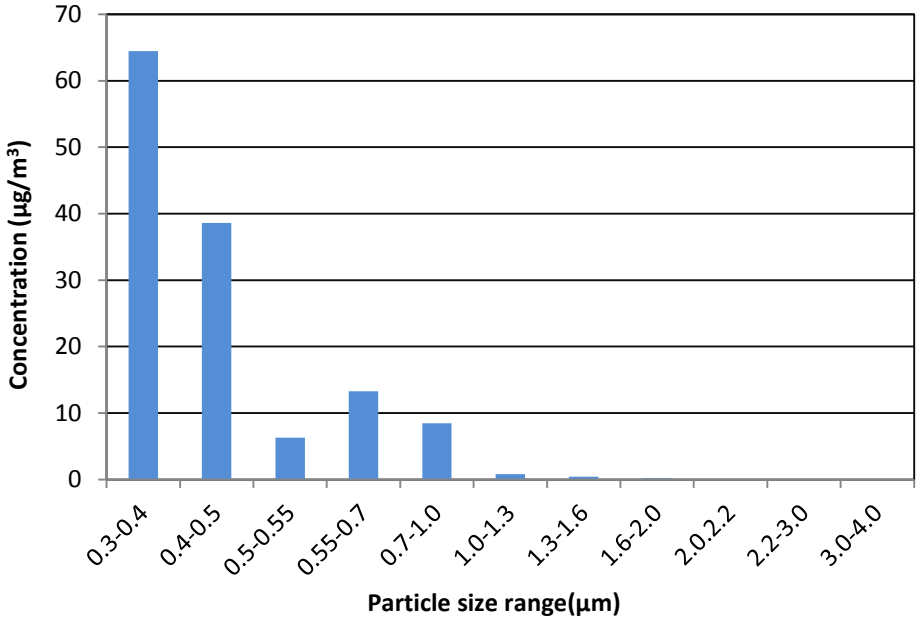


Figure 5.16 Histogram of aerosol concentration distribution at simulated initial descent from cruise test 1 (29.7 PSI, 185.2°C)

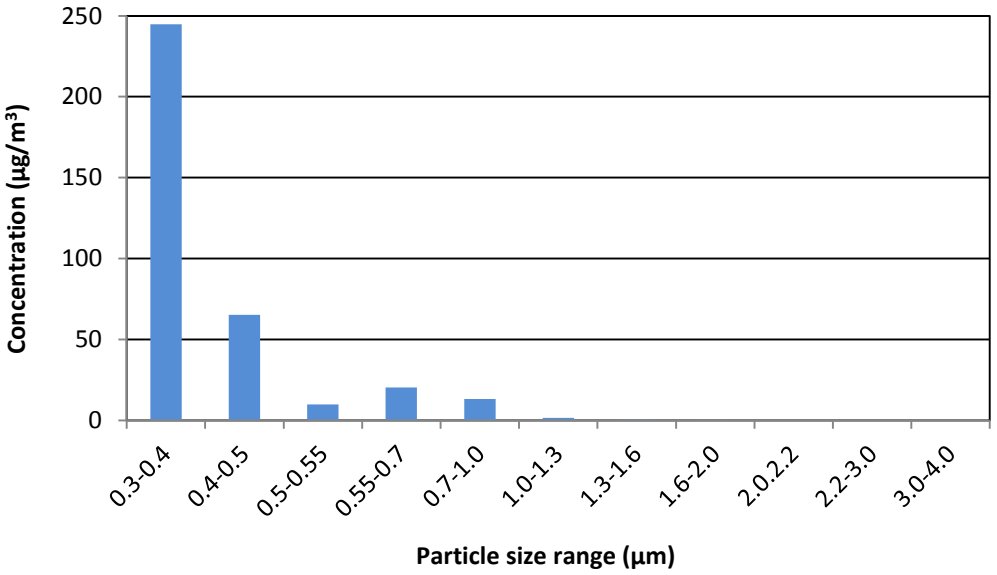


Figure 5.17 Histogram of aerosol concentration distribution at simulated end of descent test 1 (66.9 PSI, 230.7°C)

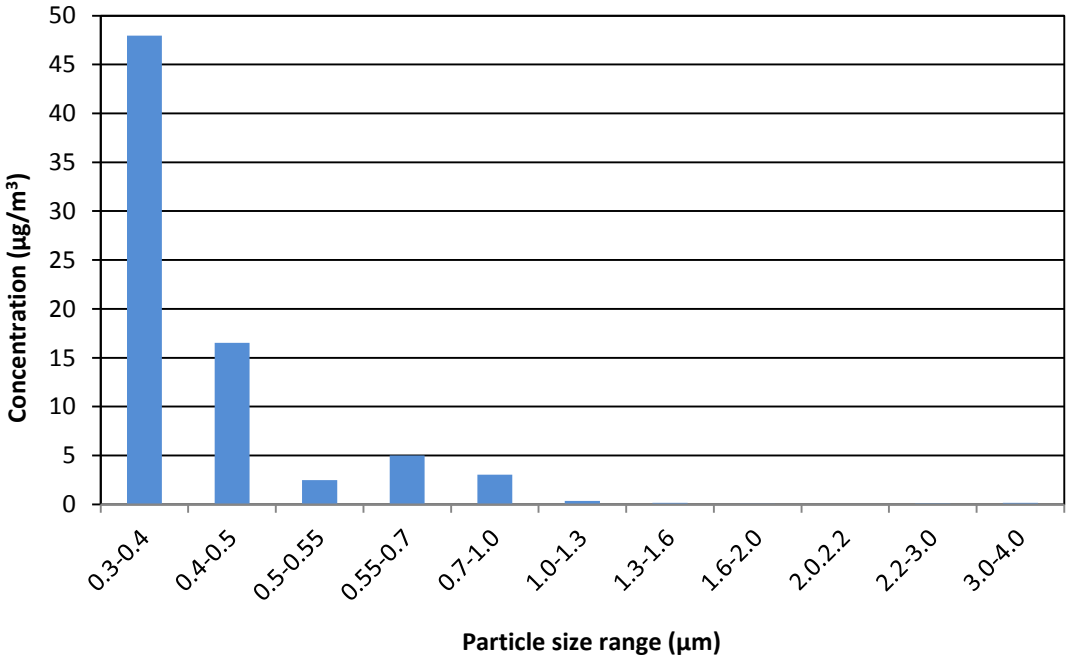


Figure 5.18 Histogram of aerosol concentration distribution at simulated high pressure to low pressure switch-over (Hot test 1: 70.9 PSI, 280.5°C)

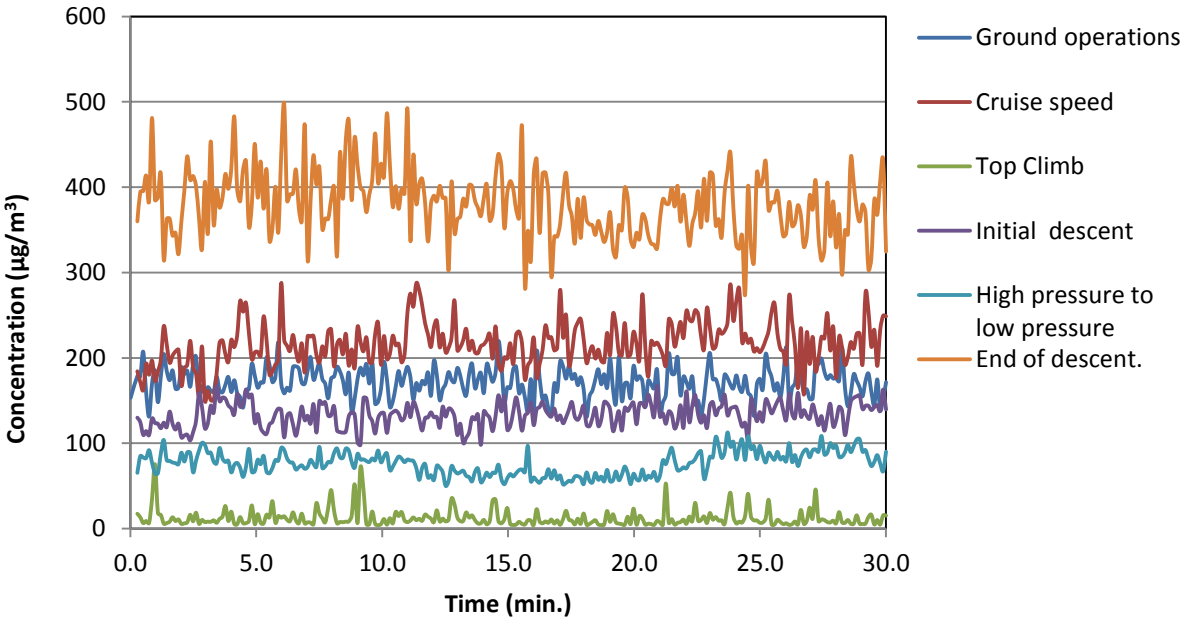


Figure 5.19 Comparison of Mobil Jet Oil II aerosol concentrations generated from different simulated bleed air conditions

Figure 5.19 shows the variation of aerosol concentrations in different simulated bleed air conditions. From Figure 5.19, simulated flight conditions for end of descent had the highest aerosol concentrations suggesting that end of descent conditions favor most aerosol formation than any other bleed air condition. The lowest aerosol formation was observed during simulated top climb conditions. Top climb or take-off operations occur at high temperatures and pressures and obviously at such conditions most aerosols have burnt out into gaseous by products.

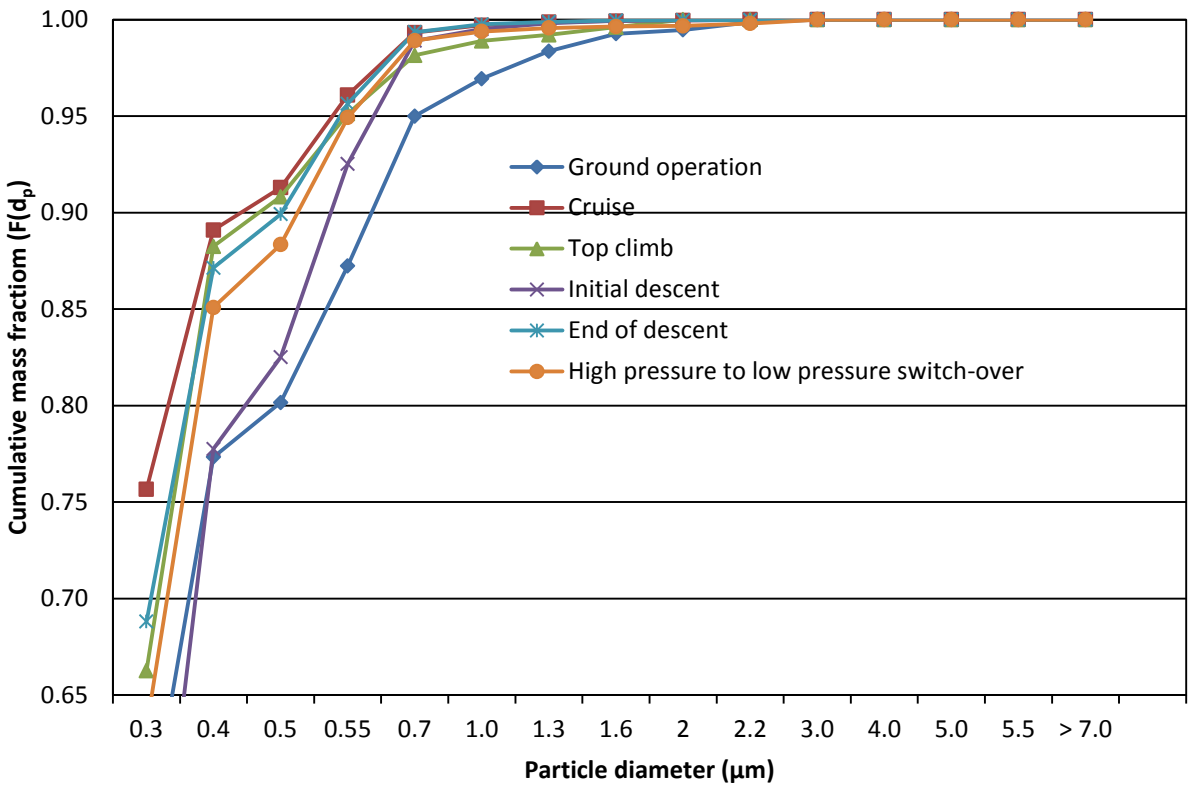


Figure 5.20 Cumulative mass distribution curves for Mobil Jet Oil II aerosols at different simulated bleed air conditions

The cumulative distribution enables one to determine readily quantitative information about the particle size distribution (Hinds, 1994). The fraction of particles less than a given size can be read from the graphs. The area under the frequency function curve between two sizes *a* and *b* equals the fraction of particles whose diameters fall within this interval.

The probit values obtained in Table 5.7 were plotted as the y-axis versus log particle size on the x-axis.

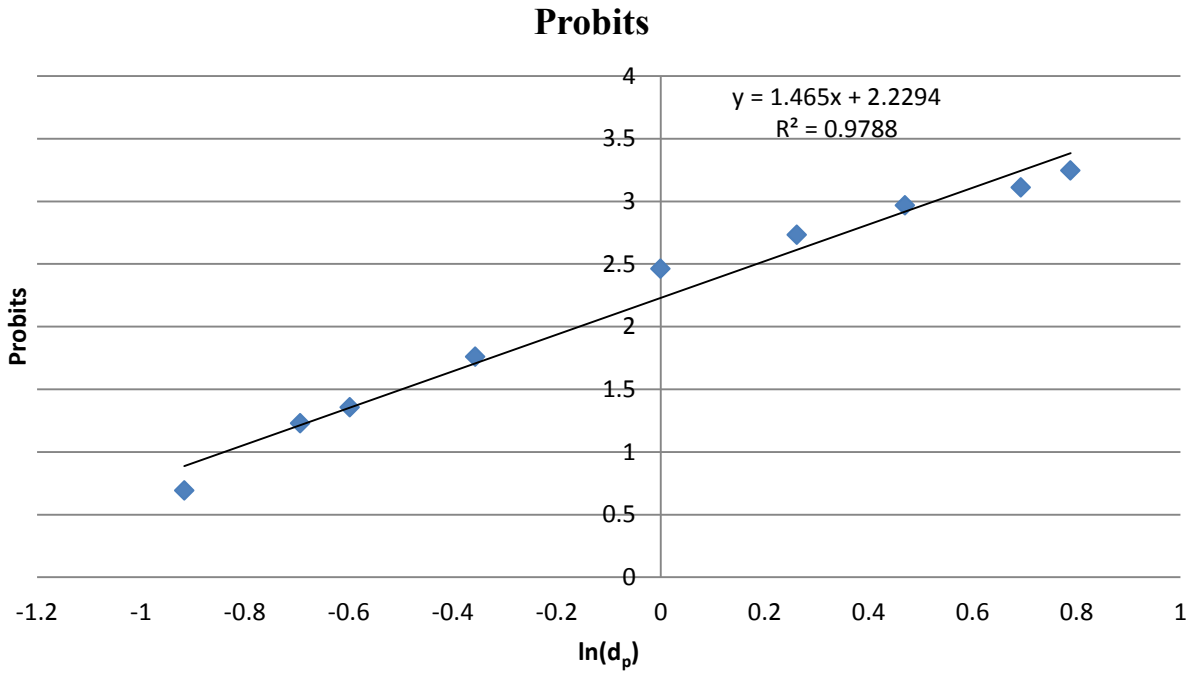


Figure 5.21 Probits versus $\ln(d_p)$ at cruise test 1 (50.7 PSI, 249.7°C)

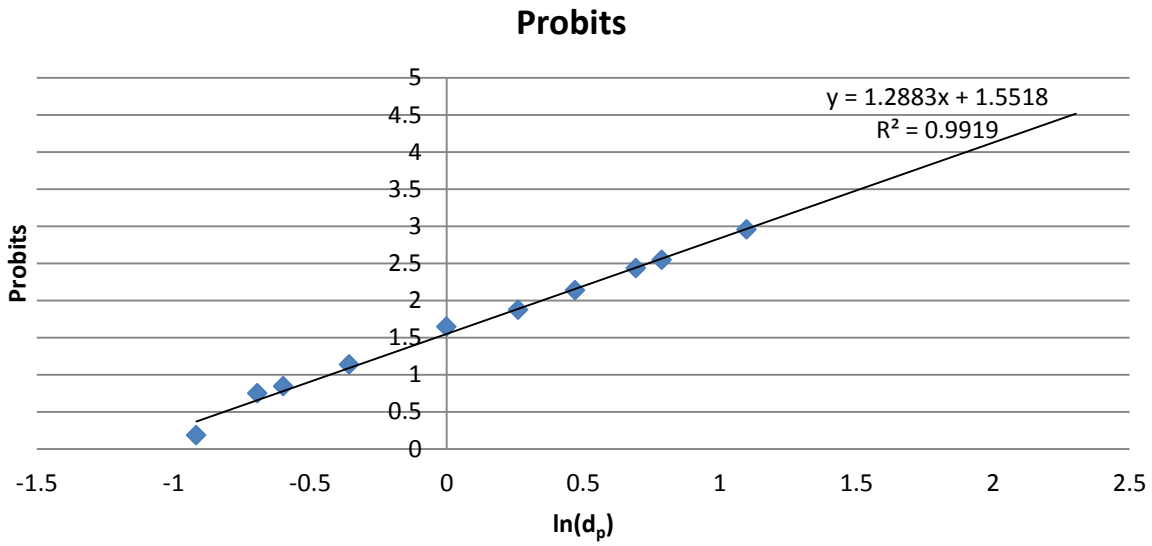


Figure 5.22 Probits versus $\ln(d_p)$ at ground operations test 1 (14.1 PSI, 170.4°C)

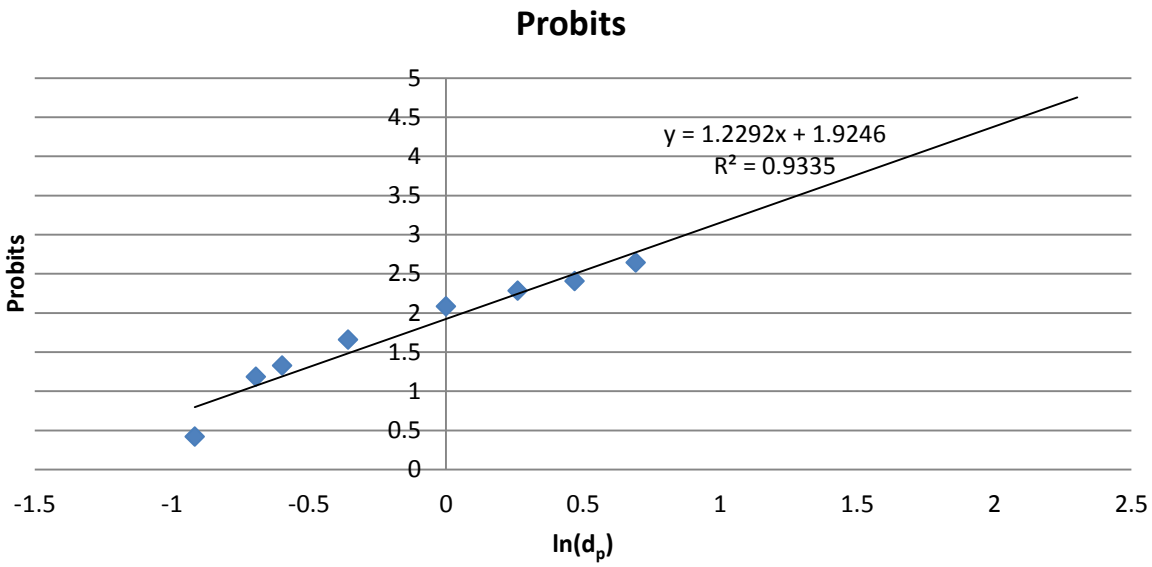


Figure 5.23 Probits versus $\ln(d_p)$ at top climb test 1 (103.2 PSI, 308.0°C)

Table 5-8 Summarized results of probit analysis parameters for simulated aircraft bleed air operations

Simulated mode of aircraft engine bleed air operation	Test	Test conditions	Equation for regression line	R^2	MMAD µm	GSD σ_g
Ground operations (Cold test)	Test 1	14.1 PSI, 170.4°C	$y = 1.2883x + 1.5518$	0.9919	0.45	1.9514
	Test 2	14.1 PSI, 170.4°C	$y = 1.377x + 1.5839$	0.9903	0.45	1.9518
Top climb (Take-off)	Test 1	103.2 PSI, 308.0°C	$y = 1.2292x + 1.9246$	0.9335	0.40	1.8887
	Test 2	104.1 PSI, 309.3°C	$y = 1.2236x + 2.0273$	0.9195	0.40	1.8799
Cruise	Test 1	50.7 PSI, 249.7°C	$y = 1.465x + 2.2294$	0.9788	0.39	1.8674
	Test 2	50.0 PSI, 251.1°C	$y = 1.4187x + 2.2382$	0.9777	0.39	1.8635
Initial descent from cruise	Test 1	29.7 PSI, 185.1°C	$y = 1.7012x + 1.9364$	0.9587	0.44	1.9368
	Test 2	29.6 PSI, 185.1°C	$y = 2.357x + 2.2489$	0.9424	0.44	1.9348
End of descent	Test 1	66.1 PSI, 230.9°C	$y = 1.4769x + 2.1693$	0.9564	0.40	1.8814
	Test 2	66.9 PSI, 230.7°C	$y = 1.2729x + 2.0894$	0.9318	0.40	1.8817
High pressure to low pressure switch-over	Test 1	70.9 PSI, 279.5°C	$y = 1.3181x + 1.9352$	0.9225	0.41	1.8974
	Test 2	74.4 PSI, 280.4°C	$y = 1.8444x + 2.2668$	0.9461	0.40	1.8875

According to Finney (1947) analytical model, a linear relationship of probits and $\ln(d_p)$ with a correlation coefficient of 1.0 ($R^2 = 1$) is a sign of a good fit for lognormal distribution. As is evident from Table 5.8, the R^2 values tend to decrease with increased temperature suggesting that the linearity of the probits decrease with bleed air conditions which are associated with high temperatures. Figures 5.21 through 5.23 support this trend.

5.4.1.3 Trends in experimental conditions: Performance parameters of BAS

Measurements of temperature and pressure variations versus time were plotted to determine the conditions of the experiment. Appendix E.1 shows plots of temperature and pressure variations in the reactor and the duct for various simulated tests conducted (Tables E.1 through E.7). Temperature and pressure profiles for all simulated bleed air conditions suggest that near steady-state conditions were achieved for all experiments conducted. At top climb and high pressure to low pressure switch-over conditions, pressure slightly fluctuated. Table 5-9 summarizes some measured parameters of simulated operational conditions of bleed air at different phases of flight.

Table 5-9 Results of simulated experimental conditions for aircraft bleed air operations

Simulated mode of aircraft engine bleed air operation	Test	Simulated bleed air conditions		Average duct flow rate (CFM)	Average aerosol concentration ($\mu g/m^3$)	MMAD (μm)	GSD σ_g	Relative humidity (%)
		Reactor pressure (PSI)	Reactor temperature (^oC)					
Ground operations (Cold test)	Test 1	14.1	170.4	1098.4	171.6	0.45	1.95	44.6
	Test 2	14.1	170.4	1098.6	173.3	0.45	1.95	43.1
Top climb (Take-off)	Test 1	103.2	308.0	1108.6	12.4	0.40	1.89	54.0
	Test 2	104.1	309.3	1107.1	16.4	0.40	1.88	52.7
Cruise	Test 1	50.7	249.7	1115.3	216.8	0.39	1.87	47.5
	Test 2	51.0	251.1	1113.9	231.7	0.39	1.87	45.9
Initial descent from cruise	Test 1	29.7	185.1	1101.9	133.2	0.44	1.94	44.6
	Test 2	29.6	185.1	1100.7	137.8	0.44	1.94	45.0
End of descent	Test 1	66.1	230.9	1108.9	355.9	0.40	1.88	61.5
	Test 2	66.9	230.7	1103.5	380.2	0.40	1.88	48.2
High pressure to low pressure switch-over	Test 1	70.9	280.5	1109.9	76.4	0.41	1.90	40.6
	Test 2	74.4	280.4	1111.4	88.6	0.40	1.89	39.1

Table 5-10 Mean aerosol characteristics and simulated bleed air conditions

Simulated mode of aircraft engine bleed air operation	Mean Pressure (PSI)	Mean Temperature (^{o}C)	Mean GMMD nm	Mean GSD σ_g
Ground operations (Cold test)	14.1	170.4	450	1.95
Top climb	103.7	308.7	400	1.88
Cruise	50.9	250.4	390	1.87
Initial descent from cruise	29.7	185.1	440	1.94
End of descent	66.5	230.8	400	1.98
High pressure to low pressure switch-over	72.7	280.0	405	1.89
Average	-	-	410	1.92
Minimum	14.1	170.4	390	1.87
Maximum	103.7	308.7	450	1.98

From Table 5-10 it is evident that the mean (range) of geometric mass mean diameter (GMMD) = 0.42 (0.39, 0.45) µm and geometric standard deviation (GSD), σ_g = 1.92 (1.87, 1.98). The ranges for both GMMD and GSD are short. Table 5-10 is derived from Table 5.9 to show the variations of GMMD and GSD with simulated bleed air conditions.

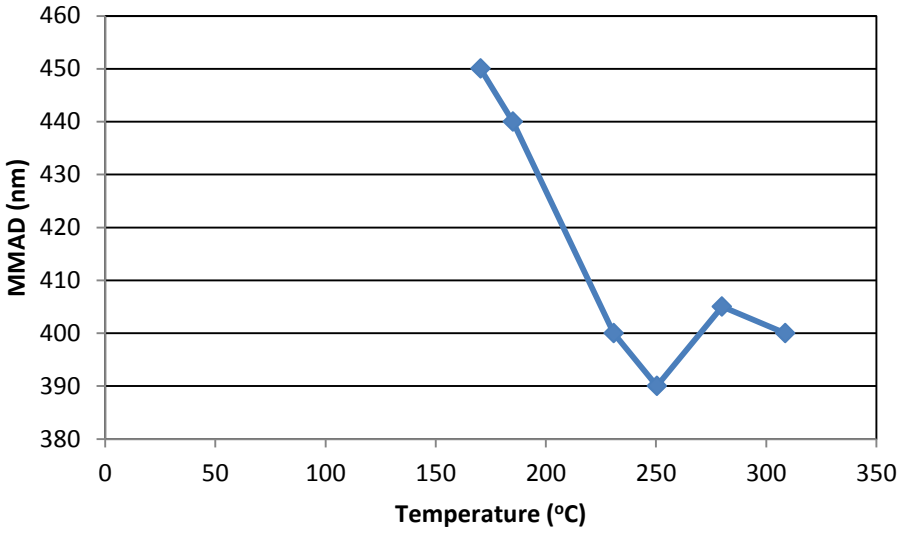


Figure 5.24 Variability of MMAD of Mobil Jet Oil II aerosols with temperature in bleed air simulator

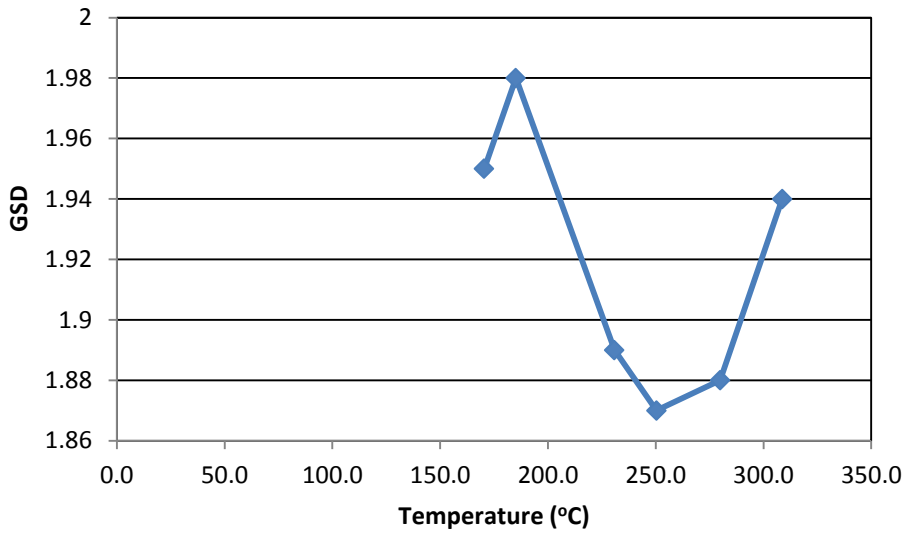


Figure 5.25 Variability of GSD of Mobil Jet Oil II aerosols with temperature in bleed air simulator

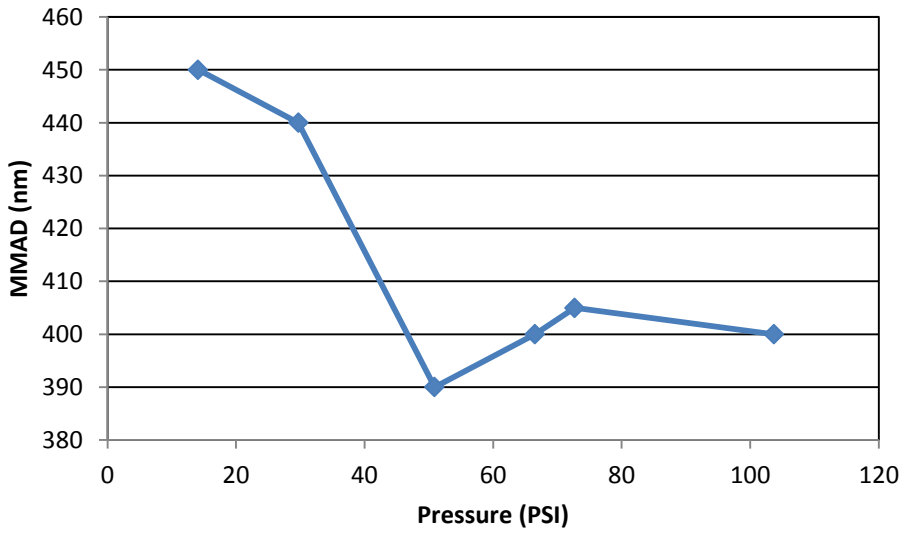


Figure 5.26 Variability of MMAD of Mobil Jet Oil II aerosols with pressure in bleed air simulator

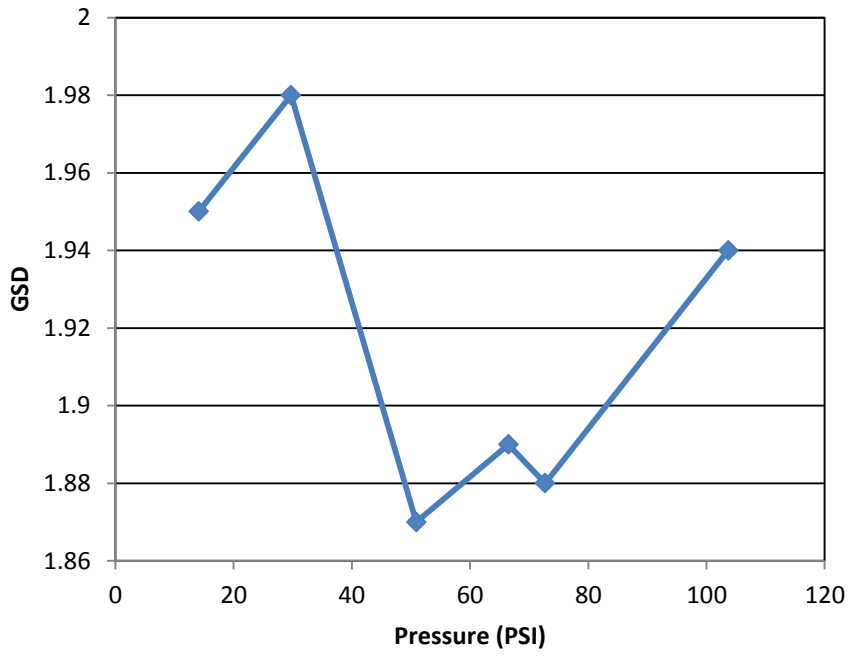


Figure 5.27 Variability of GSD of Mobil Jet Oil II aerosols with pressure in bleed air simulator

Table 5-11 Cumulative mass percentage and aerodynamic diameter for simulated bleed air conditions

Aerodynamic diameter (µm)	Ground operations	Top climb (Take-off)	Cruise	Initial descent from cruise	End of descent	High pressure to low pressure switchover
0.3	57.31507	66.25928	75.65097	48.63234	68.80793	63.27958
0.4	77.32973	88.24782	89.09422	77.75324	87.13803	85.08403
0.5	80.15243	90.81621	91.29320	82.49988	89.91333	88.34000
0.55	87.23620	95.12292	96.08905	92.52893	95.63952	94.92062
0.7	94.99994	98.14636	99.32293	98.90409	99.34610	98.91057
1.0	96.93986	98.89259	99.70623	99.51118	99.75175	99.38110
1.3	98.36680	99.20687	99.87038	99.81695	99.87994	99.56396
1.6	99.26541	99.60764	99.92512	99.94190	99.95643	99.64187
2.0	99.46794	100.00000	99.95725	99.95934	99.96942	99.67237
2.2	99.86329	100.00000	100.00000	99.97678	99.97807	99.79415
3.0	100.00000	100.00000	100.00000	100.00000	100.00000	100.00000

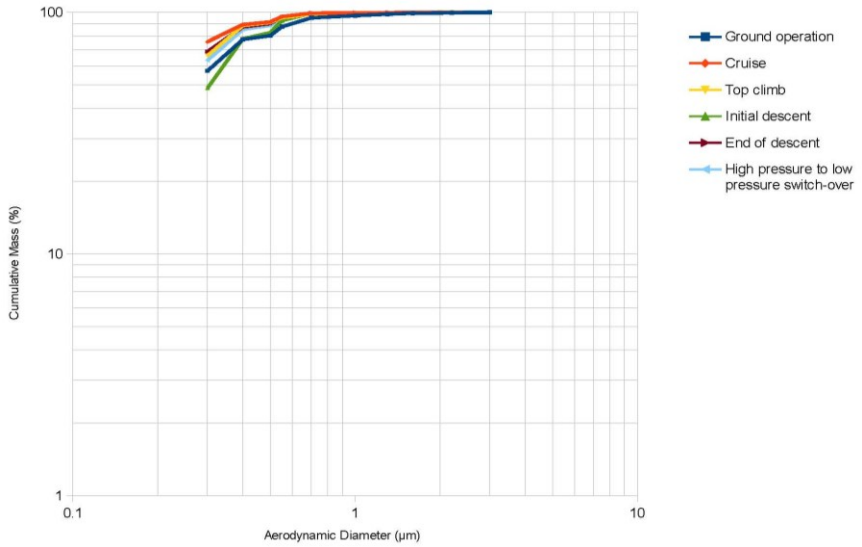


Figure 5.28 Logarithmic scale for cumulative mass percent curves vs aerodynamic diameter for simulated bleed air conditions

5.4.1.4 Carbon monoxide as a marker for pyrolysis of Mobil Jet Oil II

For this study, the electrochemical sensor which was installed to measure CO seemed to have produced noise other than reasonable data (See column showing CO measurements in Appendix E Tables E-1 through E-6).

5.4.1.5 Results of exposure tests

Table 5-12 Exposure tests

Sample ID	Amount detected in exposed filter (ng/cm^2)			m/z 368 peak pattern yes/no	Oil Pattern m/z 57, 85,113 yes/no
	o-tolyl	m-cresyl	p-cresyl		
CT1_20 cold	0.00	<100	<40	Yes, but not quantifiable	NO
CT1_70 cold	0.00	180.00	98.00	Yes, but below quantifiable	NO
CT1_86 cold	0.0	300.00	162.20	YES	YES
CT1-391 cold	N/A	N/A	N/A	-	-
HT1-20 hot	0.00	386.00	238.20	YES	YES
HT1-70 hot	0.00	556.45	291.20	NO	YES
HT1-86 hot	0.00	1318.00	788.00	YES	YES
HT1-391 hot	0.00	3280.28	2176.97	YES	YES

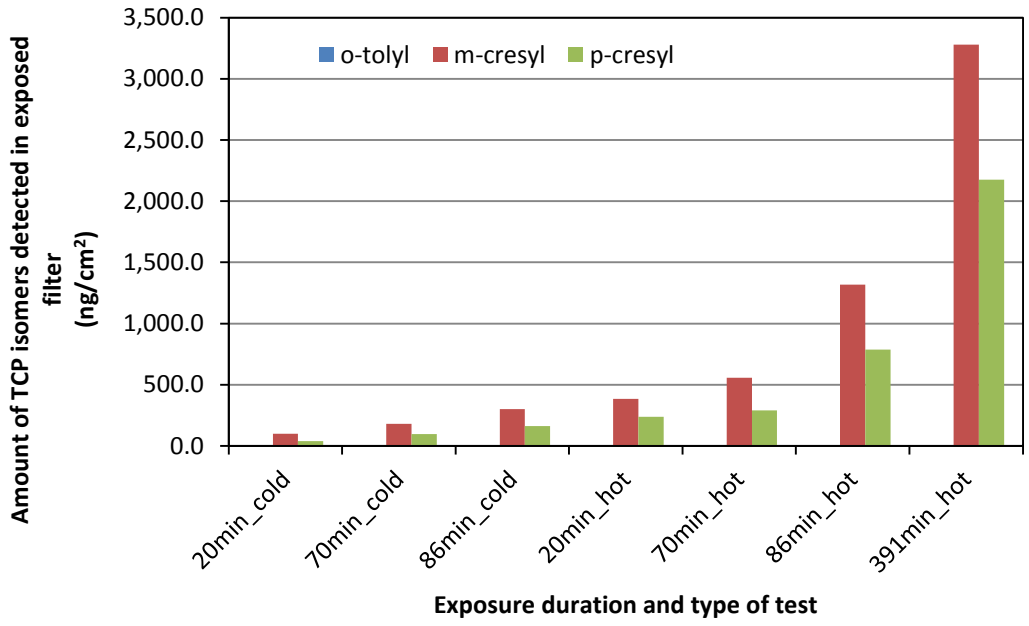


Figure 5.29 Comparative analysis of the effect of temperature on concentrations of TCP isomers on clean filters exposed in BAS at varied durations

From the Figure 5.29 it is evident that more TCPs isomers are detected in filters exposed at higher temperature than those exposed to cold suggesting that increase in temperature plays a role in increasing airborne TCPs in the air.

Table 5-13 Pattern of Mobil Jet Oil II markers on clean filters exposed in BAS

# of nozzles open	Aerosol loading (µg)	Sampling period in minutes	Test conditions	Cumulative Sample mass (µg)	m/z 368 peak pattern yes/no
1. Cold tests					
1.	0.1	20	146.3 PSI, 168.8°C	12.75	NO
2.	1.0	70	154.5 PSI, 97.2°C	148.12	NO
3.	10.0	86	148.2 PSI, 103.5°C	278.22	YES
4.	100.0	600	NA	NA	NA
1. Hot tests					
1.	0.1	20	33.4 PSI, 297.6°C	10.84	YES
2.	1.0	70	20.6 PSI, 301.7°C	89.90	YES
3.	10.0	86	18.1 PSI, 293.8°C	224.31	YES
4.	100.0	391	14.5 PSI, 298.6°C	1973.55	YES

5.4.2 Discussion

Both temperature and pressure plots (Appendix E1: Figures E.3 through E.7) show that BAS conditions were very well simulated and steady state conditions achieved. From the plots, we can conclude that the tests were conducted near steady state conditions. In addition, the results of steady state conditions demonstrate the effectiveness of the BAS. The average repeated measurements over a period of time are the best indicator of how the process varies with time. At present, bleed air emissions in commercial aircrafts are not monitored, in part due to the lack of test methods, rating systems, and real-time sensors. In fact, only limited laboratory performance data exists on bleed air emissions. The study shows that respirable particles from Mobil Jet Oil II that can be measured by the OPC fall between 0.3 to 1.6 μm. The size distribution metrics MMAD and GSD obtained from linear regression analysis of aerosol particulate data had short ranges: (0.39, 0.45) and (1.87, 1.98) μm respectively.

5.4.2.1.1 ***The development of BAS***

BAS was designed to simulate jet engine operating conditions and provide users a way to model smoke/fume incidents using a single standardized platform to conduct, monitor, and report cabin air quality incidents. BAS enables real time counting, sizing aerosol particulates in simulated bleed air. As each of the aerosol particulates within the sample are sized irrespective of the others, the experimental design allows users to produce a full and accurate PSD profile. But the real advantage of the BAS system lies in its ability to repeat the performance consistently no matter what flight conditions are to be simulated. The BAS gives airlines the ability to make sense of incidents by offering the data airlines need. The equipment promises to significantly improve smoke/fume incident monitoring.

The development of BAS marks the first platform for aerosol generation and monitoring of jet engine lubricating oil. It is ideal for a wide range of applications, including monitoring aerosol formation from any potential smoke/fume incident causing substance such as hydraulic and deicing fluids. This implies that the system can be tailored to any specific lubricating engine oil and/or hydraulic fluids used in modern aircraft engines. Therefore, BAS could also help airlines distinguish between unique features of different smoke/fume incidents. The BAS provides a tool to airlines to facilitate change and transform air quality. Adopting BAS can

improve data collection and deliver improved accuracy of air quality inventory, which can lead to improvements in cabin occupants' travelling experiences.

The BAS has been designed with one mission in mind: simulate aerosol particles generated from aircraft bleed air system, allowing scientists to better understand the pyrolysis of jet engine lubricating oil. Faced with smoke/fume incidents, airlines need facts based on scientific information so they can act to monitor aerosol particles emissions from aircraft bleed air system. The BAS will allow airlines to objectively compare monitoring methods for the most accurate prediction of aerosol size distribution. BAS can help airlines and scientists combat smoke/fume incidents. BAS will help researchers and airlines understand how jet engine oil and other potential smoke/fume causing substances affect the aircraft cabin environment. With BAS airlines can achieve the following:

- Feedback information on the chemical fingerprint and other cabin environmental impacts on air passing through the cabin
- Learn cabin air quality design practices and how to improve air quality for environmentally-conscious air travelers and crew
- Identify potential cabin air pollutants and compare physical and chemical properties of airborne particles in the cabin environment.

The development of BAS offers an opportunity for researchers to compare models and discuss hypotheses and interpretations of smoke/fume incidents. The data obtained from this study will enable researchers to understand patterns of aerosol size distributions during different phases of simulated aircraft flights. With real-time monitoring, airline operators could also analyze the data for clues on flight conditions associated with smoke/fume incidents. This could lead to the creation of database that could lay groundwork for developing sensors, which would in turn enable accurate measuring and possible control of these aerosols. Since aerosol particulates produced during incidents could cause illnesses, making a universal tool for monitoring air quality in jet engine's bleed air system is a necessity. Without such a tool, there is no independent verification that safety procedures are properly maintained i.e. no monitoring of bleed air is carried out in aircrafts.

The test facility based on ASHRAE 52.2 combined with LabVIEW software control process solutions and other accessories have resulted in a unique system that enables aircraft bleed air system simulation. The BAS is a useful smoke/fume incident handling platform that

can be expanded as the needs and requirements grow. The BAS offers robust, high-performance real-time aerosol particulate monitoring and addition of equipment that can capture aerosols counts below 0.3 μm range can be incorporated. The primary goal for using BAS is to present an accurate representation of smoke/fume incidents. This will strengthen ANSI/ASHRAE Standard 161–2007 which is the authoritative guideline for uniformity in drawing specifications and interpretation of air quality within commercial aircraft.

5.4.2.1.2 ***Comparisons of aerosol generator to aircraft bleed air system***

In this study smoke/fumes incidents generated from jet engine oil are modeled in BAS as an example to show what influences the production of aerosol particulates. The BAS system provides a practical framework for monitoring simulated bleed air, delivering and supporting air quality service during smoke/fume incidents. The integrated solution includes air sampling system and aerosol counting instruments designed to continuously monitor smoke/fume incident conditions. The wide range of aerosol particulate counts during the experiment reflects different flight conditions. However, it is important to note that the actual bleed air system as installed in the aircraft is a very complex system not comparable to a simplified BAS developed for laboratory use.

5.5 Recommendations

While this study has revealed some important jet engine oil emission characteristics, significant questions remain on the impact these emissions have on aircraft cabin air supply as it originates from real aircraft bleed operating conditions. Unresolved problems which require additional research efforts include relating these findings to real aircraft cabin. Aircraft cabin occupants may be exposed to jet engine oil emissions and other contaminants over a broad range of concentrations, and temperatures which may affect chemical composition. BAS can help determine the optimum sampling period for establishing detection limits of jet engine oil markers on exposed filters. The normal background range of cabin air contaminants identity and levels of chemicals released into cabin air during a contaminated air event should be determined. In particular, fine particulate aerosols with aerodynamic diameter less than 2.5 μm present significant health risks (Dockery, 1994; Forastiere, 2004; Pope, 2000). Thus, characteristics of fine aerosols from jet engine oil less than 0.3 μm should be investigated. It is recommended that

BAS be used to investigate what could be present in various jet engine lubricating oils and hydraulic fluids subjected to very high temperatures, producing potentially harmful gases like CO and aldehydes that can irritate human airways and various compounds that produce unpleasant odors. Further, tests on faulty engines could help identify compounds that might be released into bleed air systems.

5.6 Conclusions

1. A novel real-time monitoring system for airborne particulates formed during cabin air quality events has been implemented in a laboratory set up that simulates aircraft's bleed air systems. A methodology for assessment of aerosol particulates generated during smoke/fume incidents has been presented.
2. An air sampling methodology for monitoring aerosols in simulated aircraft's bleed air has been developed. A detection method for airborne jet engine oil aerosol formed at various simulated jet engine bleed air operating conditions has been presented. The strategy reflects a potential upgrade in response to perceived types of aerosols generated during smoke/fume incidents from Mobil Jet Oil II. Aerosol particulates from pyrolyzed Mobil Jet Oil II have been characterized. The study also presents best practices for effectively monitoring and reporting airborne contaminants in aircraft bleed air system. Further, it provides a technique for ensuring that bleed air contaminants from jet engine oil is accounted for.
3. Comparisons of analyzed data from hot and cold test runs simulating incidents suggest that both temperature and pressure are the main influencing factors in aerosol formation and PSD.
4. A new opportunity for monitoring smoke/fume incidents has been unveiled. BAS is a practical guide for achieving aerosol particulate size measurements and provides detailed information on how to launch a successful cabin air quality monitoring strategy within an airline company. The study details best practices that can help airlines optimize measurements of cabin air contaminants from bleed air supply, particularly in light of regulatory requirements. The building blocks to best practices are defined as well as procedures to ensure system adoption and successful incorporation into laboratory processes. These findings mark the first definitive evidence that varied aerosol particulates from jet oil could exist in aircraft bleed air.

5. The detection of the presence of TCP isomers in exposed filters confirms that these compounds could exist in aircraft bleed air when an incident occurs. The finding can be a useful part of aircraft cabin air safety; an obvious implication could be that cabin occupants are at greater risk of exposure to volatile TCP compounds in jet engine oil during incidents. Using BAS for monitoring airborne aerosols formed in bleed air system will enlarge the competence in this field in terms of understanding aerosol particulate contamination risks and implementing corrective actions.
6. The study provides a framework for future research in aircraft engine bleed air systems. Deploying BAS technology can advance research that could improve aircraft cabin environment conditions for air passengers' comfort. Resulting compliance standards for detection of bleed air contamination in place for the airlines could improve operating and in-cabin environmental performance, protecting the health and safety of passengers and airline crew. BAS experiments could provide data that might be considered for evaluation of health risk assessments of the air contaminants from commercial aircraft bleed air system and could be useful in improving cabin air quality guidelines and, if warranted, regulations on other products like hydraulic and de-icing fluids that might introduce airborne pollutants into aircraft cabin environment.
7. A bleed air simulator is an essential modeling tool that will enable professionals to create and refine their understanding of aerosols in civil aircraft bleed air systems. The study could provide a foundation for further investigative action on sensor development for VOCs emitted from bleed air system during smoke/fume incidents. Monitoring could provide aerosol production details on emerging trends, highlighting where opportunities lie for sensor development.
8. Finally, the study has provided stakeholders in airline industry with information about what goes on during incidents, knowledge that could enable users to develop new air quality parameters. Temperature and pressure, both of which influence smoke/fume incidents, can now be objectively assessed in the laboratory using BAS. The development of BAS is a significant step that could help airlines manage the problem of smoke/fume incidents.

5.7 References

AAIB. Bulletin 6/2009, (2009). G-BYAO EW/C2006/10/108 http://www.aaib.gov.uk/cms_resources.cfm?file=/Bulletin%206-2009.pdf (Cited May 5th, 2010).

ACGIH. (2001). Threshold Limit Values and Biological Exposure Indices (TLVs and BEIs), Cincinnati: American Conference of Governmental Industrial Hygienists. ISBN: 1-882417-40-2, pp. 58.

Air Contamination Monitor, Patent Number 5750999, (1998). https://www51.honeywell.com/technologylibrary/Technology.do?page=print&techId=17

AFL-CIO Report, (2003), Aircraft Air Quality: What is wrong with it and what needs to be done. Association of flight attendants Report submitted to The Aviation Subcommittee of the Transportation & Infrastructure Committee. U.S. House of Representatives, June 4, 2003. http://www.afanet.org/legislative/aircraft_air_quality-_61303.pdf (Cited: May 15, 2010)

Airsense Analytics, (2007). http://www.airsense.com/media///airsense/downloads/airsense-produktdatenblatt-at-engl-14.06.2011.pdf

ASHRAE. 1987 (R1992) ANSI/ASHRAE Standard 41.2-1987. Methods for Laboratory Airflow Measurement, Atlanta, GA: American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.

ASHRAE. (1995). 1995 ASHRAE Handbook—HVAC Applications, Chapter 12, Atlanta, GA: American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.

ASHRAE. (1999). ASHRAE Handbook – HVAC Applications, Chapter 9, Aircraft, American Society of Heating, Refrigerating and Air-Conditioning, Atlanta, GA.

ASHRAE. (1999). ANSI/ASHRAE Standard 52.2-1999. Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size, Atlanta, GA: American Society of Heating, Refrigerating and Air-conditioning Engineers, Inc.

ASHRAE. (2007). ANSI/ASHRAE Standard 161-2007, Air Quality Within Commercial Aircrafts. *2*0pp; Product code: 86493. ISBN: 1041-2336. Atlanta, GA: American Society of Heating, Refrigerating and Air-conditioning Engineers, Inc.

Balouet, J. C., and Winder, C., (1999). Aerotoxic syndrome in air crew as a result of exposure to airborne contaminants in aircraft, American Society of Testing and Materials (ASTM) Symposium on Air Quality and Comfort in Airliner Cabins, New Orleans.

British Airline Pilot Association (BALPA) Report, (2005). http://www.rsc.org/images/balpa_tcm18-99526.pdf (Cited: January 5, 2012).

De Nola, G., Kibby, J., Mazurek, W., (2008). Determination of *ortho*-cresyl phosphate isomers of tri-cresyl phosphate used in aircraft turbine engine oils by gas chromatography and mass spectrometry. Journal of Chromatography A, 1200 (2008) 211 – 216.

Colburn, A. P., (1933). A method for correlating forced convection heat transfer data and a comparison with fluid friction, Transactions of American Institute of Chemical Engineers, Vol. 29, pp. 174-210 ISSN 0096-7408.

Cone, J. E. (2005). Aircraft Cabin Air Quality Trends Relative to Ground Levels Standards, In Hocking, M.B., editor. Air Quality in Airplane Cabins and Similar Enclosed Spaces. Handbook of Environmental Chemistry Vol. 4, Part H (2005): 293–315. DOI 10.1007/b107249. Springler-Verlag Berlin Heidelberg, 2005.

Dittus, F. W. and Boelter, L. M. K., (1930). Heat transfer in automobile radiators of the tubular type. University of California Publication Eng. 2 (13) (1930) 443-461.

Damange, M., Gendre, J. C., Herve-Bazin, B., Carton, B., Peltier, A., (1990). Aerosol evaluation difficulties due to particle deposition on filter holders inner walls. Ann. occup. Hyg., Vol. 34, No. 4, pp. 399 – 403, © 1990 British Occupational Hygiene Society.

Dockery, D. W. and Pope, C. A., (1994). Acute Respiratory Effects of Particulate Air Pollution; Ann. Rev. Public Health 15, 107 – 132.

Finney, D. J., (1947). Probit analysis. Cambridge University Press, London and New York.

Forastiere, F., (2004). Fine Particle and Lung Cancer; Occup., Environ. Med. 2004, 61, 797–798.

Fox, R. B., (2000). Air quality and comfort measurement aboard a commuter aircraft and solutions to improve perceived occupant comfort levels. In: Nagda, N.L., editor. Air quality and comfort in airliner cabins, ASTM STP1393. West Conshohocken, PA: American Society for Testing and Materials.

Haghighat, F., Allard, F., Shimotakahara, R., (1999). Measurement of thermal comfort and indoor air quality aboard 43 flights on commercial airlines. *Indoor Built Environ.* 8(1): 58 – 66.

Hanley, J. T., Smith, D. D., Ensor, D. S., (1995). A Fractional Aerosol Filtration Efficiency of In Duct Ventilation Air Cleaners, Indoor Air. Vol. 4: 169 –178.

Harrison, R., Murawski, J., McNeely, E., Guerriero, J., and Milton, D., (2008). Management of exposure to aircraft bleed-air contaminants among airline workers: a guide for health care providers. The Annual International Aircraft Cabin Safety Symposium, Torrance, CA.

Hewitt, G. F., (1978). Measurement of two phase flow parameters, London: Academic Press.

Hinds, W. C., (1998). Aerosol Technology; properties, behavior and measurements of airborne particles. Ch. 11. 2nd ed., pp. 249. John Wiley and Sons.

Hocking, M. B., (1998). Indoor Air Quality: Recommendations Relevant to Aircraft Passenger Cabins. American Industrial Hygiene Association (AIHA) Journal 59: 446 – 454.

Holley, J. A., (2009). Reducing Smoke and Burning Odor (SBO) Events, Aeromagazine. http://www.boeing.com/commercial/aeromagazine/articles/qtr_01_09/pdfs/AERO_Q109.pdf

Incropera, F. P. and DeWitt, D. P., (2002). Fundamentals of Heat and Mass Transfer 5th ed., John Wiley and Sons New York 2002. ISBN 0-471-38650-2.

Ito, K., Kobashi, S., Tokuda, M., (1991). Mixing characteristics of a submerged jet measured using an isokinetic sampling probe. Metallurgical Trans. B. 22B: 439 – 445.

Kays, W. M. and Crawford, M. E., (2004). Convective heat transfer and mass transfer. 4th ed. McGraw-Hill Book Company New York 2004. ISBN 0-07-033 457-9.

Kibby, J., Denola, G., Hanhela, P. J., Mazurek, W., (2005). Defence Science and Technology Organisation, Department of Defence. DSTO-RR-0292. Melbourne, 2005.

Kodilkar, M., (2004). Development and Verification of a Unique HEPA Filter Test Facility. M.S. Thesis 2004.

Koehl, A., Wilks, A., Hart, J., (2007). Advanced Sensor System to Identify and Quantify Contaminants in Cockpit. USAF SBIR AF06-023. Contract Number FA8650-06-M6677

Lee, S. C., Poon, C. S., Li, X. D., Luk, F., (1999). Indoor Air quality Investigation on Commercial Aircraft. *Indoor Air* 1999; 9 (3): 180–187. Copyright © Munksgaard 1999. ISSN 0905-6947.

Lindgren, T., and Norback, D., (2002). Cabin air quality: indoor pollutants and climate during intercontinental flight with and without tobacco smoking. *Indoor Air* 2002: 12: 263–272.

Lippmann, M. (1995). Filters and Filter Holders. In: Cohen, B. S., and Hering, S. V., (eds.), Air Sampling and Instruments for Evaluation of Atmospheric Contaminants. 247–279. ACGIH. Cincinnati, Ohio.

Liu, B, Y. H., Pui, D. Y. H., Rubow, K. L., (1983). Characteristics of air sampling filter media. In: Marple, V. A. and Liu, B. Y. H. (eds.). Aerosol in mining and industrial work environments, Vol. 3. Ann Arbor Science, pp. 989 – 1038.

Pierce, W. M., Janczewski, J. N., Roethlisberger, B., Janczewski, M. G., (1999). Air quality on Commercial Aircraft. ASHRAE Journal, 14, (9) 26 – 34.

Magee Scientific, (2009). Operating Manual micro-AETHALOMETER®. http://mageesci.com/support/downloads/micro/microAeth_AE51_Operations_Manual_Jun-09.pdf

Mars, T. C. and Ballantyne, (eds.), (1994). Clinical and Experimental Toxicology of Organophosphates and Carbamates. pp. 394. Butterworth/Heinemann, 1994.

Material Safety Data Sheet (MSDS) for Tricresyl Phosphate. Issued: 05/18/2008. http://mobiljet2.com/msds.pdf

National Research Council (NRC). (2002). The Airliner Cabin Environment and the Health of Passengers and Crew Committee on Air Quality in Passenger Cabins of Commercial Aircraft. Washington DC: National Academy Press.

OSHA. (1992). Code of Federal Regulations 29, Part 1910, July 1, 1992. Washington, DC: Occupational Safety and Health Administration, U.S. Department of Labor.

Pope, C. A., (2000). Epidemiology of Fine Particulate Air Pollution and Human Health: Biological Mechanism and Who's at Risk; Environ. Health Perspect. 2000, 108, 6493 – 6502.

Ross, S. M., Harper, A. C., Burdon, J., (2006). Ill health following reported exposure to contaminated air on commercial aircraft: psychosomatic disorder or neurological injury? Journal of Occupational Health & Safety: Australia & New Zealand 22 (6): 521–528

Ross, S. M., (2008). Cognitive function following exposure to contaminated air on commercial aircraft: A case series of 27 airline pilots seen for clinical purposes Journal of Nutritional & Environmental Medicine, 17 (2): 111 – 126.

Select Committee on Science and Technology (2000). Science and Technology - Fifth Report House of Lords. http://www.publications.parliament.uk/pa/ld199900/ldselect/ldsctech/121/12107.htm. (Cited: 01/07/2012).

Schwartz, J., Dockery, D. W., Neas, L. M., (1996), Is daily mortality associated specifically with fine particles? J. Air Waste Manag. Assoc. 46: 927– 939.

Somkuti, S. G., Tilson, H. A., Brown, H. R., Campbell, G. A., Lapadula, D. M., Abou-Donia, M. B. (1988). Lack of Delayed Neurotoxic Effect after Tri-o-cresyl Phosphate Treatment in Male Fischer 344 Rats: Biochemical, Neurobehavioral and neuropathological Studies. Toxicological Sciences, 10 (2) 199 – 205.

Streicher, R. P., (1994). NIOSH/DPPSE. NIOSH Manual of Analytical Methods (NMAM) 4th (ed.) 1994.

Strøm-Tejsen, P., Żukowska, D., Fang, L., Space, D. R., Wyon, D. P., (2006). Effects of Gas-Phase Adsorption air purification on passengers and cabin crew in simulated 11-hour flights Transports: Proceedings of Healthy Buildings, 2006.

van Netten, C. and Leung, V., (2000). Comparison of the constituents of two jet engine lubricating oils and their volatile pyrolytic degradation products. Appl. Occup. Environ. Hyg. 15 (3) pp. 277 – 283.

van Netten, C. (2000). Analysis of two jet engine lubricating oil and a hydraulic fluid: their pyrolytic breakdown products and their implication on aircraft air quality. In: Nagda, N.L., (ed.) Air Quality and Comfort: In Airliner Cabins. pp. 61-75 ASTM STP 1393, American Society for Testing and Materials, West Conshohocken, PA.

van Netten, C. and Leung, V. (2001). Hydraulic fluids and jet engine oil: Pyrolysis and aircraft air quality. Arch. Environ. Health. 56 (2) 181 – 186.

van Netten, C. (2009). Design of a small personal air monitor and its application in aircraft. Science of the total environment 407 (2009) 1206 – 1210.

Winder, C. and Balouet, J. C., (2005). Aircrew exposure to chemicals in aircraft: symptoms of irritation and toxicity. J. Occup. Health Safety Aust. NZ. 17:471– 483.

Winder, C. and Balouet, J. C., (2002). The toxicity of commercial jet oils. Environ. Res. 89:146 – 164.

Yang, X., Zitova, A., Kirsch, J., Fergus, J. W., Overfelt, R. A. and Simonian, A. L., (2011). Portable and remote electrochemical sensing system for detection of tri-cresyl phosphate in gas phase. Sensors and Actuators B: (2011). Doi: 10 1016/j.snb.2011.10.076

Zieger, P., Fierz-Schmidhauser, R., Gysel1, M., Strom, J., Henne, S., Yttri, K. E., Baltensperger, U., and Weingartner, E., (2010). Effects of relative humidity on aerosol light scattering in the Arctic. J. Atmospheric Chemistry and Physics (ACP). 10: 3659 – 3698.

CHAPTER 6 - CONCLUSIONS AND FUTURE WORK

6.1 Conclusions and contributions of the study

The airline industry is struggling to cope with smoke/fume incidents. In this study technologies that could help airline industry collect data by analyzing used aircraft filters are described. This research has developed both direct and indirect test methods and procedures that could be used to investigate jet engine oil markers on used aircraft cabin air filters. The direct method uses GC/MS whereas the indirect methods employ FESEM/EDS and NAA techniques. All three methods offer different frameworks for investigating and identifying jet engine oil contaminants on the filters. The GC/MS analysis has established that jet engine lubricating oils play a role in the contamination of aircraft cabin air recirculation filters. The method can be used to analyze TCP isomers in used cabin air recirculation filters. However, both FESEM/EDS and NAA techniques allow look at used aircraft cabin air filters and provide new information on elemental deposition on used filters, providing information about past cabin air quality. The three analytical methods for used filters provided by this study are research tools that can be used to establish the past history of aircraft cabin air quality.

Using GC/MS analytical technique, this study has established a link between filter deposition in used aircraft filters and TCP isomers in the Mobil Jet Oil II that was used as representative jet engine oil. Both FESEM/EDS and NAA analyses revealed a wide range of traces of metallic elements present in used and incident filters. These results suggest that airborne particulates in aircraft cabin air contain traces of rare earth elements from outside air, and from processes occurring either in the jet engine or inside the cabin. In fact, the findings suggest that aircraft's ECS involves far more than scientists might expect. The filter analysis techniques vary widely in their ability to detect filter deposits. The NAA technique has delivered new useful data for understanding of cabin air supply. Moreover, both NAA and FESEM/EDS methods in different ways, will build on current expertise in detecting smoke/fume incidents. Both methods underscore the importance of understanding the indirect jet oil footprints on used aircraft filters.

While scientists have long known that jet engine oils have been one potential source of airborne toxic organophosphate compounds to cabin air supply in aircrafts, this research has provided new details on monitoring those pollutants in used cabin air filters. Integrating a

number of technological tools to manage pyrolysis of jet engine lubricating oil has led to the development of BAS, making possible monitoring smoke/fume incidents in a laboratory set up. The BAS development allows bleed air to be simulated and assessed. Aerosol particulates from pyrolysis of Mobil Jet Oil II have been characterized. Detection of the presence of TCP isomers on clean filters exposed to laboratory simulated incidents confirms that BAS works and confirms the fact TCP compounds could exist in aircraft bleed air after an incident. Such findings could be used to define aircraft cabin air safety standards and the risks of exposure to these compounds. The research has provided the fundamentals of a mechanism for detecting aircraft bleed air pollutants, key performance parameters, and some type of data sets that could be obtainable from real jet engine bleed air processes. In fact, the BAS platform can be used to examine any potential substance that can cause smoke/fume incidents to provide airborne particulate information for any substance. Thus, the application of BAS can simulate and sample airborne aerosols, while GC/MS can define aircraft cabin air quality incidents through analysis of exposed filters. The development of BAS is the result of advancing awareness of smoke/fume incidents, and its implementation shows how efforts to manage aircraft cabin air quality are shifting to research laboratories. The BAS protocol could be used to launch new aircraft cabin air quality standards designed to empower airlines to better measure, manage, and report aircraft engine bleed air emissions. The research could transform aircraft cabin air quality solutions, building a scientific case for monitoring incidents, and evaluating risks, and enhancing safety in the aircraft cabin.

The analyses of exposure tests (air sampling of simulated smoke/fume incidents) conducted in BAS using the same analytical methods have also established a firm link between filter deposits on clean filters with jet engine oil. The combined procedures of sampling and analyses of aircraft cabin air filters could significantly improve the process of investigating aircraft cabin air quality. The civil aviation industry could use this new scientific method of filter analysis to monitor cabin air quality incidents. With new methods of filter analysis, valuable cumulative information about air quality can be extracted from used filters. Finally, the study provides a scientific basis for future cabin air quality standards research because the information drawn from experiments in BAS could help in drawing guidelines to establish regulatory standards for TCP emissions from incident-occurrences caused by pyrolysis of jet engine oil during smoke/fume incidents.

6.1.1 Significance and impact of the study

This research has introduced the concept of analyzing used cabin air filters to help satisfy aircraft cabin air quality reporting guidelines. A lot of information can be obtained from analyzing used aircraft cabin by using FESEM/EDS, GC/MS and NAA. The study has shown that cabin filters which are the very heart of the aircraft cabin air filtration undergo a lot of changes while the aircraft is on flight and can provide data critical to understanding cabin air quality. Detecting jet engine oil contaminants in used filters provides a means of identifying bleed air contamination and, more importantly should be of interest to stakeholders in the airline industry. Both cabin air filter analysis and bleed air monitoring are important in improving aircraft cabin air quality.

Because BAS can measure aerosol particle size distribution and sample air it will be a part of a broad scientific effort to improve cabin air quality. Filter analyses support using BAS in detecting airborne pollutants deposited on cabin recirculation filters. Therefore, BAS could help airline operators to understand how to eliminate air quality incidents. Long-term monitoring could lay the groundwork for future research into smoke/fume incidents and facilitate improving safety parameters for aircrafts during incidents. Implementing of BAS will enable airlines to actually see what happens to air quality during incidents through routine analysis of exposed filters. For the airlines, this means mitigating costs and risk while increasing business value. The information derived from the BAS experiments could also help establish detection limits for potential smoke/fume causing substances as well as standards of VOCs emitted during incidents. Finally, the study finding increases options for effective detection of smoke/fume incidents. Given its high simulation performance capabilities, including achievement of steady state conditions at the reactor during its operation, current and future demand for smoke/fume incident simulation in a laboratory set up will provide continued opportunity for expanded use of this critical equipment. The study has identified principal techniques which could support the efficient use of aircraft cabin air supply.

The result of this research has been significant, from essentially operating aircraft bleed air system in the dark, relying on incomplete information, to seeing all facets of smoke/fume incident process. BAS can monitor airborne pollutant emissions that can make air passengers and crew sick and simulates varied conditions of bleed air conditions. In the process, this study has developed methods for analyzing cabin air recirculation filters, which increases the likelihood of

developing air quality standards for aircraft cabins. And overall the study has revealed significant insights into smoke/fume incidents.

To effectively implement regulations requires air quality benchmarks for aircraft bleed air systems to significantly decrease perceived negative impacts from air pollution in aircraft cabins. Increased social corporate responsibility and the push to create a more efficient and less risky cabin environment will allow airlines to show themselves as good stewards and responsible companies, managing not only the contaminants in the cabin air but addressing possible health problems of air passengers and cabin crew. The research findings of this study underscore the importance of understanding cabin air quality incidents as the results confirm that airborne emissions from smoke/fume events disperse into cabin air and migrate to deposit on cabin air recirculation filters. BAS capabilities fit on the continuum of aircraft cabin occupants' health protection and its availability offer best practices involving various technologies including aerosol sampling of particulates and gaseous byproducts from pyrolysis of jet engine oil. The new approach to monitoring aircraft engine bleed air aims to make use of technology to deliver best air quality to the aircraft cabin. It requires certain key technologies, but more broadly it focuses on developing procedures for application of the new analytical techniques for analysis of cabin air recirculation filters.

6.1.2 Limitations of the study

Although simulation of aircraft engine bleed air conditions is possible with BAS, the bleed air arrangement is complex its function in the engine bleed air system cannot be fully simulated by laboratory set up of BAS with an aerosol generator and the reactor. The duct system is a duplicate of the aircraft cabin ECS arrangement. In the BAS the simplified tube reactor is heated from the outside, not recirculating and lubricating the jet engine parts. The study cannot discern how jet engine oil contaminants could affect aircraft cabin air quality. The filter analysis was specific to TCPs in jet engine lubricating oil. However, hydraulic fluids and plasticizers can also cause emissions of organophosphate compounds in aircraft cabin environment. Thus, although the changes in elemental quantities in used filters were used as a basis of screening test for filter contamination, the altered elemental levels may have come from other sources than jet engine oil.

6.2 Recommendations and future work

It is difficult to deliver an appropriate solution with a single study like this one targeting only one type of jet engine oil. Much more research with many more filters, particularly incident filters, and very robust data would validate the findings. Identified markers for filter contamination might come not only from jet engine oil alone but also from other bleed air contaminants, so further monitoring studies should include hydraulic fluids and de-icing fluids. Air quality monitoring of different compounds, varied conditions, and vastly differing aerosol sizes and counts makes the challenge become even more daunting. Further studies should aim at investigating the binding patterns of a group of elements found in used filters. Understanding how the elements exist and bind together on filters could lead to improving the knowledge on how they exist in the cabin air. Additional research should be conducted to determine whether the threshold index or parameters for the elements identified as jet engine oil markers on incident and dirty filters would shift for an incident filter from a smoke/fume incident involving both jet engine oil and hydraulic fluid or de-icing fluids. Unless and until all emissions from smoke/fume incidents are fully disclosed, bleed air emissions will continue to be a daunting task in aircraft cabin air supply.

Because most aircraft cabins are constructed of many materials including plastics, the aircraft cabin environment could also be a source of VOCs. For that reason, further studies would be necessary to identify how these plastics contribute to elements detected by FESEM/EDS. Further studies should also focus on linking airborne pollutant deposits on aircraft filters to specific types of aircraft engines. Additional studies on used filters are recommended to investigate in-cabin pollution levels of different aircraft models and possibly the effect of the routes or regional airspace if aircraft flights remain in a particular region. The decision to monitor bleed air in a specific aircraft model should be based on the perceived risk associated with that aircraft and its engineering and architectural design, as well as the cost involved. Because jet engine oil contaminants found on the surface of used aircraft cabin filters correlate to different commercial aircraft model series or engine types, further studies may offer insight as to whether an engine type or aircraft model is associated with cabin air quality incidents. However, even with the limitations noted here, airlines should begin to use the technologies provided in this study to move toward a better understanding of air quality in aircraft cabins. This need is

reinforced by new threats like the eruption of Iceland's Eyjafjallajökull volcano in April 2010 that caused significant disruption to global aviation industry.

Appendix A - FESEM/EDS: Raw Data on Distribution of Atomic Weight Percentage of Elements in Aircraft Cabin Air Recirculation Filters

Table A-1 FESEM/EDS Data for Used Filters

Filter_ID	Sample	Spot	C	O	Na	Mg	Al	Si	P	S	Cl	K	Ca	Ti	Cr	Fe	Ni	Zn	As	Br	Ba	Ce	Total
1F3555	1	1	44.72	43.03	2.22	0.19	0.63	6.42	0.04	0.28	0.25	0.46	0.85	0.00	0.00	0.06	0.00	0.33	0.00	0.30	0.21	0.00	99.99
1F3555	1	2	40.68	45.05	2.46	0.00	0.58	8.04	0.03	0.32	0.26	0.62	0.75	0.00	0.00	0.07	0.00	0.45	0.00	0.38	0.30	0.00	99.99
1F3555	1	3	38.61	44.85	2.38	0.27	1.11	8.98	0.05	0.40	0.33	0.67	1.19	0.00	0.00	0.05	0.00	0.50	0.00	0.28	0.34	0.00	100.01
1F3555	2	1	25.69	52.57	3.04	0.39	1.47	11.09	0.06	0.55	0.58	0.57	2.70	0.00	0.00	0.11	0.00	0.39	0.00	0.44	0.33	0.00	99.98
1F3555	2	2	37.09	44.73	2.28	0.43	1.67	9.00	0.05	0.46	0.42	0.41	2.62	0.00	0.00	0.08	0.00	0.36	0.00	0.19	0.21	0.00	100.00
1F3555	2	3	18.19	56.73	3.76	0.48	1.97	12.82	0.07	0.56	0.41	0.65	2.81	0.00	0.00	0.13	0.00	0.60	0.00	0.43	0.39	0.00	100.00
1S78FS	1	1	39.29	44.05	2.73	0.00	0.68	9.70	0.04	0.52	0.15	0.77	0.53	0.00	0.00	0.06	0.00	0.68	0.00	0.39	0.42	0.00	100.01
1S78FS	1	2	38.51	45.76	2.57	0.00	0.56	9.06	0.07	0.53	0.09	0.75	0.58	0.00	0.00	0.08	0.00	0.56	0.00	0.50	0.37	0.00	99.99
1S78FS	1	3	39.86	45.73	2.53	0.00	0.57	8.41	0.05	0.33	0.13	0.63	0.50	0.00	0.00	0.06	0.00	0.48	0.00	0.40	0.32	0.00	100.00
1S78FS	2	1	50.80	38.64	1.63	0.00	0.50	5.77	0.07	0.35	0.20	0.52	0.53	0.00	0.00	0.08	0.00	0.37	0.00	0.31	0.22	0.00	99.99
1S78FS	2	2	47.24	40.33	2.10	0.00	0.43	7.01	0.05	0.30	0.24	0.62	0.51	0.00	0.00	0.06	0.00	0.45	0.00	0.39	0.28	0.00	100.01
1S78FS	2	3	57.62	33.52	1.11	0.00	0.33	4.79	0.07	0.34	0.24	0.52	0.51	0.00	0.00	0.08	0.00	0.37	0.00	0.28	0.23	0.00	100.01
2D968E	1	1	13.85	61.02	4.54	0.00	1.17	14.95	0.03	0.43	0.00	1.08	1.02	0.00	0.00	0.06	0.00	0.77	0.00	0.52	0.57	0.00	100.01
2D968E	1	2	23.64	56.17	3.66	0.00	0.96	11.89	0.03	0.29	0.09	0.82	0.87	0.00	0.00	0.05	0.00	0.64	0.00	0.44	0.46	0.00	100.01
2D968E	1	3	12.36	63.09	3.76	0.00	1.28	14.61	0.06	0.29	0.00	0.95	1.70	0.00	0.00	0.03	0.00	0.67	0.00	0.70	0.49	0.00	99.99
2D968E	2	1	32.95	50.23	2.64	0.00	1.07	9.67	0.03	0.27	0.08	0.65	1.17	0.00	0.00	0.05	0.00	0.49	0.00	0.34	0.35	0.00	99.99
2D968E	2	2	11.53	61.85	3.89	0.00	1.41	15.35	0.09	0.44	0.11	1.06	2.02	0.00	0.00	0.08	0.00	0.88	0.00	0.76	0.54	0.00	100.01
2D968E	2	3	21.52	55.60	3.67	0.00	0.99	13.55	0.06	0.39	0.00	1.03	1.20	0.00	0.00	0.07	0.00	0.84	0.00	0.58	0.51	0.00	100.01
3C297F	1	1	29.03	47.56	3.20	0.00	0.69	13.43	0.06	0.44	0.34	1.21	1.37	0.00	0.00	0.11	0.00	1.16	0.00	0.74	0.67	0.00	100.01
3C297F	1	2	21.98	55.29	3.85	0.00	1.00	13.15	0.03	0.39	0.28	0.96	1.17	0.00	0.00	0.06	0.00	0.80	0.00	0.56	0.50	0.00	100.02
3C297F	1	3	35.72	47.32	2.83	0.00	0.94	9.41	0.03	0.39	0.24	0.64	1.14	0.00	0.00	0.09	0.00	0.56	0.00	0.34	0.34	0.00	99.99
3C297F	2	1	16.16	58.55	3.86	0.42	1.90	13.35	0.06	0.48	0.32	0.77	2.50	0.00	0.00	0.10	0.00	0.74	0.00	0.32	0.47	0.00	100.00
3C297F	2	2	4.10	65.54	3.63	0.65	2.41	16.03	0.00	0.63	0.47	0.77	4.07	0.00	0.00	0.12	0.00	0.63	0.00	0.54	0.41	0.00	100.00
3C297F	2	3	13.04	61.07	3.18	0.55	1.97	13.93	0.05	0.43	0.34	0.67	3.23	0.00	0.00	0.06	0.00	0.59	0.00	0.53	0.36	0.00	100.00
4S190C	1	1	51.72	37.29	1.63	0.19	0.72	5.41	0.06	0.55	0.22	0.53	0.86	0.00	0.00	0.12	0.00	0.34	0.00	0.17	0.21	0.00	100.02
4S190C	1	2	43.40	42.82	2.10	0.00	0.58	7.46	0.03	0.52	0.19	0.64	0.95	0.00	0.00	0.12	0.00	0.49	0.00	0.42	0.28	0.00	100.00
4S190C	1	3	45.85	41.20	1.98	0.00	0.53	7.07	0.03	0.49	0.19	0.60	0.83	0.00	0.00	0.11	0.00	0.44	0.00	0.38	0.30	0.00	100.00
4S190C	2	1	46.17	41.26	2.21	0.00	0.30	7.01	0.03	0.54	0.12	0.57	0.47	0.00	0.00	0.09	0.00	0.47	0.00	0.46	0.29	0.00	99.99
4S190C	2	2	46.83	40.53	2.27	0.00	0.21	7.14	0.04	0.51	0.10	0.59	0.44	0.00	0.00	0.06	0.00	0.50	0.00	0.49	0.28	0.00	99.99
4S190C	2	3	48.22	40.39	1.93	0.00	0.45	6.49	0.02	0.37	0.12	0.48	0.53	0.00	0.00	0.06	0.00	0.36	0.00	0.34	0.23	0.00	99.99
5H2F01	1	1	48.26	36.22	1.81	0.21	0.62	7.94	0.08	0.61	0.63	0.77	1.32	0.00	0.00	0.12	0.00	0.54	0.00	0.51	0.36	0.00	100.00
5H2F01	1	2	44.69	42.77	1.91	0.20	0.78	6.31	0.07	0.47	0.35	0.59	0.89	0.00	0.00	0.10	0.00	0.38	0.00	0.25	0.25	0.00	100.01
5H2F01	1	3	48.55	38.61	1.56	0.38	1.00	5.98	0.08	0.55	0.44	0.51	1.30	0.00	0.00	0.15	0.08	0.36	0.00	0.22	0.24	0.00	100.01
5H2F01	2	1	31.19	50.97	3.19	0.25	1.29	9.66	0.04	0.38	0.16	0.71	1.02	0.00	0.00	0.10	0.00	0.56	0.00	0.14	0.35	0.00	100.01
5H2F01	2	2	30.94	50.30	2.89	0.33	1.01	10.25	0.03	0.47	0.18	0.75	1.37	0.00	0.00	0.06	0.00	0.55	0.00	0.50	0.36	0.00	99.99
5H2F01	2	3	33.28	49.22	2.52	0.37	1.12	9.48	0.05	0.40	0.23	0.61	1.39	0.00	0.00	0.08	0.00	0.46	0.00	0.48	0.31	0.00	100.00
7WQF45	1	1	45.13	42.54	2.21	0.00	0.61	6.40	0.03	0.58	0.20	0.42	0.89	0.00	0.00	0.08	0.08	0.27	0.00	0.34	0.21	0.00	99.99
7WQF45	1	2	52.04	37.37	2.07	0.00	0.44	5.29	0.04	0.62	0.22	0.39	0.60	0.00	0.00	0.09	0.07	0.26	0.00	0.30	0.20	0.00	100.00
7WQF45	1	3	51.00	38.78	1.88	0.16	0.69	5.22	0.00	0.40	0.19	0.32	0.75	0.00	0.00	0.05	0.05	0.21	0.00	0.13	0.17	0.00	100.00
7WQF45	2	1	35.45	47.34	3.79	0.00	0.81	9.23	0.03	0.66	0.15	0.63	0.71	0.00	0.00	0.04	0.00	0.48	0.00	0.33	0.33	0.00	99.98
7WQF45	2	2	47.95	40.24	2.53	0.00	0.55	6.20	0.04	0.50	0.15	0.42	0.57	0.00	0.00	0.04	0.04	0.27	0.00	0.26	0.24	0.00	100.00
7WQF45	2	3	42.58	43.44	3.07	0.00	0.36	7.39	0.04	0.56	0.17	0.44	0.68	0.00	0.00	0.04	0.04	0.38	0.00	0.52	0.27	0.00	99.98

7ZMK52	1	1	51.79	36.87	1.50	0.16	0.81	5.81	0.04	0.50	0.13	0.53	0.94	0.00	0.00	0.15	0.00	0.34	0.00	0.21	0.23	0.00	100.01
7ZMK52	1	2	52.48	36.80	1.22	0.16	1.04	5.32	0.05	0.52	0.14	0.48	1.12	0.00	0.00	0.12	0.00	0.32	0.00	0.04	0.19	0.00	100.00
7ZMK52	1	3	43.35	42.94	2.05	0.20	0.92	7.11	0.06	0.57	0.13	0.56	1.10	0.00	0.00	0.14	0.00	0.39	0.00	0.24	0.25	0.00	100.01
7ZMK52	2	1	51.49	38.02	1.60	0.15	0.73	5.64	0.03	0.41	0.09	0.46	0.65	0.00	0.00	0.08	0.00	0.32	0.00	0.11	0.22	0.00	100.00
7ZMK52	2	2	47.36	39.51	2.04	0.16	0.81	7.01	0.06	0.55	0.13	0.61	0.69	0.00	0.00	0.13	0.00	0.46	0.00	0.21	0.27	0.00	100.00
7ZMK52	2	3	45.46	41.37	2.06	0.15	0.73	7.05	0.06	0.53	0.13	0.55	0.90	0.00	0.00	0.09	0.00	0.38	0.00	0.27	0.27	0.00	100.00
8P6G4X	1	1	25.78	53.94	3.21	0.00	0.79	11.78	0.02	0.29	0.19	0.80	1.08	0.00	0.00	0.09	0.00	0.80	0.00	0.78	0.45	0.00	100.00
8P6G4X	1	2	33.63	49.61	2.88	0.00	0.56	9.65	0.07	0.28	0.21	0.76	0.76	0.00	0.00	0.06	0.00	0.61	0.00	0.54	0.39	0.00	100.01
8P6G4X	1	3	43.49	43.53	2.08	0.00	0.67	7.46	0.02	0.24	0.17	0.56	0.77	0.00	0.00	0.04	0.00	0.36	0.00	0.33	0.30	0.00	100.02
8P6G4X	2	1	17.92	58.41	4.46	0.00	0.95	13.71	0.03	0.36	0.24	1.02	0.89	0.00	0.00	0.08	0.00	0.78	0.00	0.63	0.52	0.00	100.00
8P6G4X	2	2	20.87	59.08	4.08	0.00	0.97	11.82	0.01	0.23	0.15	0.81	0.91	0.00	0.00	0.06	0.00	0.63	0.00	0.01	0.39	0.00	100.02
8P6G4X	2	3	19.45	57.22	3.75	0.00	1.73	13.64	0.01	0.00	0.00	0.98	1.57	0.00	0.00	0.03	0.00	0.99	0.00	0.10	0.54	0.00	100.01
9E003T	1	1	32.46	49.93	3.42	0.00	0.72	9.40	0.03	0.38	0.51	0.58	1.19	0.00	0.00	0.08	0.00	0.44	0.00	0.53	0.32	0.00	99.99
9E003T	1	2	33.44	49.18	3.40	0.00	0.71	9.00	0.05	0.45	0.67	0.58	1.13	0.00	0.00	0.05	0.00	0.51	0.00	0.49	0.33	0.00	99.99
9E003T	1	3	33.36	49.92	3.11	0.00	0.75	9.22	0.04	0.28	0.30	0.59	1.10	0.00	0.00	0.03	0.00	0.52	0.00	0.46	0.33	0.00	100.01
9E003T	2	1	19.59	56.90	3.77	0.28	1.60	12.62	0.04	0.50	0.36	0.76	2.06	0.00	0.00	0.10	0.00	0.65	0.00	0.32	0.47	0.00	100.02
9E003T	2	2	38.89	45.83	2.69	0.26	1.04	7.75	0.05	0.38	0.31	0.47	1.37	0.00	0.00	0.08	0.00	0.32	0.00	0.32	0.24	0.00	100.00
9E003T	2	3	19.59	56.90	3.77	0.28	1.60	12.62	0.04	0.50	0.36	0.76	2.06	0.00	0.00	0.10	0.00	0.65	0.00	0.32	0.47	0.00	100.02
9RZMC2	1	1	47.97	39.62	2.00	0.00	0.35	6.85	0.03	0.53	0.08	0.55	0.76	0.00	0.00	0.12	0.00	0.41	0.00	0.47	0.27	0.00	100.01
9RZMC2	1	2	48.59	39.64	2.06	0.00	0.40	6.59	0.04	0.48	0.12	0.54	0.49	0.00	0.00	0.07	0.00	0.39	0.00	0.34	0.26	0.00	100.01
9RZMC2	1	3	44.86	40.67	2.34	0.00	0.62	7.99	0.03	0.55	0.14	0.68	0.73	0.00	0.00	0.08	0.00	0.60	0.00	0.35	0.35	0.00	99.99
9RZMC2	2	1	41.42	43.50	2.48	0.20	0.92	8.12	0.03	0.59	0.14	0.65	0.81	0.00	0.00	0.11	0.00	0.49	0.00	0.25	0.29	0.00	100.00
9RZMC2	2	2	47.83	40.21	2.13	0.00	0.58	6.57	0.03	0.47	0.11	0.50	0.61	0.00	0.00	0.07	0.00	0.36	0.00	0.28	0.25	0.00	100.00
9RZMC2	2	3	50.68	38.79	1.92	0.00	0.29	5.75	0.04	0.47	0.11	0.46	0.47	0.00	0.00	0.06	0.00	0.36	0.00	0.39	0.22	0.00	100.01
43RTYZ	1	1	46.00	41.21	2.39	0.00	0.41	6.70	0.02	0.69	0.11	0.50	0.76	0.00	0.00	0.07	0.11	0.32	0.00	0.48	0.22	0.00	99.99
43RTYZ	1	2	47.47	40.43	2.24	0.00	0.39	6.25	0.05	0.67	0.14	0.55	0.58	0.00	0.00	0.10	0.11	0.37	0.00	0.41	0.24	0.00	100.00
43RTYZ	1	3	52.60	36.19	1.87	0.14	0.74	5.28	0.04	0.81	0.16	0.43	0.86	0.00	0.00	0.11	0.11	0.30	0.00	0.18	0.19	0.00	100.01
43RTYZ	2	1	48.19	39.82	2.01	0.18	0.55	6.13	0.03	0.49	0.19	0.45	0.92	0.00	0.00	0.08	0.11	0.32	0.00	0.34	0.20	0.00	100.01
43RTYZ	2	2	49.00	39.22	2.06	0.19	0.74	5.90	0.02	0.46	0.13	0.43	0.92	0.00	0.00	0.06	0.13	0.30	0.00	0.25	0.19	0.00	100.00
43RTYZ	2	3	50.94	38.60	1.66	0.18	0.62	5.44	0.03	0.41	0.14	0.36	0.87	0.00	0.00	0.06	0.06	0.22	0.00	0.25	0.16	0.00	100.00
73J43M	1	1	39.81	47.13	1.87	0.40	1.09	6.59	0.05	0.31	0.38	0.42	1.16	0.00	0.00	0.07	0.00	0.28	0.00	0.25	0.18	0.00	99.99
73J43M	1	2	38.39	46.48	2.56	0.25	1.02	7.96	0.05	0.39	0.36	0.64	0.88	0.00	0.00	0.09	0.00	0.43	0.00	0.21	0.29	0.00	100.00
73J43M	1	3	45.39	41.82	1.93	0.22	0.81	6.52	0.06	0.38	0.41	0.52	1.02	0.00	0.00	0.09	0.00	0.36	0.00	0.24	0.25	0.00	100.02
73J43M	2	1	0.55	69.75	5.46	0.34	1.16	17.25	0.06	0.48	0.14	1.16	1.17	0.00	0.00	0.08	0.00	0.92	0.00	0.89	0.58	0.00	99.99
73J43M	2	2	0.00	69.03	5.90	0.33	1.42	17.57	0.08	0.59	0.19	1.20	1.22	0.00	0.00	0.11	0.00	0.99	0.00	0.74	0.63	0.00	100.00
73J43M	2	3	0.00	69.46	6.16	0.25	1.50	17.39	0.03	0.53	0.16	1.20	1.19	0.00	0.00	0.10	0.00	0.84	0.00	0.61	0.58	0.00	100.00
83MIA9	1	1	64.12	35.53	0.12	0.01	0.00	0.17	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.00	99.99
83MIA9	1	2	60.29	39.66	0.00	0.00	0.00	0.02	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	99.99
83MIA9	1	3	63.33	36.50	0.04	0.00	0.03	0.07	0.00	0.01	0.01	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	100.00
83MIA9	2	1	32.16	50.09	2.91	0.13	0.97	9.92	0.03	0.78	0.05	0.73	0.92	0.00	0.00	0.10	0.00	0.53	0.00	0.33	0.36	0.00	100.01
83MIA9	2	2	35.15	47.87	2.61	0.09	0.88	9.07	0.03	0.99	0.10	0.76	1.06	0.00	0.00	0.10	0.00	0.59	0.00	0.34	0.35	0.00	99.99
83MIA9	2	3	39.38	45.03	2.19	0.10	1.06	8.50	0.04	0.96	0.67	1.06	0.00	0.00	0.00	0.05	0.00	0.46	0.00	0.20	0.31	0.00	100.01
584C32	1	1	11.17	58.95	4.90	0.00	1.22	17.13	0.08	0.83	0.25	1.42	1.20	0.00	0.00	0.12	0.00	1.34	0.00	0.66	0.74	0.00	100.01
584C32	1	2	0.00	65.72	5.16	0.00	0.76	19.98	0.07	0.75	0.22	1.52	1.97	0.00	0.00	0.15	0.00	1.42	0.00	1.41	0.86	0.00	99.99
584C32	1	3	11.12	63.67	4.43	0.00	0.62	14.87	0.10	0.45	0.19	0.98	1.18	0.00	0.00	0.08	0.00	0.76	0.00	1.05	0.50	0.00	100.00
584C32	2	1	37.69	45.72	2.60	0.30	1.21	8.80	0.05	0.45	0.27	0.68	1.08	0.00	0.00	0.09	0.00	0.54	0.00	0.17	0.34	0.00	99.99
584C32	2	2	25.84	54.15	3.81	0.00	0.82	11.29	0.05	0.50	0.34	0.77	0.81	0.00	0.00	0.10	0.00	0.61	0.00	0.52	0.40	0.00	100.01
584C32	2	3	22.57	55.64	3.67	0.29	0.83	12.06	0.06	0.50	0.28	0.96	1.13	0.00	0.00	0.06	0.00	0.73	0.00	0.70	0.52	0.00	100.00
794TWZ	1	1	42.18	44.64	2.09	0.00	0.54	6.65	0.03	0.32	0.53	0.45	1.43	0.00	0.00	0.06	0.00	0.42	0.00	0.42	0.24	0.00	100.00
794TWZ	1	2	52.70	37.34	1.73	0.14	0.56	4.76	0.03	0.31	0.52	0.33	0.91	0.00	0.00	0.05	0.00	0.26	0.00	0.17	0.18	0.00	99.99

794TWZ	1	3	40.28	46.65	2.40	0.18	0.81	6.53	0.03	0.35	0.43	0.40	1.15	0.00	0.00	0.05	0.00	0.32	0.00	0.21	0.21	0.00	100.00
794TWZ	2	1	20.45	57.16	3.70	0.00	0.76	12.64	0.06	0.46	0.37	0.75	1.64	0.00	0.00	0.08	0.00	0.63	0.00	0.87	0.45	0.00	100.02
794TWZ	2	2	26.92	53.23	3.48	0.00	0.90	10.89	0.02	0.45	0.33	0.68	1.52	0.00	0.00	0.04	0.00	0.58	0.00	0.55	0.39	0.00	99.98
794TWZ	2	3	27.77	53.58	2.20	0.45	1.57	9.94	0.03	0.28	0.32	0.38	2.47	0.00	0.00	0.04	0.00	0.36	0.00	0.39	0.22	0.00	100.00
AI644T	1	1	0.00	67.66	5.06	0.00	1.05	19.38	0.00	0.12	0.16	1.18	2.28	0.00	0.00	0.07	0.00	1.13	0.00	1.16	0.76	0.00	100.01
AI644T	1	2	0.00	67.72	4.99	0.00	1.22	19.40	0.05	0.12	0.00	1.16	2.36	0.00	0.00	0.08	0.00	1.15	0.00	1.01	0.73	0.00	99.99
AI644T	1	3	0.00	70.55	4.77	0.00	1.45	17.58	0.09	0.10	0.00	0.86	2.33	0.00	0.00	0.04	0.00	0.84	0.00	0.88	0.52	0.00	100.01
AI644T	2	1	17.36	57.76	4.42	0.00	1.01	14.67	0.02	0.13	0.48	1.02	0.98	0.00	0.00	0.06	0.00	0.95	0.00	0.50	0.65	0.00	100.01
AI644T	2	2	35.35	48.60	3.10	0.00	0.55	9.13	0.00	0.12	0.44	0.64	0.68	0.00	0.00	0.02	0.00	0.60	0.00	0.38	0.38	0.00	99.99
AI644T	2	3	0.00	70.12	4.95	0.00	1.16	17.43	0.02	0.12	0.36	0.98	2.22	0.00	0.00	0.03	0.00	1.04	0.00	0.96	0.63	0.00	100.02
B014NE	1	1	51.92	38.27	1.69	0.00	0.38	5.57	0.02	0.29	0.09	0.44	0.46	0.00	0.00	0.05	0.00	0.35	0.00	0.26	0.21	0.00	100.00
B014NE	1	2	52.50	38.14	1.45	0.00	0.57	5.05	0.07	0.32	0.12	0.39	0.73	0.00	0.00	0.06	0.00	0.24	0.00	0.20	0.17	0.00	100.01
B014NE	1	3	45.92	41.91	1.94	0.00	0.54	6.93	0.02	0.35	0.11	0.52	0.73	0.00	0.00	0.06	0.00	0.38	0.00	0.35	0.24	0.00	100.00
B014NE	2	1	43.01	43.88	1.40	0.16	1.07	7.31	0.02	0.27	0.09	0.39	1.56	0.00	0.00	0.03	0.00	0.29	0.00	0.31	0.19	0.00	99.98
B014NE	2	2	44.91	42.27	2.07	0.00	0.55	7.36	0.02	0.27	0.11	0.51	0.90	0.00	0.00	0.03	0.00	0.36	0.00	0.37	0.28	0.00	100.01
B014NE	2	3	40.11	45.14	2.52	0.00	0.74	8.39	0.03	0.37	0.11	0.60	0.91	0.00	0.00	0.05	0.00	0.43	0.00	0.30	0.29	0.00	99.99
B92YNB	1	1	49.88	39.28	2.14	0.17	0.62	5.25	0.05	0.48	0.22	0.43	0.64	0.00	0.00	0.11	0.07	0.28	0.00	0.20	0.18	0.00	100.00
B92YNB	1	2	41.63	44.46	2.24	0.22	0.93	7.08	0.03	0.47	0.21	0.45	1.24	0.00	0.00	0.12	0.10	0.34	0.00	0.25	0.24	0.00	100.01
B92YNB	1	3	38.75	46.12	2.50	0.00	0.63	8.27	0.05	0.43	0.18	0.67	0.94	0.00	0.00	0.12	0.10	0.53	0.00	0.42	0.30	0.00	100.01
B92YNB	2	1	50.76	38.47	2.13	0.17	0.95	5.19	0.03	0.58	0.16	0.43	0.50	0.00	0.00	0.09	0.00	0.25	0.00	0.10	0.19	0.00	100.00
B92YNB	2	2	48.85	39.03	2.07	0.00	0.52	6.06	0.04	0.76	0.18	0.50	0.83	0.00	0.00	0.12	0.09	0.30	0.00	0.40	0.22	0.00	99.97
B92YNB	2	3	51.52	38.08	2.06	0.14	0.51	5.07	0.05	0.63	0.16	0.41	0.59	0.00	0.00	0.07	0.07	0.20	0.00	0.28	0.17	0.00	100.01
BRT6RD	1	1	43.34	43.84	1.63	0.00	0.89	7.16	0.04	0.25	0.11	0.41	1.45	0.00	0.00	0.04	0.00	0.33	0.00	0.31	0.21	0.00	100.01
BRT6RD	1	2	36.44	47.59	2.20	0.20	0.86	8.98	0.03	0.30	0.11	0.55	1.51	0.00	0.00	0.04	0.00	0.45	0.00	0.46	0.28	0.00	100.00
BRT6RD	1	3	45.12	41.74	2.01	0.00	0.92	7.42	0.02	0.31	0.12	0.55	0.92	0.00	0.00	0.05	0.00	0.39	0.00	0.17	0.25	0.00	99.99
BRT6RD	2	1	53.05	36.52	1.70	0.00	0.42	5.54	0.03	0.64	0.16	0.49	0.54	0.00	0.00	0.09	0.00	0.31	0.00	0.31	0.22	0.00	100.02
BRT6RD	2	2	52.93	36.42	1.58	0.13	0.60	5.36	0.04	0.75	0.14	0.47	0.80	0.00	0.00	0.08	0.00	0.29	0.00	0.21	0.19	0.00	99.99
BRT6RD	2	3	57.22	33.64	1.30	0.00	0.45	4.66	0.05	0.64	0.18	0.48	0.68	0.00	0.00	0.08	0.00	0.27	0.00	0.18	0.18	0.00	100.01
ESF946	1	1	37.72	46.41	2.92	0.00	0.51	8.59	0.01	0.57	0.31	0.60	0.92	0.00	0.00	0.09	0.00	0.50	0.00	0.51	0.34	0.00	100.00
ESF946	1	2	45.80	41.07	2.56	0.00	0.54	6.55	0.05	0.54	0.39	0.51	0.88	0.00	0.00	0.10	0.00	0.41	0.00	0.33	0.27	0.00	100.00
ESF946	1	3	39.32	45.54	2.68	0.20	0.66	7.97	0.03	0.43	0.22	0.49	1.26	0.00	0.00	0.09	0.00	0.40	0.00	0.41	0.29	0.00	99.99
ESF946	2	1	36.43	48.09	3.34	0.00	0.74	8.57	0.03	0.33	0.22	0.54	0.62	0.00	0.00	0.05	0.00	0.45	0.00	0.27	0.34	0.00	100.02
ESF946	2	2	27.06	53.09	3.97	0.00	0.64	11.26	0.04	0.37	0.23	0.69	0.99	0.00	0.00	0.06	0.00	0.56	0.00	0.61	0.43	0.00	100.00
ESF946	2	3	32.37	50.50	3.46	0.00	0.85	9.47	0.02	0.37	0.23	0.60	0.94	0.00	0.00	0.03	0.00	0.46	0.00	0.34	0.35	0.00	99.99
G48MJ6	1	1	14.42	58.56	4.46	0.34	1.84	14.33	0.04	0.66	0.54	0.95	2.04	0.00	0.00	0.13	0.00	0.76	0.00	0.37	0.55	0.00	99.99
G48MJ6	1	2	24.69	54.38	3.38	0.31	1.38	11.27	0.04	0.43	0.34	0.68	1.72	0.00	0.00	0.07	0.00	0.50	0.00	0.46	0.36	0.00	100.01
G48MJ6	1	3	26.39	52.86	3.41	0.33	1.38	10.64	0.03	0.50	0.55	0.59	1.99	0.00	0.00	0.09	0.00	0.52	0.00	0.42	0.31	0.00	100.01
G48MJ6	2	1	29.32	51.05	3.62	0.00	0.79	10.73	0.07	0.44	0.51	0.79	0.96	0.00	0.00	0.06	0.00	0.70	0.00	0.50	0.47	0.00	100.01
G48MJ6	2	2	35.15	48.37	3.09	0.00	0.72	8.99	0.02	0.31	0.43	0.68	0.88	0.00	0.00	0.07	0.00	0.58	0.00	0.33	0.39	0.00	100.01
G48MJ6	2	3	44.79	41.98	2.24	0.00	0.55	7.06	0.03	0.28	0.37	0.48	1.12	0.00	0.00	0.04	0.00	0.42	0.00	0.37	0.30	0.00	100.03
JD5RT2	1	1	18.37	57.33	4.46	0.23	1.56	12.95	0.06	0.45	0.52	0.81	1.70	0.00	0.00	0.10	0.00	0.71	0.00	0.27	0.48	0.00	100.00
JD5RT2	1	2	35.38	48.20	2.95	0.15	0.92	8.72	0.02	0.31	0.29	0.55	1.29	0.00	0.00	0.07	0.00	0.52	0.00	0.29	0.35	0.00	100.01
JD5RT2	1	3	9.05	63.66	4.84	0.26	1.62	15.17	0.04	0.48	0.33	0.92	1.81	0.00	0.00	0.08	0.00	0.74	0.00	0.46	0.55	0.00	100.01
JD5RT2	2	1	15.45	60.55	4.37	0.26	1.34	12.93	0.06	0.49	0.47	0.78	1.67	0.00	0.00	0.09	0.00	0.62	0.00	0.49	0.43	0.00	100.00
JD5RT2	2	2	21.10	56.60	3.18	0.33	1.71	12.01	0.06	0.43	0.28	0.67	2.35	0.00	0.00	0.02	0.00	0.59	0.00	0.29	0.39	0.00	100.01
JD5RT2	2	3	15.70	60.85	4.20	0.00	0.91	12.97	0.06	0.49	0.47	0.77	1.66	0.00	0.00	0.09	0.00	0.62	0.00	0.78	0.43	0.00	100.00
JR3584	1	1	36.78	47.23	2.60	0.00	0.67	9.23	0.03	0.50	0.00	0.68	0.89	0.00	0.00	0.05	0.00	0.57	0.00	0.42	0.35	0.00	100.00
JR3584	1	2	29.43	51.05	2.91	0.00	0.81	11.17	0.05	0.78	0.00	0.84	1.22	0.00	0.00	0.06	0.00	0.66	0.00	0.59	0.44	0.00	100.01
JR3584	1	3	37.10	47.05	2.77	0.00	0.61	9.07	0.01	0.57	0.00	0.70	0.72	0.00	0.00	0.06	0.00	0.54	0.00	0.42	0.36	0.00	99.98
JR3584	2	1	48.62	40.51	1.86	0.00	0.61	5.90	0.04	0.52	0.09	0.42	0.66	0.00	0.00	0.05	0.00	0.29	0.00	0.21	0.21	0.00	99.99

JR3584	2	2	46.72	42.49	1.92	0.00	0.58	5.81	0.02	0.47	0.00	0.39	0.83	0.00	0.00	0.06	0.00	0.29	0.00	0.24	0.18	0.00	100.00
JR3584	2	3	35.31	47.39	2.13	0.00	0.94	9.40	0.04	0.61	0.11	0.62	2.01	0.00	0.00	0.08	0.00	0.51	0.00	0.53	0.33	0.00	100.01
KI9846	1	1	0.00	69.31	4.96	0.00	1.26	17.51	0.04	0.49	0.38	1.12	2.36	0.00	0.00	0.06	0.00	0.88	0.00	1.02	0.60	0.00	99.99
KI9846	1	2	2.41	68.16	5.77	0.00	1.47	16.71	0.07	0.51	0.39	1.07	1.33	0.00	0.00	0.12	0.00	0.83	0.00	0.57	0.58	0.00	99.99
KI9846	1	3	21.48	58.61	4.37	0.00	0.61	11.10	0.03	0.39	0.29	0.70	0.82	0.00	0.00	0.09	0.00	0.48	0.00	0.67	0.37	0.00	100.01
KI9846	2	1	31.45	48.66	3.36	0.00	0.73	10.55	0.06	0.64	0.50	0.84	1.28	0.00	0.00	0.12	0.00	0.77	0.00	0.59	0.47	0.00	100.02
KI9846	2	2	47.93	38.58	2.29	0.19	0.72	6.95	0.06	0.39	0.44	0.56	0.82	0.00	0.00	0.05	0.00	0.46	0.00	0.24	0.30	0.00	99.98
KI9846	2	3	34.16	48.67	3.00	0.00	0.70	9.29	0.05	0.41	0.39	0.67	1.23	0.00	0.00	0.08	0.00	0.50	0.00	0.49	0.35	0.00	99.99
MSU4TD	1	1	0.00	67.85	5.06	0.13	2.27	18.82	0.01	0.14	0.20	1.28	2.12	0.00	0.00	0.01	0.00	1.12	0.00	0.29	0.69	0.00	99.99
MSU4TD	1	2	0.00	67.07	5.14	0.08	1.38	19.27	0.03	0.11	0.18	1.41	2.27	0.00	0.00	0.05	0.00	1.40	0.00	0.85	0.76	0.00	100.00
MSU4TD	1	3	0.00	67.51	5.50	0.09	1.72	19.17	0.00	0.08	0.13	1.29	1.93	0.00	0.00	0.06	0.00	1.24	0.00	0.59	0.71	0.00	100.02
MSU4TD	2	1	0.00	68.64	5.41	0.12	1.36	18.37	0.04	0.18	0.28	1.22	1.98	0.00	0.00	0.00	0.00	1.00	0.00	0.76	0.63	0.00	99.99
MSU4TD	2	2	27.73	51.81	3.06	0.05	0.71	12.19	0.02	0.16	0.18	0.88	1.39	0.00	0.00	0.03	0.00	0.77	0.00	0.57	0.47	0.00	100.02
MSU4TD	2	3	0.00	67.12	5.43	0.08	1.28	19.56	0.00	0.13	0.17	1.39	1.89	0.00	0.00	0.06	0.00	1.27	0.00	0.84	0.77	0.00	99.99
MTCL37	1	1	5.57	65.01	4.85	0.00	1.57	17.16	0.01	0.38	0.13	1.11	1.94	0.00	0.00	0.08	0.00	0.95	0.00	0.65	0.58	0.00	99.99
MTCL37	1	2	18.49	58.72	4.10	0.00	1.02	13.29	0.04	0.35	0.11	0.94	1.13	0.00	0.00	0.10	0.00	0.70	0.00	0.55	0.48	0.00	100.02
MTCL37	1	3	0.00	67.98	5.38	0.00	1.80	18.59	0.03	0.35	0.00	1.16	2.41	0.00	0.00	0.06	0.00	0.96	0.00	0.65	0.62	0.00	99.99
MTCL37	2	1	45.37	41.23	2.13	0.00	0.50	7.20	0.09	0.43	0.29	0.59	0.85	0.00	0.00	0.10	0.00	0.44	0.00	0.50	0.28	0.00	100.00
MTCL37	2	2	34.29	46.55	2.53	0.00	1.23	10.54	0.11	0.47	0.29	0.81	1.57	0.00	0.00	0.12	0.00	0.60	0.00	0.47	0.42	0.00	100.00
MTCL37	2	3	41.83	43.07	2.34	0.00	0.61	7.64	0.12	0.57	0.40	0.69	1.14	0.00	0.00	0.17	0.00	0.55	0.00	0.55	0.32	0.00	100.00
N6D5A7	1	1	0.00	68.16	5.73	0.00	1.51	18.14	0.08	0.66	0.33	1.11	1.87	0.00	0.00	0.10	0.00	0.93	0.00	0.77	0.62	0.00	100.01
N6D5A7	1	2	0.00	68.79	4.99	0.00	1.51	17.34	0.10	0.71	0.43	0.98	2.79	0.00	0.00	0.12	0.00	0.78	0.00	0.95	0.51	0.00	100.00
N6D5A7	1	3	0.00	69.32	5.34	0.00	1.29	16.99	0.09	0.72	0.45	1.17	2.10	0.00	0.00	0.13	0.00	0.85	0.00	0.96	0.60	0.00	100.01
N6D5A7	2	1	39.34	45.99	2.78	0.00	0.46	7.68	0.01	0.31	0.53	0.50	1.10	0.00	0.00	0.07	0.00	0.44	0.00	0.51	0.28	0.00	100.00
N6D5A7	2	2	40.89	43.41	2.64	0.18	0.63	8.09	0.02	0.32	0.55	0.56	1.34	0.00	0.00	0.12	0.00	0.52	0.00	0.42	0.32	0.00	100.01
N6D5A7	2	3	19.48	56.88	4.05	0.00	0.91	13.32	0.06	0.48	0.39	0.93	1.44	0.00	0.00	0.07	0.00	0.84	0.00	0.64	0.53	0.00	100.02
PN38IZ	1	1	25.02	52.58	3.74	0.00	1.09	11.94	0.08	0.61	0.45	0.73	1.95	0.00	0.00	0.09	0.00	0.70	0.00	0.57	0.44	0.00	99.99
PN38IZ	1	2	2.61	65.30	5.56	0.00	1.26	17.96	0.07	0.66	0.52	1.18	2.12	0.00	0.00	0.17	0.00	1.03	0.00	0.86	0.69	0.00	99.99
PN38IZ	1	3	20.33	57.17	3.71	0.00	1.30	12.12	0.06	0.44	0.40	0.77	1.99	0.00	0.00	0.09	0.00	0.66	0.00	0.51	0.44	0.00	99.99
PN38IZ	2	1	27.53	51.38	3.49	0.36	1.49	10.55	0.05	0.53	0.59	0.84	1.63	0.00	0.00	0.09	0.00	0.84	0.00	0.15	0.51	0.00	100.03
PN38IZ	2	2	26.99	52.16	3.29	0.38	1.73	10.78	0.05	0.37	0.60	0.67	1.77	0.00	0.00	0.09	0.00	0.55	0.00	0.17	0.39	0.00	99.99
PN38IZ	2	3	0.00	65.98	5.56	0.00	1.26	19.19	0.05	0.72	0.53	1.39	2.05	0.00	0.00	0.18	0.00	1.36	0.00	0.93	0.81	0.00	100.01
R67R85	1	1	49.50	39.91	2.13	0.00	0.49	5.61	0.02	0.50	0.15	0.42	0.49	0.00	0.00	0.05	0.06	0.23	0.00	0.26	0.18	0.00	100.00
R67R85	1	2	46.32	41.37	2.59	0.00	0.68	6.11	0.02	0.67	0.21	0.44	0.72	0.00	0.00	0.08	0.10	0.27	0.00	0.24	0.19	0.00	100.01
R67R85	1	3	53.08	37.18	1.89	0.00	0.28	4.85	0.03	0.57	0.22	0.38	0.58	0.00	0.00	0.06	0.08	0.25	0.00	0.39	0.16	0.00	100.00
R67R85	2	1	49.84	39.13	2.12	0.17	0.61	5.21	0.03	0.74	0.19	0.44	0.65	0.00	0.00	0.11	0.09	0.29	0.00	0.23	0.17	0.00	100.02
R67R85	2	2	48.09	40.21	2.30	0.00	0.52	5.91	0.04	0.76	0.15	0.49	0.56	0.00	0.00	0.08	0.11	0.30	0.00	0.28	0.20	0.00	100.00
R67R85	2	3	42.64	43.39	2.71	0.00	0.71	7.12	0.06	0.86	0.13	0.57	0.73	0.00	0.00	0.09	0.07	0.33	0.00	0.33	0.25	0.00	99.99
STJH77	1	1	37.74	46.58	2.40	0.00	0.97	8.73	0.03	0.65	0.07	0.61	1.14	0.00	0.00	0.06	0.00	0.47	0.00	0.27	0.29	0.00	100.01
STJH77	1	2	35.21	48.50	2.23	0.00	1.20	9.13	0.04	0.51	0.00	0.51	1.62	0.00	0.00	0.06	0.00	0.39	0.00	0.32	0.27	0.00	99.99
STJH77	1	3	33.30	48.57	2.51	0.00	1.04	10.24	0.03	0.66	0.14	0.75	1.27	0.00	0.00	0.05	0.00	0.68	0.00	0.35	0.41	0.00	100.00
STJH77	2	1	43.40	43.20	2.21	0.00	0.63	7.48	0.05	0.81	0.08	0.64	0.50	0.00	0.00	0.08	0.00	0.39	0.00	0.25	0.29	0.00	100.01
STJH77	2	2	46.06	40.71	2.15	0.00	0.42	7.30	0.05	0.85	0.10	0.63	0.46	0.00	0.00	0.07	0.00	0.49	0.00	0.38	0.33	0.00	100.00
STJH77	2	3	42.47	43.57	2.04	0.00	0.71	7.90	0.01	0.68	0.10	0.57	0.86	0.00	0.00	0.06	0.00	0.41	0.00	0.33	0.27	0.00	99.98
TBD533	1	1	38.06	45.99	2.60	0.22	1.00	8.44	0.06	0.47	0.19	0.48	1.38	0.00	0.00	0.11	0.00	0.43	0.00	0.32	0.25	0.00	100.00
TBD533	1	2	40.11	44.25	2.90	0.00	0.74	8.36	0.04	0.52	0.22	0.59	0.99	0.00	0.00	0.10	0.00	0.50	0.00	0.34	0.34	0.00	100.00
TBD533	1	3	39.03	45.61	2.89	0.19	0.92	7.98	0.04	0.52	0.21	0.53	1.02	0.00	0.00	0.09	0.00	0.46	0.00	0.19	0.32	0.00	100.00
TBD533	2	1	40.31	45.02	3.08	0.00	0.67	7.88	0.04	0.59	0.11	0.53	0.75	0.00	0.00	0.03	0.00	0.36	0.00	0.35	0.28	0.00	100.00
TBD533	2	2	45.36	42.61	2.54	0.00	0.55	6.23	0.03	0.58	0.14	0.48	0.61	0.00	0.00	0.09	0.00	0.26	0.00	0.30	0.23	0.00	100.01
TBD533	2	3	40.81	44.54	2.95	0.21	0.93	7.42	0.04	0.69	0.14	0.51	0.91	0.00	0.00	0.07	0.00	0.34	0.00	0.19	0.26	0.00	100.01

TJ66RG	1	1	56.13	34.65	1.51	0.22	0.68	4.27	0.06	0.61	0.21	0.41	0.59	0.00	0.00	0.12	0.00	0.25	0.00	0.09	0.18	0.00	99.98
TJ66RG	1	2	52.59	37.02	1.58	0.18	0.71	5.29	0.06	0.51	0.19	0.50	0.61	0.00	0.00	0.11	0.00	0.30	0.00	0.14	0.19	0.00	99.98
TJ66RG	1	3	54.32	36.21	1.59	0.16	0.81	4.59	0.05	0.53	0.20	0.44	0.56	0.00	0.00	0.11	0.00	0.25	0.00	0.00	0.19	0.00	100.01
TJ66RG	2	1	49.47	39.24	2.09	0.15	0.67	5.90	0.05	0.54	0.13	0.48	0.49	0.00	0.00	0.08	0.00	0.33	0.00	0.13	0.23	0.00	99.98
TJ66RG	2	2	48.59	39.98	2.09	0.13	0.78	5.98	0.03	0.57	0.12	0.50	0.50	0.00	0.00	0.10	0.00	0.31	0.00	0.10	0.23	0.00	100.01
TJ66RG	2	3	47.70	39.56	2.33	0.13	0.55	6.88	0.05	0.50	0.13	0.58	0.56	0.00	0.00	0.09	0.00	0.39	0.00	0.26	0.28	0.00	99.99
UGA145	1	1	0.00	70.12	4.95	0.00	1.16	17.43	0.02	0.12	0.36	0.98	2.22	0.00	0.00	0.03	0.00	1.04	0.00	0.96	0.63	0.00	100.02
UGA145	1	2	0.00	69.30	3.95	0.00	1.85	17.91	0.03	0.42	0.10	1.12	2.87	0.00	0.00	0.08	0.00	0.95	0.00	0.81	0.61	0.00	100.00
UGA145	1	3	0.00	71.23	3.06	0.00	2.40	16.60	0.02	0.32	0.00	0.76	3.77	0.00	0.00	0.06	0.00	0.62	0.00	0.78	0.38	0.00	100.00
UGA145	2	1	38.95	46.34	2.16	0.00	0.69	8.60	0.04	0.23	0.00	0.56	1.16	0.00	0.00	0.04	0.00	0.48	0.00	0.45	0.30	0.00	100.00
UGA145	2	2	25.69	53.87	3.50	0.00	0.95	11.92	0.03	0.44	0.14	0.87	0.94	0.00	0.00	0.03	0.00	0.73	0.00	0.44	0.46	0.00	100.01
UGA145	2	3	37.23	47.09	2.48	0.00	0.32	9.17	0.03	0.36	0.11	0.68	0.94	0.00	0.00	0.04	0.00	0.55	0.00	0.67	0.34	0.00	100.01
VT23AC	1	1	13.24	61.30	4.23	0.00	1.51	14.83	0.00	0.14	0.25	0.96	1.72	0.00	0.00	0.05	0.00	0.85	0.00	0.42	0.52	0.00	100.02
VT23AC	1	2	0.00	69.47	4.83	0.07	1.28	18.04	0.00	0.15	0.28	1.10	2.25	0.00	0.00	0.06	0.00	0.89	0.00	0.99	0.58	0.00	99.99
VT23AC	1	3	0.00	69.62	4.89	0.10	1.83	17.70	0.01	0.14	0.34	1.05	2.30	0.00	0.00	0.07	0.00	0.76	0.00	0.62	0.57	0.00	100.00
VT23AC	2	1	9.24	63.74	4.98	0.05	1.29	16.01	0.00	0.09	0.28	1.07	1.26	0.00	0.00	0.05	0.00	0.87	0.00	0.49	0.59	0.00	100.01
VT23AC	2	2	0.00	65.93	5.42	0.07	1.81	20.17	0.03	0.10	0.31	1.61	1.79	0.00	0.00	0.03	0.00	1.39	0.00	0.43	0.91	0.00	100.00
VT23AC	2	3	0.00	65.32	5.41	0.08	1.30	20.12	0.00	0.09	0.44	1.60	2.14	0.00	0.00	0.04	0.00	1.66	0.00	0.78	1.02	0.00	100.00
WH3JMZ	1	1	14.47	59.17	3.78	0.00	0.93	14.91	0.06	0.41	0.24	1.30	1.96	0.00	0.00	0.11	0.00	1.21	0.00	0.76	0.69	0.00	100.00
WH3JMZ	1	2	0.00	67.44	4.76	0.00	0.98	18.80	0.03	0.48	0.26	1.67	1.94	0.00	0.00	0.15	0.00	1.48	0.00	1.06	0.95	0.00	100.00
WH3JMZ	1	3	27.87	53.76	3.05	0.00	1.18	10.53	0.02	0.26	0.14	0.72	1.16	0.00	0.00	0.04	0.00	0.61	0.00	0.26	0.39	0.00	99.99
WH3JMZ	2	1	34.31	49.16	2.84	0.00	0.91	9.41	0.03	0.24	0.16	0.63	1.11	0.00	0.00	0.05	0.00	0.52	0.00	0.30	0.32	0.00	99.99
WH3JMZ	2	2	0.60	68.37	5.34	0.00	1.90	17.73	0.05	0.48	0.28	1.23	1.94	0.00	0.00	0.10	0.00	0.88	0.00	0.48	0.62	0.00	100.00
WH3JMZ	2	3	16.42	59.45	4.04	0.00	0.96	13.95	0.05	0.35	0.20	0.86	1.66	0.00	0.00	0.07	0.00	0.70	0.00	0.79	0.50	0.00	100.00
CRH8ES	1	1	11.35	62.05	5.40	0.35	0.99	14.71	0.14	0.70	0.13	0.95	1.21	0.00	0.00	0.09	0.00	0.82	0.00	0.58	0.53	0.00	100.00
CRH8ES	1	2	0.00	68.41	6.23	0.00	0.76	18.43	0.00	0.84	0.16	1.17	1.25	0.00	0.00	0.09	0.00	1.01	0.00	1.01	0.64	0.00	100.00
CRH8ES	1	3	0.00	67.82	6.15	0.50	1.83	17.82	0.16	0.80	0.00	1.15	1.69	0.00	0.00	0.08	0.00	0.95	0.00	0.45	0.61	0.00	100.01
CRH8ES	2	1	0.00	67.94	6.46	0.00	1.14	18.51	0.09	0.52	0.26	1.15	1.30	0.00	0.00	0.09	0.00	1.03	0.00	0.81	0.69	0.00	99.99
CRH8ES	2	2	23.63	55.17	4.67	0.29	0.98	11.66	0.10	0.41	0.23	0.67	0.84	0.00	0.00	0.06	0.00	0.60	0.00	0.29	0.39	0.00	99.99
CRH8ES	2	3	35.40	48.06	3.55	0.24	0.80	9.12	0.08	0.35	0.14	0.52	0.68	0.00	0.00	0.04	0.00	0.46	0.00	0.22	0.32	0.00	99.98
DAW454	1	1	15.71	59.70	5.07	0.00	0.70	13.93	0.14	0.56	0.14	0.88	1.00	0.00	0.00	0.10	0.00	0.92	0.00	0.66	0.50	0.00	100.01
DAW454	1	2	8.23	64.28	5.62	0.00	1.22	15.27	0.08	0.78	0.13	1.06	1.17	0.00	0.00	0.11	0.00	0.89	0.00	0.58	0.58	0.00	100.00
DAW454	1	3	0.00	67.75	5.74	0.48	1.32	18.62	0.10	0.55	0.00	1.11	1.84	0.00	0.00	0.07	0.00	0.98	0.00	0.79	0.65	0.00	100.00
DAW454	2	1	8.20	64.16	5.23	0.37	1.16	15.28	0.12	0.92	0.24	1.07	1.23	0.00	0.00	0.13	0.00	0.79	0.00	0.54	0.55	0.00	99.99
DAW454	2	2	0.00	67.90	5.24	0.63	2.47	16.81	0.19	1.07	0.21	1.03	2.65	0.00	0.00	0.16	0.00	0.92	0.00	0.14	0.59	0.00	100.01
DAW454	2	3	7.03	64.73	5.07	0.44	1.44	15.61	0.11	0.65	0.25	1.00	1.62	0.00	0.00	0.07	0.00	0.85	0.00	0.55	0.57	0.00	99.99
DSF6UE	1	1	0.00	68.52	6.32	0.00	0.84	18.25	0.05	0.58	0.13	1.02	1.62	0.00	0.00	0.09	0.00	0.94	0.00	1.01	0.62	0.00	99.99
DSF6UE	1	2	0.00	67.26	6.57	0.49	2.18	18.02	0.08	0.60	0.19	1.05	1.72	0.00	0.00	0.12	0.00	0.97	0.00	0.16	0.58	0.00	99.99
DSF6UE	1	3	0.00	68.13	6.38	0.00	1.25	17.98	0.04	0.68	0.14	1.04	1.83	0.00	0.00	0.08	0.00	1.05	0.00	0.78	0.61	0.00	99.99
DSF6UE	2	1	45.60	41.35	2.20	0.00	0.63	6.27	0.07	0.37	0.59	0.42	1.49	0.00	0.00	0.13	0.00	0.32	0.00	0.36	0.20	0.00	100.00
DSF6UE	2	2	52.68	36.97	1.75	0.20	0.72	3.94	0.06	0.56	0.79	0.31	1.54	0.00	0.00	0.12	0.00	0.13	0.00	0.12	0.12	0.00	100.01
DSF6UE	2	3	52.46	36.53	1.82	0.22	0.79	4.80	0.05	0.51	0.54	0.40	1.30	0.00	0.00	0.11	0.00	0.24	0.00	0.08	0.15	0.00	100.00
12HD94	1	1	47.14	39.89	2.35	0.19	1.02	5.90	0.05	0.44	0.65	0.42	1.38	0.00	0.00	0.11	0.00	0.22	0.00	0.01	0.20	0.00	99.97
12HD94	1	2	51.05	37.82	1.92	0.19	0.73	4.73	0.07	0.51	0.57	0.38	1.39	0.00	0.00	0.11	0.00	0.22	0.00	0.15	0.16	0.00	100.00
12HD94	1	3	51.99	36.61	1.86	0.25	0.60	5.15	0.05	0.48	0.53	0.40	1.36	0.00	0.00	0.10	0.00	0.21	0.00	0.25	0.16	0.00	100.00
12HD94	2	1	0.00	68.85	5.85	0.52	1.59	17.56	0.04	0.44	0.00	0.90	2.05	0.00	0.00	0.10	0.00	0.89	0.00	0.63	0.56	0.00	99.98
12HD94	2	2	0.00	67.71	6.24	0.50	1.43	17.88	0.07	0.67	0.00	1.07	1.84	0.00	0.00	0.11	0.00	1.21	0.00	0.61	0.66	0.00	100.00
12HD94	2	3	19.16	57.24	4.69	0.00	0.64	13.73	0.05	0.41	0.00	0.84	1.11	0.00	0.00	0.07	0.00	0.81	0.00	0.71	0.53	0.00	99.99
LF4EQ2	1	1	52.85	34.80	2.08	0.21	0.84	6.89	0.05	0.34	0.00	0.43	0.81	0.00	0.00	0.06	0.00	0.29	0.00	0.10	0.24	0.00	99.99
LF4EQ2	1	2	51.80	35.82	2.34	0.20	0.63	6.83	0.09	0.31	0.07	0.41	0.67	0.00	0.00	0.04	0.00	0.36	0.00	0.18	0.25	0.00	100.00

LF4EQ2	1	3	58.61	31.20	1.83	0.16	0.60	5.59	0.05	0.31	0.07	0.33	0.62	0.00	0.00	0.06	0.00	0.24	0.00	0.12	0.20	0.00	99.99
LF4EQ2	2	1	69.95	24.82	0.85	0.07	0.26	2.88	0.05	0.19	0.04	0.20	0.29	0.00	0.00	0.03	0.00	0.17	0.00	0.08	0.11	0.00	99.99
LF4EQ2	2	2	70.76	24.37	0.83	0.07	0.30	2.64	0.05	0.20	0.00	0.19	0.31	0.00	0.00	0.01	0.00	0.14	0.00	0.03	0.10	0.00	100.00
LF4EQ2	2	3	70.77	24.19	0.90	0.07	0.13	2.80	0.04	0.20	0.00	0.19	0.27	0.00	0.00	0.03	0.00	0.14	0.00	0.16	0.10	0.00	99.99
SJA33J	1	1	37.42	46.68	2.50	0.00	0.71	9.41	0.03	0.17	0.12	0.70	0.94	0.00	0.00	0.06	0.00	0.52	0.00	0.38	0.36	0.00	100.00
SJA33J	1	2	31.63	50.75	2.84	0.00	0.81	10.22	0.02	0.19	0.15	0.67	1.25	0.00	0.00	0.05	0.00	0.59	0.00	0.50	0.34	0.00	100.01
SJA33J	1	3	21.17	56.72	3.78	0.00	1.23	12.99	0.01	0.19	0.13	0.95	1.12	0.00	0.00	0.02	0.00	0.76	0.00	0.46	0.47	0.00	100.00
SJA33J	2	1	36.54	47.90	2.42	0.00	0.93	9.07	0.01	0.16	0.16	0.65	1.06	0.00	0.00	0.03	0.00	0.49	0.00	0.27	0.32	0.00	100.01
SJA33J	2	2	45.98	41.46	2.20	0.00	0.55	7.08	0.02	0.21	0.19	0.61	0.66	0.00	0.00	0.03	0.00	0.45	0.00	0.28	0.29	0.00	100.01
SJA33J	2	3	51.04	38.83	1.25	0.00	0.54	5.71	0.00	0.11	0.10	0.38	1.20	0.00	0.00	0.03	0.00	0.33	0.00	0.28	0.20	0.00	100.00
YEK752	1	1	30.12	50.30	3.42	0.00	0.77	11.29	0.02	0.42	0.25	0.89	0.90	0.00	0.00	0.06	0.00	0.65	0.00	0.44	0.47	0.00	100.00
YEK752	1	2	34.46	48.40	3.18	0.00	0.65	9.55	0.02	0.37	0.26	0.77	0.86	0.00	0.00	0.06	0.00	0.63	0.00	0.38	0.41	0.00	100.00
YEK752	1	3	43.33	43.91	1.82	0.23	0.97	6.77	0.02	0.20	0.16	0.41	1.40	0.00	0.00	0.05	0.00	0.35	0.00	0.16	0.21	0.00	99.99
YEK752	2	1	32.42	50.03	3.01	0.00	0.52	10.20	0.05	0.25	0.18	0.72	1.04	0.00	0.00	0.05	0.00	0.57	0.00	0.60	0.37	0.00	100.01
YEK752	2	2	42.88	43.45	2.15	0.00	0.55	7.75	0.02	0.24	0.18	0.53	1.11	0.00	0.00	0.05	0.00	0.41	0.00	0.41	0.27	0.00	100.00
YEK752	2	3	35.69	47.96	2.79	0.00	0.53	9.44	0.05	0.26	0.21	0.71	0.85	0.00	0.00	0.06	0.00	0.56	0.00	0.53	0.37	0.00	100.01
LR8C66	1	1	19.65	57.08	4.55	0.32	0.95	13.47	0.08	0.21	0.11	0.79	1.06	0.00	0.00	0.04	0.00	0.68	0.00	0.52	0.50	0.00	100.01
LR8C66	1	2	9.47	60.81	5.08	0.00	1.39	17.09	0.16	0.50	0.33	1.15	1.50	0.00	0.00	0.05	0.00	1.09	0.00	0.61	0.76	0.00	99.99
LR8C66	1	3	0.00	66.80	6.37	0.00	1.02	19.87	0.12	0.30	0.00	1.26	1.41	0.00	0.00	0.05	0.00	1.11	0.00	0.93	0.76	0.00	100.00
LR8C66	2	1	35.77	47.77	3.39	0.00	0.61	9.19	0.06	0.42	0.21	0.57	0.70	0.00	0.00	0.08	0.00	0.45	0.00	0.43	0.36	0.00	100.01
LR8C66	2	2	43.96	42.11	2.79	0.19	0.91	7.45	0.07	0.36	0.16	0.47	0.73	0.00	0.00	0.07	0.00	0.37	0.00	0.12	0.25	0.00	100.01
LR8C66	2	3	37.85	47.85	3.57	0.00	0.31	7.65	0.07	0.38	0.20	0.51	0.46	0.00	0.00	0.03	0.00	0.41	0.00	0.42	0.30	0.00	100.01
E63JV3	1	1	26.07	52.76	3.62	0.29	1.27	11.57	0.10	0.47	0.16	0.75	1.41	0.00	0.00	0.10	0.00	0.73	0.00	0.24	0.46	0.00	100.00
E63JV3	1	2	46.60	40.95	2.20	0.00	0.36	6.84	0.04	0.35	0.22	0.47	0.84	0.00	0.00	0.05	0.00	0.44	0.00	0.37	0.28	0.00	100.01
E63JV3	1	3	23.83	55.37	3.88	0.00	0.73	11.62	0.09	0.52	0.18	0.80	1.06	0.00	0.00	0.09	0.00	0.83	0.00	0.50	0.47	0.00	99.97
E63JV3	2	1	31.34	50.37	3.51	0.30	1.30	9.88	0.05	0.39	0.13	0.67	1.01	0.00	0.00	0.14	0.00	0.51	0.00	0.04	0.35	0.00	99.99
E63JV3	2	2	26.38	53.85	3.84	0.31	1.26	10.72	0.08	0.45	0.13	0.70	1.06	0.00	0.00	0.11	0.00	0.59	0.00	0.13	0.40	0.00	100.01
E63JV3	2	3	29.64	51.27	3.38	0.28	1.13	10.35	0.08	0.44	0.11	0.61	1.46	0.00	0.00	0.11	0.00	0.55	0.00	0.24	0.35	0.00	100.00
GF68X3	1	1	51.86	36.81	2.41	0.28	0.64	4.50	0.08	1.11	0.33	0.42	0.87	0.00	0.00	0.19	0.00	0.22	0.00	0.12	0.17	0.00	100.01
GF68X3	1	2	54.68	33.75	2.32	0.29	0.51	4.97	0.06	1.01	0.30	0.47	0.82	0.00	0.00	0.16	0.00	0.32	0.00	0.12	0.21	0.00	99.99
GF68X3	1	3	59.29	32.09	1.95	0.24	0.51	3.04	0.09	0.93	0.40	0.32	0.62	0.00	0.00	0.16	0.00	0.20	0.00	0.04	0.12	0.00	100.00
GF68X3	2	1	42.56	43.58	3.17	0.20	0.52	7.17	0.07	0.65	0.06	0.47	0.55	0.00	0.00	0.07	0.00	0.41	0.00	0.26	0.27	0.00	100.01
GF68X3	2	2	36.60	46.54	3.67	0.24	0.87	8.70	0.07	0.79	0.00	0.58	0.84	0.00	0.00	0.08	0.00	0.47	0.00	0.22	0.33	0.00	100.00
GF68X3	2	3	37.84	46.94	3.14	0.00	0.19	8.27	0.08	0.74	0.00	0.57	0.78	0.00	0.00	0.06	0.00	0.48	0.00	0.60	0.31	0.00	100.00
7GH325	1	1	38.34	46.67	2.86	0.00	0.41	8.79	0.05	0.25	0.00	0.61	0.61	0.00	0.00	0.07	0.00	0.54	0.00	0.43	0.37	0.00	100.00
7GH325	1	2	37.93	46.41	2.72	0.19	0.49	9.22	0.05	0.29	0.00	0.58	0.80	0.00	0.00	0.05	0.00	0.46	0.00	0.45	0.36	0.00	100.00
7GH325	1	3	31.35	51.35	3.31	0.00	0.43	10.29	0.05	0.31	0.00	0.65	0.72	0.00	0.00	0.06	0.00	0.54	0.00	0.59	0.35	0.00	100.00
7GH325	2	1	29.03	51.64	3.32	0.28	1.17	10.80	0.05	0.42	0.00	0.69	1.26	0.00	0.00	0.07	0.00	0.61	0.00	0.30	0.38	0.00	100.02
7GH325	2	2	28.00	51.52	3.54	0.33	0.96	11.52	0.08	0.41	0.00	0.77	1.27	0.00	0.00	0.14	0.00	0.64	0.00	0.40	0.41	0.00	99.99
7GH325	2	3	24.18	54.46	3.62	0.33	1.07	12.15	0.03	0.30	0.00	0.80	1.38	0.00	0.00	0.12	0.00	0.65	0.00	0.43	0.45	0.00	99.97
K76GHR	1	1	39.29	45.32	2.47	0.00	0.60	8.57	0.02	0.37	0.31	0.69	0.91	0.00	0.00	0.09	0.00	0.60	0.00	0.41	0.36	0.00	100.01
K76GHR	1	2	36.83	47.33	2.70	0.21	0.75	8.68	0.05	0.36	0.21	0.67	1.01	0.00	0.00	0.08	0.00	0.44	0.00	0.36	0.32	0.00	100.00
K76GHR	1	3	26.08	52.83	3.72	0.00	0.77	12.19	0.09	0.46	0.25	1.00	0.81	0.00	0.00	0.08	0.00	0.69	0.00	0.56	0.49	0.00	100.02
K76GHR	2	1	46.66	40.25	1.96	0.00	0.80	7.15	0.05	0.30	0.21	0.54	1.13	0.00	0.00	0.06	0.00	0.39	0.00	0.24	0.25	0.00	99.99
K76GHR	2	2	49.08	38.06	1.95	0.00	0.79	6.89	0.04	0.37	0.29	0.58	0.99	0.00	0.00	0.08	0.00	0.38	0.00	0.22	0.29	0.00	100.01
K76GHR	2	3	53.22	36.03	1.57	0.15	0.63	5.68	0.04	0.31	0.31	0.44	0.91	0.00	0.00	0.08	0.00	0.27	0.00	0.14	0.21	0.00	99.99
WBH9G4	1	1	33.80	48.34	3.77	0.00	0.41	10.34	0.08	0.33	0.14	0.64	0.63	0.00	0.00	0.05	0.00	0.53	0.00	0.56	0.38	0.00	100.00
WBH9G4	1	2	30.74	50.08	3.99	0.00	0.60	11.19	0.10	0.31	0.10	0.67	0.69	0.00	0.00	0.03	0.00	0.58	0.00	0.49	0.42	0.00	99.99
WBH9G4	1	3	29.14	50.78	4.08	0.00	0.23	11.90	0.10	0.35	0.11	0.72	0.71	0.00	0.00	0.04	0.00	0.65	0.00	0.78	0.41	0.00	100.00
WBH9G4	2	1	46.62	39.76	2.76	0.20	0.75	7.40	0.09	0.29	0.13	0.43	0.70	0.00	0.00	0.03	0.00	0.41	0.00	0.16	0.26	0.00	99.99

WBH9G4	2	2	48.22	39.07	2.41	0.19	0.61	6.89	0.09	0.31	0.19	0.41	0.71	0.00	0.00	0.06	0.00	0.35	0.00	0.26	0.25	0.00	100.02
WBH9G4	2	3	34.92	46.89	3.65	0.27	0.97	9.97	0.09	0.34	0.15	0.60	0.93	0.00	0.00	0.00	0.10	0.53	0.00	0.25	0.35	0.00	100.01
907BVA	1	1	59.68	31.17	1.35	0.19	0.42	3.29	0.10	1.17	0.34	0.44	0.75	0.00	0.07	0.48	0.00	0.20	0.00	0.23	0.13	0.00	100.01
907BVA	1	2	63.84	28.68	1.11	0.23	0.47	2.22	0.09	1.10	0.30	0.38	0.77	0.11	0.07	0.44	0.00	0.14	0.00	0.04	0.00	0.00	99.99
907BVA	1	3	63.49	28.35	1.33	0.15	0.27	2.93	0.05	1.07	0.30	0.42	0.65	0.00	0.06	0.40	0.00	0.21	0.00	0.20	0.12	0.00	100.00
907BVA	2	1	71.15	25.04	0.50	0.12	0.27	0.84	0.07	0.50	0.60	0.16	0.51	0.03	0.01	0.18	0.00	0.00	0.00	0.00	0.00	0.00	99.98
907BVA	2	2	66.65	27.26	0.71	0.21	0.30	1.68	0.11	0.90	0.57	0.31	0.80	0.06	0.02	0.33	0.00	0.00	0.00	0.09	0.00	0.00	100.00
907BVA	2	3	68.80	26.11	0.64	0.19	0.32	1.47	0.08	0.68	0.51	0.23	0.61	0.07	0.03	0.24	0.00	0.00	0.00	0.02	0.00	0.00	100.00
MA7ET5	1	1	30.76	49.51	3.71	0.00	0.34	11.21	0.15	0.58	0.00	0.73	1.05	0.00	0.00	0.11	0.00	0.66	0.00	0.77	0.43	0.00	100.01
MA7ET5	1	2	22.37	54.93	4.52	0.31	1.42	12.37	0.12	0.56	0.14	0.75	1.15	0.00	0.00	0.06	0.00	0.68	0.00	0.19	0.43	0.00	100.00
MA7ET5	1	3	11.78	61.49	4.96	0.00	0.77	15.14	0.09	0.65	0.18	0.89	1.62	0.00	0.00	0.08	0.00	0.83	0.00	0.94	0.56	0.00	99.98
MA7ET5	2	1	17.00	56.81	4.75	0.35	1.20	13.50	0.15	1.21	0.17	0.89	1.93	0.00	0.00	0.17	0.00	0.80	0.00	0.57	0.50	0.00	100.00
MA7ET5	2	2	16.73	56.78	4.80	0.00	1.00	14.69	0.17	0.92	0.13	0.99	1.40	0.00	0.00	0.16	0.00	0.95	0.00	0.67	0.62	0.00	100.01
MA7ET5	2	3	6.69	64.18	5.67	0.37	1.29	16.15	0.13	0.73	0.00	0.94	1.64	0.00	0.00	0.12	0.00	0.78	0.00	0.74	0.57	0.00	100.00
TT15A5	1	1	31.02	48.41	2.57	0.36	1.45	10.79	0.01	0.43	0.40	0.66	2.48	0.00	0.00	0.10	0.00	0.62	0.00	0.34	0.36	0.00	100.00
TT15A5	1	2	0.00	65.91	5.09	0.43	2.25	18.75	0.08	0.59	0.31	1.28	2.76	0.00	0.00	0.11	0.00	1.21	0.00	0.47	0.74	0.00	99.98
TT15A5	1	3	7.56	63.67	4.03	0.46	2.09	15.68	0.03	0.45	0.40	0.85	3.00	0.00	0.00	0.04	0.00	0.75	0.00	0.48	0.51	0.00	100.00
TT15A5	2	1	32.13	47.69	3.08	0.00	1.15	10.84	0.01	0.48	0.51	0.95	1.49	0.00	0.00	0.08	0.00	0.74	0.00	0.33	0.53	0.00	100.01
TT15A5	2	2	49.23	38.66	1.67	0.21	0.72	6.07	0.01	0.40	0.42	0.50	1.15	0.00	0.00	0.07	0.00	0.41	0.00	0.22	0.24	0.00	99.98
TT15A5	2	3	32.70	49.09	2.90	0.27	1.18	9.65	0.04	0.40	0.23	0.69	1.56	0.00	0.00	0.10	0.00	0.51	0.00	0.30	0.38	0.00	100.00
11S754	1	1	0.00	67.07	5.14	0.59	1.93	18.32	0.11	0.40	0.34	1.01	2.91	0.00	0.00	0.07	0.00	0.88	0.00	0.63	0.60	0.00	100.00
11S754	1	2	0.70	65.70	6.02	0.46	2.08	18.78	0.12	0.46	0.24	1.12	2.15	0.00	0.00	0.12	0.00	1.04	0.00	0.35	0.67	0.00	100.01
11S754	1	3	25.51	52.15	3.95	0.34	1.47	12.41	0.04	0.27	0.17	0.71	1.55	0.00	0.00	0.05	0.00	0.72	0.00	0.21	0.46	0.00	100.01
11S754	2	1	0.00	66.56	6.46	0.48	1.81	18.32	0.12	0.70	0.45	1.15	1.70	0.00	0.00	0.11	0.00	1.04	0.00	0.41	0.69	0.00	100.00
11S754	2	2	30.95	49.34	3.50	0.30	0.74	10.90	0.11	0.31	0.25	0.64	1.37	0.00	0.00	0.09	0.00	0.58	0.00	0.54	0.38	0.00	100.00
11S754	2	3	37.62	46.05	3.46	0.21	0.66	8.67	0.07	0.36	0.38	0.64	0.66	0.00	0.00	0.02	0.00	0.53	0.00	0.29	0.35	0.00	99.97
17BDAR	1	1	34.93	47.42	3.20	0.29	1.15	9.38	0.09	0.63	0.07	0.59	1.17	0.00	0.00	0.08	0.00	0.53	0.00	0.15	0.32	0.00	100.00
17BDAR	1	2	27.18	52.32	3.45	0.32	1.44	11.14	0.11	0.72	0.11	0.71	1.24	0.00	0.00	0.11	0.00	0.59	0.03	0.16	0.36	0.00	99.99
17BDAR	1	3	35.70	47.69	3.21	0.23	0.73	8.92	0.11	0.66	0.08	0.60	0.85	0.00	0.00	0.08	0.00	0.45	0.00	0.32	0.35	0.00	99.98
17BDAR	2	1	0.00	67.42	6.05	0.37	1.97	18.51	0.13	0.66	0.04	1.17	1.46	0.00	0.00	0.09	0.00	1.13	0.00	0.29	0.72	0.00	100.01
17BDAR	2	2	0.00	68.01	6.38	0.21	1.43	18.45	0.10	0.56	0.04	1.15	1.32	0.00	0.00	0.06	0.00	1.05	0.02	0.56	0.66	0.00	100.00
17BDAR	2	3	0.00	68.28	6.50	0.34	1.06	18.18	0.06	0.70	0.05	1.23	1.19	0.00	0.00	0.06	0.00	0.99	0.00	0.72	0.64	0.00	100.00
TC66HR	1	1	55.21	35.11	2.09	0.00	0.21	5.15	0.03	0.36	0.09	0.44	0.36	0.00	0.00	0.05	0.00	0.33	0.00	0.35	0.21	0.00	99.99
TC66HR	1	2	50.47	38.82	2.44	0.00	0.30	5.68	0.03	0.40	0.09	0.47	0.39	0.00	0.00	0.06	0.00	0.31	0.00	0.31	0.21	0.00	99.98
TC66HR	1	3	53.54	36.65	2.00	0.00	0.43	5.27	0.02	0.38	0.09	0.46	0.41	0.00	0.00	0.04	0.00	0.31	0.00	0.16	0.23	0.00	99.99
TC66HR	2	1	54.20	36.07	2.00	0.00	0.31	5.15	0.03	0.54	0.08	0.45	0.38	0.00	0.00	0.06	0.00	0.26	0.00	0.26	0.19	0.00	99.98
TC66HR	2	2	55.39	33.82	2.11	0.00	0.31	5.49	0.05	0.68	0.14	0.54	0.51	0.00	0.00	0.08	0.00	0.37	0.00	0.29	0.23	0.00	100.01
TC66HR	2	3	56.94	33.76	1.52	0.00	0.34	4.73	0.04	0.52	0.13	0.46	0.72	0.00	0.00	0.10	0.00	0.26	0.00	0.29	0.19	0.00	100.00
F1JH39	1	1	37.66	47.00	2.87	0.24	0.75	8.16	0.05	0.31	0.30	0.60	0.94	0.00	0.00	0.06	0.00	0.48	0.00	0.28	0.29	0.00	99.99
F1JH39	1	2	42.27	44.72	2.55	0.00	0.38	7.12	0.05	0.32	0.28	0.53	0.65	0.00	0.00	0.06	0.00	0.38	0.00	0.39	0.28	0.00	99.98
F1JH39	1	3	43.34	43.70	2.39	0.23	0.88	6.66	0.06	0.35	0.34	0.49	0.78	0.00	0.00	0.08	0.00	0.38	0.00	0.09	0.22	0.00	99.99
F1JH39	2	1	41.72	41.65	2.49	0.21	0.90	8.79	0.08	0.68	0.19	0.74	1.26	0.00	0.00	0.14	0.00	0.61	0.00	0.17	0.38	0.00	100.01
F1JH39	2	2	59.79	31.51	1.12	0.18	0.45	4.17	0.09	0.50	0.34	0.40	0.72	0.00	0.00	0.12	0.00	0.28	0.00	0.17	0.17	0.00	100.01
F1JH39	2	3	62.04	31.31	0.97	0.14	0.38	2.96	0.09	0.47	0.29	0.28	0.56	0.00	0.00	0.10	0.00	0.17	0.00	0.12	0.12	0.00	100.00
GO9JVE	1	1	62.06	29.41	1.60	0.11	0.30	4.47	0.04	0.52	0.00	0.34	0.46	0.00	0.00	0.05	0.00	0.24	0.00	0.24	0.16	0.00	100.00
GO9JVE	1	2	63.82	28.07	1.53	0.11	0.30	4.21	0.05	0.52	0.06	0.34	0.37	0.00	0.00	0.05	0.00	0.19	0.00	0.21	0.16	0.00	99.99
GO9JVE	1	3	59.61	31.38	1.76	0.00	0.33	4.88	0.04	0.51	0.05	0.39	0.35	0.00	0.00	0.05	0.00	0.24	0.00	0.24	0.18	0.00	100.01
GO9JVE	2	1	53.07	36.02	2.13	0.15	0.42	6.00	0.02	0.51	0.00	0.43	0.42	0.00	0.00	0.03	0.00	0.32	0.00	0.25	0.24	0.00	100.01
GO9JVE	2	2	40.00	44.64	2.47	0.24	1.13	8.56	0.02	0.49	0.00	0.52	1.06	0.00	0.00	0.07	0.00	0.38	0.00	0.15	0.28	0.00	100.01
GO9JVE	2	3	51.68	36.71	2.07	0.16	0.53	6.37	0.03	0.55	0.00	0.44	0.62	0.00	0.00	0.04	0.00	0.30	0.00	0.28	0.21	0.00	99.99

HIDE4H	1	1	30.62	51.51	3.57	0.32	1.01	9.41	0.10	0.65	0.14	0.62	0.84	0.00	0.00	0.12	0.00	0.50	0.00	0.26	0.33	0.00	100.00
HIDE4H	1	2	31.57	50.75	3.51	0.30	0.94	9.44	0.08	0.69	0.10	0.64	0.76	0.00	0.00	0.14	0.00	0.47	0.00	0.27	0.33	0.00	99.99
HIDE4H	1	3	35.79	47.23	3.29	0.29	1.14	8.82	0.10	0.75	0.14	0.66	0.78	0.00	0.00	0.16	0.00	0.43	0.00	0.10	0.32	0.00	100.00
HIDE4H	2	1	0.00	67.25	5.99	0.50	1.64	18.47	0.14	0.78	0.00	1.11	1.75	0.00	0.00	0.12	0.00	1.00	0.00	0.59	0.68	0.00	100.02
HIDE4H	2	2	16.58	58.15	4.51	0.38	1.26	13.87	0.12	0.71	0.00	0.92	1.44	0.00	0.00	0.13	0.00	0.86	0.00	0.51	0.54	0.00	99.98
HIDE4H	2	3	0.00	67.91	6.14	0.46	1.66	18.06	0.13	0.81	0.00	1.13	1.45	0.00	0.00	0.08	0.00	0.99	0.00	0.55	0.60	0.00	99.97
HGD63H	1	1	54.54	35.36	1.72	0.00	0.31	5.32	0.03	0.35	0.41	0.49	0.56	0.00	0.00	0.10	0.00	0.39	0.00	0.20	0.22	0.00	100.00
HGD63H	1	2	56.76	32.99	1.60	0.16	0.31	5.17	0.05	0.44	0.52	0.53	0.58	0.00	0.00	0.09	0.00	0.34	0.00	0.20	0.27	0.00	100.01
HGD63H	1	3	54.47	34.92	1.70	0.16	0.44	5.32	0.04	0.40	0.53	0.51	0.67	0.00	0.00	0.09	0.00	0.37	0.00	0.15	0.24	0.00	100.01
HGD63H	2	1	28.96	52.12	3.26	0.00	0.49	11.03	0.03	0.35	0.29	0.86	0.88	0.00	0.00	0.08	0.00	0.67	0.00	0.56	0.45	0.00	100.03
HGD63H	2	2	4.06	65.73	5.36	0.00	0.92	17.67	0.07	0.52	0.33	1.38	1.26	0.00	0.00	0.16	0.00	1.07	0.00	0.76	0.72	0.00	100.01
HGD63H	2	3	31.13	49.91	3.07	0.00	0.35	11.03	0.03	0.27	0.26	0.97	1.08	0.00	0.00	0.11	0.00	0.72	0.00	0.58	0.49	0.00	100.00
RP14DE	1	1	2.11	66.97	6.12	0.00	0.61	17.88	0.13	0.57	0.16	1.19	1.35	0.00	0.00	0.14	0.00	1.07	0.00	1.03	0.68	0.00	100.01
RP14DE	1	2	8.36	63.39	5.42	0.00	0.79	16.20	0.14	0.54	0.15	1.05	1.47	0.00	0.00	0.10	0.00	0.89	0.00	0.93	0.57	0.00	100.00
RP14DE	1	3	14.85	59.39	5.39	0.39	1.27	14.13	0.08	0.53	0.15	0.86	1.24	0.00	0.00	0.09	0.00	0.78	0.00	0.36	0.49	0.00	100.00
RP14DE	2	1	0.00	68.53	5.95	0.00	0.72	19.02	0.11	0.41	0.17	1.15	1.16	0.00	0.00	0.07	0.00	1.02	0.00	1.01	0.67	0.00	99.99
RP14DE	2	2	20.63	56.95	4.64	0.28	0.94	12.57	0.10	0.34	0.14	0.77	1.02	0.00	0.00	0.08	0.00	0.71	0.00	0.40	0.42	0.00	99.99
RP14DE	2	3	0.00	67.72	5.98	0.45	1.67	18.01	0.13	0.49	0.21	1.13	1.92	0.00	0.00	0.11	0.00	0.98	0.00	0.57	0.63	0.00	100.00
2965CL	1	1	48.60	38.49	1.68	0.29	0.66	6.33	0.06	0.52	0.46	0.54	1.12	0.50	0.00	0.13	0.00	0.34	0.00	0.18	0.00	0.10	100.00
2965CL	1	2	55.23	34.11	1.34	0.38	0.61	4.63	0.06	0.61	0.57	0.44	0.93	0.56	0.00	0.15	0.00	0.26	0.00	0.09	0.00	0.04	100.01
2965CL	1	3	55.39	34.44	1.47	0.19	0.36	4.81	0.07	0.50	0.43	0.47	0.80	0.15	0.00	0.11	0.00	0.26	0.00	0.30	0.22	0.01	99.98
2965CL	2	1	46.12	40.26	1.75	0.31	0.51	7.11	0.08	0.57	0.32	0.64	0.83	0.57	0.00	0.08	0.00	0.41	0.00	0.33	0.00	0.11	100.00
2965CL	2	2	42.93	43.20	1.86	0.36	0.71	7.18	0.06	0.41	0.26	0.58	0.97	0.65	0.00	0.11	0.00	0.40	0.00	0.22	0.00	0.10	100.00
2965CL	2	3	34.72	47.29	2.73	0.34	0.78	9.89	0.03	0.47	0.22	0.82	0.97	0.27	0.00	0.05	0.00	0.61	0.00	0.40	0.40	0.01	100.00
HFU84F	1	1	13.64	59.79	5.15	0.37	1.31	14.65	0.13	0.85	0.17	0.98	1.02	0.00	0.00	0.14	0.00	0.78	0.00	0.44	0.58	0.00	100.00
HFU84F	1	2	34.35	47.98	3.47	0.24	1.10	9.60	0.09	0.61	0.16	0.64	0.70	0.00	0.00	0.05	0.00	0.51	0.00	0.10	0.39	0.00	99.99
HFU84F	1	3	44.42	41.02	2.61	0.24	0.71	7.55	0.08	0.62	0.28	0.57	0.83	0.00	0.00	0.11	0.00	0.42	0.00	0.21	0.35	0.00	100.02
HFU84F	2	1	58.61	31.77	1.57	0.18	0.54	4.59	0.07	0.45	0.46	0.40	0.67	0.00	0.00	0.11	0.00	0.26	0.00	0.11	0.20	0.00	99.99
HFU84F	2	2	46.08	40.72	2.36	0.21	0.64	6.68	0.07	0.48	0.32	0.54	0.79	0.00	0.00	0.09	0.00	0.50	0.00	0.23	0.27	0.00	99.98
HFU84F	2	3	44.27	41.54	2.56	0.28	1.13	7.17	0.00	0.50	0.29	0.52	0.99	0.00	0.00	0.09	0.00	0.39	0.00	0.00	0.26	0.00	99.99
FWX130	1	1	22.65	54.77	4.18	0.36	1.34	12.21	0.13	0.66	0.11	0.73	1.41	0.00	0.00	0.08	0.00	0.60	0.00	0.35	0.42	0.00	100.00
FWX130	1	2	16.26	58.89	4.53	0.34	1.20	13.90	0.11	0.63	0.00	0.77	1.57	0.00	0.00	0.09	0.00	0.68	0.00	0.52	0.49	0.00	99.98
FWX130	1	3	25.57	53.95	3.63	0.37	1.14	11.14	0.09	0.57	0.10	0.65	1.42	0.00	0.00	0.07	0.00	0.54	0.00	0.39	0.36	0.00	99.99
FWX130	2	1	0.00	66.79	7.07	0.41	0.80	18.67	0.13	0.87	0.18	1.17	1.17	0.00	0.00	0.04	0.00	1.05	0.00	0.94	0.71	0.00	100.00
FWX130	2	2	1.32	66.31	6.32	0.40	1.42	17.69	0.17	0.99	0.21	1.19	1.50	0.00	0.00	0.14	0.00	1.04	0.00	0.63	0.65	0.00	99.98
FWX130	2	3	18.08	57.18	4.28	0.00	0.77	13.39	0.17	1.00	0.14	0.93	1.65	0.00	0.00	0.16	0.00	0.89	0.00	0.86	0.52	0.00	100.02
M6AAM6	1	1	11.95	58.56	4.13	0.48	1.41	15.68	0.06	0.66	0.35	1.21	2.64	0.00	0.00	0.13	0.00	1.35	0.00	0.63	0.77	0.00	100.01
M6AAM6	1	2	11.95	58.56	4.13	0.48	1.41	15.68	0.06	0.66	0.35	1.21	2.64	0.00	0.00	0.13	0.00	1.35	0.00	0.63	0.77	0.00	100.01
M6AAM6	1	3	38.05	46.12	2.91	0.24	0.76	8.55	0.04	0.37	0.24	0.52	1.07	0.00	0.00	0.04	0.00	0.43	0.00	0.36	0.30	0.00	100.00
M6AAM6	2	1	49.01	38.38	2.76	0.19	0.47	6.62	0.03	0.46	0.21	0.43	0.60	0.00	0.00	0.04	0.00	0.30	0.00	0.26	0.22	0.00	99.98
M6AAM6	2	2	48.51	39.86	2.19	0.00	0.37	6.31	0.03	0.40	0.33	0.40	0.67	0.00	0.00	0.03	0.00	0.34	0.00	0.32	0.25	0.00	100.01
M6AAM6	2	3	42.85	44.68	2.65	0.21	0.54	6.59	0.03	0.34	0.26	0.37	0.66	0.00	0.00	0.03	0.00	0.31	0.00	0.25	0.20	0.00	99.97
L6159B	1	1	32.22	50.47	3.70	0.00	0.64	9.60	0.03	0.41	0.33	0.61	0.69	0.00	0.00	0.04	0.00	0.49	0.00	0.43	0.34	0.00	100.00
L6159B	1	2	30.31	51.22	3.97	0.00	0.58	10.41	0.03	0.40	0.33	0.68	0.63	0.00	0.00	0.02	0.00	0.57	0.00	0.48	0.38	0.00	100.01
L6159B	1	3	36.54	47.45	3.55	0.00	0.55	8.68	0.06	0.44	0.32	0.58	0.62	0.00	0.00	0.04	0.00	0.45	0.00	0.37	0.34	0.00	99.99
L6159B	2	1	39.91	46.20	3.07	0.00	0.27	7.56	0.03	0.39	0.28	0.43	0.71	0.00	0.00	0.06	0.00	0.32	0.00	0.52	0.25	0.00	100.00
L6159B	2	2	39.27	45.68	3.15	0.20	0.55	8.12	0.04	0.39	0.28	0.49	0.79	0.00	0.00	0.04	0.00	0.34	0.00	0.39	0.27	0.00	100.00
L6159B	2	3	34.25	49.07	3.70	0.00	0.37	9.04	0.03	0.53	0.33	0.53	0.77	0.00	0.00	0.06	0.00	0.44	0.00	0.57	0.30	0.00	99.99
CE9B19	1	1	47.31	40.45	2.11	0.00	0.50	6.73	0.04	0.37	0.28	0.54	0.70	0.00	0.00	0.08	0.00	0.33	0.00	0.33	0.25	0.00	100.02
CE9B19	1	2	47.08	41.60	1.92	0.00	0.43	6.06	0.06	0.37	0.27	0.43	0.76	0.00	0.00	0.06	0.00	0.31	0.00	0.43	0.21	0.00	99.99

CE9B19	1	3	47.37	40.25	1.92	0.22	0.80	6.31	0.02	0.46	0.26	0.42	1.11	0.00	0.00	0.12	0.00	0.31	0.00	0.23	0.20	0.00	100.00
CE9B19	2	1	47.76	40.33	2.06	0.00	0.57	6.48	0.05	0.39	0.21	0.47	0.76	0.00	0.00	0.06	0.00	0.35	0.00	0.29	0.21	0.00	99.99
CE9B19	2	2	47.64	40.14	2.14	0.00	0.57	6.45	0.06	0.46	0.27	0.50	0.74	0.00	0.00	0.08	0.00	0.38	0.00	0.35	0.22	0.00	100.00
CE9B19	2	3	48.81	39.39	2.29	0.00	0.60	6.44	0.06	0.28	0.23	0.52	0.52	0.00	0.00	0.05	0.00	0.35	0.00	0.21	0.25	0.00	100.00
27QR6F	1	1	0.00	69.86	5.66	0.00	0.74	18.38	0.04	0.14	0.35	1.08	1.18	0.00	0.00	0.00	0.00	0.95	0.00	0.98	0.64	0.00	100.00
27QR6F	1	2	0.00	69.97	5.80	0.00	1.14	18.48	0.02	0.00	0.26	1.06	0.97	0.00	0.00	0.02	0.00	0.96	0.00	0.64	0.68	0.00	100.00
27QR6F	1	3	0.00	69.90	5.80	0.00	1.18	18.43	0.00	0.00	0.27	1.03	1.15	0.00	0.00	0.03	0.00	0.89	0.00	0.67	0.66	0.00	100.01
27QR6F	2	1	39.80	45.14	2.92	0.21	0.89	8.02	0.03	0.19	0.35	0.52	0.96	0.00	0.00	0.04	0.00	0.47	0.00	0.16	0.31	0.00	100.01
27QR6F	2	2	31.45	49.69	3.49	0.30	0.92	10.40	0.01	0.24	0.32	0.65	1.09	0.00	0.00	0.09	0.00	0.62	0.00	0.31	0.42	0.00	100.00
27QR6F	2	3	39.86	45.27	2.59	0.25	0.94	8.09	0.01	0.22	0.29	0.47	1.09	0.00	0.00	0.04	0.00	0.42	0.00	0.17	0.29	0.00	100.00
JGFDGG	1	1	57.54	33.38	2.02	0.14	0.46	4.09	0.04	0.68	0.35	0.38	0.41	0.00	0.00	0.06	0.00	0.18	0.00	0.12	0.15	0.00	100.00
JGFDGG	1	2	54.44	35.32	2.12	0.20	0.37	4.97	0.04	0.66	0.23	0.40	0.46	0.00	0.00	0.08	0.00	0.26	0.00	0.28	0.18	0.00	100.01
JGFDGG	1	3	58.02	33.24	1.85	0.15	0.58	3.81	0.06	0.64	0.36	0.35	0.45	0.00	0.00	0.07	0.00	0.19	0.00	0.09	0.13	0.00	99.99
JGFDGG	2	1	50.98	38.73	2.32	0.15	0.52	5.11	0.04	0.52	0.21	0.37	0.42	0.00	0.00	0.06	0.00	0.22	0.00	0.20	0.16	0.00	100.01
JGFDGG	2	2	50.49	38.07	2.34	0.21	0.65	5.46	0.03	0.70	0.32	0.42	0.61	0.00	0.00	0.08	0.00	0.26	0.00	0.19	0.16	0.00	99.99
JGFDGG	2	3	53.51	35.53	2.07	0.23	0.77	5.26	0.05	0.61	0.34	0.41	0.59	0.00	0.00	0.09	0.00	0.26	0.00	0.10	0.19	0.00	100.01
FTRT75	1	1	66.05	28.66	0.89	0.21	0.43	1.65	0.06	0.33	0.76	0.28	0.43	0.07	0.00	0.09	0.00	0.10	0.00	0.00	0.00	0.00	100.01
FTRT75	1	2	66.84	28.91	0.87	0.10	0.14	1.02	0.04	0.31	0.93	0.26	0.32	0.05	0.00	0.06	0.00	0.06	0.00	0.10	0.00	0.00	100.01
FTRT75	1	3	66.64	28.93	0.73	0.14	0.26	1.24	0.06	0.31	0.82	0.28	0.37	0.05	0.00	0.06	0.00	0.08	0.00	0.04	0.00	0.00	100.01
FTRT75	2	1	52.05	36.08	2.05	0.19	0.61	6.26	0.06	0.46	0.10	0.46	0.79	0.00	0.00	0.10	0.00	0.36	0.00	0.17	0.25	0.00	99.99
FTRT75	2	2	46.06	40.11	2.48	0.21	0.68	7.43	0.07	0.39	0.08	0.51	0.82	0.00	0.00	0.08	0.00	0.52	0.00	0.22	0.31	0.00	99.97
FTRT75	2	3	42.28	42.91	2.67	0.24	0.88	8.09	0.06	0.43	0.08	0.50	0.90	0.00	0.00	0.07	0.00	0.44	0.00	0.16	0.29	0.00	100.00
WAQE67	1	1	23.70	51.47	3.52	0.37	0.74	13.86	0.05	0.56	0.15	1.01	1.86	0.00	0.00	0.16	0.00	1.14	0.00	0.72	0.68	0.00	99.99
WAQE67	1	2	36.99	44.61	2.73	0.27	0.85	10.11	0.07	0.48	0.17	0.78	1.29	0.00	0.00	0.08	0.00	0.73	0.00	0.36	0.49	0.00	100.01
WAQE67	1	3	35.13	44.66	2.84	0.27	0.53	11.11	0.06	0.55	0.22	0.91	1.38	0.00	0.00	0.13	0.00	1.03	0.00	0.59	0.58	0.00	99.99
WAQE67	2	1	43.43	41.59	2.32	0.24	0.85	8.12	0.06	0.52	0.08	0.56	1.10	0.00	0.00	0.10	0.00	0.49	0.00	0.24	0.30	0.00	100.00
WAQE67	2	2	39.83	44.38	2.61	0.22	0.81	8.62	0.07	0.47	0.10	0.57	1.07	0.00	0.00	0.13	0.00	0.50	0.00	0.28	0.33	0.00	99.99
WAQE67	2	3	41.06	43.72	2.79	0.20	0.84	8.32	0.04	0.47	0.08	0.59	0.80	0.00	0.00	0.10	0.00	0.50	0.00	0.16	0.32	0.00	99.99
75G8FW	1	1	0.00	55.77	5.73	0.00	1.00	26.62	0.12	1.23	0.00	2.37	2.22	0.00	0.00	0.07	0.00	2.34	0.00	1.07	1.45	0.00	99.99
75G8FW	1	2	0.00	65.54	6.50	0.00	1.16	20.05	0.16	0.82	0.16	1.42	1.21	0.00	0.00	0.07	0.00	1.29	0.00	0.75	0.87	0.00	100.00
75G8FW	1	3	25.05	56.26	4.19	0.00	0.58	10.55	0.06	0.50	0.00	0.66	0.61	0.00	0.00	0.00	0.00	0.62	0.00	0.54	0.37	0.00	99.99
75G8FW	2	1	5.84	64.90	6.27	0.00	0.61	17.02	0.11	0.66	0.00	1.08	1.00	0.00	0.00	0.08	0.00	0.88	0.00	0.96	0.61	0.00	100.02
75G8FW	2	2	28.88	50.86	4.38	0.28	1.07	10.99	0.10	0.65	0.00	0.76	0.68	0.00	0.00	0.09	0.00	0.63	0.00	0.21	0.42	0.00	100.00
75G8FW	2	3	27.78	52.19	4.02	0.28	0.97	11.16	0.10	0.59	0.00	0.68	0.88	0.00	0.00	0.06	0.00	0.52	0.00	0.36	0.40	0.00	99.99
U44MXV	1	1	50.25	38.44	1.58	0.14	0.82	5.47	0.05	0.35	0.43	0.46	1.33	0.00	0.00	0.08	0.00	0.29	0.00	0.11	0.19	0.00	99.99
U44MXV	1	2	47.49	40.07	1.82	0.16	0.75	6.62	0.04	0.28	0.26	0.53	1.08	0.00	0.00	0.09	0.00	0.36	0.00	0.20	0.24	0.00	99.99
U44MXV	1	3	45.45	41.95	1.74	0.00	0.68	6.89	0.03	0.26	0.26	0.49	1.31	0.00	0.00	0.03	0.00	0.35	0.00	0.33	0.23	0.00	100.00
U44MXV	2	1	57.39	32.76	1.43	0.17	0.63	4.31	0.05	0.49	0.65	0.49	1.01	0.00	0.00	0.12	0.00	0.28	0.00	0.06	0.17	0.00	100.01
U44MXV	2	2	63.59	28.92	0.96	0.15	0.42	2.58	0.04	0.44	0.83	0.38	1.10	0.00	0.00	0.11	0.00	0.20	0.00	0.14	0.13	0.00	99.99
U44MXV	2	3	58.37	31.44	1.15	0.19	0.54	4.04	0.05	0.54	0.81	0.54	1.50	0.00	0.00	0.13	0.00	0.32	0.00	0.17	0.21	0.00	100.00
MB6LV1	1	1	44.92	40.82	2.94	0.00	0.64	7.60	0.05	0.57	0.08	0.52	0.75	0.00	0.00	0.04	0.00	0.47	0.00	0.29	0.29	0.00	99.98
MB6LV1	1	2	48.09	38.85	2.77	0.00	0.59	7.05	0.06	0.50	0.08	0.49	0.52	0.00	0.00	0.04	0.00	0.42	0.00	0.25	0.29	0.00	100.00
MB6LV1	1	3	47.32	39.35	2.89	0.00	0.42	7.38	0.03	0.42	0.08	0.52	0.47	0.00	0.00	0.04	0.00	0.44	0.00	0.34	0.32	0.00	100.02
MB6LV1	2	1	40.99	44.36	2.94	0.00	0.45	8.15	0.04	0.43	0.11	0.53	0.81	0.00	0.00	0.05	0.00	0.42	0.00	0.45	0.27	0.00	100.00
MB6LV1	2	2	44.85	42.14	2.79	0.00	0.43	7.02	0.06	0.47	0.13	0.48	0.62	0.00	0.00	0.06	0.00	0.35	0.00	0.38	0.24	0.00	100.02
MB6LV1	2	3	48.64	39.95	2.51	0.00	0.41	5.99	0.04	0.49	0.09	0.39	0.61	0.00	0.00	0.02	0.00	0.33	0.00	0.32	0.21	0.00	100.00
NM81X7	1	1	44.89	42.50	2.11	0.19	0.61	6.70	0.06	0.33	0.36	0.56	0.81	0.00	0.00	0.08	0.00	0.38	0.00	0.16	0.25	0.00	99.99
NM81X7	1	2	46.27	40.15	2.04	0.18	0.54	7.58	0.03	0.35	0.26	0.66	0.78	0.00	0.00	0.07	0.00	0.51	0.00	0.25	0.33	0.00	100.00
NM81X7	1	3	54.39	35.60	1.67	0.00	0.20	5.49	0.02	0.26	0.31	0.47	0.61	0.00	0.00	0.06	0.00	0.39	0.00	0.31	0.22	0.00	100.00
NM81X7	2	1	27.01	52.36	3.25	0.00	0.83	12.24	0.02	0.26	0.18	0.92	1.14	0.00	0.00	0.03	0.00	0.82	0.00	0.40	0.52	0.00	99.98

NM81X7	2	2	0.00	66.97	5.71	0.00	0.56	19.95	0.00	0.44	0.25	1.55	1.31	0.00	0.00	0.04	0.00	1.40	0.00	0.96	0.86	0.00	100.00
NM81X7	2	3	33.21	48.75	3.03	0.00	0.52	10.80	0.02	0.27	0.16	0.96	0.71	0.00	0.00	0.04	0.00	0.69	0.00	0.36	0.48	0.00	100.00
85HXNS	1	1	42.00	46.12	2.50	0.00	0.44	6.99	0.03	0.16	0.11	0.46	0.36	0.00	0.00	0.00	0.00	0.34	0.00	0.26	0.23	0.00	100.00
85HXNS	1	2	27.25	55.04	3.59	0.00	0.70	10.52	0.00	0.25	0.11	0.69	0.53	0.00	0.00	0.03	0.00	0.48	0.00	0.44	0.36	0.00	99.99
85HXNS	1	3	30.93	51.94	3.22	0.30	1.07	9.73	0.03	0.23	0.12	0.58	0.72	0.00	0.00	0.06	0.00	0.50	0.00	0.25	0.31	0.00	99.99
85HXNS	2	1	31.39	52.33	3.27	0.00	0.71	9.57	0.02	0.25	0.11	0.60	0.56	0.00	0.00	0.03	0.00	0.45	0.00	0.39	0.31	0.00	99.99
85HXNS	2	2	46.60	42.53	2.34	0.00	0.56	6.30	0.02	0.14	0.07	0.45	0.28	0.00	0.00	0.02	0.00	0.34	0.00	0.12	0.23	0.00	100.00
85HXNS	2	3	26.56	54.62	4.04	0.00	0.66	10.99	0.03	0.30	0.10	0.76	0.50	0.00	0.00	0.05	0.00	0.56	0.00	0.47	0.35	0.00	99.99
2D152A	1	1	14.76	60.63	4.40	0.38	1.40	13.95	0.02	0.22	0.37	0.78	1.45	0.00	0.00	0.03	0.00	0.78	0.00	0.31	0.52	0.00	100.00
2D152A	1	2	31.16	51.18	3.36	0.00	0.60	10.32	0.03	0.15	0.20	0.61	0.96	0.00	0.00	0.03	0.00	0.53	0.00	0.50	0.37	0.00	100.00
2D152A	1	3	27.85	53.81	3.58	0.00	0.64	10.81	0.00	0.17	0.22	0.59	0.91	0.00	0.00	0.01	0.00	0.55	0.00	0.49	0.36	0.00	99.99
2D152A	2	1	43.36	43.75	2.25	0.00	0.53	7.37	0.03	0.32	0.13	0.48	0.78	0.00	0.00	0.03	0.00	0.37	0.00	0.38	0.25	0.00	100.03
2D152A	2	2	35.49	47.75	2.92	0.25	0.89	9.25	0.04	0.44	0.17	0.60	1.04	0.00	0.00	0.05	0.00	0.49	0.00	0.30	0.33	0.00	100.01
2D152A	2	3	33.93	49.32	2.97	0.22	0.71	9.45	0.05	0.46	0.22	0.57	0.95	0.00	0.00	0.02	0.00	0.43	0.00	0.35	0.35	0.00	100.00
BHU548	1	1	61.46	30.42	1.19	0.17	0.49	3.70	0.07	0.58	0.21	0.37	0.75	0.00	0.00	0.10	0.00	0.27	0.00	0.06	0.16	0.00	100.00
BHU548	1	3	61.38	28.54	1.37	0.16	0.58	4.60	0.10	0.79	0.30	0.44	0.97	0.00	0.00	0.16	0.00	0.27	0.00	0.12	0.21	0.00	99.99
BHU548	2	1	57.30	32.82	1.54	0.16	0.63	4.66	0.07	0.62	0.27	0.40	0.87	0.00	0.00	0.09	0.00	0.30	0.00	0.08	0.20	0.00	100.01
BHU548	2	2	58.22	32.95	1.40	0.21	0.40	4.09	0.07	0.62	0.25	0.39	0.68	0.00	0.00	0.11	0.00	0.27	0.00	0.17	0.18	0.00	100.01
BHU548	2	3	54.61	34.22	1.57	0.20	0.64	5.35	0.07	0.73	0.29	0.61	0.82	0.00	0.00	0.23	0.00	0.30	0.00	0.14	0.23	0.00	100.01
CP163W	1	1	38.00	45.61	3.40	0.00	0.35	9.15	0.00	0.44	0.17	0.64	0.75	0.00	0.00	0.05	0.00	0.54	0.00	0.53	0.37	0.00	100.00
CP163W	1	2	44.99	41.09	2.69	0.00	0.77	7.41	0.03	0.52	0.20	0.50	0.84	0.00	0.00	0.07	0.00	0.43	0.00	0.18	0.29	0.00	100.01
CP163W	1	3	38.73	44.43	3.64	0.25	0.91	8.57	0.05	0.65	0.25	0.53	0.92	0.00	0.00	0.05	0.00	0.53	0.00	0.18	0.31	0.00	100.00
CP163W	2	1	35.65	48.48	3.56	0.00	0.23	8.68	0.04	0.52	0.24	0.53	0.62	0.00	0.00	0.05	0.00	0.48	0.00	0.60	0.31	0.00	99.99
CP163W	2	2	34.09	49.87	3.46	0.00	0.38	8.90	0.02	0.47	0.15	0.51	0.84	0.00	0.00	0.06	0.00	0.39	0.00	0.57	0.29	0.00	100.00
CP163W	2	3	36.84	47.48	3.40	0.25	1.12	8.25	0.02	0.42	0.14	0.49	0.88	0.00	0.00	0.04	0.00	0.37	0.00	0.03	0.26	0.00	99.99
PL2IX1	1	1	21.27	57.31	4.06	0.36	1.33	11.80	0.03	0.34	0.18	0.62	1.52	0.00	0.00	0.05	0.00	0.48	0.00	0.28	0.38	0.00	100.01
PL2IX1	1	2	27.92	53.26	3.29	0.31	0.95	10.71	0.03	0.31	0.17	0.53	1.33	0.00	0.00	0.01	0.00	0.45	0.00	0.39	0.35	0.00	100.01
PL2IX1	1	3	20.29	58.00	4.32	0.33	1.17	12.37	0.00	0.30	0.20	0.63	1.12	0.00	0.00	0.00	0.00	0.53	0.00	0.34	0.40	0.00	100.00
PL2IX1	2	1	51.14	37.87	2.32	0.16	0.42	5.64	0.02	0.52	0.21	0.42	0.55	0.00	0.00	0.05	0.00	0.26	0.00	0.24	0.18	0.00	100.00
PL2IX1	2	2	57.61	32.97	1.88	0.00	0.28	4.66	0.04	0.55	0.29	0.39	0.55	0.00	0.00	0.06	0.00	0.28	0.00	0.25	0.18	0.00	99.99
PL2IX1	2	3	56.33	34.52	1.82	0.00	0.33	4.67	0.03	0.44	0.26	0.36	0.56	0.00	0.00	0.05	0.00	0.24	0.00	0.23	0.15	0.00	99.99
T007ML	1	1	20.76	57.58	3.13	0.00	0.85	12.36	0.04	0.28	0.34	0.77	2.00	0.00	0.00	0.04	0.00	0.72	0.00	0.74	0.38	0.00	99.99
T007ML	1	2	1.22	68.52	5.17	0.00	1.12	17.71	0.04	0.33	0.38	1.22	1.81	0.00	0.00	0.05	0.00	1.13	0.00	0.61	0.69	0.00	100.00
T007ML	1	3	9.81	62.66	4.11	0.00	0.99	16.29	0.00	0.23	0.24	1.17	1.99	0.00	0.00	0.04	0.00	0.99	0.00	0.81	0.67	0.00	100.00
T007ML	2	1	43.95	41.52	1.88	0.00	0.58	8.11	0.04	0.21	0.34	0.68	1.29	0.00	0.00	0.05	0.00	0.61	0.00	0.35	0.39	0.00	100.00
T007ML	2	2	16.38	56.93	3.87	0.00	0.35	15.72	0.08	0.46	0.53	1.33	1.49	0.00	0.00	0.09	0.00	1.02	0.00	1.06	0.69	0.00	100.00
T007ML	2	3	33.92	47.92	3.15	0.00	0.57	10.22	0.05	0.42	0.52	0.89	0.85	0.00	0.00	0.07	0.00	0.66	0.00	0.32	0.44	0.00	100.00
DR87FE	1	1	67.22	27.69	0.73	0.16	0.39	1.34	0.12	0.43	0.91	0.27	0.47	0.08	0.00	0.09	0.00	0.09	0.00	0.00	0.00	0.00	99.99
DR87FE	1	2	66.81	27.78	0.79	0.17	0.38	1.17	0.17	0.52	1.10	0.31	0.56	0.05	0.00	0.10	0.00	0.09	0.00	0.00	0.00	0.00	100.00
DR87FE	1	3	69.62	25.79	0.80	0.17	0.26	0.87	0.10	0.47	1.05	0.26	0.45	0.05	0.00	0.08	0.00	0.00	0.00	0.04	0.00	0.00	100.01
DR87FE	2	1	0.00	67.07	5.64	0.47	2.54	18.39	0.09	0.48	0.17	1.03	2.19	0.00	0.00	0.06	0.00	1.16	0.00	0.04	0.68	0.00	100.01
DR87FE	2	2	32.67	48.61	3.71	0.00	0.32	10.55	0.13	0.57	0.14	0.71	0.80	0.00	0.00	0.10	0.00	0.58	0.00	0.70	0.41	0.00	100.00
DR87FE	2	3	23.72	54.36	4.43	0.00	0.57	12.72	0.10	0.43	0.18	0.79	0.82	0.00	0.00	0.06	0.00	0.71	0.00	0.64	0.49	0.00	100.02
HFD9LM	1	1	48.90	39.55	2.15	0.00	0.51	6.29	0.05	0.49	0.10	0.44	0.63	0.00	0.00	0.07	0.00	0.29	0.00	0.30	0.22	0.00	99.99
HFD9LM	1	2	47.88	40.09	2.44	0.16	0.69	6.27	0.05	0.49	0.11	0.48	0.54	0.00	0.00	0.12	0.00	0.33	0.00	0.13	0.23	0.00	100.01
HFD9LM	1	3	50.23	38.80	2.02	0.00	0.49	5.87	0.04	0.45	0.12	0.41	0.69	0.00	0.00	0.09	0.00	0.27	0.00	0.29	0.21	0.00	99.98
HFD9LM	2	1	52.42	36.53	2.20	0.00	0.41	5.89	0.03	0.52	0.13	0.46	0.55	0.00	0.00	0.07	0.00	0.24	0.00	0.33	0.21	0.00	99.99
HFD9LM	2	2	55.54	34.22	2.20	0.14	0.50	5.16	0.05	0.53	0.13	0.43	0.40	0.00	0.00	0.09	0.00	0.25	0.00	0.17	0.19	0.00	100.00
HFD9LM	2	3	57.29	32.89	1.90	0.15	0.47	4.85	0.06	0.60	0.13	0.40	0.56	0.00	0.00	0.09	0.00	0.24	0.00	0.19	0.17	0.00	99.99
3Q5J9L	1	1	67.56	27.60	1.02	0.23	0.29	0.82	0.10	0.43	1.06	0.24	0.43	0.05	0.00	0.12	0.00	0.00	0.00	0.04	0.00	0.00	99.99

3Q5J9L	1	2	67.01	27.76	1.08	0.22	0.23	0.87	0.08	0.49	1.24	0.28	0.47	0.04	0.00	0.15	0.00	0.00	0.00	0.09	0.01	0.00	100.02
3Q5J9L	1	3	66.42	28.16	1.22	0.19	0.35	0.87	0.06	0.52	1.22	0.30	0.49	0.05	0.00	0.10	0.00	0.00	0.00	0.04	0.00	0.00	99.99
3Q5J9L	2	1	63.48	26.18	1.49	0.22	0.95	3.70	0.09	0.79	0.79	0.49	1.01	0.00	0.00	0.22	0.00	0.38	0.00	0.00	0.21	0.00	100.00
3Q5J9L	2	2	63.25	27.70	1.19	0.17	0.60	3.04	0.10	0.67	0.99	0.52	0.96	0.04	0.00	0.24	0.00	0.28	0.00	0.08	0.17	0.00	100.00
3Q5J9L	2	3	64.82	28.91	1.16	0.18	0.49	1.85	0.07	0.46	0.84	0.30	0.47	0.00	0.00	0.12	0.02	0.15	0.00	0.08	0.07	0.00	99.99
6025ES	1	1	42.33	42.96	2.50	0.28	0.79	7.50	0.11	0.62	0.29	0.59	0.94	0.00	0.00	0.13	0.00	0.41	0.00	0.28	0.28	0.00	100.01
6025ES	1	2	49.36	38.14	1.90	0.19	0.70	6.49	0.10	0.56	0.22	0.52	0.86	0.00	0.00	0.11	0.00	0.41	0.00	0.18	0.25	0.00	99.99
6025ES	1	3	6.58	63.78	5.07	0.48	1.65	16.73	0.15	0.64	0.16	1.14	1.50	0.00	0.00	0.16	0.00	0.91	0.00	0.45	0.60	0.00	100.00
6025ES	2	1	14.93	59.34	4.74	0.00	0.56	15.06	0.14	0.55	0.10	0.99	1.20	0.00	0.00	0.10	0.00	0.86	0.00	0.87	0.57	0.00	100.01
6025ES	2	2	17.83	57.89	4.33	0.36	1.47	13.53	0.12	0.53	0.09	0.86	1.44	0.00	0.00	0.10	0.00	0.72	0.00	0.26	0.49	0.00	100.02
6025ES	2	3	28.38	52.40	3.84	0.31	1.14	10.45	0.12	0.48	0.08	0.66	0.96	0.00	0.00	0.08	0.00	0.52	0.00	0.21	0.36	0.00	99.99
IU74E2	1	1	26.59	53.69	3.12	0.25	1.30	11.12	0.04	0.25	0.15	0.82	1.28	0.00	0.00	0.07	0.00	0.65	0.00	0.28	0.41	0.00	100.02
IU74E2	1	2	30.97	51.30	2.78	0.29	1.13	9.84	0.02	0.25	0.14	0.74	1.22	0.00	0.00	0.08	0.00	0.57	0.00	0.32	0.36	0.00	100.01
IU74E2	1	3	24.91	54.41	3.00	0.41	1.37	11.65	0.07	0.25	0.12	0.82	1.44	0.00	0.00	0.10	0.00	0.60	0.00	0.41	0.42	0.00	99.98
IU74E2	2	1	46.03	41.17	2.02	0.00	0.47	7.16	0.03	0.29	0.22	0.60	0.78	0.00	0.00	0.10	0.00	0.41	0.00	0.43	0.29	0.00	100.00
IU74E2	2	2	54.70	35.12	1.42	0.16	0.71	5.36	0.03	0.27	0.23	0.49	0.71	0.00	0.00	0.09	0.00	0.34	0.00	0.14	0.24	0.00	100.01
IU74E2	2	3	44.13	42.43	1.92	0.28	1.17	7.32	0.03	0.22	0.16	0.53	0.98	0.00	0.00	0.07	0.00	0.41	0.00	0.10	0.26	0.00	100.01
U5D8UN	1	1	55.91	35.25	1.81	0.07	0.51	4.43	0.01	0.35	0.21	0.38	0.48	0.00	0.00	0.05	0.00	0.26	0.00	0.11	0.16	0.00	99.99
U5D8UN	1	2	45.03	41.96	2.47	0.12	0.76	6.78	0.04	0.40	0.24	0.53	0.82	0.00	0.00	0.07	0.00	0.37	0.00	0.15	0.25	0.00	99.99
U5D8UN	1	3	46.17	41.10	2.17	0.17	0.66	6.88	0.02	0.32	0.18	0.50	0.94	0.00	0.00	0.06	0.00	0.34	0.00	0.26	0.23	0.00	100.00
U5D8UN	2	1	49.66	39.07	2.17	0.08	0.61	5.94	0.03	0.28	0.26	0.46	0.61	0.00	0.00	0.07	0.00	0.34	0.00	0.19	0.22	0.00	99.99
U5D8UN	2	2	50.12	39.12	2.14	0.09	0.63	5.73	0.04	0.26	0.19	0.41	0.59	0.00	0.00	0.05	0.00	0.29	0.00	0.14	0.20	0.00	100.00
U5D8UN	2	3	51.83	37.83	2.03	0.07	0.57	5.68	0.02	0.24	0.14	0.42	0.50	0.00	0.00	0.05	0.00	0.28	0.00	0.15	0.20	0.00	100.01
AA61L3	1	1	43.75	42.91	3.12	0.17	0.57	7.11	0.02	0.42	0.14	0.47	0.50	0.00	0.00	0.00	0.00	0.36	0.00	0.21	0.25	0.00	100.00
AA61L3	1	2	42.64	43.65	3.18	0.15	0.65	7.35	0.03	0.40	0.13	0.47	0.48	0.00	0.00	0.04	0.00	0.40	0.00	0.17	0.26	0.00	100.00
AA61L3	1	3	38.61	45.58	3.53	0.18	0.72	8.70	0.02	0.44	0.13	0.57	0.51	0.00	0.00	0.02	0.00	0.47	0.00	0.21	0.32	0.00	100.01
AA61L3	2	1	56.02	33.21	2.39	0.12	0.39	5.58	0.03	0.60	0.09	0.43	0.36	0.00	0.00	0.04	0.00	0.33	0.00	0.20	0.22	0.00	100.01
AA61L3	2	2	49.43	37.56	2.58	0.17	0.60	6.76	0.03	0.73	0.10	0.50	0.63	0.00	0.00	0.05	0.00	0.38	0.00	0.22	0.26	0.00	100.00
AA61L3	2	3	53.51	35.35	2.29	0.15	0.62	5.71	0.02	0.69	0.10	0.43	0.46	0.00	0.00	0.05	0.00	0.31	0.00	0.09	0.22	0.00	100.00
LM6524	1	1	37.34	47.57	3.65	0.17	0.74	7.92	0.01	0.23	0.48	0.47	0.53	0.00	0.00	0.03	0.00	0.40	0.00	0.17	0.28	0.00	99.99
LM6524	1	2	39.11	46.24	3.49	0.17	0.67	7.84	0.00	0.24	0.42	0.45	0.48	0.00	0.00	0.03	0.00	0.40	0.00	0.18	0.27	0.00	99.99
LM6524	1	3	37.33	46.73	3.54	0.22	0.84	8.57	0.02	0.25	0.39	0.48	0.67	0.00	0.00	0.03	0.00	0.47	0.00	0.17	0.29	0.00	100.00
LM6524	2	1	51.90	36.29	2.44	0.21	0.62	5.88	0.04	0.61	0.20	0.44	0.54	0.00	0.00	0.09	0.00	0.32	0.00	0.18	0.22	0.00	99.98
LM6524	2	2	53.03	35.85	2.42	0.20	0.69	5.34	0.04	0.65	0.23	0.43	0.43	0.00	0.00	0.10	0.00	0.28	0.00	0.11	0.20	0.00	100.00
LM6524	2	3	49.89	38.04	2.59	0.19	0.61	5.76	0.04	0.73	0.26	0.48	0.52	0.00	0.00	0.10	0.00	0.34	0.00	0.22	0.23	0.00	100.00
J9GF37	1	1	57.14	33.55	1.62	0.16	0.47	4.81	0.07	0.28	0.34	0.40	0.50	0.00	0.00	0.05	0.00	0.31	0.00	0.10	0.21	0.00	100.01
J9GF37	1	2	58.14	33.17	1.42	0.17	0.35	4.33	0.04	0.26	0.34	0.42	0.53	0.00	0.00	0.03	0.00	0.42	0.00	0.13	0.25	0.00	100.00
J9GF37	1	3	59.02	31.81	1.47	0.17	0.55	4.21	0.08	0.40	0.46	0.47	0.59	0.00	0.00	0.08	0.00	0.39	0.00	0.07	0.24	0.00	100.01
J9GF37	2	1	57.54	31.95	1.61	0.15	0.61	5.48	0.08	0.33	0.32	0.44	0.70	0.00	0.00	0.06	0.00	0.36	0.00	0.13	0.25	0.00	100.01
J9GF37	2	2	56.59	32.90	1.77	0.17	0.54	5.37	0.10	0.34	0.37	0.43	0.63	0.00	0.00	0.06	0.00	0.34	0.00	0.16	0.23	0.00	100.00
J9GF37	2	3	55.47	33.56	1.86	0.19	0.52	5.63	0.09	0.36	0.36	0.45	0.67	0.00	0.00	0.08	0.00	0.33	0.00	0.18	0.24	0.00	99.99
AO354G	1	1	48.74	39.58	2.66	0.00	0.38	6.20	0.04	0.46	0.20	0.43	0.38	0.00	0.00	0.04	0.00	0.36	0.00	0.28	0.24	0.00	99.99
AO354G	1	2	47.13	39.91	2.68	0.19	0.76	6.82	0.03	0.44	0.18	0.44	0.63	0.00	0.00	0.03	0.00	0.40	0.00	0.11	0.25	0.00	100.00
AO354G	1	3	44.65	41.99	3.03	0.19	0.58	7.05	0.03	0.44	0.16	0.46	0.47	0.00	0.00	0.04	0.00	0.42	0.00	0.21	0.27	0.00	99.99
AO354G	2	1	45.37	41.56	2.66	0.17	0.64	7.10	0.02	0.34	0.19	0.46	0.58	0.00	0.00	0.04	0.00	0.39	0.00	0.20	0.26	0.00	99.98
AO354G	2	2	45.04	41.91	2.77	0.19	0.71	6.97	0.03	0.36	0.16	0.44	0.57	0.00	0.00	0.04	0.00	0.38	0.00	0.17	0.26	0.00	100.00
AO354G	2	3	46.64	40.46	2.65	0.18	0.71	6.90	0.04	0.35	0.18	0.47	0.56	0.00	0.00	0.06	0.00	0.40	0.00	0.14	0.27	0.00	100.01
2U1KD6	1	1	63.76	28.62	1.07	0.19	0.43	2.22	0.07	1.18	0.45	0.35	0.92	0.05	0.05	0.43	0.00	0.08	0.00	0.07	0.05	0.00	99.99
2U1KD6	1	2	64.75	27.81	1.18	0.18	0.49	2.67	0.06	0.85	0.33	0.34	0.71	0.02	0.04	0.31	0.00	0.12	0.00	0.06	0.08	0.00	100.00
2U1KD6	1	3	61.42	30.50	1.38	0.18	0.63	2.97	0.06	0.82	0.32	0.35	0.76	0.04	0.04	0.32	0.00	0.12	0.00	0.03	0.08	0.00	100.02

2U1KD6	2	1	58.98	32.13	1.06	0.14	0.67	3.96	0.05	0.70	0.17	0.33	1.09	0.03	0.04	0.23	0.00	0.18	0.00	0.11	0.10	0.00	99.97
2U1KD6	2	2	62.23	29.67	1.42	0.22	0.45	3.25	0.07	0.87	0.18	0.35	0.61	0.02	0.03	0.24	0.00	0.18	0.00	0.11	0.12	0.00	100.02
2U1KD6	2	3	58.10	33.27	1.36	0.16	0.55	3.85	0.07	0.67	0.20	0.35	0.74	0.02	0.03	0.24	0.00	0.17	0.00	0.11	0.11	0.00	100.00
ADJ145	1	1	31.62	49.76	3.87	0.20	1.06	10.44	0.01	0.19	0.32	0.66	0.73	0.00	0.00	0.03	0.00	0.58	0.00	0.15	0.40	0.00	100.02
ADJ145	1	2	30.40	52.32	3.58	0.22	0.88	9.73	0.02	0.11	0.27	0.57	0.81	0.00	0.00	0.00	0.00	0.48	0.00	0.23	0.36	0.00	99.98
ADJ145	1	3	19.42	58.84	4.17	0.30	1.42	12.53	0.02	0.11	0.25	0.73	0.99	0.00	0.00	0.05	0.00	0.59	0.00	0.12	0.43	0.00	99.97
ADJ145	2	1	19.42	58.84	4.17	0.30	1.42	12.53	0.02	0.11	0.25	0.73	0.99	0.00	0.00	0.05	0.00	0.59	0.00	0.12	0.43	0.00	99.97
ADJ145	2	2	8.45	64.30	5.15	0.41	1.63	15.66	0.02	0.18	0.30	0.87	1.53	0.00	0.00	0.03	0.00	0.70	0.00	0.27	0.52	0.00	100.02
ADJ145	2	3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table A-2 FESEM/EDS Data for Incident Filters

Filter_ID	Sample	Spot	C	O	Na	Mg	Al	Si	P	S	Cl	K	Ca	Ti	Fe	Zn	Br	Ba	Cu	Ce	Total
198	1	1	66.11	28.49	0.61	0.19	0.51	1.33	0.08	0.49	0.78	0.31	0.77	0.07	0.15	0.06	0.04	0.00	0.00	0.00	99.99
198	1	2	64.38	28.74	0.70	0.33	0.56	2.50	0.00	0.50	0.66	0.39	0.77	0.00	0.15	0.16	0.07	0.10	0.00	0.00	100.01
198	1	3	66.68	27.55	0.67	0.19	0.34	2.12	0.00	0.43	0.55	0.29	0.70	0.00	0.11	0.12	0.17	0.08	0.00	0.00	100.00
198	2	1	65.65	28.60	0.59	0.28	0.43	2.02	0.00	0.71	0.39	0.28	0.68	0.06	0.14	0.09	0.08	0.00	0.00	0.00	100.00
198	2	2	65.95	28.64	0.60	0.18	0.46	1.54	0.06	0.67	0.52	0.29	0.77	0.06	0.18	0.05	0.04	0.00	0.00	0.00	100.01
198	2	3	66.57	27.73	0.62	0.15	0.48	1.77	0.00	0.73	0.48	0.31	0.74	0.07	0.17	0.09	0.09	0.00	0.00	0.00	100.00
199	1	1	67.39	27.88	0.57	0.19	0.52	1.55	0.05	0.56	0.37	0.25	0.42	0.05	0.13	0.06	0.00	0.00	0.00	0.00	99.99
199	1	2	64.50	29.48	0.82	0.10	0.43	2.59	0.06	0.73	0.15	0.30	0.39	0.00	0.12	0.10	0.12	0.10	0.00	0.00	99.99
199	1	3	60.21	31.82	1.12	0.11	0.51	3.86	0.06	0.84	0.10	0.37	0.42	0.00	0.13	0.19	0.12	0.14	0.00	0.00	100.00
199	2	1	63.65	30.40	0.81	0.18	0.43	2.12	0.06	0.50	0.51	0.30	0.57	0.00	0.17	0.13	0.10	0.08	0.00	0.00	100.01
199	2	2	63.09	27.99	0.97	0.15	0.51	3.47	0.07	0.87	0.56	0.57	0.88	0.00	0.22	0.32	0.14	0.20	0.00	0.00	100.01
199	2	3	62.53	28.46	1.00	0.16	0.50	3.09	0.09	0.75	0.80	0.47	1.26	0.00	0.28	0.26	0.16	0.13	0.06	0.00	100.00
951	1	1	40.36	46.97	2.08	0.00	0.62	7.42	0.02	0.18	0.11	0.51	0.73	0.00	0.03	0.40	0.29	0.28	0.00	0.00	100.00
951	1	2	12.44	62.60	4.14	0.00	1.37	14.75	0.02	0.30	0.14	0.99	1.43	0.00	0.06	0.76	0.51	0.51	0.00	0.00	100.02
951	1	3	29.72	52.38	2.97	0.00	0.87	10.61	0.01	0.25	0.11	0.71	1.05	0.00	0.03	0.53	0.39	0.37	0.00	0.00	100.00
951	2	1	0.00	70.33	6.03	0.00	1.53	18.21	0.00	0.19	0.00	1.17	0.62	0.00	0.00	0.94	0.37	0.62	0.00	0.00	100.01
951	2	2	0.00	68.58	4.91	0.00	1.98	18.59	0.03	0.17	0.00	1.18	2.27	0.00	0.04	1.16	0.43	0.66	0.00	0.00	100.00
951	2	3	0.00	69.18	5.12	0.00	1.49	18.62	0.02	0.18	0.00	1.19	1.81	0.00	0.02	1.06	0.65	0.66	0.00	0.00	100.00
2757	1	1	0.00	68.82	5.50	0.00	1.17	19.24	0.02	0.11	0.00	1.15	1.27	0.00	0.01	1.12	0.85	0.75	0.00	0.00	100.01
2757	1	2	53.47	35.71	1.53	0.00	0.46	6.02	0.03	0.51	0.08	0.50	0.72	0.00	0.07	0.32	0.31	0.23	0.05	0.00	100.01
2757	1	3	61.60	29.82	1.16	0.00	0.35	4.76	0.01	0.47	0.10	0.44	0.50	0.00	0.06	0.29	0.23	0.20	0.00	0.00	99.99
2757	2	1	53.55	35.92	1.73	0.00	0.47	5.81	0.01	0.48	0.10	0.54	0.41	0.00	0.06	0.40	0.24	0.25	0.04	0.00	100.01
2757	2	2	64.24	29.04	0.70	0.08	0.54	3.21	0.04	0.40	0.20	0.29	0.82	0.03	0.07	0.13	0.11	0.09	0.00	0.00	99.99
2757	2	3	65.15	28.38	0.80	0.11	0.47	2.80	0.04	0.48	0.24	0.30	0.74	0.08	0.16	0.00	0.10	0.11	0.04	0.00	100.00
2974	1	1	0.00	68.54	5.83	0.00	1.05	19.17	0.04	0.15	0.05	1.16	1.09	0.00	0.06	1.18	0.96	0.74	0.00	0.00	100.02
2974	1	2	0.00	67.07	5.64	0.00	1.26	20.18	0.03	0.17	0.00	1.35	1.17	0.00	0.09	1.33	0.85	0.87	0.00	0.00	100.01
2974	1	3	0.00	69.15	5.75	0.00	0.99	18.89	0.02	0.14	0.00	1.10	1.23	0.00	0.05	1.02	0.96	0.69	0.00	0.00	99.99
2974	2	1	0.00	68.11	5.61	0.00	1.37	19.10	0.03	0.15	0.09	1.24	1.33	0.00	0.00	1.32	0.84	0.81	0.00	0.00	100.00
2974	2	2	0.00	67.57	5.48	0.36	1.76	19.22	0.04	0.09	0.00	1.16	1.77	0.00	0.06	1.19	0.57	0.72	0.00	0.00	99.99
2974	2	3	0.00	68.82	5.50	0.00	1.17	19.24	0.02	0.11	0.00	1.15	1.27	0.00	0.01	1.12	0.85	0.75	0.00	0.00	100.01
6712	1	1	30.24	50.88	3.31	0.00	0.60	11.22	0.01	0.28	0.15	0.79	0.86	0.00	0.03	0.63	0.56	0.44	0.00	0.00	100.00
6712	1	2	25.46	52.94	3.84	0.00	0.81	12.92	0.01	0.31	0.11	0.93	0.82	0.00	0.05	0.79	0.49	0.52	0.00	0.00	100.00
6712	1	3	38.51	46.48	2.55	0.00	0.56	8.95	0.01	0.22	0.11	0.64	0.67	0.00	0.06	0.49	0.39	0.34	0.00	0.00	99.98
6712	2	1	0.00	69.37	4.99	0.00	1.13	18.70	0.02	0.23	0.12	1.19	1.59	0.00	0.05	0.99	0.96	0.65	0.00	0.00	99.99
6712	2	2	0.00	68.64	5.07	0.52	2.31	18.11	0.04	0.24	0.15	1.10	1.98	0.00	0.05	0.91	0.27	0.61	0.00	0.00	100.00
6712	2	3	0.00	69.00	5.03	0.45	1.85	18.37	0.03	0.21	0.12	1.11	1.71	0.00	0.05	0.92	0.54	0.59	0.00	0.00	99.98
7008	1	1	48.29	40.40	1.44	0.29	0.76	5.91	0.03	0.58	0.07	0.43	0.95	0.03	0.07	0.28	0.27	0.17	0.00	0.00	99.97
7008	1	2	49.84	40.11	1.62	0.13	0.51	5.57	0.02	0.49	0.04	0.45	0.46	0.00	0.04	0.28	0.22	0.20	0.00	0.00	99.98

7008	1	3	50.04	39.58	1.52	0.22	0.72	5.60	0.02	0.50	0.06	0.38	0.68	0.03	0.04	0.24	0.20	0.16	0.00	0.00	99.99
7008	2	1	30.76	51.66	3.20	0.00	0.52	10.38	0.03	0.30	0.09	0.73	0.74	0.00	0.04	0.55	0.60	0.39	0.00	0.00	99.99
7008	2	2	30.86	50.93	3.13	0.26	1.00	10.46	0.02	0.27	0.08	0.73	0.95	0.00	0.04	0.58	0.33	0.37	0.00	0.00	100.01
7008	2	3	35.40	48.96	2.64	0.31	0.99	8.85	0.03	0.22	0.10	0.53	0.94	0.00	0.05	0.41	0.29	0.28	0.00	0.00	100.00
7220	1	1	0.00	68.52	4.97	0.00	1.52	19.01	0.03	0.15	0.00	1.26	1.91	0.00	0.04	1.15	0.75	0.69	0.00	0.00	100.00
7220	1	2	0.00	66.77	5.16	0.00	1.49	19.69	0.05	0.22	0.00	1.49	1.96	0.00	0.04	1.57	0.70	0.85	0.00	0.00	99.99
7220	1	3	0.00	62.26	4.72	0.00	1.72	22.28	0.01	0.00	0.00	1.90	2.91	0.00	0.05	2.27	0.73	1.17	0.00	0.00	100.02
7220	2	1	0.00	69.56	6.02	0.00	1.27	18.41	0.02	0.00	0.19	1.21	1.06	0.00	0.03	0.96	0.63	0.64	0.00	0.00	100.00
7220	2	2	0.00	69.24	5.51	0.00	1.52	18.39	0.02	0.13	0.15	1.25	1.43	0.00	0.04	1.12	0.52	0.67	0.00	0.00	99.99
7220	2	3	0.00	69.28	5.21	0.00	1.57	18.57	0.02	0.13	0.00	1.22	1.66	0.00	0.04	1.06	0.58	0.66	0.00	0.00	100.00
22551	1	1	48.08	40.16	1.92	0.00	0.63	6.80	0.03	0.22	0.14	0.56	0.44	0.00	0.03	0.42	0.27	0.30	0.00	0.00	100.00
22551	1	2	49.64	39.36	1.77	0.15	0.88	5.99	0.03	0.24	0.16	0.49	0.52	0.00	0.04	0.42	0.05	0.26	0.00	0.00	100.00
22551	1	3	45.91	41.74	1.81	0.16	0.81	6.87	0.02	0.23	0.15	0.49	0.86	0.00	0.05	0.40	0.23	0.26	0.00	0.00	99.99
22551	2	1	54.33	34.99	1.78	0.13	0.75	5.82	0.04	0.26	0.15	0.48	0.47	0.00	0.06	0.38	0.12	0.25	0.00	0.00	100.01
22551	2	2	22.73	55.76	3.81	0.00	0.70	12.80	0.01	0.28	0.12	0.89	0.89	0.00	0.05	0.70	0.76	0.50	0.00	0.00	100.00
22551	2	3	44.22	43.13	2.20	0.00	0.50	7.30	0.01	0.25	0.11	0.55	0.55	0.00	0.07	0.44	0.38	0.29	0.00	0.00	100.00
23937	1	1	51.01	36.93	1.78	0.00	0.58	6.76	0.02	0.31	0.14	0.55	0.85	0.00	0.07	0.42	0.31	0.27	0.00	0.00	100.00
23937	1	2	58.69	32.41	1.16	0.13	0.57	4.50	0.04	0.30	0.22	0.40	0.83	0.00	0.10	0.25	0.23	0.18	0.00	0.00	100.01
23937	1	3	48.76	39.49	1.71	0.18	0.76	6.44	0.02	0.25	0.15	0.48	0.88	0.00	0.10	0.35	0.19	0.23	0.00	0.00	99.99
23937	2	1	53.55	36.55	1.59	0.14	0.74	5.25	0.03	0.26	0.17	0.44	0.55	0.00	0.11	0.28	0.14	0.19	0.00	0.00	99.99
23937	2	2	56.91	34.17	1.46	0.16	0.62	4.38	0.05	0.36	0.19	0.39	0.67	0.03	0.11	0.21	0.12	0.15	0.00	0.00	99.98
23937	2	3	60.08	30.91	1.38	0.20	0.47	4.61	0.04	0.35	0.19	0.42	0.55	0.03	0.12	0.28	0.20	0.18	0.00	0.00	100.01
24034	1	1	54.76	35.02	1.45	0.23	0.64	5.30	0.00	0.40	0.19	0.53	0.66	0.00	0.14	0.29	0.18	0.22	0.00	0.00	100.01
24034	1	2	52.92	36.36	1.71	0.19	0.69	5.65	0.00	0.40	0.17	0.54	0.56	0.00	0.14	0.29	0.16	0.22	0.00	0.00	100.00
24034	1	3	57.74	33.38	1.21	0.16	0.53	4.48	0.00	0.38	0.22	0.46	0.68	0.00	0.15	0.25	0.20	0.17	0.00	0.00	100.01
24034	2	1	51.74	37.58	1.30	0.14	0.77	5.65	0.00	0.31	0.14	0.44	1.14	0.00	0.11	0.27	0.22	0.19	0.00	0.00	100.00
24034	2	2	58.94	32.46	1.01	0.22	0.69	4.08	0.00	0.39	0.25	0.42	0.91	0.00	0.16	0.23	0.10	0.14	0.00	0.00	100.00
24034	2	3	60.36	32.32	1.07	0.15	0.52	3.48	0.00	0.37	0.22	0.34	0.67	0.00	0.11	0.18	0.08	0.14	0.00	0.00	100.01
24169	1	1	0.00	68.71	5.52	0.00	1.20	18.80	0.00	0.13	0.08	1.12	1.55	0.05	0.05	1.16	0.94	0.68	0.00	0.00	99.99
24169	1	2	0.00	68.23	5.41	0.37	1.80	18.51	0.01	0.15	0.27	1.09	1.79	0.10	0.06	1.04	0.53	0.66	0.00	0.00	100.02
24169	1	3	0.00	67.99	5.63	0.00	1.18	19.46	0.01	0.15	0.06	1.30	1.20	0.00	0.04	1.22	0.87	0.80	0.10	0.00	100.01
24169	2	1	0.00	68.21	5.37	0.37	1.76	18.86	0.01	0.13	0.00	1.12	1.72	0.00	0.06	1.14	0.57	0.67	0.00	0.00	99.99
24169	2	2	0.00	68.58	5.45	0.00	1.28	19.11	0.01	0.12	0.00	1.17	1.54	0.04	0.05	1.10	0.84	0.71	0.00	0.00	100.00
24169	2	3	0.00	68.14	5.28	0.39	1.69	18.72	0.05	0.13	0.10	1.08	1.95	0.06	0.05	1.04	0.67	0.64	0.00	0.00	99.99
26701	1	1	59.16	32.00	1.20	0.16	0.66	4.39	0.07	0.29	0.30	0.40	0.70	0.08	0.10	0.22	0.13	0.13	0.00	0.00	99.99
26701	1	2	58.75	32.02	1.25	0.00	0.53	4.86	0.05	0.26	0.33	0.49	0.64	0.00	0.08	0.32	0.19	0.22	0.00	0.00	99.99
26701	1	3	52.10	36.41	1.78	0.14	0.54	6.08	0.06	0.31	0.31	0.60	0.65	0.00	0.08	0.37	0.30	0.27	0.00	0.00	100.00
26701	2	1	51.07	37.49	1.22	0.00	0.62	6.16	0.07	0.28	0.23	0.47	1.36	0.00	0.08	0.29	0.43	0.21	0.00	0.00	99.98
26701	2	2	47.30	39.81	1.56	0.00	0.83	7.00	0.04	0.23	0.24	0.50	1.48	0.00	0.10	0.33	0.35	0.25	0.00	0.00	100.02
26701	2	3	47.56	40.80	1.71	0.00	0.74	6.32	0.05	0.20	0.24	0.47	1.00	0.00	0.07	0.35	0.27	0.22	0.00	0.00	100.00

27055	1	1	47.87	39.29	1.83	0.00	0.53	7.11	0.04	0.30	0.30	0.59	0.98	0.00	0.11	0.40	0.37	0.27	0.00	0.00	99.99
27055	1	2	42.71	43.10	2.04	0.00	0.66	8.05	0.05	0.24	0.31	0.66	1.04	0.00	0.12	0.44	0.31	0.29	0.00	0.00	100.02
27055	1	3	47.47	39.94	1.66	0.00	0.70	6.95	0.03	0.23	0.27	0.48	1.23	0.00	0.12	0.34	0.36	0.22	0.00	0.00	100.00
27055	2	1	52.92	36.25	1.45	0.00	0.51	5.92	0.05	0.25	0.30	0.48	0.92	0.00	0.09	0.30	0.32	0.23	0.00	0.00	99.99
27055	2	2	48.34	39.01	1.70	0.00	0.63	7.12	0.03	0.19	0.23	0.52	1.10	0.00	0.09	0.42	0.36	0.26	0.00	0.00	100.00
27055	2	3	40.49	45.06	2.10	0.00	0.52	8.48	0.04	0.22	0.12	0.61	1.05	0.00	0.09	0.38	0.58	0.27	0.00	0.00	100.01
27165	1	1	54.17	36.19	1.24	0.00	0.62	4.92	0.04	0.37	0.21	0.43	1.04	0.00	0.11	0.20	0.26	0.19	0.00	0.00	99.99
27165	1	2	49.20	39.40	1.21	0.00	0.75	6.06	0.03	0.33	0.20	0.44	1.47	0.00	0.11	0.25	0.38	0.17	0.00	0.00	100.00
27165	1	3	55.17	34.96	1.12	0.16	0.68	4.95	0.05	0.35	0.23	0.39	1.19	0.00	0.11	0.19	0.28	0.16	0.00	0.00	99.99
27165	2	1	39.87	45.08	2.50	0.00	0.66	8.33	0.05	0.56	0.15	0.84	0.61	0.00	0.12	0.51	0.34	0.36	0.00	0.00	99.98
27165	2	2	45.34	41.80	2.03	0.00	0.49	6.93	0.07	0.55	0.12	0.67	0.77	0.00	0.14	0.39	0.43	0.27	0.00	0.00	100.00
27165	2	3	49.69	38.18	1.79	0.00	0.67	6.52	0.05	0.55	0.13	0.62	0.74	0.00	0.13	0.35	0.31	0.26	0.00	0.00	99.99
27200	1	1	40.25	45.71	2.27	0.00	0.65	8.18	0.00	0.24	0.13	0.53	0.91	0.00	0.06	0.40	0.38	0.30	0.00	0.00	100.01
27200	1	2	39.34	46.08	2.38	0.00	0.80	8.42	0.00	0.24	0.12	0.57	0.93	0.00	0.06	0.49	0.27	0.30	0.00	0.00	100.00
27200	1	3	30.50	51.76	2.46	0.00	1.28	10.27	0.00	0.23	0.10	0.63	1.56	0.00	0.06	0.52	0.27	0.35	0.00	0.00	99.99
27200	2	1	54.07	35.85	1.58	0.12	0.55	5.12	0.00	0.52	0.17	0.46	0.77	0.00	0.10	0.30	0.20	0.19	0.00	0.00	100.00
27200	2	2	58.23	32.85	1.28	0.19	0.50	4.40	0.00	0.49	0.25	0.47	0.64	0.00	0.10	0.25	0.15	0.19	0.00	0.00	99.99
27200	2	3	52.66	37.03	1.74	0.18	0.58	5.38	0.00	0.48	0.22	0.49	0.51	0.00	0.09	0.31	0.12	0.21	0.00	0.00	100.00
27390	1	1	62.09	31.78	0.85	0.15	0.51	2.57	0.04	0.39	0.29	0.31	0.54	0.16	0.11	0.11	0.08	0.00	0.00	0.03	100.01
27390	1	2	57.93	32.54	1.39	0.15	0.63	4.93	0.05	0.44	0.14	0.52	0.54	0.05	0.12	0.26	0.12	0.18	0.00	0.00	99.99
27390	1	3	58.92	31.79	1.32	0.17	0.58	4.66	0.06	0.49	0.18	0.47	0.57	0.08	0.14	0.26	0.14	0.16	0.00	0.00	99.99
27390	2	1	61.90	30.63	0.94	0.14	0.57	3.38	0.05	0.40	0.31	0.38	0.68	0.19	0.13	0.15	0.11	0.00	0.00	0.04	100.00
27390	2	2	59.04	31.75	1.22	0.17	0.56	4.46	0.07	0.49	0.26	0.49	0.68	0.05	0.16	0.26	0.19	0.15	0.00	0.00	100.00
27390	2	3	67.36	25.78	0.84	0.16	0.41	2.85	0.06	0.54	0.40	0.42	0.57	0.06	0.17	0.17	0.11	0.11	0.00	0.00	100.01
27420	1	1	42.89	43.20	2.11	0.00	0.58	7.97	0.05	0.25	0.20	0.61	0.88	0.00	0.09	0.46	0.42	0.29	0.00	0.00	100.00
27420	1	2	46.65	41.38	2.05	0.00	0.62	6.80	0.03	0.19	0.21	0.53	0.66	0.00	0.06	0.35	0.20	0.27	0.00	0.00	100.00
27420	1	3	45.91	41.14	2.01	0.00	0.39	7.50	0.03	0.19	0.27	0.62	0.68	0.00	0.09	0.47	0.39	0.31	0.00	0.00	100.00
27420	2	1	46.80	41.41	1.80	0.00	0.47	6.80	0.03	0.17	0.18	0.54	0.75	0.00	0.05	0.38	0.37	0.26	0.00	0.00	100.01
27420	2	2	49.73	39.63	1.81	0.00	0.52	6.09	0.02	0.18	0.25	0.48	0.44	0.00	0.08	0.32	0.21	0.24	0.00	0.00	100.00
27420	2	3	46.01	41.41	2.32	0.00	0.56	7.26	0.03	0.23	0.13	0.61	0.44	0.00	0.06	0.41	0.24	0.29	0.00	0.00	100.00
27559	1	1	32.35	51.03	2.77	0.00	0.90	9.62	0.04	0.27	0.09	0.71	0.93	0.00	0.04	0.55	0.34	0.36	0.00	0.00	100.00
27559	1	2	33.26	50.14	2.49	0.00	0.73	9.87	0.00	0.25	0.09	0.67	1.10	0.00	0.05	0.52	0.48	0.36	0.00	0.00	100.01
27559	1	3	30.97	52.05	2.54	0.00	1.11	9.77	0.03	0.28	0.13	0.63	1.37	0.00	0.00	0.45	0.33	0.34	0.00	0.00	100.00
27559	2	1	23.86	55.78	3.38	0.00	0.98	11.96	0.05	0.29	0.14	0.87	1.07	0.00	0.04	0.71	0.43	0.45	0.00	0.00	100.01
27559	2	2	28.57	53.62	2.80	0.00	1.10	10.45	0.03	0.28	0.10	0.76	1.00	0.00	0.04	0.58	0.27	0.38	0.00	0.00	99.98
27559	2	3	31.74	51.36	3.00	0.00	1.00	9.96	0.01	0.23	0.08	0.71	0.76	0.00	0.02	0.56	0.21	0.37	0.00	0.00	100.01
27571	1	1	61.42	30.81	1.01	0.00	0.51	3.93	0.04	0.62	0.12	0.37	0.57	0.03	0.09	0.20	0.13	0.15	0.00	0.00	100.00
27571	1	2	64.29	28.63	0.92	0.11	0.51	3.35	0.05	0.66	0.11	0.36	0.52	0.02	0.10	0.19	0.07	0.12	0.00	0.00	100.01
27571	1	3	57.32	33.28	1.15	0.10	0.69	4.77	0.03	0.50	0.09	0.37	1.03	0.04	0.07	0.25	0.15	0.16	0.00	0.00	100.00
27571	2	1	33.15	48.20	3.24	0.00	0.93	10.96	0.02	0.44	0.07	0.87	0.66	0.01	0.06	0.65	0.29	0.45	0.00	0.00	100.00

27571	2	2	40.83	43.40	2.27	0.00	0.86	9.02	0.02	0.38	0.10	0.77	0.92	0.01	0.07	0.62	0.31	0.40	0.00	0.00	99.98
27571	2	3	40.68	44.43	2.46	0.00	0.71	8.66	0.03	0.34	0.09	0.70	0.66	0.02	0.05	0.54	0.30	0.33	0.00	0.00	100.00
27659	1	1	43.10	44.26	2.04	0.00	0.63	7.42	0.00	0.08	0.17	0.50	0.85	0.00	0.05	0.35	0.30	0.26	0.00	0.00	100.01
27659	1	2	42.89	44.42	1.96	0.00	0.74	7.45	0.00	0.07	0.15	0.48	0.96	0.00	0.03	0.35	0.25	0.25	0.00	0.00	100.00
27659	1	3	38.72	45.75	2.02	0.00	0.87	8.96	0.01	0.08	0.16	0.50	1.72	0.00	0.09	0.41	0.44	0.28	0.00	0.00	100.01
27659	2	1	38.93	47.64	2.36	0.00	0.71	7.83	0.00	0.08	0.17	0.51	0.77	0.00	0.03	0.45	0.25	0.27	0.00	0.00	100.00
27659	2	2	39.76	47.24	2.36	0.00	0.46	7.52	0.02	0.07	0.19	0.48	0.83	0.00	0.03	0.37	0.44	0.24	0.00	0.00	100.01
27659	2	3	34.24	49.64	2.48	0.00	1.39	9.37	0.00	0.09	0.14	0.69	1.00	0.00	0.00	0.58	0.00	0.37	0.00	0.00	99.99
27660	1	1	40.61	44.58	2.44	0.00	0.67	8.76	0.00	0.11	0.15	0.67	0.78	0.00	0.04	0.52	0.30	0.36	0.00	0.00	99.99
27660	1	2	24.33	54.52	3.35	0.00	1.01	13.00	0.02	0.10	0.19	1.01	0.79	0.00	0.01	0.73	0.36	0.57	0.00	0.00	99.99
27660	1	3	33.98	47.94	2.73	0.00	0.93	10.64	0.00	0.08	0.12	0.79	1.33	0.00	0.04	0.63	0.35	0.43	0.00	0.00	99.99
27660	2	1	23.51	56.18	3.02	0.00	1.16	11.96	0.04	0.09	0.09	0.79	1.53	0.00	0.05	0.69	0.44	0.43	0.00	0.00	99.98
27660	2	2	37.97	47.29	2.23	0.00	0.98	8.56	0.00	0.09	0.13	0.59	1.11	0.00	0.05	0.41	0.28	0.29	0.00	0.00	99.98
27660	2	3	29.17	52.39	2.71	0.00	1.10	10.78	0.02	0.09	0.13	0.66	1.49	0.00	0.03	0.55	0.55	0.34	0.00	0.00	100.01
27678	1	1	66.61	26.81	0.83	0.19	0.46	2.02	0.07	0.52	0.80	0.38	0.85	0.11	0.15	0.09	0.07	0.00	0.05	0.00	100.01
27678	1	2	65.94	26.88	0.89	0.31	0.49	2.45	0.07	0.52	0.79	0.42	0.70	0.14	0.15	0.13	0.09	0.00	0.03	0.00	100.00
27678	1	3	65.59	27.81	0.90	0.16	0.41	2.27	0.06	0.48	0.69	0.39	0.70	0.14	0.12	0.13	0.11	0.00	0.04	0.00	100.00
27678	2	1	66.94	23.65	0.85	0.14	0.52	3.21	0.07	0.62	0.98	0.62	1.16	0.62	0.19	0.27	0.10	0.00	0.07	0.00	100.01
27678	2	2	66.72	28.11	0.73	0.13	0.33	1.44	0.05	0.42	0.72	0.28	0.59	0.19	0.09	0.07	0.07	0.00	0.04	0.00	99.98
27678	2	3	64.03	30.30	0.80	0.24	0.39	1.43	0.10	0.44	0.82	0.32	0.68	0.10	0.17	0.05	0.08	0.00	0.05	0.00	100.00
27694	1	1	69.65	25.45	0.64	0.12	0.42	1.52	0.03	0.42	0.62	0.28	0.47	0.07	0.13	0.10	0.02	0.05	0.00	0.00	99.99
27694	1	2	69.64	25.75	0.61	0.13	0.39	1.41	0.05	0.44	0.58	0.23	0.49	0.06	0.11	0.06	0.03	0.02	0.00	0.00	100.00
27694	1	3	68.46	26.64	0.55	0.19	0.40	1.44	0.07	0.45	0.53	0.26	0.62	0.05	0.17	0.07	0.06	0.03	0.00	0.00	99.99
27694	2	1	55.17	34.45	1.60	0.25	0.70	5.01	0.06	0.49	0.22	0.43	0.78	0.09	0.15	0.26	0.15	0.16	0.00	0.00	99.97
27694	2	2	56.08	33.59	1.60	0.22	0.49	5.18	0.05	0.46	0.22	0.47	0.66	0.10	0.17	0.28	0.26	0.16	0.00	0.00	99.99
27694	2	3	57.52	33.94	1.19	0.21	0.55	4.00	0.06	0.42	0.31	0.43	0.64	0.09	0.16	0.21	0.13	0.14	0.00	0.00	100.00
28058	1	1	66.03	26.44	0.84	0.19	0.56	3.42	0.05	0.46	0.33	0.43	0.56	0.08	0.17	0.18	0.14	0.12	0.00	0.00	100.00
28058	1	2	66.95	26.68	0.70	0.17	0.40	2.79	0.04	0.42	0.31	0.36	0.57	0.17	0.15	0.14	0.16	0.00	0.00	0.00	100.01
28058	1	3	64.73	28.93	0.70	0.19	0.51	2.45	0.05	0.37	0.37	0.31	0.92	0.13	0.14	0.11	0.10	0.00	0.00	0.00	100.01
28058	2	1	66.17	28.63	0.59	0.19	0.45	1.49	0.06	0.42	0.64	0.30	0.75	0.07	0.17	0.00	0.08	0.00	0.00	0.00	100.01
28058	2	2	66.88	27.52	0.59	0.23	0.62	1.61	0.08	0.44	0.69	0.29	0.76	0.06	0.16	0.05	0.04	0.00	0.00	0.00	100.02
28058	2	3	63.40	30.87	0.56	0.23	0.55	1.80	0.06	0.43	0.63	0.31	0.79	0.06	0.18	0.05	0.07	0.00	0.00	0.00	99.99
28240	1	1	24.29	54.56	3.48	0.00	0.94	12.53	0.02	0.44	0.00	0.92	1.05	0.00	0.06	0.74	0.50	0.46	0.00	0.00	99.99
28240	1	2	26.06	53.93	3.17	0.00	1.09	11.86	0.01	0.30	0.00	0.78	1.30	0.00	0.04	0.60	0.44	0.41	0.00	0.00	99.99
28240	1	3	31.59	50.43	2.83	0.00	1.05	10.61	0.03	0.29	0.00	0.70	1.16	0.00	0.03	0.61	0.31	0.37	0.00	0.00	100.01
28240	2	1	23.94	55.94	2.33	0.00	1.18	11.85	0.04	0.27	0.00	0.65	2.26	0.00	0.03	0.47	0.69	0.35	0.00	0.00	100.00
28240	2	2	17.38	59.04	3.80	0.00	1.41	14.00	0.00	0.45	0.11	0.95	1.18	0.00	0.06	0.76	0.34	0.53	0.00	0.00	100.01
28240	2	3	30.82	50.43	3.20	0.00	1.03	11.04	0.00	0.36	0.00	0.84	0.83	0.00	0.06	0.69	0.25	0.45	0.00	0.00	100.00
28297	1	1	0.00	67.01	5.60	0.00	1.48	20.26	0.03	0.21	0.00	1.50	1.15	0.00	0.01	1.24	0.68	0.84	0.00	0.00	100.01
28297	1	2	0.00	67.01	5.60	0.00	1.48	20.26	0.03	0.21	0.00	1.50	1.15	0.00	0.01	1.24	0.68	0.84	0.00	0.00	100.01

28297	1	3	36.21	46.94	2.85	0.00	0.72	10.23	0.02	0.12	0.00	0.78	0.67	0.00	0.05	0.62	0.34	0.45	0.00	0.00	100.00
28297	2	1	28.97	52.77	2.93	0.00	0.68	10.93	0.02	0.10	0.12	0.71	1.26	0.00	0.02	0.53	0.60	0.36	0.00	0.00	100.00
28297	2	2	21.44	57.12	3.57	0.00	0.91	12.93	0.00	0.10	0.09	0.84	1.25	0.00	0.05	0.66	0.59	0.45	0.00	0.00	100.00
28297	2	3	22.07	56.01	3.32	0.00	0.79	13.07	0.05	0.08	0.00	0.90	1.58	0.00	0.05	0.84	0.68	0.55	0.00	0.00	99.99
28802	1	1	27.54	53.07	3.26	0.00	0.59	11.76	0.01	0.08	0.20	0.83	0.92	0.00	0.04	0.67	0.59	0.45	0.00	0.00	100.01
28802	1	2	24.73	54.79	3.25	0.00	0.74	12.41	0.02	0.09	0.18	0.94	0.98	0.00	0.05	0.75	0.57	0.49	0.00	0.00	99.99
28802	1	3	32.48	50.48	2.68	0.00	1.04	10.07	0.01	0.05	0.16	0.62	1.15	0.00	0.04	0.57	0.30	0.35	0.00	0.00	100.00
28802	2	1	11.53	63.93	3.01	0.00	1.76	14.51	0.04	0.11	0.28	0.85	2.31	0.00	0.05	0.56	0.64	0.41	0.00	0.00	99.99
28802	2	2	0.00	70.06	4.05	0.00	2.09	17.82	0.05	0.09	0.18	1.01	2.55	0.00	0.06	0.85	0.66	0.52	0.00	0.00	99.99
28802	2	3	0.00	69.44	4.26	0.00	1.82	18.29	0.03	0.12	0.27	1.09	2.34	0.00	0.06	0.90	0.77	0.60	0.00	0.00	99.99
28825	1	1	37.14	48.14	2.36	0.00	0.71	8.58	0.03	0.14	0.11	0.46	1.28	0.00	0.02	0.36	0.42	0.25	0.00	0.00	100.00
28825	1	2	5.30	65.65	5.46	0.00	2.16	17.06	0.01	0.24	0.17	1.15	1.12	0.00	0.04	0.96	0.00	0.67	0.00	0.00	99.99
28825	1	3	17.24	59.82	4.13	0.00	0.90	13.71	0.00	0.16	0.19	0.94	1.09	0.00	0.02	0.71	0.61	0.48	0.00	0.00	100.00
28825	2	1	38.71	47.32	2.20	0.00	0.64	7.95	0.03	0.23	0.20	0.55	0.93	0.00	0.06	0.42	0.50	0.27	0.00	0.00	100.01
28825	2	2	52.21	37.54	1.41	0.00	0.84	5.53	0.03	0.21	0.16	0.46	0.91	0.00	0.09	0.31	0.08	0.21	0.00	0.00	99.99
28825	2	3	48.56	38.98	1.79	0.00	0.59	6.87	0.03	0.29	0.27	0.57	0.92	0.00	0.12	0.40	0.36	0.25	0.00	0.00	100.00
28832	1	1	52.29	36.00	1.60	0.00	0.54	6.55	0.03	0.35	0.15	0.58	0.82	0.00	0.07	0.41	0.30	0.27	0.05	0.00	100.01
28832	1	2	48.19	38.36	1.77	0.00	0.52	7.50	0.04	0.33	0.13	0.68	1.11	0.00	0.08	0.49	0.42	0.34	0.03	0.00	99.99
28832	1	3	53.08	34.97	1.65	0.00	0.53	6.72	0.04	0.34	0.13	0.59	0.83	0.00	0.06	0.42	0.32	0.28	0.04	0.00	100.00
28832	2	1	59.35	32.54	1.11	0.15	0.54	3.83	0.05	0.34	0.37	0.43	0.67	0.00	0.12	0.21	0.14	0.14	0.02	0.00	100.01
28832	2	2	60.01	31.40	1.21	0.13	0.65	4.15	0.04	0.36	0.34	0.46	0.71	0.00	0.10	0.22	0.05	0.15	0.03	0.00	100.01
28832	2	3	64.52	28.72	0.97	0.13	0.39	2.78	0.06	0.43	0.44	0.38	0.69	0.00	0.10	0.15	0.11	0.12	0.01	0.00	100.00
28836	1	1	50.42	38.57	1.59	0.15	0.51	5.70	0.02	0.31	0.20	0.49	0.76	0.49	0.11	0.33	0.26	0.00	0.00	0.08	99.99
28836	1	2	52.13	36.85	1.49	0.12	0.75	5.59	0.03	0.32	0.21	0.50	0.92	0.54	0.07	0.29	0.12	0.00	0.00	0.07	100.00
28836	1	3	51.25	38.18	1.52	0.00	0.56	5.74	0.01	0.23	0.17	0.46	0.81	0.35	0.09	0.28	0.27	0.00	0.00	0.07	99.99
28836	2	1	51.36	36.73	1.21	0.00	0.66	5.81	0.03	0.42	0.20	0.50	1.26	1.00	0.14	0.33	0.28	0.00	0.00	0.07	100.00
28836	2	2	53.81	34.79	1.34	0.15	0.67	5.46	0.06	0.43	0.17	0.55	0.85	1.02	0.12	0.34	0.12	0.00	0.05	0.06	99.99
28845	1	1	0.00	67.00	5.74	0.00	0.93	19.68	0.03	0.26	0.18	1.55	1.37	0.00	0.09	1.36	0.99	0.82	0.00	0.00	100.00
28845	1	2	28.45	49.62	3.41	0.00	0.80	12.58	0.02	0.21	0.21	1.05	1.29	0.00	0.08	1.13	0.52	0.63	0.00	0.00	100.00
28845	1	3	24.07	54.40	3.20	0.26	1.25	12.30	0.01	0.19	0.22	0.82	1.62	0.00	0.08	0.70	0.43	0.46	0.00	0.00	100.01
28845	2	1	29.74	51.85	3.07	0.00	0.85	10.83	0.02	0.18	0.17	0.68	1.18	0.00	0.05	0.53	0.48	0.37	0.00	0.00	100.00
28845	2	2	32.04	50.00	3.17	0.00	0.71	10.69	0.01	0.18	0.15	0.76	0.78	0.00	0.06	0.63	0.42	0.41	0.00	0.00	100.01
28845	2	3	30.60	50.39	3.36	0.00	0.61	11.14	0.01	0.19	0.23	0.82	0.94	0.00	0.06	0.71	0.52	0.44	0.00	0.00	100.02
28845	2	3	52.17	36.39	1.35	0.14	0.63	5.46	0.04	0.42	0.16	0.56	0.95	0.99	0.11	0.34	0.20	0.00	0.00	0.07	99.98
28914	1	1	33.05	50.35	2.63	0.00	0.74	9.75	0.00	0.11	0.13	0.64	1.25	0.00	0.02	0.52	0.46	0.35	0.00	0.00	100.00
28914	1	2	24.75	54.16	3.57	0.00	0.98	12.54	0.01	0.11	0.14	0.89	1.17	0.00	0.06	0.71	0.44	0.48	0.00	0.00	100.01
28914	1	3	24.00	55.65	3.33	0.00	0.84	12.11	0.00	0.18	0.14	0.83	1.23	0.00	0.04	0.67	0.54	0.45	0.00	0.00	100.01
28914	2	1	21.92	56.01	4.05	0.00	0.82	13.18	0.00	0.16	0.13	0.92	0.94	0.00	0.04	0.80	0.52	0.51	0.00	0.00	100.00
28914	2	2	27.67	52.46	3.24	0.00	0.79	11.88	0.02	0.13	0.14	0.85	1.04	0.00	0.06	0.74	0.49	0.48	0.00	0.00	99.99
28914	2	3	27.15	52.58	3.18	0.00	1.16	11.73	0.02	0.14	0.19	0.83	1.23	0.00	0.07	0.74	0.51	0.48	0.00	0.00	100.01

28937	1	1	63.13	29.25	0.88	0.17	0.53	3.35	0.05	0.39	0.39	0.40	0.75	0.28	0.11	0.15	0.11	0.00	0.00	0.04	99.98
28937	1	2	65.81	27.12	0.87	0.14	0.58	2.99	0.05	0.42	0.35	0.38	0.69	0.27	0.09	0.14	0.08	0.00	0.00	0.03	100.01
28937	1	3	64.19	28.92	0.89	0.17	0.66	2.88	0.04	0.38	0.36	0.35	0.60	0.27	0.10	0.15	0.01	0.00	0.00	0.03	100.00
28937	2	1	57.95	32.19	1.30	0.13	0.52	4.89	0.03	0.35	0.30	0.45	1.00	0.09	0.11	0.29	0.23	0.17	0.00	0.01	100.01
28937	2	2	60.50	30.80	1.13	0.13	0.41	4.23	0.05	0.38	0.37	0.44	0.77	0.09	0.08	0.26	0.19	0.16	0.00	0.00	99.99
28937	2	3	54.33	35.08	1.33	0.21	0.70	5.48	0.04	0.34	0.26	0.46	0.98	0.10	0.09	0.30	0.14	0.17	0.00	0.00	100.01
28958	1	1	41.89	43.13	2.24	0.19	0.84	8.61	0.01	0.17	0.17	0.62	1.00	0.00	0.07	0.46	0.27	0.33	0.00	0.00	100.00
28958	1	2	40.51	44.57	2.52	0.00	0.46	8.89	0.00	0.15	0.14	0.66	0.73	0.00	0.03	0.53	0.45	0.35	0.00	0.00	99.99
28958	1	3	33.93	48.67	3.15	0.00	0.66	10.35	0.03	0.15	0.14	0.79	0.64	0.00	0.07	0.64	0.40	0.39	0.00	0.00	100.01
28958	2	1	36.45	46.46	2.72	0.00	0.84	10.02	0.02	0.17	0.18	0.72	1.03	0.00	0.04	0.62	0.36	0.38	0.00	0.00	100.01
28958	2	2	33.95	48.24	2.85	0.00	0.76	10.36	0.02	0.16	0.20	0.79	1.08	0.00	0.06	0.66	0.48	0.40	0.00	0.00	100.01
28958	2	3	40.59	44.33	2.44	0.00	0.74	8.68	0.03	0.16	0.20	0.63	0.94	0.00	0.05	0.56	0.30	0.35	0.00	0.00	100.00
29428	1	1	16.63	60.11	3.93	0.00	0.86	14.06	0.00	0.00	0.15	0.95	1.37	0.00	0.04	0.68	0.71	0.51	0.00	0.00	100.00
29428	1	2	0.00	68.75	5.00	0.00	1.45	19.04	0.02	0.09	0.16	1.27	1.77	0.00	0.03	0.97	0.75	0.70	0.00	0.00	100.00
29428	1	3	0.00	70.00	5.00	0.00	1.23	18.30	0.00	0.09	0.16	1.12	1.72	0.00	0.05	0.83	0.93	0.57	0.00	0.00	100.00
29428	2	1	0.00	70.15	4.00	0.42	2.43	17.13	0.01	0.11	0.13	0.88	3.13	0.00	0.02	0.75	0.34	0.51	0.00	0.00	100.01
29428	2	2	0.00	70.88	4.19	0.00	0.99	17.33	0.00	0.10	0.13	0.99	2.57	0.00	0.01	0.99	1.23	0.59	0.00	0.00	100.00
29428	2	3	15.91	60.60	3.55	0.31	1.43	13.80	0.00	0.08	0.00	0.83	1.91	0.00	0.00	0.65	0.48	0.45	0.00	0.00	100.00
29432	1	1	38.88	46.96	2.33	0.19	0.81	8.13	0.01	0.17	0.00	0.48	1.07	0.00	0.05	0.35	0.31	0.26	0.00	0.00	100.00
29432	1	2	44.38	43.80	2.10	0.00	0.47	6.85	0.02	0.25	0.05	0.47	0.62	0.00	0.06	0.32	0.36	0.24	0.00	0.00	99.99
29432	1	3	44.25	43.18	2.28	0.00	0.47	7.26	0.03	0.25	0.05	0.52	0.61	0.00	0.07	0.37	0.37	0.28	0.00	0.00	99.99
29432	2	1	45.36	41.67	2.04	0.00	0.45	7.68	0.03	0.24	0.07	0.59	0.76	0.00	0.03	0.41	0.38	0.29	0.00	0.00	100.00
29432	2	2	46.73	42.93	1.79	0.00	0.29	6.08	0.00	0.14	0.00	0.42	0.63	0.00	0.04	0.35	0.39	0.21	0.00	0.00	100.00
29432	2	3	49.87	39.57	1.49	0.00	0.61	6.06	0.02	0.20	0.07	0.50	0.78	0.00	0.04	0.37	0.19	0.23	0.00	0.00	100.00
29434	1	1	22.76	55.09	3.35	0.00	0.96	12.91	0.00	0.11	0.16	0.92	1.78	0.00	0.05	0.85	0.56	0.50	0.00	0.00	100.00
29434	1	2	20.73	57.51	3.21	0.27	1.27	12.76	0.00	0.12	0.10	0.80	1.68	0.00	0.05	0.58	0.50	0.42	0.00	0.00	100.00
29434	1	3	0.00	69.05	5.66	0.00	1.27	18.20	0.00	0.17	0.12	1.18	1.88	0.00	0.05	1.00	0.77	0.65	0.00	0.00	100.00
29434	2	1	0.00	69.22	4.12	0.44	1.99	18.47	0.00	0.09	0.00	1.12	2.34	0.00	0.04	0.90	0.67	0.60	0.00	0.00	100.00
29434	2	2	21.33	56.45	3.81	0.00	1.07	13.42	0.02	0.13	0.00	0.92	1.17	0.00	0.02	0.69	0.46	0.51	0.00	0.00	100.00
29434	2	3	33.50	49.21	2.89	0.00	0.69	10.42	0.01	0.12	0.12	0.76	0.81	0.00	0.03	0.63	0.39	0.43	0.00	0.00	100.01
29440	1	1	45.46	41.14	2.06	0.18	0.85	6.96	0.04	0.32	0.29	0.53	1.24	0.00	0.09	0.37	0.21	0.24	0.00	0.00	99.98
29440	1	2	49.64	38.91	1.73	0.17	0.80	5.89	0.04	0.26	0.27	0.43	1.10	0.00	0.11	0.32	0.13	0.19	0.00	0.00	99.99
29440	1	3	50.84	38.34	1.72	0.26	0.72	5.41	0.02	0.27	0.27	0.43	0.96	0.00	0.11	0.29	0.17	0.19	0.00	0.00	100.00
29440	2	1	46.37	40.31	2.27	0.00	0.70	7.24	0.01	0.31	0.31	0.62	0.75	0.00	0.10	0.47	0.24	0.31	0.00	0.00	100.01
29440	2	2	36.45	46.72	3.13	0.00	1.28	9.26	0.02	0.32	0.29	0.74	0.76	0.00	0.10	0.57	0.00	0.37	0.00	0.00	100.01
29440	2	3	35.73	46.83	3.09	0.00	0.67	9.92	0.02	0.35	0.19	0.78	0.84	0.00	0.11	0.63	0.43	0.41	0.00	0.00	100.00
29442	1	1	18.67	57.93	3.43	0.00	0.90	14.13	0.02	0.11	0.23	0.93	1.48	0.00	0.04	0.89	0.72	0.51	0.00	0.00	99.99
29442	1	2	1.47	68.06	4.42	0.00	0.91	18.69	0.02	0.13	0.20	1.17	2.10	0.00	0.09	0.97	1.14	0.62	0.00	0.00	99.99
29442	1	3	11.45	62.42	3.87	0.00	0.99	15.86	0.00	0.13	0.17	1.05	1.72	0.00	0.05	0.89	0.86	0.55	0.00	0.00	100.01
29442	2	1	22.19	57.04	3.28	0.00	0.85	12.42	0.04	0.09	0.12	0.80	1.38	0.00	0.01	0.66	0.69	0.43	0.00	0.00	100.00

29442	2	2	0.00	69.66	5.05	0.00	1.85	18.32	0.07	0.10	0.17	1.12	1.69	0.00	0.03	0.90	0.46	0.57	0.00	0.00	99.99
29442	2	3	14.80	61.88	3.89	0.00	0.80	14.17	0.00	0.09	0.14	0.86	1.35	0.00	0.04	0.75	0.79	0.46	0.00	0.00	100.02
29599	1	1	31.84	50.33	3.28	0.00	0.76	10.48	0.00	0.18	0.13	0.77	0.70	0.00	0.02	0.66	0.36	0.44	0.06	0.00	100.01
29599	1	2	0.00	68.68	4.84	0.00	1.58	19.00	0.00	0.10	0.13	1.22	1.93	0.00	0.04	1.00	0.73	0.66	0.08	0.00	99.99
29599	1	3	28.79	51.11	3.49	0.00	0.88	12.09	0.00	0.12	0.11	0.91	0.73	0.00	0.03	0.85	0.37	0.51	0.02	0.00	100.01
29599	2	1	39.58	45.40	2.62	0.00	0.61	8.96	0.00	0.08	0.11	0.63	0.72	0.00	0.04	0.52	0.37	0.34	0.03	0.00	100.01
29599	2	2	31.32	51.38	2.95	0.00	0.71	10.33	0.00	0.09	0.08	0.62	1.14	0.00	0.01	0.51	0.51	0.33	0.02	0.00	100.00
29606	1	1	40.49	45.83	2.45	0.00	0.32	8.15	0.01	0.15	0.10	0.59	0.62	0.00	0.01	0.45	0.52	0.32	0.00	0.00	100.01
29606	1	2	31.36	51.44	3.01	0.00	0.80	10.20	0.01	0.16	0.12	0.72	0.86	0.00	0.04	0.55	0.37	0.37	0.00	0.00	100.01
29606	1	3	37.02	47.52	2.61	0.00	0.70	9.18	0.03	0.16	0.12	0.59	0.88	0.00	0.00	0.47	0.38	0.34	0.00	0.00	100.00
29606	2	1	24.92	54.90	3.88	0.00	1.00	12.09	0.02	0.15	0.00	0.86	0.70	0.00	0.03	0.64	0.32	0.47	0.00	0.00	99.98
29606	2	2	10.99	63.51	4.85	0.00	0.86	15.67	0.02	0.17	0.00	1.06	0.87	0.00	0.03	0.75	0.71	0.53	0.00	0.00	100.02
29606	2	3	18.05	59.64	3.67	0.00	0.96	13.61	0.00	0.14	0.00	0.93	1.24	0.00	0.00	0.68	0.62	0.48	0.00	0.00	100.02
29750	1	1	33.26	49.87	2.83	0.00	0.65	9.86	0.01	0.16	0.13	0.70	1.05	0.00	0.05	0.56	0.51	0.36	0.00	0.00	100.00
29750	1	2	36.54	47.38	2.45	0.00	0.81	9.42	0.04	0.17	0.10	0.60	1.20	0.00	0.04	0.49	0.42	0.33	0.00	0.00	99.99
29750	1	3	34.25	48.65	2.85	0.00	0.71	10.02	0.01	0.18	0.12	0.72	1.00	0.00	0.05	0.56	0.48	0.39	0.00	0.00	99.99
29750	2	1	43.23	43.55	2.16	0.18	0.81	7.49	0.01	0.16	0.14	0.50	0.88	0.00	0.05	0.38	0.21	0.25	0.00	0.00	100.00
29750	2	2	43.49	43.44	2.20	0.15	0.72	7.46	0.01	0.16	0.12	0.51	0.79	0.00	0.05	0.38	0.26	0.25	0.00	0.00	99.99
29750	2	3	41.88	44.18	2.38	0.00	0.51	8.26	0.00	0.18	0.13	0.59	0.66	0.00	0.05	0.46	0.42	0.30	0.00	0.00	100.00
29932	1	1	34.36	49.61	2.45	0.00	0.94	9.45	0.02	0.08	0.11	0.59	1.25	0.00	0.00	0.49	0.31	0.33	0.00	0.00	99.99
29932	1	2	36.96	47.64	2.70	0.00	0.59	9.31	0.02	0.09	0.11	0.64	0.68	0.00	0.02	0.48	0.40	0.35	0.00	0.00	99.99
29932	1	3	33.82	48.96	3.05	0.00	0.76	10.38	0.01	0.08	0.07	0.74	0.71	0.00	0.02	0.63	0.35	0.40	0.00	0.00	99.98
29932	2	1	35.96	48.32	2.71	0.00	0.70	9.44	0.01	0.00	0.11	0.64	0.79	0.00	0.02	0.56	0.39	0.36	0.00	0.00	100.01
29932	2	2	39.73	45.92	2.52	0.00	0.44	8.65	0.01	0.08	0.08	0.63	0.64	0.00	0.00	0.52	0.42	0.35	0.00	0.00	99.99
29932	2	3	29.41	51.91	2.99	0.00	0.80	11.28	0.01	0.08	0.09	0.75	1.13	0.00	0.02	0.62	0.48	0.43	0.00	0.00	100.00
30103	1	1	24.72	55.52	3.25	0.00	0.93	11.78	0.02	0.09	0.14	0.70	1.33	0.00	0.03	0.59	0.53	0.37	0.00	0.00	100.00
30103	1	2	16.58	60.75	4.01	0.00	0.85	13.74	0.02	0.00	0.13	0.86	1.20	0.00	0.02	0.68	0.72	0.45	0.00	0.00	100.01
30103	1	3	25.74	55.18	3.33	0.00	0.94	11.37	0.02	0.00	0.12	0.70	1.13	0.00	0.02	0.58	0.45	0.36	0.06	0.00	100.00
30103	2	1	15.13	58.49	3.52	0.36	2.02	14.77	0.02	0.12	0.21	0.93	2.77	0.00	0.05	0.86	0.23	0.51	0.00	0.00	99.99
30103	2	2	25.14	53.01	3.10	0.00	0.77	12.86	0.02	0.11	0.16	0.89	1.73	0.00	0.05	0.90	0.73	0.52	0.00	0.00	99.99
30103	2	3	17.57	58.10	4.35	0.00	0.87	14.60	0.01	0.10	0.13	1.13	0.93	0.00	0.03	0.92	0.63	0.63	0.00	0.00	100.00
30121	1	1	32.46	49.19	2.64	0.22	0.87	10.49	0.02	0.23	0.18	0.71	1.43	0.00	0.06	0.61	0.48	0.40	0.00	0.00	99.99
30121	1	2	28.10	52.49	2.91	0.00	0.78	11.45	0.06	0.27	0.12	0.82	1.33	0.00	0.05	0.63	0.59	0.42	0.00	0.00	100.02
30121	1	3	31.11	50.56	3.21	0.00	0.83	10.63	0.02	0.19	0.19	0.75	1.01	0.00	0.05	0.61	0.44	0.39	0.00	0.00	99.99
30121	2	1	0.00	69.26	5.36	0.00	1.03	18.73	0.03	0.06	0.00	1.33	1.50	0.00	0.02	1.08	0.92	0.69	0.00	0.00	100.01
30121	2	2	0.00	68.54	4.79	0.00	1.46	19.02	0.00	0.04	0.00	1.32	2.11	0.00	0.03	1.20	0.76	0.75	0.00	0.00	100.02
30121	2	3	0.00	68.96	4.53	0.00	1.63	18.94	0.02	0.07	0.00	1.31	1.96	0.00	0.03	1.10	0.73	0.71	0.00	0.00	99.99
30335	1	1	65.30	28.80	0.62	0.17	0.46	2.12	0.05	0.45	0.42	0.28	0.83	0.08	0.17	0.08	0.12	0.04	0.00	0.00	99.99
30335	1	2	68.90	25.56	0.44	0.17	0.46	1.87	0.07	0.48	0.49	0.26	0.82	0.09	0.19	0.07	0.09	0.04	0.00	0.00	100.00
30335	1	3	63.41	29.09	0.71	0.19	0.68	3.04	0.06	0.44	0.40	0.34	1.11	0.11	0.16	0.14	0.03	0.10	0.00	0.00	100.01

30335	2	1	65.43	27.34	0.62	0.21	0.58	2.65	0.06	0.49	0.58	0.36	1.08	0.15	0.17	0.13	0.08	0.08	0.00	0.00	100.01
30335	2	2	63.93	28.92	0.80	0.24	0.53	2.86	0.08	0.46	0.45	0.31	0.85	0.16	0.13	0.11	0.07	0.11	0.00	0.00	100.01
30335	2	3	61.87	31.52	0.69	0.26	0.31	2.66	0.06	0.40	0.43	0.28	0.94	0.08	0.13	0.09	0.21	0.07	0.00	0.00	100.00
30339	1	1	31.32	50.50	3.00	0.00	0.58	10.99	0.02	0.13	0.14	0.79	0.90	0.00	0.05	0.70	0.46	0.43	0.00	0.00	100.01
30339	1	2	21.33	56.73	3.53	0.00	0.52	13.42	0.02	0.15	0.15	0.94	1.20	0.00	0.06	0.76	0.67	0.51	0.00	0.00	99.99
30339	1	3	1.85	66.75	4.62	0.00	1.31	18.84	0.01	0.21	0.30	1.29	2.17	0.00	0.08	1.11	0.76	0.70	0.00	0.00	100.00
30339	2	1	33.62	48.70	2.94	0.00	0.57	10.47	0.03	0.15	0.16	0.82	0.90	0.00	0.06	0.66	0.49	0.44	0.00	0.00	100.01
30339	2	2	6.47	64.04	4.81	0.00	1.01	17.98	0.03	0.25	0.19	1.28	1.45	0.00	0.08	0.95	0.83	0.65	0.00	0.00	100.02
30339	2	3	35.67	47.03	2.97	0.19	0.69	10.15	0.03	0.19	0.22	0.80	0.69	0.00	0.06	0.60	0.28	0.42	0.00	0.00	99.99
30343	1	1	34.13	48.20	2.67	0.00	0.51	10.48	0.02	0.23	0.13	0.77	1.19	0.00	0.05	0.65	0.55	0.42	0.00	0.00	100.00
30343	1	2	34.45	47.70	2.67	0.00	0.41	10.76	0.01	0.23	0.15	0.79	1.09	0.00	0.06	0.63	0.62	0.42	0.00	0.00	99.99
30343	1	3	39.36	44.62	2.63	0.00	0.40	9.53	0.05	0.25	0.16	0.77	0.75	0.00	0.07	0.60	0.41	0.41	0.00	0.00	100.01
30343	2	1	35.01	47.71	2.77	0.20	0.60	9.97	0.02	0.30	0.17	0.80	0.94	0.00	0.08	0.62	0.41	0.40	0.00	0.00	100.00
30343	2	2	44.03	42.22	2.13	0.00	0.48	8.02	0.03	0.23	0.16	0.62	0.83	0.00	0.06	0.49	0.38	0.32	0.00	0.00	100.00
30343	2	3	42.64	43.01	2.18	0.15	0.78	8.09	0.03	0.24	0.16	0.61	1.07	0.00	0.06	0.45	0.24	0.29	0.00	0.00	100.00
30353	1	1	65.72	27.65	0.91	0.16	0.56	3.08	0.05	0.38	0.20	0.29	0.49	0.17	0.10	0.13	0.11	0.00	0.00	0.00	100.00
30353	1	2	66.70	26.96	0.77	0.26	0.41	2.86	0.05	0.38	0.20	0.29	0.54	0.07	0.08	0.16	0.15	0.12	0.00	0.00	100.00
30353	1	3	67.24	26.79	0.75	0.13	0.37	2.76	0.06	0.39	0.20	0.30	0.47	0.13	0.12	0.14	0.15	0.00	0.00	0.00	100.00
30353	2	1	67.64	26.73	0.72	0.15	0.44	2.13	0.04	0.39	0.45	0.27	0.59	0.13	0.12	0.10	0.08	0.00	0.00	0.00	99.98
30353	2	2	65.03	28.88	0.92	0.13	0.40	2.87	0.03	0.27	0.27	0.25	0.53	0.00	0.08	0.12	0.14	0.09	0.00	0.00	100.01
30353	2	3	64.61	29.25	0.97	0.11	0.36	3.02	0.03	0.25	0.22	0.27	0.43	0.00	0.07	0.13	0.14	0.13	0.00	0.00	99.99
30363	1	1	63.89	29.46	0.84	0.20	0.84	2.44	0.07	0.45	0.49	0.29	0.66	0.00	0.17	0.10	0.00	0.11	0.00	0.00	100.01
30363	1	2	63.82	28.34	0.98	0.21	0.65	3.14	0.07	0.53	0.57	0.40	0.70	0.11	0.18	0.16	0.00	0.12	0.00	0.00	99.98
30363	1	3	67.52	26.85	0.79	0.15	0.44	2.02	0.08	0.43	0.54	0.27	0.54	0.06	0.13	0.10	0.01	0.06	0.00	0.00	99.99
30363	2	1	60.00	30.96	1.33	0.20	0.62	4.26	0.07	0.48	0.29	0.41	0.56	0.12	0.15	0.26	0.11	0.18	0.00	0.00	100.00
30363	2	2	65.05	26.83	0.97	0.17	0.58	3.41	0.07	0.60	0.42	0.45	0.69	0.12	0.15	0.30	0.04	0.16	0.00	0.00	100.01
30363	2	3	60.50	30.60	0.95	0.13	0.55	4.33	0.04	0.46	0.27	0.43	0.83	0.10	0.15	0.29	0.22	0.15	0.00	0.00	100.00
30598	1	1	64.25	27.89	1.05	0.12	0.30	4.22	0.04	0.26	0.17	0.39	0.50	0.08	0.13	0.24	0.20	0.16	0.00	0.00	100.00
30598	1	2	64.83	27.93	1.07	0.12	0.46	3.63	0.03	0.32	0.21	0.32	0.47	0.15	0.12	0.21	0.09	0.00	0.00	0.04	100.00
30598	1	3	64.39	28.01	1.06	0.15	0.32	3.63	0.04	0.33	0.30	0.37	0.51	0.29	0.15	0.21	0.19	0.00	0.00	0.05	100.00
30598	2	1	67.66	26.59	0.96	0.11	0.33	2.36	0.05	0.35	0.43	0.31	0.39	0.10	0.11	0.13	0.09	0.00	0.00	0.03	100.00
30598	2	2	69.79	24.97	0.76	0.11	0.30	2.21	0.03	0.35	0.33	0.28	0.49	0.00	0.12	0.10	0.09	0.09	0.00	0.00	100.02
30598	2	3	68.79	25.03	0.84	0.13	0.46	2.54	0.04	0.41	0.35	0.30	0.54	0.20	0.16	0.14	0.04	0.00	0.00	0.03	100.00
30670	1	1	47.82	40.53	1.82	0.00	0.49	6.72	0.02	0.17	0.17	0.51	0.73	0.00	0.07	0.39	0.30	0.25	0.00	0.00	99.99
30670	1	2	32.36	49.93	2.98	0.00	0.61	10.35	0.04	0.21	0.21	0.77	0.92	0.00	0.09	0.61	0.53	0.39	0.00	0.00	100.00
30670	1	3	32.23	50.48	3.02	0.00	0.61	10.09	0.02	0.18	0.22	0.77	0.83	0.00	0.09	0.59	0.49	0.38	0.00	0.00	100.00
30670	2	1	40.54	44.29	2.38	0.20	0.95	8.30	0.05	0.26	0.33	0.60	1.11	0.00	0.08	0.44	0.20	0.28	0.00	0.00	100.01
30670	2	2	17.38	58.26	3.64	0.00	1.15	13.87	0.05	0.31	0.56	1.10	1.51	0.00	0.12	0.82	0.65	0.58	0.00	0.00	100.00
30670	2	3	39.38	45.77	2.41	0.00	0.36	8.53	0.00	0.14	0.16	0.67	1.00	0.00	0.06	0.65	0.49	0.38	0.00	0.00	100.00
30674	1	1	34.91	48.67	2.47	0.00	0.57	9.88	0.02	0.09	0.14	0.69	1.07	0.00	0.04	0.58	0.48	0.38	0.00	0.00	99.99

30674	1	2	25.04	54.66	3.14	0.00	0.55	12.41	0.00	0.10	0.15	0.81	1.27	0.00	0.04	0.62	0.74	0.47	0.00	0.00	100.00
30674	1	3	13.11	61.20	3.82	0.00	1.24	15.53	0.01	0.10	0.15	1.03	1.69	0.00	0.02	0.93	0.61	0.57	0.00	0.00	100.01
30674	2	1	0.00	69.63	4.48	0.00	1.21	18.48	0.00	0.12	0.00	1.13	2.32	0.00	0.01	0.97	1.01	0.64	0.00	0.00	100.00
30674	2	2	0.00	68.99	4.65	0.44	2.27	18.08	0.00	0.06	0.00	1.08	2.58	0.00	0.04	0.84	0.37	0.58	0.00	0.00	99.98
30674	2	3	0.59	68.83	4.52	0.00	1.54	18.58	0.02	0.08	0.00	1.18	2.23	0.00	0.05	0.92	0.83	0.63	0.00	0.00	100.00
A3861HC	1	1	0.00	68.30	5.30	0.00	1.38	18.32	0.05	0.52	0.27	1.07	2.35	0.00	0.07	0.92	0.85	0.61	0.00	0.00	100.01
A3861HC	1	2	1.11	68.28	5.09	0.00	1.38	17.57	0.03	0.53	0.26	1.00	2.44	0.00	0.10	0.82	0.82	0.57	0.00	0.00	100.00
A3861HC	1	3	13.60	61.13	4.98	0.00	0.60	14.60	0.04	0.50	0.27	0.98	1.15	0.00	0.07	0.78	0.76	0.53	0.00	0.00	99.99
A3861HC	2	1	4.94	65.52	4.73	0.00	0.88	17.43	0.05	0.55	0.31	1.15	1.94	0.00	0.10	0.90	0.89	0.61	0.00	0.00	100.00
A3861HC	2	2	41.60	42.96	2.40	0.22	0.96	8.10	0.04	0.40	0.40	0.64	1.13	0.00	0.07	0.54	0.18	0.35	0.00	0.00	99.99
A3861HC	2	3	25.95	54.29	3.82	0.00	0.53	11.32	0.03	0.39	0.31	0.81	0.84	0.00	0.06	0.61	0.63	0.41	0.00	0.00	100.00
A3869HC	1	1	36.99	47.27	2.66	0.00	0.44	9.20	0.01	0.38	0.16	0.71	0.77	0.00	0.05	0.55	0.41	0.40	0.00	0.00	100.00
A3869HC	1	2	17.01	59.41	4.05	0.00	0.60	14.25	0.06	0.43	0.19	0.95	1.07	0.00	0.09	0.67	0.69	0.52	0.00	0.00	99.99
A3869HC	1	3	16.70	59.24	4.22	0.00	0.85	14.46	0.04	0.43	0.20	0.97	1.04	0.00	0.06	0.77	0.54	0.50	0.00	0.00	100.02
A3869HC	2	1	42.05	43.37	2.15	0.00	0.69	8.10	0.03	0.42	0.23	0.56	1.27	0.00	0.07	0.38	0.38	0.30	0.00	0.00	100.00
A3869HC	2	2	41.42	43.90	2.12	0.00	0.51	8.39	0.01	0.39	0.19	0.58	1.24	0.00	0.07	0.44	0.43	0.31	0.00	0.00	100.00
A3869HC	2	3	29.22	51.36	2.66	0.00	0.57	11.13	0.06	0.50	0.23	0.81	1.64	0.00	0.10	0.58	0.70	0.44	0.00	0.00	100.00
A3871HC	1	1	0.00	68.59	5.90	0.00	1.28	18.19	0.04	0.48	0.23	1.19	1.61	0.00	0.08	1.00	0.75	0.65	0.00	0.00	99.99
A3871HC	1	2	0.00	68.28	5.64	0.00	1.36	18.55	0.01	0.47	0.21	1.26	1.60	0.00	0.07	1.03	0.84	0.69	0.00	0.00	100.01
A3871HC	1	3	0.00	68.27	5.35	0.00	2.09	18.03	0.05	0.49	0.23	1.17	1.84	0.00	0.10	0.94	0.75	0.68	0.00	0.00	99.99
A3871HC	2	1	0.00	67.27	5.26	0.00	1.68	19.21	0.04	0.49	0.26	1.25	1.87	0.00	0.12	1.16	0.65	0.75	0.00	0.00	100.01
A3871HC	2	2	0.00	66.74	5.89	0.00	1.38	19.49	0.07	0.56	0.30	1.45	1.28	0.00	0.10	1.28	0.63	0.85	0.00	0.00	100.02
A3871HC	2	3	0.00	67.44	5.62	0.00	1.29	18.98	0.06	0.46	0.27	1.37	1.63	0.00	0.08	1.21	0.78	0.80	0.00	0.00	99.99
A3873HC	1	1	27.06	53.04	3.44	0.00	0.83	11.53	0.02	0.38	0.24	0.79	1.10	0.00	0.06	0.59	0.45	0.48	0.00	0.00	100.01
A3873HC	1	2	34.47	49.72	2.91	0.00	0.44	9.26	0.02	0.28	0.17	0.62	0.81	0.00	0.04	0.48	0.48	0.32	0.00	0.00	100.02
A3873HC	1	3	13.67	60.34	4.43	0.00	0.59	15.37	0.03	0.51	0.24	1.06	1.44	0.00	0.07	0.85	0.81	0.58	0.00	0.00	99.99
A3873HC	2	1	28.92	52.22	3.46	0.00	0.66	11.07	0.03	0.35	0.16	0.78	0.88	0.00	0.04	0.55	0.44	0.45	0.00	0.00	100.01
A3873HC	2	2	28.14	52.94	3.52	0.00	0.65	10.76	0.08	0.38	0.25	0.78	0.96	0.00	0.06	0.57	0.50	0.42	0.00	0.00	100.01
A3873HC	2	3	10.38	63.71	3.87	0.00	1.45	15.02	0.06	0.42	0.16	0.83	2.25	0.00	0.03	0.63	0.73	0.47	0.00	0.00	100.01
A3875HC	1	1	32.44	49.31	3.21	0.00	0.74	10.73	0.02	0.31	0.22	0.78	0.82	0.00	0.04	0.61	0.33	0.44	0.00	0.00	100.00
A3875HC	1	2	30.90	50.34	3.28	0.00	0.66	11.15	0.02	0.33	0.23	0.76	0.82	0.00	0.05	0.61	0.44	0.42	0.00	0.00	100.01
A3875HC	1	3	37.34	47.29	2.70	0.00	0.47	9.14	0.03	0.28	0.21	0.63	0.69	0.00	0.04	0.46	0.41	0.34	0.00	0.00	100.03
A3875HC	2	1	34.41	49.17	2.54	0.00	0.72	9.56	0.03	0.22	0.17	0.60	1.27	0.00	0.05	0.46	0.47	0.33	0.00	0.00	100.00
A3875HC	2	2	39.53	46.07	1.83	0.00	0.66	8.18	0.02	0.21	0.19	0.43	1.74	0.00	0.05	0.32	0.54	0.24	0.00	0.00	100.01
A3875HC	2	3	27.78	53.23	2.52	0.00	1.40	10.77	0.05	0.22	0.19	0.65	1.93	0.00	0.05	0.50	0.35	0.36	0.00	0.00	100.00
KK3050200	1	1	32.75	49.87	2.89	0.34	1.21	9.10	0.08	0.29	0.22	0.64	1.29	0.00	0.17	0.53	0.25	0.36	0.00	0.00	99.99
KK3050200	1	2	29.69	52.21	3.11	0.36	1.08	9.55	0.07	0.30	0.27	0.67	1.37	0.00	0.17	0.51	0.25	0.38	0.00	0.00	99.99
KK3050200	1	3	0.00	67.77	5.16	0.56	1.60	18.15	0.09	0.38	0.19	1.12	2.25	0.00	0.25	1.08	0.73	0.66	0.00	0.00	99.99
KK3050200	2	1	32.32	48.97	3.04	0.37	0.98	10.13	0.10	0.28	0.28	0.74	1.22	0.00	0.19	0.65	0.31	0.41	0.00	0.00	99.99
KK3050200	2	2	28.39	51.75	3.44	0.27	0.90	11.11	0.08	0.25	0.16	0.77	1.22	0.00	0.12	0.71	0.36	0.48	0.00	0.00	100.01

KK3050200	2	3	0.00	68.08	5.82	0.49	1.68	18.18	0.08	0.28	0.26	1.11	1.76	0.00	0.15	0.99	0.47	0.65	0.00	0.00	100.00
1A2610	1	1	43.83	42.44	2.12	0.19	0.84	7.63	0.03	0.43	0.21	0.63	0.58	0.00	0.12	0.47	0.18	0.31	0.00	0.00	100.01
1A2610	1	2	43.94	42.61	2.14	0.18	0.71	7.49	0.02	0.42	0.21	0.63	0.59	0.00	0.09	0.44	0.23	0.30	0.00	0.00	100.00
1A2610	1	3	41.30	44.35	2.20	0.21	0.82	8.06	0.03	0.39	0.21	0.64	0.72	0.00	0.10	0.44	0.24	0.29	0.00	0.00	100.00
1A2610	2	1	33.41	49.64	2.75	0.22	0.86	9.57	0.03	0.37	0.18	0.67	1.05	0.00	0.08	0.50	0.35	0.32	0.00	0.00	100.00
1A2610	2	2	38.03	46.89	2.24	0.21	0.79	8.41	0.02	0.36	0.16	0.57	1.19	0.00	0.08	0.42	0.38	0.26	0.00	0.00	100.01
1A2610	2	3	35.22	48.37	2.28	0.24	1.13	9.28	0.02	0.35	0.15	0.61	1.30	0.00	0.08	0.44	0.23	0.29	0.00	0.00	99.99
2A2610	1	1	48.77	38.93	1.92	0.15	1.02	6.68	0.02	0.38	0.15	0.55	0.60	0.00	0.06	0.38	0.14	0.25	0.00	0.00	100.00
2A2610	1	2	48.33	39.24	1.97	0.18	0.87	6.75	0.01	0.46	0.11	0.55	0.67	0.00	0.08	0.40	0.13	0.25	0.00	0.00	100.00
2A2610	1	3	49.44	38.67	1.72	0.16	0.65	6.35	0.02	0.41	0.36	0.51	0.80	0.00	0.09	0.38	0.20	0.23	0.00	0.00	99.99
604010-16	1	1	66.36	28.36	0.64	0.20	0.32	1.67	0.06	0.51	0.53	0.31	0.62	0.05	0.15	0.06	0.14	0.01	0.00	0.00	99.99
604010-16	1	2	68.49	26.33	0.56	0.14	0.29	1.79	0.06	0.47	0.58	0.36	0.53	0.05	0.11	0.11	0.09	0.05	0.00	0.00	100.01
604010-16	1	3	68.19	26.96	0.51	0.12	0.31	1.59	0.05	0.48	0.49	0.26	0.66	0.03	0.12	0.08	0.10	0.04	0.00	0.00	99.99
604010-16	2	1	63.12	30.48	0.86	0.20	0.48	2.78	0.06	0.40	0.26	0.29	0.61	0.00	0.14	0.10	0.14	0.08	0.00	0.00	100.00
604010-16	2	2	57.00	35.01	1.31	0.20	0.52	3.85	0.06	0.39	0.20	0.37	0.55	0.00	0.11	0.16	0.15	0.12	0.00	0.00	100.00
604010-16	2	3	62.83	30.76	0.83	0.15	0.49	2.92	0.05	0.40	0.29	0.34	0.47	0.00	0.13	0.12	0.13	0.08	0.00	0.00	99.99
604010-41	1	1	57.79	32.92	1.25	0.21	0.68	4.42	0.05	0.56	0.29	0.46	0.70	0.00	0.19	0.19	0.13	0.16	0.00	0.00	100.00
604010-41	1	2	54.59	34.82	1.65	0.16	0.68	5.32	0.05	0.52	0.21	0.51	0.67	0.00	0.16	0.27	0.19	0.19	0.00	0.00	99.99
604010-41	1	3	59.85	32.61	1.15	0.17	0.49	3.41	0.06	0.47	0.33	0.38	0.53	0.00	0.13	0.17	0.15	0.12	0.00	0.00	100.02
604010-41	2	1	64.96	28.51	0.65	0.24	0.61	2.09	0.07	0.60	0.55	0.32	1.02	0.06	0.24	0.00	0.08	0.00	0.00	0.00	100.00
604010-41	2	2	60.40	31.24	0.72	0.21	0.79	3.23	0.07	0.63	0.40	0.39	1.36	0.10	0.23	0.12	0.10	0.00	0.00	0.00	99.99
604010-41	2	3	57.67	32.96	1.18	0.30	0.81	3.83	0.07	0.77	0.35	0.46	1.04	0.00	0.22	0.15	0.08	0.12	0.00	0.00	100.01
650390-13	1	1	65.13	29.14	0.77	0.20	0.44	2.11	0.05	0.49	0.33	0.29	0.61	0.17	0.13	0.08	0.08	0.00	0.00	0.00	100.02
650390-13	1	2	64.58	30.68	0.71	0.16	0.49	1.63	0.06	0.39	0.32	0.22	0.40	0.11	0.10	0.07	0.08	0.00	0.00	0.00	100.00
650390-13	1	3	67.88	27.22	0.60	0.26	0.46	1.72	0.08	0.44	0.35	0.22	0.51	0.06	0.11	0.05	0.02	0.00	0.00	0.00	99.98
650390-13	2	1	65.07	30.23	0.68	0.17	0.52	1.39	0.00	0.44	0.51	0.23	0.49	0.07	0.14	0.04	0.00	0.00	0.00	0.00	99.98
650390-13	2	2	65.75	29.38	0.71	0.17	0.43	1.45	0.06	0.50	0.50	0.24	0.51	0.07	0.14	0.06	0.04	0.00	0.00	0.00	100.01
650390-13	2	3	65.98	28.82	0.71	0.16	0.40	1.61	0.10	0.48	0.43	0.26	0.64	0.09	0.16	0.07	0.10	0.00	0.00	0.00	100.01
650390-46	1	1	63.62	28.56	0.74	0.25	0.67	3.13	0.08	0.76	0.25	0.41	0.79	0.09	0.30	0.16	0.12	0.07	0.00	0.00	100.00
650390-46	1	2	66.47	26.68	0.70	0.25	0.47	2.85	0.08	0.65	0.21	0.36	0.67	0.07	0.23	0.10	0.15	0.05	0.00	0.00	99.99
650390-46	1	3	65.07	26.02	0.78	0.29	0.74	3.71	0.10	0.90	0.24	0.50	0.86	0.08	0.31	0.17	0.15	0.09	0.00	0.00	100.01
650390-46	2	1	64.39	29.30	0.68	0.21	0.62	2.38	0.07	0.52	0.33	0.32	0.73	0.07	0.23	0.08	0.03	0.05	0.00	0.00	100.01
650390-46	2	2	62.05	31.26	0.81	0.21	0.50	2.74	0.06	0.58	0.28	0.31	0.64	0.08	0.19	0.08	0.17	0.05	0.00	0.00	100.01
650390-46	2	3	62.96	30.75	0.77	0.21	0.48	2.55	0.09	0.56	0.25	0.30	0.52	0.08	0.18	0.09	0.14	0.06	0.00	0.00	99.99
A217994HC	1	1	62.61	29.86	0.90	0.17	0.24	3.97	0.02	0.52	0.10	0.33	0.61	0.00	0.06	0.20	0.28	0.14	0.00	0.00	100.01
A217994HC	1	2	65.60	28.70	0.81	0.11	0.27	2.82	0.02	0.42	0.14	0.28	0.38	0.00	0.06	0.13	0.12	0.11	0.00	0.00	99.97
A217994HC	1	3	62.68	30.04	1.01	0.12	0.39	3.82	0.04	0.45	0.09	0.36	0.48	0.00	0.07	0.20	0.13	0.14	0.00	0.00	100.02
A217994HC	2	1	60.10	32.10	1.11	0.13	0.48	3.63	0.04	0.89	0.12	0.35	0.54	0.00	0.08	0.16	0.12	0.14	0.00	0.00	99.99
A217994HC	2	2	60.32	31.07	1.15	0.14	0.55	4.02	0.05	1.06	0.08	0.36	0.64	0.00	0.10	0.19	0.13	0.15	0.00	0.00	100.01
A217994HC	2	3	64.66	29.19	0.71	0.12	0.39	2.72	0.04	0.83	0.08	0.25	0.58	0.00	0.09	0.12	0.12	0.10	0.00	0.00	100.00

A21803HC	1	1	55.91	34.92	1.53	0.00	0.34	5.01	0.03	0.42	0.13	0.47	0.46	0.00	0.05	0.29	0.23	0.20	0.00	0.00	99.99
A21803HC	1	2	35.25	48.33	2.93	0.00	0.67	9.41	0.04	0.52	0.11	0.68	0.72	0.00	0.08	0.52	0.37	0.36	0.00	0.00	99.99
A21803HC	1	3	40.64	44.17	2.48	0.00	0.57	8.72	0.02	0.47	0.13	0.61	0.92	0.00	0.04	0.49	0.44	0.31	0.00	0.00	100.01
A21803HC	2	1	44.78	41.65	2.19	0.17	0.50	7.49	0.03	0.40	0.12	0.52	1.04	0.00	0.00	0.43	0.44	0.26	0.00	0.00	100.02
A21803HC	2	2	53.28	34.02	1.37	0.00	1.88	6.14	0.04	0.43	0.13	0.57	0.82	0.00	0.06	0.49	0.49	0.29	0.00	0.00	100.01
A21803HC	2	3	48.56	39.36	1.72	0.16	1.00	6.59	0.03	0.35	0.10	0.47	0.94	0.00	0.04	0.37	0.05	0.27	0.00	0.00	100.01
A22023HC	1	1	52.88	38.80	1.57	0.16	0.40	4.37	0.03	0.45	0.09	0.29	0.43	0.00	0.04	0.14	0.21	0.13	0.00	0.00	99.99
A22023HC	1	2	49.64	41.02	1.71	0.13	0.41	4.91	0.04	0.51	0.10	0.33	0.53	0.00	0.05	0.20	0.28	0.14	0.00	0.00	100.00
A22023HC	1	3	48.12	41.81	1.97	0.14	0.57	5.35	0.02	0.52	0.09	0.39	0.43	0.00	0.04	0.23	0.14	0.17	0.00	0.00	99.99
A22023HC	2	1	36.13	45.84	2.55	0.00	0.30	10.47	0.02	0.66	0.14	0.83	1.13	0.00	0.06	0.71	0.68	0.47	0.00	0.00	99.99
A22023HC	2	2	41.75	44.46	2.07	0.19	0.94	7.59	0.03	0.48	0.09	0.57	0.94	0.00	0.05	0.43	0.12	0.29	0.00	0.00	100.00
A22023HC	2	3	47.60	40.83	1.82	0.00	0.30	6.46	0.03	0.49	0.11	0.55	0.67	0.00	0.04	0.44	0.37	0.29	0.00	0.00	100.00
A2258 HC	1	1	36.79	47.42	2.45	0.00	1.02	8.66	0.01	0.36	0.24	0.61	1.25	0.00	0.04	0.53	0.32	0.31	0.00	0.00	100.01
A2258 HC	1	2	36.12	47.16	2.52	0.00	1.10	9.03	0.03	0.46	0.27	0.63	1.50	0.00	0.05	0.52	0.29	0.31	0.00	0.00	99.99
A2258 HC	1	3	31.12	49.92	3.14	0.00	0.85	10.43	0.02	0.53	0.32	0.82	1.27	0.00	0.06	0.70	0.41	0.40	0.00	0.00	99.99
A2258 HC	2	1	31.28	50.62	2.40	0.00	1.27	10.52	0.03	0.09	0.13	0.58	1.84	0.00	0.08	0.46	0.40	0.30	0.00	0.00	100.00
A2258 HC	2	2	48.39	39.93	1.56	0.00	0.65	6.57	0.01	0.17	0.19	0.38	1.27	0.00	0.03	0.32	0.32	0.20	0.00	0.00	99.99
A2258 HC	2	3	45.82	41.78	1.66	0.00	0.85	6.93	0.01	0.13	0.19	0.39	1.41	0.00	0.05	0.33	0.26	0.19	0.00	0.00	100.00
A22607HC	1	1	59.94	32.06	1.30	0.09	0.47	3.65	0.05	0.96	0.08	0.37	0.50	0.00	0.09	0.19	0.11	0.12	0.00	0.00	99.98
A22607HC	1	2	62.48	30.66	1.09	0.10	0.49	2.87	0.05	1.04	0.09	0.34	0.44	0.00	0.08	0.14	0.04	0.10	0.00	0.00	100.01
A22607HC	1	3	61.41	31.42	1.08	0.13	0.48	3.06	0.04	1.03	0.09	0.33	0.48	0.00	0.12	0.14	0.08	0.11	0.00	0.00	100.00
A22607HC	2	1	58.66	32.57	1.46	0.00	0.47	4.39	0.03	0.59	0.12	0.40	0.60	0.00	0.08	0.23	0.23	0.17	0.00	0.00	100.00
A22607HC	2	2	56.42	33.75	1.68	0.00	0.36	5.15	0.03	0.63	0.13	0.50	0.51	0.00	0.08	0.31	0.25	0.21	0.00	0.00	100.01
A22607HC	2	3	55.14	34.90	1.67	0.00	0.44	5.17	0.03	0.62	0.12	0.47	0.66	0.00	0.08	0.28	0.23	0.19	0.00	0.00	100.00
A22609HC	1	1	66.07	29.09	0.65	0.15	0.52	0.91	0.08	0.88	0.53	0.21	0.71	0.06	0.12	0.00	0.02	0.00	0.00	0.00	100.00
A22609HC	1	2	65.08	29.91	0.51	0.18	0.55	1.14	0.07	0.78	0.51	0.20	0.69	0.04	0.19	0.04	0.10	0.00	0.00	0.00	99.99
A22609HC	1	3	67.59	24.82	0.52	0.18	0.73	1.68	0.10	1.33	0.90	0.40	1.22	0.10	0.29	0.13	0.00	0.00	0.00	0.00	99.99
A22609HC	2	1	59.90	30.94	1.47	0.10	0.53	4.29	0.04	0.97	0.14	0.43	0.55	0.00	0.07	0.25	0.13	0.19	0.00	0.00	100.00
A22609HC	2	2	60.54	31.42	1.11	0.10	0.44	3.82	0.04	0.80	0.14	0.36	0.66	0.00	0.06	0.19	0.18	0.13	0.00	0.00	99.99
A22609HC	2	3	59.66	31.63	1.25	0.00	0.50	4.32	0.03	0.82	0.14	0.41	0.67	0.00	0.05	0.21	0.17	0.16	0.00	0.00	100.02
A22623HC	1	1	46.55	40.71	2.48	0.00	0.49	6.53	0.02	0.52	0.37	0.65	0.60	0.00	0.07	0.42	0.28	0.31	0.00	0.00	100.00
A22623HC	1	2	47.58	40.82	2.10	0.00	0.63	6.39	0.04	0.31	0.30	0.51	0.48	0.00	0.06	0.38	0.16	0.25	0.00	0.00	100.01
A22623HC	1	3	36.99	48.84	2.81	0.00	0.48	7.93	0.01	0.36	0.26	0.61	0.56	0.00	0.04	0.41	0.40	0.29	0.00	0.00	99.99
A22623HC	2	1	42.99	43.76	2.31	0.00	0.65	7.49	0.01	0.22	0.29	0.53	0.74	0.00	0.07	0.42	0.29	0.24	0.00	0.00	100.01
A22623HC	2	2	40.45	45.64	2.70	0.00	0.71	7.88	0.03	0.19	0.29	0.57	0.47	0.00	0.08	0.47	0.24	0.29	0.00	0.00	100.01
A22623HC	2	3	32.59	49.41	3.15	0.00	0.98	10.70	0.04	0.17	0.19	0.77	0.68	0.00	0.05	0.59	0.26	0.41	0.00	0.00	99.99
A242337HC	1	1	50.31	38.95	1.81	0.00	0.61	6.08	0.02	0.18	0.16	0.42	0.63	0.00	0.02	0.34	0.23	0.23	0.00	0.00	99.99
A242337HC	1	2	46.71	41.10	2.40	0.00	0.62	7.00	0.00	0.19	0.17	0.55	0.32	0.00	0.03	0.41	0.19	0.30	0.00	0.00	99.99
A242337HC	1	3	44.14	43.55	2.28	0.00	0.48	7.24	0.00	0.16	0.16	0.56	0.34	0.00	0.05	0.41	0.35	0.28	0.00	0.00	100.00
A242337HC	2	1	49.18	38.86	2.01	0.00	0.57	6.89	0.03	0.22	0.19	0.55	0.49	0.00	0.04	0.40	0.28	0.30	0.00	0.00	100.01

A242337HC	2	2	58.69	32.66	1.15	0.00	0.54	4.83	0.01	0.17	0.13	0.36	0.76	0.00	0.03	0.29	0.19	0.19	0.00	0.00	100.00
A242337HC	2	3	58.40	33.52	1.00	0.12	0.80	4.23	0.04	0.16	0.16	0.32	0.79	0.00	0.04	0.26	0.00	0.17	0.00	0.00	100.01
A24237HC	1	1	47.93	40.79	2.08	0.00	0.62	6.34	0.03	0.19	0.16	0.45	0.58	0.00	0.05	0.31	0.26	0.23	0.00	0.00	100.02
A24237HC	1	2	48.18	40.43	2.06	0.00	0.51	6.47	0.02	0.19	0.17	0.48	0.53	0.00	0.05	0.32	0.33	0.26	0.00	0.00	100.00
A24237HC	1	3	51.16	38.22	1.87	0.00	0.63	5.94	0.01	0.20	0.17	0.44	0.54	0.00	0.06	0.33	0.20	0.24	0.00	0.00	100.01
A24237HC	2	1	52.01	37.19	1.80	0.00	0.53	6.18	0.02	0.17	0.19	0.46	0.53	0.00	0.05	0.36	0.27	0.25	0.00	0.00	100.01
A24237HC	2	2	57.11	34.02	1.50	0.00	0.34	5.13	0.01	0.14	0.13	0.39	0.43	0.00	0.02	0.28	0.28	0.20	0.00	0.00	99.98
A24237HC	2	3	51.09	37.89	1.64	0.00	0.77	6.16	0.02	0.19	0.22	0.43	0.75	0.00	0.06	0.35	0.19	0.24	0.00	0.00	100.00
A24246HC	1	1	51.59	37.90	1.92	0.00	0.42	5.67	0.03	0.41	0.17	0.48	0.56	0.00	0.05	0.30	0.28	0.21	0.00	0.00	99.99
A24246HC	1	2	54.51	35.85	1.82	0.00	0.35	5.09	0.04	0.49	0.19	0.45	0.45	0.00	0.06	0.28	0.23	0.20	0.00	0.00	100.01
A24246HC	1	3	52.95	36.20	1.90	0.00	0.47	5.89	0.05	0.46	0.18	0.49	0.54	0.00	0.06	0.32	0.25	0.23	0.00	0.00	99.99
A24246HC	2	1	53.94	34.87	2.09	0.00	0.41	5.84	0.04	0.59	0.24	0.57	0.45	0.00	0.06	0.40	0.24	0.27	0.00	0.00	100.01
A24246HC	2	2	50.94	37.28	2.24	0.00	0.43	6.27	0.04	0.50	0.21	0.53	0.55	0.00	0.08	0.37	0.31	0.25	0.00	0.00	100.00
A24246HC	2	3	53.42	34.72	2.23	0.00	0.39	6.20	0.04	0.61	0.24	0.59	0.49	0.00	0.06	0.42	0.30	0.29	0.00	0.00	100.00
A24665	1	1	51.85	37.11	1.98	0.13	0.69	5.83	0.03	0.55	0.09	0.52	0.48	0.00	0.06	0.36	0.12	0.22	0.00	0.00	100.02
A24665	1	2	48.98	39.19	2.17	0.00	0.48	6.49	0.02	0.60	0.08	0.54	0.46	0.00	0.07	0.35	0.28	0.24	0.05	0.00	100.00
A24665	1	3	49.12	39.47	1.91	0.00	0.44	6.30	0.03	0.55	0.08	0.55	0.54	0.00	0.07	0.37	0.34	0.24	0.00	0.00	100.01
A24665	2	1	49.60	39.59	1.92	0.15	0.57	5.67	0.04	0.58	0.05	0.46	0.58	0.00	0.07	0.28	0.24	0.20	0.00	0.00	100.00
A24665	2	2	47.23	40.43	1.74	0.26	0.77	6.61	0.05	0.61	0.08	0.49	0.85	0.00	0.07	0.35	0.24	0.22	0.00	0.00	100.00
A24665	2	3	50.37	38.41	1.59	0.24	0.90	5.68	0.04	0.66	0.09	0.48	0.83	0.00	0.09	0.29	0.11	0.21	0.00	0.00	99.99
A3195HC	1	1	24.92	53.11	3.38	0.00	1.00	12.34	0.02	0.53	0.29	1.07	1.30	0.00	0.10	0.91	0.48	0.55	0.00	0.00	100.00
A3195HC	1	2	14.14	58.98	4.36	0.00	1.15	15.48	0.05	0.63	0.38	1.36	1.11	0.00	0.12	1.03	0.54	0.67	0.00	0.00	100.00
A3195HC	1	3	28.08	52.27	3.16	0.00	1.14	10.77	0.06	0.45	0.28	0.81	1.51	0.00	0.07	0.64	0.36	0.41	0.00	0.00	100.01
A3195HC	2	1	1.40	67.60	5.26	0.00	1.06	18.07	0.04	0.42	0.18	1.33	1.94	0.00	0.09	1.05	0.94	0.64	0.00	0.00	100.02
A3195HC	2	2	0.00	68.75	5.51	0.00	1.30	18.40	0.06	0.45	0.15	1.31	1.60	0.00	0.10	0.97	0.76	0.63	0.00	0.00	99.99
A3195HC	2	3	32.28	48.70	3.08	0.00	0.87	10.77	0.06	0.40	0.21	0.81	1.28	0.00	0.11	0.61	0.43	0.40	0.00	0.00	100.01
A3740HC	1	1	37.82	47.25	2.28	0.00	0.70	8.54	0.04	0.33	0.15	0.62	1.02	0.00	0.08	0.48	0.37	0.31	0.00	0.00	99.99
A3740HC	1	2	19.55	56.79	3.80	0.00	1.20	13.86	0.01	0.48	0.16	1.02	1.25	0.00	0.03	0.86	0.47	0.54	0.00	0.00	100.02
A3740HC	1	3	22.81	55.65	3.77	0.00	0.97	12.80	0.00	0.35	0.16	0.91	0.90	0.00	0.03	0.72	0.46	0.48	0.00	0.00	100.01
A3740HC	2	1	32.94	50.55	2.59	0.00	0.51	9.41	0.02	0.37	0.22	0.66	1.33	0.00	0.04	0.43	0.61	0.32	0.00	0.00	100.00
A3740HC	2	2	32.04	50.40	2.41	0.00	1.09	9.84	0.04	0.45	0.19	0.67	1.63	0.00	0.09	0.47	0.36	0.31	0.00	0.00	99.99
A3740HC	2	3	20.22	57.30	3.58	0.00	0.79	13.11	0.04	0.51	0.17	0.94	1.42	0.00	0.04	0.70	0.73	0.44	0.00	0.00	99.99
A3745HC	1	1	27.46	52.46	3.61	0.00	0.88	11.37	0.03	0.48	0.17	0.86	1.06	0.00	0.08	0.66	0.46	0.43	0.00	0.00	100.01
A3745HC	1	2	26.84	52.97	3.24	0.00	1.06	11.40	0.03	0.43	0.15	0.80	1.48	0.00	0.09	0.64	0.47	0.42	0.00	0.00	100.02
A3745HC	1	3	17.19	59.69	4.47	0.00	1.09	13.87	0.01	0.27	0.10	0.91	0.73	0.00	0.02	0.74	0.42	0.48	0.00	0.00	99.99
A3745HC	2	1	14.48	60.43	4.76	0.00	0.97	15.01	0.02	0.30	0.12	1.06	0.77	0.00	0.07	0.86	0.58	0.58	0.00	0.00	100.01
A3745HC	2	2	16.68	58.94	4.17	0.00	1.24	14.62	0.02	0.30	0.13	0.99	1.10	0.00	0.04	0.75	0.47	0.54	0.00	0.00	99.99
A3760HC	1	1	41.79	43.56	2.40	0.00	0.57	8.39	0.03	0.35	0.13	0.63	0.84	0.00	0.07	0.48	0.41	0.35	0.00	0.00	100.00
A3760HC	1	2	44.86	41.40	2.49	0.00	0.52	7.73	0.01	0.36	0.11	0.60	0.66	0.00	0.07	0.41	0.44	0.33	0.00	0.00	99.99
A3760HC	1	3	45.91	40.03	2.15	0.00	0.92	7.91	0.03	0.38	0.09	0.66	0.80	0.00	0.07	0.52	0.17	0.38	0.00	0.00	100.02

A3760HC	2	1	55.44	35.31	1.63	0.00	0.29	4.47	0.05	0.37	0.51	0.38	0.59	0.09	0.08	0.26	0.38	0.15	0.00	0.00	100.00
A3760HC	2	2	52.59	36.44	2.00	0.00	0.33	5.67	0.02	0.37	0.28	0.43	0.87	0.00	0.09	0.28	0.38	0.24	0.00	0.00	99.99
A3760HC	2	3	45.64	41.35	2.09	0.00	0.41	7.25	0.04	0.39	0.15	0.57	0.82	0.00	0.12	0.41	0.49	0.29	0.00	0.00	100.02
A3764HC	1	1	13.83	61.28	3.91	0.00	1.37	14.68	0.02	0.28	0.09	0.94	1.70	0.00	0.06	0.76	0.57	0.51	0.00	0.00	100.00
A3764HC	1	2	5.21	65.97	4.54	0.00	1.72	16.75	0.03	0.38	0.00	1.03	2.35	0.00	0.10	0.83	0.58	0.53	0.00	0.00	100.02
A3764HC	1	3	18.61	57.06	4.32	0.00	0.85	14.56	0.03	0.37	0.12	1.06	0.91	0.00	0.03	0.86	0.63	0.57	0.00	0.00	99.98
A3764HC	2	1	37.19	46.89	2.95	0.00	0.64	8.86	0.05	0.42	0.17	0.68	0.80	0.00	0.08	0.54	0.36	0.35	0.00	0.00	99.98
A3764HC	2	2	32.46	49.09	3.33	0.00	0.97	10.32	0.03	0.48	0.12	0.75	1.09	0.00	0.06	0.56	0.36	0.37	0.00	0.00	99.99
A3764HC	2	3	31.74	49.33	3.33	0.00	0.79	10.76	0.03	0.51	0.14	0.86	0.93	0.00	0.06	0.63	0.48	0.42	0.00	0.00	100.01
A3765HC	1	1	0.00	67.34	6.07	0.00	1.35	18.82	0.06	0.66	0.24	1.39	1.50	0.00	0.10	1.01	0.72	0.73	0.00	0.00	99.99
A3765HC	1	2	23.10	55.06	3.86	0.00	1.20	12.31	0.04	0.42	0.18	0.85	1.42	0.00	0.07	0.66	0.38	0.45	0.00	0.00	100.00
A3765HC	1	3	22.63	55.70	4.19	0.00	1.06	12.45	0.03	0.41	0.15	0.88	0.98	0.00	0.07	0.66	0.39	0.42	0.00	0.00	100.02
A3765HC	2	1	33.77	48.15	2.96	0.00	0.77	10.28	0.05	0.40	0.20	0.75	1.07	0.00	0.09	0.59	0.50	0.39	0.05	0.00	100.02
A3765HC	2	2	38.06	45.44	2.79	0.00	0.76	9.12	0.02	0.36	0.21	0.73	1.03	0.00	0.10	0.59	0.35	0.38	0.04	0.00	99.98
A3765HC	2	3	37.57	46.08	2.54	0.00	0.67	9.18	0.05	0.31	0.22	0.69	1.24	0.00	0.06	0.55	0.48	0.33	0.02	0.00	99.99
A3798HC	1	1	23.35	55.07	3.94	0.00	0.97	11.94	0.03	0.62	0.16	0.94	1.27	0.00	0.11	0.69	0.47	0.43	0.00	0.00	99.99
A3798HC	1	2	19.55	57.33	4.56	0.00	0.80	12.84	0.03	0.69	0.19	0.98	1.03	0.00	0.09	0.73	0.61	0.49	0.08	0.00	100.00
A3798HC	1	3	14.88	59.94	4.78	0.00	0.90	14.16	0.07	0.72	0.19	1.10	1.21	0.00	0.10	0.75	0.67	0.50	0.00	0.00	99.97
A3798HC	2	1	34.63	48.07	3.02	0.00	0.72	9.48	0.04	0.54	0.19	0.76	1.01	0.00	0.09	0.56	0.45	0.38	0.07	0.00	100.01
A3798HC	2	2	37.86	45.37	3.17	0.00	0.74	9.07	0.02	0.58	0.21	0.76	0.80	0.00	0.11	0.56	0.36	0.37	0.04	0.00	100.02
A3798HC	2	3	35.99	47.78	3.02	0.00	0.87	8.86	0.01	0.50	0.16	0.64	0.93	0.00	0.09	0.46	0.36	0.31	0.03	0.00	100.01
A3803HC	1	1	0.00	69.35	4.56	0.00	1.61	17.42	0.06	0.66	0.23	1.08	2.75	0.00	0.12	0.84	0.78	0.55	0.00	0.00	100.01
A3803HC	1	2	35.62	48.20	2.45	0.00	0.79	8.97	0.05	0.39	0.19	0.62	1.46	0.00	0.07	0.50	0.37	0.32	0.00	0.00	100.00
A3803HC	1	3	19.97	56.91	4.06	0.00	0.70	13.19	0.10	0.59	0.22	0.97	1.22	0.06	0.16	0.74	0.64	0.46	0.00	0.00	99.99
A3803HC	2	1	33.79	48.94	3.11	0.23	0.61	9.67	0.05	0.51	0.15	0.80	0.77	0.00	0.10	0.61	0.26	0.40	0.00	0.00	100.00
A3803HC	2	2	21.68	56.70	4.14	0.00	0.45	12.47	0.03	0.56	0.15	0.97	0.92	0.02	0.08	0.76	0.61	0.48	0.00	0.00	100.02
A3803HC	2	3	36.37	47.57	2.26	0.00	0.82	9.05	0.02	0.41	0.19	0.63	1.39	0.03	0.10	0.45	0.40	0.31	0.00	0.00	100.00
A3807HC	1	1	36.37	47.57	2.26	0.00	0.82	9.05	0.02	0.41	0.19	0.63	1.39	0.03	0.10	0.45	0.40	0.31	0.00	0.00	100.00
A3807HC	1	2	19.71	56.92	3.85	0.00	0.95	13.49	0.03	0.50	0.23	1.00	1.44	0.02	0.08	0.75	0.54	0.49	0.00	0.00	100.00
A3807HC	1	3	42.61	43.74	2.22	0.18	0.69	7.48	0.03	0.38	0.20	0.64	0.84	0.01	0.08	0.46	0.14	0.30	0.00	0.00	100.00
A3807HC	2	1	0.00	67.91	5.64	0.00	1.12	19.11	0.04	0.62	0.20	1.43	1.44	0.01	0.07	1.01	0.71	0.71	0.00	0.00	100.02
A3807HC	2	2	0.00	68.96	5.35	0.00	0.97	18.36	0.06	0.65	0.17	1.34	1.58	0.02	0.09	0.96	0.81	0.68	0.00	0.00	100.00
A3807HC	2	3	31.66	49.18	3.06	0.00	0.60	11.01	0.04	0.47	0.15	0.85	1.26	0.03	0.07	0.71	0.49	0.43	0.00	0.00	100.01
A3809HC	1	1	36.82	47.29	2.28	0.00	0.84	8.95	0.01	0.25	0.24	0.62	1.35	0.00	0.06	0.52	0.41	0.35	0.00	0.00	99.99
A3809HC	1	2	11.88	60.67	4.51	0.00	1.24	15.48	0.08	0.48	0.39	1.10	1.85	0.00	0.08	0.90	0.71	0.63	0.00	0.00	100.00
A3809HC	1	3	24.38	52.98	3.69	0.32	1.39	12.08	0.05	0.50	0.55	0.84	1.57	0.00	0.08	0.74	0.30	0.54	0.00	0.00	100.01
A3809HC	2	1	37.01	46.75	2.61	0.18	0.73	8.90	0.03	0.35	0.22	0.65	1.29	0.00	0.07	0.50	0.37	0.34	0.00	0.00	100.00
A3809HC	2	2	36.55	46.67	2.90	0.20	0.76	9.28	0.03	0.37	0.25	0.77	0.90	0.00	0.08	0.57	0.28	0.40	0.00	0.00	100.01
A3809HC	2	3	24.55	54.42	3.15	0.00	0.90	11.87	0.01	0.38	0.25	0.82	1.91	0.00	0.00	0.67	0.61	0.46	0.00	0.00	100.00
A3854HC	1	1	21.67	57.30	3.70	0.00	0.48	12.80	0.03	0.19	0.14	0.91	0.92	0.00	0.04	0.71	0.64	0.48	0.00	0.00	100.01

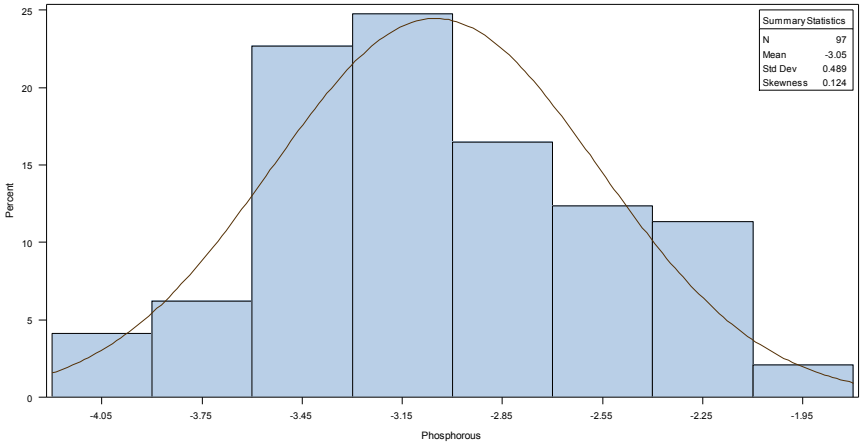
A3854HC	1	2	0.00	68.00	4.93	0.00	1.24	19.60	0.00	0.30	0.21	1.33	1.68	0.00	0.11	1.02	0.85	0.74	0.00	0.00	100.01
A3854HC	1	3	15.66	59.69	3.85	0.00	1.19	14.66	0.00	0.32	0.18	0.97	1.51	0.00	0.05	0.81	0.55	0.56	0.00	0.00	100.00
A3854HC	2	1	30.72	51.18	3.11	0.00	0.43	10.90	0.00	0.25	0.10	0.79	0.84	0.00	0.04	0.66	0.51	0.45	0.00	0.00	99.98
A3854HC	2	2	13.25	61.69	4.16	0.00	0.87	15.01	0.00	0.30	0.16	1.09	1.33	0.00	0.06	0.86	0.64	0.58	0.00	0.00	100.00
A3854HC	2	3	18.65	58.18	3.61	0.00	0.85	13.72	0.03	0.30	0.14	0.92	1.58	0.00	0.08	0.77	0.65	0.50	0.00	0.00	99.98
DM3452216022	1	1	0.00	68.31	6.35	0.49	1.30	18.69	0.10	0.16	0.00	0.95	1.55	0.00	0.00	0.98	0.49	0.62	0.00	0.00	99.99
DM3452216022	1	2	0.00	68.79	6.38	0.51	1.12	18.43	0.08	0.13	0.00	0.92	1.47	0.00	0.00	0.97	0.60	0.60	0.00	0.00	100.00
DM3452216022	1	3	0.00	68.73	6.21	0.50	1.30	18.44	0.07	0.00	0.00	0.92	1.66	0.00	0.00	1.00	0.54	0.62	0.00	0.00	99.99
DM3452216022	2	1	0.00	67.83	6.06	0.52	1.08	19.21	0.11	0.00	0.00	1.01	1.67	0.00	0.00	1.13	0.68	0.71	0.00	0.00	100.01
DM3452216022	2	2	0.00	68.70	5.91	0.57	1.52	18.21	0.10	0.16	0.12	0.91	1.85	0.00	0.00	0.93	0.41	0.61	0.00	0.00	100.00
DM3452216022	2	3	0.00	67.93	6.37	0.50	1.38	19.03	0.07	0.00	0.00	1.02	1.48	0.00	0.00	1.12	0.41	0.69	0.00	0.00	100.00
KK2322123-084	1	1	56.54	33.06	1.70	0.22	0.56	5.02	0.06	0.50	0.22	0.40	0.87	0.04	0.11	0.36	0.14	0.20	0.00	0.00	100.00
KK2322123-084	1	2	55.00	34.39	1.75	0.18	0.87	5.22	0.04	0.43	0.21	0.39	0.72	0.04	0.11	0.32	0.12	0.19	0.00	0.00	99.98
KK2322123-084	1	3	58.43	32.13	1.55	0.19	0.53	4.53	0.06	0.43	0.28	0.37	0.79	0.06	0.10	0.28	0.11	0.17	0.00	0.00	100.01
KK2322123-084	2	1	0.00	66.78	5.86	0.40	1.42	19.64	0.03	0.27	0.00	1.23	1.64	0.05	0.05	1.23	0.66	0.74	0.00	0.00	100.00
KK2322123-084	2	2	0.00	66.02	5.62	0.41	1.57	19.82	0.07	0.33	0.07	1.22	2.12	0.05	0.08	1.27	0.59	0.76	0.00	0.00	100.00
KK2322123-084	2	3	0.00	67.08	5.94	0.48	1.71	18.98	0.02	0.36	0.00	1.16	1.80	0.04	0.09	1.22	0.40	0.70	0.00	0.00	99.98

Table A-3 SAS OUTPUT

Distribution of Phosphorus in Used Aircraft filters

Tests for Normality in Used Filters

Test		--Statistic---		-----p Value------
Shapiro-Wilk	W	0.987845	Pr < W	0.5193
Kolmogorov-Smirnov	D	0.066844	Pr > D	>0.1500
Cramer-von Mises	W-Sq	0.069021	Pr > W-Sq	>0.2500
Anderson-Darling	A-Sq	0.404191	Pr > A-Sq	>0.2500

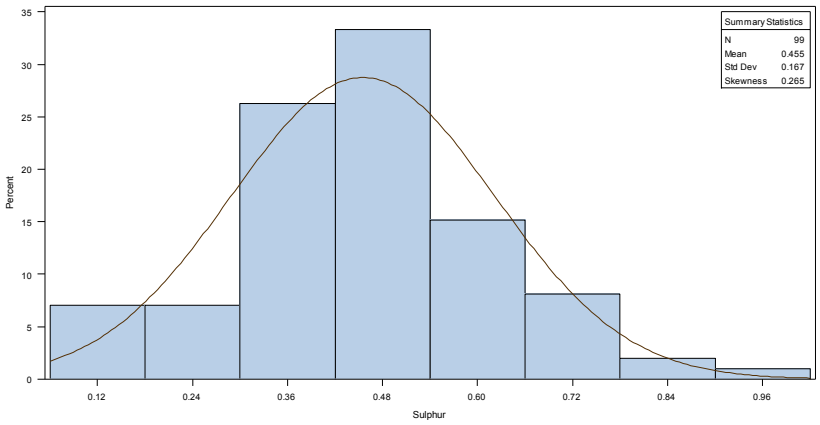


Distribution of Sulfur in Used Aircraft filters

Tests for Normality

Test		--Statistic---		-----p Value------
Shapiro-Wilk	W	0.984392	Pr < W	0.2933
Kolmogorov-Smirnov	D	0.060424	Pr > D	>0.1500
Cramer-von Mises	W-Sq	0.049581	Pr > W-Sq	>0.2500
Anderson-Darling	A-Sq	0.348491	Pr > A-Sq	>0.2500

Distribution of Sulfur in Used Aircraft filters



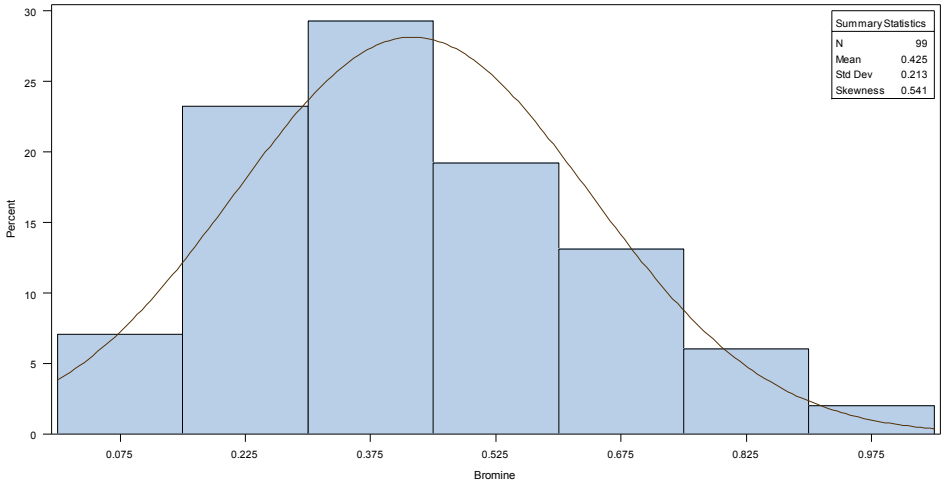
Distribution of Bromine in Used Aircraft filters

Tests for Normality

Tests for Normality

Test		--Statistic---		-----p Value------
Shapiro-Wilk	W	0.970355	Pr < W	0.0246
Kolmogorov-Smirnov	D	0.072203	Pr > D	>0.1500
Cramer-von Mises	W-Sq	0.112564	Pr > W-Sq	0.0792
Anderson-Darling	A-Sq	0.715408	Pr > A-Sq	0.0628

Distribution of Bromine in Used Aircraft filters



Distribution of Phosphorus in **Incident** Aircraft filters

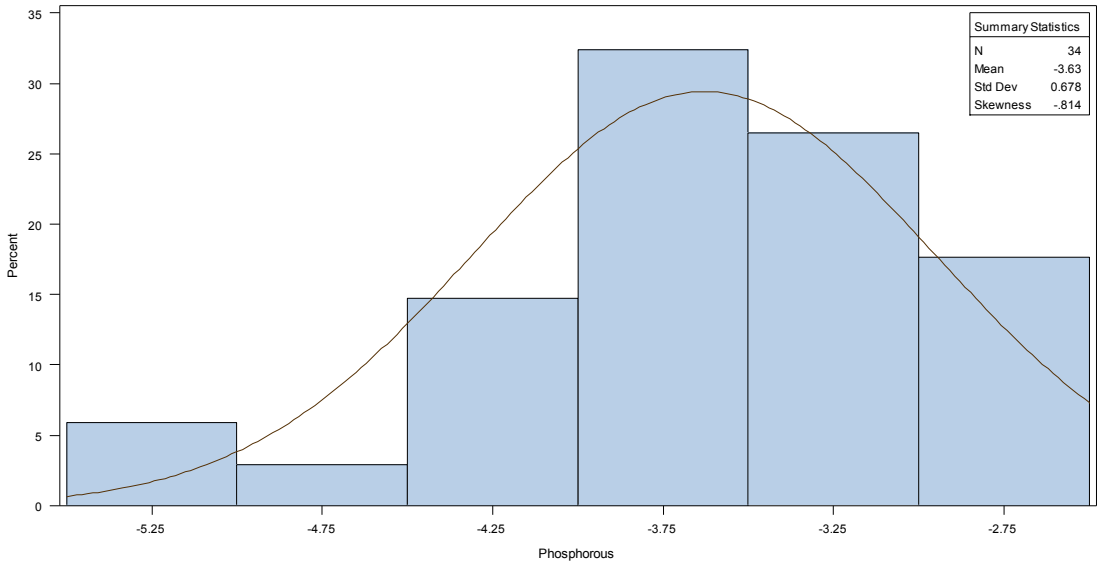
The UNIVARIATE Procedure

Variable: Phosphorus

Tests for Normality

Test		--Statistic---		-----p Value------
Shapiro-Wilk	W	0.946063	Pr < W	0.0936
Kolmogorov-Smirnov	D	0.112885	Pr > D	>0.1500
Cramer-von Mises	W-Sq	0.064399	Pr > W-Sq	>0.2500
Anderson-Darling	A-Sq	0.492896	Pr > A-Sq	0.2118

Distribution of Phosphorous in Incident Filters



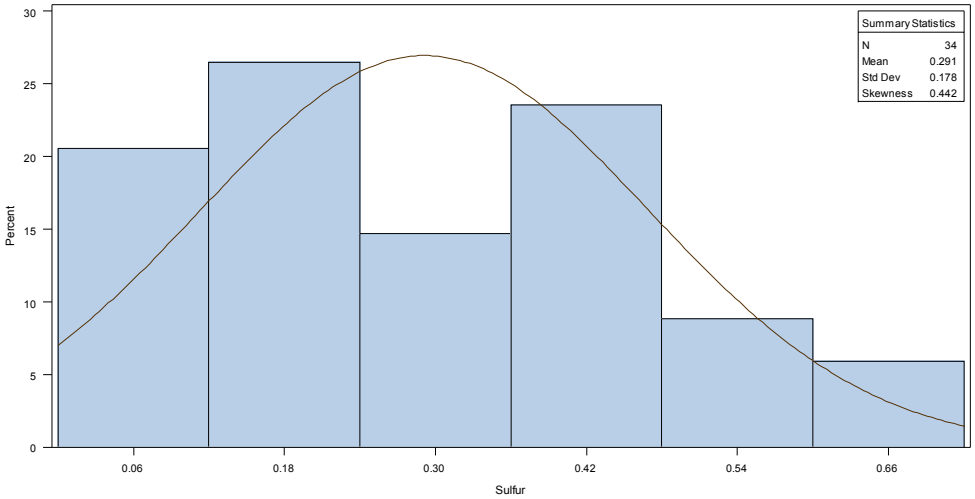
Distribution of Sulfur in Incident Filter

Variable: Sulfur

Tests for Normality

Test		--Statistic---		-----p Value------
Shapiro-Wilk	W	0.948786	Pr < W	0.1129
Kolmogorov-Smirnov	D	0.11385	Pr > D	>0.1500
Cramer-von Mises	W-Sq	0.103149	Pr > W-Sq	0.0985
Anderson-Darling	A-Sq	0.628608	Pr > A-Sq	0.0948

Distribution of Sulfur in Incident Aircraft filters

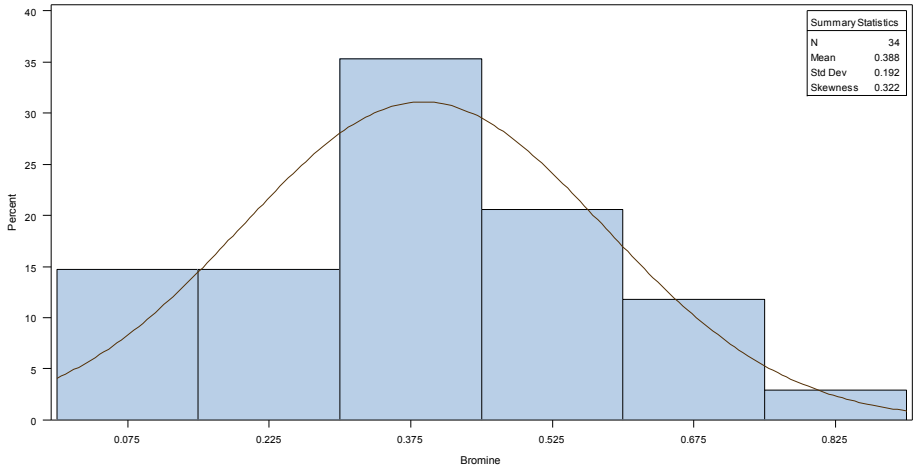


Distribution of Bromine in Incident Aircraft filters

Tests for Normality

Test		--Statistic---		-----p Value------
Shapiro-Wilk	W	0.972406	Pr < W	0.5309
Kolmogorov-Smirnov	D	0.097589	Pr > D	>0.1500
Cramer-von Mises	W-Sq	0.050127	Pr > W-Sq	>0.2500
Anderson-Darling	A-Sq	0.31333	Pr > A-Sq	>0.2500

Distribution of Bromine in Incident Aircraft filters



Calculation and Test of Correlations, 95% CI for Used Filters

The CORR Procedure

Pearson Correlation Coefficients, N = 99

Prob > |r| under H0: Rho=0

	P	S	Br
P	1.00000	0.58591	0.07262
		<.0001	0.4750
S	0.58591	1.00000	-0.28531
	<.0001		0.0042
Br	0.07262	-0.28531	1.00000
	0.4750	0.0042	

Calculation and Test of Correlations, 95% CI for **Incident** Filters

The CORR Procedure

Pearson Correlation Coefficients, N = 34

Prob > |r| under H0: Rho=0

	P	S	Br
P	1.00000	0.65239	-0.56459
		<.0001	0.0005
S	0.65239	1.00000	-0.62509
	<.0001		<.0001
Br	-0.56459	-0.62509	1.00000
	0.0005	<.0001	

The TTEST Procedure

Variable: Phosphorus

Category	Method	Mean	95% CL	Mean	Std Dev	95% CL	Std Dev
Incident		0.0320	0.0256	0.0384	0.0184	0.0148	0.0242
Used		0.0524	0.0469	0.0579	0.0278	0.0244	0.0323
Diff (1-2)	Pooled	-0.0204	-0.0305	-0.0103	0.0258	0.0230	0.0293
Diff (1-2)	Satterthwaite	-0.0204	-0.0288	-0.0120			

Method	Variances	DF	t Value	Pr > |t|
Pooled	Equal	131	-3.98	0.0001
Satterthwaite	Unequal	87.29	-4.84	<.0001

The TTEST Procedure

Variable: sulfur

Category	Method	Mean	95% CL Mean		Std Dev	95% CL	Std Dev
Incident		0.2798	0.2161	0.3435	0.1766	0.1415	0.2347
Used		0.4553	0.4220	0.4885	0.1666	0.1462	0.1937
Diff (1-2)	Pooled	-0.1755	-0.2435	-0.1074	0.1691	0.1507	0.1925
Diff (1-2)	Satterthwaite	-0.1755	-0.2466	-0.1043			

Method	Variances	DF	t Value	Pr > |t|
Pooled	Equal	129	-5.10	<.0001
Satterthwaite	Unequal	50.101	-4.95	<.0001

Equality of Variances

Method	Num DF	Den DF	F Value	Pr > F
Folded F	31	98	1.12	0.6522

The TTEST Procedure

Variable: Bromine

Category	Method	Mean	95% CL	Mean	Std Dev	95% CL	Std Dev
Incident		0.3878	0.3207	0.4549	0.1924	0.1552	0.2533
Used		0.4252	0.3828	0.4677	0.2127	0.1866	0.2473
Diff (1-2)	Pooled	-0.0374	-0.1191	0.0443	0.2078	0.1854	0.2364
Diff (1-2)	Satterthwaite	-0.0374	-0.1160	0.0411			

Method	Variances	DF	t Value	Pr > |t|
Pooled	Equal	131	-0.91	0.3664
Satterthwaite	Unequal	62.778	-0.95	0.3447

Equality of Variances

Method	Num DF	Den DF	F Value	Pr > F
Folded F	98	33	1.22	0.5214

Table A-4 ANALYSIS OF VARIANCE (ANOVA) USING PROC GML and PROC MIXED PROCEDURES

SAS OUTPUT

Obs	Filter_ ID	Aircraft	Phosphorus	Sulfur	Bromine	Category
1	1F3555	B777	0.0480	0.4040	0.3160	Used
2	IS78FS	B777	0.0583	0.3950	0.3783	Used
3	2D968E	B777	0.0500	0.3517	0.5567	Used
4	3C297F	B737	0.0400	0.4740	0.4940	Used
5	4S190C	B777	0.0300	0.4860	0.4180	Used
6	5H2F01	B777	0.0583	0.4800	0.3500	Used
7	7WQF45	B777	0.0275	0.5250	0.2575	Used
8	7ZMK52	B777	0.0500	0.5133	0.1800	Used
9	8P6G4X	B737	0.0325	0.2325	0.5125	Used
10	9E003T	B777	0.0425	0.3725	0.4500	Used
11	9RZMC2	B777	0.0333	0.5150	0.3467	Used
12	43RTYZ	B777	0.0317	0.5883	0.3183	Used
13	73J43M	B777	0.0540	0.4600	0.5400	Used
14	83MIA9	B777	0.0167	0.4567	0.1517	Used
15	584C32	B777	0.0683	0.5800	0.7517	Used
16	794TWZ	B777	0.0300	0.3150	0.2975	Used
17	AI644T	B777	0.0320	0.1180	0.7860	Used
18	B014NE	B777	0.0320	0.3200	0.2960	Used
19	B92YNB	B777	0.0420	0.5180	0.2500	Used
20	BRT6RD	B777	0.0360	0.4500	0.2660	Used
21	ESF946	B777	0.0300	0.4560	0.4400	Used
22	G48MJ6	B777	0.0400	0.4680	0.4160	Used
23	JD5RT2	B777	0.0467	0.4583	0.4700	Used
24	JHHCD2	B737	0.0067	0.1233	0.7300	Used
25	JR3584	B777	0.0360	0.5760	0.3980	Used
26	KI9846	B777	0.0475	0.4500	0.6875	Used
27	MSU4TD	B777	0.0200	0.1400	0.6850	Used
28	MTCL37	B777	0.0720	0.4400	0.5640	Used
29	N6D5A7	B777	0.0600	0.5440	0.7220	Used
30	PN38IZ	B777	0.0620	0.5600	0.6080	Used
31	R67R85	B777	0.0340	0.6720	0.3000	Used
32	STJH77	B777	0.0400	0.6960	0.3140	Used
33	TBD533	B777	0.0417	0.5617	0.2817	Used
34	TJ66RG	B777	0.0433	0.5333	0.1200	Used
35	UGA145	B777	0.0300	0.3375	0.5850	Used
36	VT23AC	B777	0.0080	0.1140	0.6620	Used
37	WH3JMZ	B777	0.0400	0.3700	0.6083	Used
38	CRH8ES	B777	0.0980	0.6540	0.6280	Used
39	DAW454	B777	0.1233	0.7550	0.5433	Used

40	DSF6UE	B777	0.0600	0.5580	0.4860	Used
41	12HD94	A320	0.0580	0.5160	0.3600	Used
42	LF4EQ2	B767	0.0550	0.2583	0.1117	Used
43	SJA33J	A320	0.0150	0.1717	0.3617	Used
44	YEK752	A320	0.0300	0.2900	0.4200	Used
45	LR8C66	B777	0.0933	0.3617	0.5050	Used
46	I89VFS	B777	0.0667	0.4700	0.8483	Used
47	E63JV3	B737	0.0700	0.4200	0.2040	Used
48	7YS36N	B777	0.0400	0.4160	0.1760	Used
49	W9E578	B747	0.0225	0.3875	0.5225	Used
50	8835TV	A320	0.0300	0.3933	0.1367	Used
51	WR2F6B	B767	0.0375	0.4225	0.3025	Used
52	HME4A8	B777	0.0375	0.2800	0.7100	Used
53	163B4J	B747	0.0325	0.6250	0.3425	Used
54	46NKJF	B777	0.0800	0.6880	0.6260	Used
55	R5BH23	B777	0.0483	0.3100	0.7533	Used
56	GF68X3	B777	0.0750	0.8717	0.2267	Used
57	7GH325	B777	0.0575	0.3150	0.4675	Used
58	K76GHR	A320	0.0400	0.3420	0.2740	Used
59	QOX417	B737	0.0460	0.3220	0.6920	Used
60	WBH9G4	B777	0.0920	0.3240	0.4480	Used
61	907BVA	B777	0.0860	0.9840	0.1160	Used
62	MA7ET5	B777	0.1440	0.8000	0.5880	Used
63	TT15A5	B737	0.0225	0.4400	0.3625	Used
64	NZ2T7W	B777	0.0360	0.3040	1.0000	Used
65	11S754	B777	0.1000	0.4280	0.4280	Used
66	17BDAR	B777	0.0980	0.6540	0.3760	Used
67	TC66HR	B767	0.0350	0.4850	0.2725	Used
68	F1JH39	B737	0.0740	0.4620	0.1660	Used
69	GO9JVE	B747	0.0333	0.5167	0.2283	Used
70	HIDE4H	B777	0.0933	0.6967	0.2100	Used
71	HGD63H	A320	0.0440	0.3960	0.3780	Used
72	RP14DE	B737	0.1150	0.4800	0.7167	Used
73	77G4CJ	B777	0.0940	0.6280	0.8640	Used
74	2965CL	A320	0.0580	0.5160	0.2440	Used
75	B322IJ	B737	0.0700	0.2720	1.0120	Used
76	HFU84F	B777	0.0725	0.6025	0.1625	Used
77	FWX130	B777	0.1167	0.7000	0.5600	Used
78	M6AAM6	B747	0.0425	0.4725	0.4325	Used
79	L6159B	B747	0.0367	0.4267	0.4600	Used
80	CE9B19	A320	0.0500	0.3920	0.3020	Used
81	27QR6F	B777	0.0183	0.1317	0.4883	Used
82	JGFDGG	B747	0.0433	0.6350	0.1633	Used
83	FTRT75	B737	0.0560	0.3680	0.0940	Used
84	WAQE67	B777	0.0583	0.5083	0.3917	Used
85	75G8FW	B777	0.1080	0.7580	0.5860	Used

86	U44MXV	A320	0.0433	0.3933	0.1683	Used
87	G8UX4V	B777	0.0860	0.5960	0.5700	Used
88	MB6LV1	B747	0.0467	0.4733	0.3400	Used
89	NM81X7	A320	0.0260	0.3300	0.4080	Used
90	85HXNS	B747	0.0217	0.2217	0.3217	Used
91	ZD152A	B747	0.0280	0.2880	0.3900	Used
92	BHU548	B737	0.0760	0.6680	0.1140	Used
93	CP163W	B747	0.0267	0.5033	0.3483	Used
94	PL2IX1	B747	0.0250	0.4100	0.2883	Used
95	T007ML	A320	0.0417	0.3217	0.6483	Used
96	DR87FE	B777	0.1220	0.4940	0.1560	Used
97	IUY3T4	B767	0.0280	0.1220	0.8180	Used
98	HFD9LM	B767	0.0480	0.5260	0.2240	Used
99	3Q5J9L	B767	0.0840	0.5740	0.0480	Used
100	2974	B737	0.0433	0.0000	0.6000	Incident
101	22551	A320	0.0233	0.2467	0.3017	Incident
102	26701	A320	0.0567	0.2617	0.2783	Incident
103	27055	A320	0.0400	0.2383	0.3833	Incident
104	27165	A320	0.0483	0.4517	0.3333	Incident
105	27420	A320	0.0317	0.2017	0.3050	Incident
106	27559	B737	0.0267	0.2667	0.3433	Incident
107	27659	A320	0.0075	0.0800	0.2825	Incident
108	27660	A320	0.0133	0.0933	0.3800	Incident
109	27694	A320	0.0533	0.4467	0.1083	Incident
110	28240	B737	0.0167	0.3517	0.4217	Incident
111	28297	B737	0.0250	0.1367	0.5950	Incident
112	28802	A320	0.0200	0.0825	0.5250	Incident
113	28825	A320	0.0200	0.2260	0.3100	Incident
114	29428	B737	0.0050	0.0783	0.7400	Incident
115	29434	B737	0.0050	0.1233	0.5583	Incident
116	29442	B737	0.0200	0.1150	0.8525	Incident
117	29606	B737	0.0150	0.1550	0.4867	Incident
118	30121	B737	0.0300	0.1640	0.6320	Incident
119	30335	B737	0.0633	0.4533	0.1000	Incident
120	30363	B737	0.0667	0.4917	0.0633	Incident
121	30670	B737	0.0360	0.2260	0.4340	Incident
122	30674	B737	0.0167	0.0900	0.6400	Incident
123	60401016	A320	0.0567	0.4417	0.1250	Incident
124	65039046	A320	0.0800	0.6617	0.1267	Incident
125	A3795HC	B767	0.0460	0.4860	0.5500	Incident
126	A3740HC	B767	0.0250	0.4150	0.5000	Incident
127	A3760HC	B767	0.0300	0.3700	0.3783	Incident
128	A3869HC	B767	0.0350	0.4250	0.5250	Incident
129	A21803HC	B737	0.0317	0.4317	0.3367	Incident
130	A22023HC	B737	0.0283	0.5183	0.3000	Incident
131	A217994H	B737	0.0350	0.6950	0.1500	Incident

132	A22623HC	B737	0.0250	0.2950	0.2717	Incident
133	A242337H	B737	0.0120	0.1840	0.2480	Incident

The GLM Procedure

Class Level Information

Class	Levels	Values
Category	2	Incident Used

Number of Observations Read 133

Number of Observations Used 133

The GLM Procedure

Dependent Variable: Phosphorus

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	1	0.01052622	0.01052622	15.86	0.0001
Error	131	0.08693870	0.00066365		
Corrected Total	132	0.09746492			

R-Square	Coeff Var	Root MSE	Phosphorus Mean
0.108000	54.59507	0.025761	0.047186

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Category	1	0.01052622	0.01052622	15.86	0.0001

Parameter		Estimate	Standard Error	t Value	Pr > |t|
Intercept		0.0524000000 B	0.00258913	20.24	<.0001
Category	Incident	-.0203941176 B	0.00512082	-3.98	0.0001
Category	Used	0.0000000000 B	.	.	.

The GLM Procedure

Dependent Variable: Sulfur

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	1	0.69011107	0.69011107	24.10	<.0001
Error	131	3.75130778	0.02863594		
Corrected Total	132	4.44141885			

R-Square	Coeff Var	Root MSE	Sulfur Mean
0.155381	40.85481	0.169222	0.414202

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Category	1	0.69011107	0.69011107	24.10	<.0001

Parameter		Estimate	Standard Error	t Value	Pr > |t|
Intercept		0.4564161616 B	0.01700741	26.84	<.0001

Category	Incident	-.1651308675	B	0.03363756	-4.91	<.0001
Category	Used	0.0000000000	B	.	.	.

NOTE: The X'X matrix has been found to be singular, and a generalized inverse was used to solve the normal equations. Terms whose estimates are followed by the letter 'B' are not uniquely estimable.

The GLM Procedure

Dependent Variable: Bromine

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	1	0.03546400	0.03546400	0.82	0.3664
Error	131	5.65414144	0.04316139		
Corrected Total	132	5.68960544			

R-Square	Coeff Var	Root MSE	Bromine Mean
0.006233	49.97960	0.207753	0.415676

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Category	1	0.03546400	0.03546400	0.82	0.3664

Parameter		Estimate		Standard Error	t Value	Pr > |t|
Intercept		0.4252454545	B	0.02087998	20.37	<.0001
Category	Incident	-.0374336898	B	0.04129680	-0.91	0.3664
Category	Used	0.0000000000	B	.	.	.

NOTE: The X'X matrix has been found to be singular, and a generalized inverse was used to solve the normal equations. Terms whose estimates are followed by the letter 'B' are not uniquely estimable.

The GLM Procedure

Least Squares Means

Adjustment for Multiple Comparisons: Bonferroni

Category	Phosphorus LSMEAN	Standard Error	H0:LSMEAN=0 Pr > |t|	H0:LSMean1=LSMean2 Pr > |t|
Incident	0.03200588	0.00441806	<.0001	0.0001
Used	0.05240000	0.00258913	<.0001	

Phosphorus

Category	LSMEAN	95% Confidence Limits	
Incident	0.032006	0.023266	0.040746
Used	0.052400	0.047278	0.057522

Least Squares Means for Effect Category

Difference Between	Simultaneous 95% Confidence Limits for

i	j	Means	LSMean(i)-LSMean(j)	
1	2	-0.020394	-0.030524	-0.010264

Category	Sulfur LSMEAN	Standard Error	H0:LSMEAN=0 Pr > |t|	H0:LSMean1= LSMean2 Pr > |t|
Incident	0.29128529	0.02902126	<.0001	<.0001
Used	0.45641616	0.01700741	<.0001	

Category	Sulfur LSMEAN	95% Confidence Limits	
Incident	0.291285	0.233874	0.348696
Used	0.456416	0.422771	0.490061

Least Squares Means for Effect Category

i	j	Difference Between Means	Simultaneous 95% Confidence Limits for LSMean(i)-LSMean(j)	
1	2	-0.165131	-0.231674	-0.098588

The GLM Procedure
Least Squares Means
Adjustment for Multiple Comparisons: Bonferroni

Category	Bromine LSMEAN	Standard Error	H0:LSMEAN=0 Pr > |t|	H0:LSMean1= LSMean2 Pr > |t|
Incident	0.38781176	0.03562938	<.0001	0.3664
Used	0.42524545	0.02087998	<.0001	

Category	Bromine LSMEAN	95% Confidence Limits	
Incident	0.387812	0.317328	0.458295
Used	0.425245	0.383940	0.466551

Least Squares Means for Effect Category

i	j	Difference Between Means	Simultaneous 95% Confidence Limits for LSMean(i)-LSMean(j)	
1	2	-0.037434	-0.119129	0.044261

---------- Category=Incident ----------

The GLM Procedure
Class Level Information

Class	Levels	Values
Aircraft	3	A320 B737 B767

```
                          Number of Observations Read          34
                          Number of Observations Used          34

------------------------------------ Category=Incident --------------------------
                                  The GLM Procedure
Dependent Variable: Phosphorus
                                Sum of
Source              DF         Squares        Mean Square    F Value   Pr > F
Model                2       0.00069703       0.00034851       1.04    0.3666
Error               31       0.01042177       0.00033619
Corrected Total     33       0.01111880

                R-Square     Coeff Var      Root MSE    Phosphorus Mean
                0.062689      57.28753      0.018335            0.032006

Source              DF     Type III SS     Mean Square    F Value    Pr > F
Aircraft             2      0.00069703      0.00034851       1.04    0.3666

                                  Standard
 Parameter        Estimate         Error    t Value    Pr > |t|
 Intercept          0.0340000000 B      0.00916769       3.71      0.0008
 Aircraft  A320     0.0035666667 B      0.01058594       0.34      0.7384
 Aircraft  B737     -.0061444444 B      0.01013526      -0.61      0.5488
 Aircraft  B767     0.0000000000 B       .                .         .

NOTE: The X'X matrix has been found to be singular, and a generalized inverse was used to solve
the normal equations.  Terms whose estimates are followed by the letter 'B' are not uniquely estimable.
------------------------------------ Category=Incident --------------------------
                                  The GLM Procedure
Dependent Variable: Sulfur
                                Sum of
Source              DF         Squares         Mean Square    F Value   Pr > F
Model               2           0.08292664      0.04146332      1.34    0.2765
Error               31          0.95886146      0.03093102
Corrected Total     33          1.04178810

                R-Square     Coeff Var      Root MSE    Sulfur Mean
                0.079600      60.37797      0.175872       0.291285
Source              DF     Type III SS     Mean Square    F Value    Pr > F
Aircraft             2      0.08292664      0.04146332      1.34      0.2765

                                            Standard
      Parameter             Estimate          Error        t Value   Pr > |t|
      Intercept          0.4240000000 B      0.08793608       4.82    <.0001
      Aircraft  A320     -.1380000000 B      0.10153984      -1.36    0.1839
      Aircraft  B737     -.1586833333 B      0.09721699      -1.63    0.1127
```

Aircraft	B767	0.0000000000	B	.	.	.

NOTE: The X'X matrix has been found to be singular, and a generalized inverse was used to solve the normal equations. Terms whose estimates are followed by the letter 'B' are not uniquely estimable.

---------- Category=Incident ----------

The GLM Procedure

Dependent Variable: Bromine

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	2	0.19424205	0.09712103	2.93	0.0683
Error	31	1.02752910	0.03314610		
Corrected Total	33	1.22177116			

R-Square	Coeff Var	Root MSE	Bromine Mean
0.158984	46.94564	0.182061	0.387812

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Aircraft	2	0.19424205	0.09712103	2.93	0.0683

Parameter		Estimate	Standard Error	t Value	Pr > |t|
Intercept		0.4883250000 B	0.09103035	5.36	<.0001
Aircraft	A320	-.2000666667 B	0.10511280	-1.90	0.0663
Aircraft	B737	-.0564805556 B	0.10063784	-0.56	0.5787
Aircraft	B767	0.0000000000 B	.	.	.

NOTE: The X'X matrix has been found to be singular, and a generalized inverse was used to solve the normal equations. Terms whose estimates are followed by the letter 'B' are not uniquely estimable.

---------- Category=Incident ----------

The GLM Procedure

Levene's Test for Homogeneity of Phosphorus Variance

ANOVA of Absolute Deviations from Group Means

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Aircraft	2	0.000489	0.000244	2.17	0.1311
Error	31	0.00349	0.000113		

O'Brien's Test for Homogeneity of Phosphorus Variance

ANOVA of O'Brien's Spread Variable, W = 0.5

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Aircraft	2	5.375E-7	2.687E-7	1.12	0.3384
Error	31	7.422E-6	2.394E-7		

Brown and Forsythe's Test for Homogeneity of Phosphorus Variance

ANOVA of Absolute Deviations from Group Medians

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Aircraft	2	0.000495	0.000248	2.10	0.1400
Error	31	0.00366	0.000118		

Bartlett's Test for Homogeneity of Phosphorus Variance

Source	DF	Chi-Square	Pr > ChiSq
Aircraft	2	2.7343	0.2548

---------- Category=Incident ----------

The GLM Procedure

O'Brien's Test for Homogeneity of Sulfur Variance

ANOVA of O'Brien's Spread Variable, W = 0.5

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Aircraft	2	0.00361	0.00180	0.94	0.4007
Error	31	0.0593	0.00191		

Brown and Forsythe's Test for Homogeneity of Sulfur Variance

ANOVA of Absolute Deviations from Group Medians

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Aircraft	2	0.0454	0.0227	1.63	0.2132
Error	31	0.4330	0.0140		

Bartlett's Test for Homogeneity of Sulfur Variance

Source	DF	Chi-Square	Pr > ChiSq
Aircraft	2	4.8336	0.0892

Levene's Test for Homogeneity of Bromine Variance

ANOVA of Absolute Deviations from Group Means

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Aircraft	2	0.0959	0.0480	4.67	0.0169
Error	31	0.3187	0.0103		

O'Brien's Test for Homogeneity of Bromine Variance

ANOVA of O'Brien's Spread Variable, W = 0.5

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Aircraft	2	0.0121	0.00605	3.22	0.0535
Error	31	0.0582	0.00188		

---------- Category=Incident ----------

The GLM Procedure

Brown and Forsythe's Test for Homogeneity of Bromine Variance

ANOVA of Absolute Deviations from Group Medians

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Aircraft	2	0.1023	0.0512	4.79	0.0154
Error	31	0.3311	0.0107		

Bartlett's Test for Homogeneity of Bromine Variance

Source	DF	Chi-Square	Pr > ChiSq
Aircraft	2	6.7115	0.0349

Welch's ANOVA for Phosphorus

Source	DF	F Value	Pr > F
Aircraft	2.0000	0.97	0.4063
Error	12.4849		

Welch's ANOVA for Sulfur

Source	DF	F Value	Pr > F
Aircraft	2.0000	6.43	0.0075
Error	18.6834		

Welch's ANOVA for Bromine

Source	DF	F Value	Pr > F
Aircraft	2.0000	7.50	0.0065
Error	13.3635		

---------- Category=Incident ----------

The GLM Procedure

Level of Aircraft	N	Phosphorus Mean	Phosphorus Std Dev	Sulfur Mean	Sulfur Std Dev	Bromine Mean	Bromine Std Dev
A320	12	0.03756667	0.02184538	0.28600000	0.17958848	0.28825833	0.12125487
B737	18	0.02785556	0.01702998	0.26531667	0.18743583	0.43184444	0.22339733
B767	4	0.03400000	0.00898146	0.42400000	0.04775633	0.48832500	0.07613730

---------- Category=Incident ----------

The GLM Procedure

Least Squares Means

Adjustment for Multiple Comparisons: Bonferroni

Aircraft	Phosphorous LSMEAN	Standard Error	Pr > |t|	LSMEAN Number
A320	0.03756667	0.00529297	<.0001	1
B737	0.02785556	0.00432169	<.0001	2

B767	0.03400000	0.00916769	0.0008	3

Least Squares Means for effect Aircraft
Pr > |t| for H0: LSMean(i)=LSMean(j)
Dependent Variable: Phosphorus

i/j	1	2	3
1		0.4958	1.0000
2	0.4958		1.0000
3	1.0000	1.0000	

Aircraft	Phosphorus LSMEAN	95% Confidence Limits	
A320	0.037567	0.026772	0.048362
B737	0.027856	0.019041	0.036670
B767	0.034000	0.015302	0.052698

Least Squares Means for Effect Aircraft

i	j	Difference Between Means	Simultaneous 95% Confidence Limits for LSMean(i)-LSMean(j)	
1	2	0.009711	-0.007583	0.027005
1	3	0.003567	-0.023226	0.030359
2	3	-0.006144	-0.031796	0.019507

Aircraft	Sulfur LSMEAN	Standard Error	Pr > |t|	LSMEAN Number
A320	0.28600000	0.05076992	<.0001	1
B737	0.26531667	0.04145346	<.0001	2
B767	0.42400000	0.08793608	<.0001	3

---------- Category=Incident ----------

The GLM Procedure
Least Squares Means
Adjustment for Multiple Comparisons: Bonferroni
Least Squares Means for effect Aircraft
Pr > |t| for H0: LSMean(i)=LSMean(j)
Dependent Variable: Sulfur

i/j	1	2	3
1		1.0000	0.5518
2	1.0000		0.3382
3	0.5518	0.3382	

Aircraft	Sulfur LSMEAN	95% Confidence Limits	
A320	0.286000	0.182454	0.389546
B737	0.265317	0.180772	0.349862
B767	0.424000	0.244653	0.603347

Least Squares Means for Effect Aircraft

i	j	Difference Between Means	Simultaneous 95% Confidence Limits for LSMean(i)-LSMean(j)	
1	2	0.020683	-0.145203	0.186570
1	3	-0.138000	-0.394990	0.118990
2	3	-0.158683	-0.404732	0.087366

Aircraft	Bromine LSMEAN	Standard Error	Pr > |t|	LSMEAN Number
A320	0.28825833	0.05255640	<.0001	1
B737	0.43184444	0.04291212	<.0001	2
B767	0.48832500	0.09103035	<.0001	3

---------- Category=Incident ----------

The GLM Procedure

Least Squares Means

Adjustment for Multiple Comparisons: Bonferroni

Least Squares Means for effect Aircraft

Pr > |t| for H0: LSMean(i)=LSMean(j)

Dependent Variable: Bromine

i/j	1	2	3
1		0.1274	0.1989
2	0.1274		1.0000
3	0.1989	1.0000	

Aircraft	Bromine LSMEAN	95% Confidence Limits	
A320	0.288258	0.181069	0.395448
B737	0.431844	0.344325	0.519364
B767	0.488325	0.302667	0.673983

Least Squares Means for Effect Aircraft

i	j	Difference Between Means	Simultaneous 95% Confidence Limits for LSMean(i)-LSMean(j)	
1	2	-0.143586	-0.315309	0.028137
1	3	-0.200067	-0.466099	0.065966
2	3	-0.056481	-0.311187	0.198226

---------- Category=Used ----------

The GLM Procedure

Class Level Information

Class	Levels	Values

Aircraft	5	A320 B737 B747 B767 B777	
Number of Observations Read		99	
Number of Observations Used		99	

---------- Category=Used ----------

The GLM Procedure

Dependent Variable: Phosphorus

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	4	0.00837897	0.00209474	2.92	0.0252
Error	94	0.06744093	0.00071746		
Corrected Total	98	0.07581990			

R-Square	Coeff Var	Root MSE	Phosphorus Mean
0.110511	51.11714	0.026785	0.052400

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Aircraft	4	0.00837897	0.00209474	2.92	0.0252

Parameter		Estimate	Standard Error	t Value	Pr > |t|
Intercept		0.0582750000 B	0.00345798	16.85	<.0001
Aircraft	A320	-.0186386364 B	0.00878527	-2.12	0.0365
Aircraft	B737	-.0029386364 B	0.00878527	-0.33	0.7388
Aircraft	B747	-.0256477273 B	0.00878527	-2.92	0.0044
Aircraft	B767	-.0103583333 B	0.01146882	-0.90	0.3687
Aircraft	B777	0.0000000000 B	.	.	.

NOTE: The X'X matrix has been found to be singular, and a generalized inverse was used to solve the normal equations. Terms whose estimates are followed by the letter 'B' are not uniquely estimable.

---------- Category=Used ----------

The GLM Procedure

Dependent Variable: Sulfur

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	4	0.23224815	0.05806204	2.20	0.0745
Error	94	2.47727153	0.02635395		
Corrected Total	98	2.70951967			

R-Square	Coeff Var	Root MSE	Sulfur Mean
0.085716	35.56820	0.162339	0.456416

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Aircraft	4	0.23224815	0.05806204	2.20	0.0745

Parameter		Estimate	Standard Error	t Value	Pr > |t|

Intercept		0.4918983333	B	0.02095788	23.47	<.0001
Aircraft	A320	-.1226256061	B	0.05324515	-2.30	0.0235
Aircraft	B737	-.1044619697	B	0.05324515	-1.96	0.0527
Aircraft	B747	-.0410165152	B	0.05324515	-0.77	0.4430
Aircraft	B767	-.0939316667	B	0.06950941	-1.35	0.1798
Aircraft	B777	0.0000000000	B	.	.	.

NOTE: The X'X matrix has been found to be singular, and a generalized inverse was used to solve the normal equations. Terms whose estimates are followed by the letter 'B' are not uniquely estimable.

---------- Category=Used ----------

The GLM Procedure

Dependent Variable: Bromine

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	4	0.34560513	0.08640128	1.99	0.1027
Error	94	4.08676515	0.04347623		
Corrected Total	98	4.43237029			

R-Square	Coeff Var	Root MSE	Bromine Mean
0.077973	49.03275	0.208510	0.425245

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Aircraft	4	0.34560513	0.08640128	1.99	0.1027

Parameter		Estimate	Standard Error	t Value	Pr > |t|
Intercept		0.4614416667	B	0.02691846	17.14	<.0001
Aircraft	A320	-.1249871212	B	0.06838851	-1.83	0.0708
Aircraft	B737	0.0019856061	B	0.06838851	0.03	0.9769
Aircraft	B747	-.1125871212	B	0.06838851	-1.65	0.1030
Aircraft	B767	-.1653250000	B	0.08927845	-1.85	0.0672
Aircraft	B777	0.0000000000	B	.	.	.

NOTE: The X'X matrix has been found to be singular, and a generalized inverse was used to solve the normal equations. Terms whose estimates are followed by the letter 'B' are not uniquely estimable.

---------- Category=Used ----------

The GLM Procedure

Levene's Test for Homogeneity of Phosphorus Variance

ANOVA of Absolute Deviations from Group Means

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Aircraft	4	0.00427	0.00107	4.41	0.0026

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Error	94	0.0228	0.000242		

O'Brien's Test for Homogeneity of Phosphorus Variance

ANOVA of O'Brien's Spread Variable, W = 0.5

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Aircraft	4	0.000011	2.733E-6	2.15	0.0810
Error	94	0.000120	1.273E-6		

Brown and Forsythe's Test for Homogeneity of Phosphorus Variance

ANOVA of Absolute Deviations from Group Medians

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Aircraft	4	0.00397	0.000994	3.10	0.0192
Error	94	0.0301	0.000321		

Bartlett's Test for Homogeneity of Phosphorus Variance

Source	DF	Chi-Square	Pr > ChiSq
Aircraft	4	21.7194	0.0002

Levene's Test for Homogeneity of Sulfur Variance

ANOVA of Absolute Deviations from Group Means

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Aircraft	4	0.0503	0.0126	1.22	0.3062
Error	94	0.9665	0.0103		

---------- Category=Used ----------

The GLM Procedure

O'Brien's Test for Homogeneity of Sulfur Variance

ANOVA of O'Brien's Spread Variable, W = 0.5

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Aircraft	4	0.00626	0.00156	0.90	0.4683
Error	94	0.1637	0.00174		

Brown and Forsythe's Test for Homogeneity of Sulfur Variance

ANOVA of Absolute Deviations from Group Medians

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Aircraft	4	0.0527	0.0132	1.19	0.3214
Error	94	1.0432	0.0111		

Bartlett's Test for Homogeneity of Sulfur Variance

Source	DF	Chi-Square	Pr > ChiSq
Aircraft	4	5.8852	0.2079

Levene's Test for Homogeneity of Bromine Variance
ANOVA of Absolute Deviations from Group Means

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Aircraft	4	0.2144	0.0536	3.80	0.0066
Error	94	1.3253	0.0141		

O'Brien's Test for Homogeneity of Bromine Variance
ANOVA of O'Brien's Spread Variable, W = 0.5

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Aircraft	4	0.0498	0.0124	3.10	0.0192
Error	94	0.3778	0.00402		

---------- Category=Used ----------

The GLM Procedure
Brown and Forsythe's Test for Homogeneity of Bromine Variance
ANOVA of Absolute Deviations from Group Medians

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Aircraft	4	0.2114	0.0529	3.52	0.0100
Error	94	1.4102	0.0150		

Bartlett's Test for Homogeneity of Bromine Variance

Source	DF	Chi-Square	Pr > ChiSq
Aircraft	4	13.1484	0.0106

Welch's ANOVA for Phosphorus

Source	DF	F Value	Pr > F
Aircraft	4.0000	7.55	0.0006
Error	21.4623		

Welch's ANOVA for Sulfur

Source	DF	F Value	Pr > F
Aircraft	4.0000	2.90	0.0478
Error	20.3635		

Welch's ANOVA for Bromine

Source	DF	F Value	Pr > F
Aircraft	4.0000	2.67	0.0626
Error	19.9063		

---------- Category=Used ----------

The GLM Procedure

Level of		Phosphorus		Sulfur		Bromine	
Aircraft	N	Mean	Std Dev	Mean	Std Dev	Mean	Std Dev
A320	11	0.03963636	0.01340644	0.36927273	0.09762773	0.33645455	0.13931162
B737	11	0.05533636	0.03008845	0.38743636	0.14694177	0.46342727	0.30269724
B747	11	0.03262727	0.00873591	0.45088182	0.12553661	0.34885455	0.10231460
B767	6	0.04791667	0.02012068	0.39796667	0.17390879	0.29611667	0.27339821
B777	60	0.05827500	0.03019796	0.49189833	0.17742151	0.46144167	0.20576505

---------- Category=Used ----------

The GLM Procedure

Least Squares Means

Adjustment for Multiple Comparisons: Bonferroni

Aircraft	Phosphorus LSMEAN	Standard Error	Pr > |t|	LSMEAN Number
A320	0.03963636	0.00807610	<.0001	1
B737	0.05533636	0.00807610	<.0001	2
B747	0.03262727	0.00807610	0.0001	3
B767	0.04791667	0.01093509	<.0001	4
B777	0.05827500	0.00345798	<.0001	5

Least Squares Means for effect Aircraft

Pr > |t| for H0: LSMean(i)=LSMean(j)

Dependent Variable: Phosphorus

i/j	1	2	3	4	5
1		1.0000	1.0000	1.0000	0.3650
2	1.0000		0.4969	1.0000	1.0000
3	1.0000	0.4969		1.0000	0.0439
4	1.0000	1.0000	1.0000		1.0000
5	0.3650	1.0000	0.0439	1.0000	

Aircraft	Phosphorus LSMEAN	95% Confidence Limits	
A320	0.039636	0.023601	0.055672
B737	0.055336	0.039301	0.071372
B747	0.032627	0.016592	0.048663
B767	0.047917	0.026205	0.069629
B777	0.058275	0.051409	0.065141

Least Squares Means for Effect Aircraft

i	j	Difference Between Means	Simultaneous 95% Confidence Limits for LSMean(i)-LSMean(j)	
1	2	-0.015700	-0.048534	0.017134
1	3	0.007009	-0.025825	0.039843
1	4	-0.008280	-0.047361	0.030800
1	5	-0.018639	-0.043895	0.006617
2	3	0.022709	-0.010125	0.055543

2	4	0.007420	-0.031661	0.046500
2	5	-0.002939	-0.028195	0.022317

---------- Category=Used ----------

The GLM Procedure

Least Squares Means

Adjustment for Multiple Comparisons: Bonferroni

Least Squares Means for Effect Aircraft

i	j	Difference Between Means	Simultaneous 95% Confidence Limits for LSMean(i)-LSMean(j)	
3	4	-0.015289	-0.054370	0.023791
3	5	-0.025648	-0.050904	-0.000392
4	5	-0.010358	-0.043329	0.022612

Aircraft	Sulfur LSMEAN	Standard Error	Pr > |t|	LSMEAN Number
A320	0.36927273	0.04894705	<.0001	1
B737	0.38743636	0.04894705	<.0001	2
B747	0.45088182	0.04894705	<.0001	3
B767	0.39796667	0.06627462	<.0001	4
B777	0.49189833	0.02095788	<.0001	5

Least Squares Means for effect Aircraft

Pr > |t| for H0: LSMean(i)=LSMean(j)

Dependent Variable: Sulfur

i/j	1	2	3	4	5
1		1.0000	1.0000	1.0000	0.2348
2	1.0000		1.0000	1.0000	0.5273
3	1.0000	1.0000		1.0000	1.0000
4	1.0000	1.0000	1.0000		1.0000
5	0.2348	0.5273	1.0000	1.0000	

Aircraft	Sulfur LSMEAN	95% Confidence Limits	
A320	0.369273	0.272087	0.466458
B737	0.387436	0.290251	0.484622
B747	0.450882	0.353696	0.548067
B767	0.397967	0.266377	0.529556
B777	0.491898	0.450286	0.533511

---------- Category=Used ----------

The GLM Procedure

Least Squares Means

Adjustment for Multiple Comparisons: Bonferroni

Least Squares Means for Effect Aircraft

i	j	Difference Between Means	Simultaneous 95% Confidence Limits for LSMean(i)-LSMean(j)	
1	2	-0.018164	-0.217162	0.180835
1	3	-0.081609	-0.280607	0.117389
1	4	-0.028694	-0.265549	0.208162
1	5	-0.122626	-0.275695	0.030444
2	3	-0.063445	-0.262444	0.135553
2	4	-0.010530	-0.247386	0.226325
2	5	-0.104462	-0.257531	0.048607
3	4	0.052915	-0.183940	0.289771
3	5	-0.041017	-0.194086	0.112053
4	5	-0.093932	-0.293757	0.105894

Aircraft	Bromine LSMEAN	Standard Error	Pr > |t|	LSMEAN Number
A320	0.33645455	0.06286799	<.0001	1
B737	0.46342727	0.06286799	<.0001	2
B747	0.34885455	0.06286799	<.0001	3
B767	0.29611667	0.08512366	0.0008	4
B777	0.46144167	0.02691846	<.0001	5

Least Squares Means for effect Aircraft

Pr > |t| for H0: LSMean(i)=LSMean(j)

Dependent Variable: Bromine

i/j	1	2	3	4	5
1		1.0000	1.0000	1.0000	0.7078
2	1.0000		1.0000	1.0000	1.0000
3	1.0000	1.0000		1.0000	1.0000
4	1.0000	1.0000	1.0000		0.6719
5	0.7078	1.0000	1.0000	0.6719	

Aircraft	Bromine LSMEAN	95% Confidence Limits	
A320	0.336455	0.211629	0.461280
B737	0.463427	0.338601	0.588253

---------- Category=Used ----------

The GLM Procedure

Least Squares Means

Bromine

Aircraft	LSMEAN	95% Confidence Limits	
B747	0.348855	0.224029	0.473680
B767	0.296117	0.127102	0.465132
B777	0.461442	0.407994	0.514889

Least Squares Means for Effect Aircraft

i	j	Difference Between Means	Simultaneous 95% Confidence Limits for LSMean(i)-LSMean(j)	
1	2	-0.126973	-0.382568	0.128622
1	3	-0.012400	-0.267995	0.243195
1	4	0.040338	-0.263881	0.344557
1	5	-0.124987	-0.321591	0.071616
2	3	0.114573	-0.141022	0.370168
2	4	0.167311	-0.136908	0.471530
2	5	0.001986	-0.194618	0.198589
3	4	0.052738	-0.251481	0.356957
3	5	-0.112587	-0.309191	0.084016
4	5	-0.165325	-0.421983	0.091333

---------- Category=Incident ----------

The Mixed Procedure

Model Information

Data Set	WORK.FILTER
Dependent Variable	Phosphorus
Covariance Structure	Variance Components
Group Effect	Aircraft
Estimation Method	REML
Residual Variance Method	None
Fixed Effects SE Method	Model-Based
Degrees of Freedom Method	Satterthwaite

Class Level Information

Class	Levels	Values
Aircraft	3	A320 B737 B767

Dimensions

Covariance Parameters	3
Columns in X	4
Columns in Z	0
Subjects	34
Max Obs Per Subject	1

Number of Observations

Number of Observations Read	34
Number of Observations Used	34
Number of Observations Not Used	0

Iteration History

Iteration	Evaluations	-2 Res Log Like	Criterion
0	1	-153.19744834	
1	1	-156.13715819	0.00000000

Convergence criteria met.

---------- Category=Incident ----------

The Mixed Procedure

Covariance Parameter Estimates

Cov Parm	Group	Estimate
Residual	Aircraft A320	0.000477
Residual	Aircraft B737	0.000290
Residual	Aircraft B767	0.000081

Fit Statistics

-2 Res Log Likelihood	-156.1
AIC (smaller is better)	-150.1
AICC (smaller is better)	-149.2
BIC (smaller is better)	-145.6

Null Model Likelihood Ratio Test

DF	Chi-Square	Pr > ChiSq
2	2.94	0.2300

Type 3 Tests of Fixed Effects

Effect	Num DF	Den DF	F Value	Pr > F
Aircraft	2	13.6	1.02	0.3865

Least Squares Means

Effect	Aircraft	Estimate	Standard Error	DF	t Value	Pr > |t|	Alpha	Lower	Upper
Aircraft	A320	0.03757	0.006306	11	5.96	<.0001	0.05	0.02369	0.05145
Aircraft	B737	0.02786	0.004014	17	6.94	<.0001	0.05	0.01939	0.03632
Aircraft	B767	0.03400	0.004491	3	7.57	0.0048	0.05	0.01971	0.04829

Differences of Least Squares Means

Effect	Aircraft_Aircraft	Estimate	Standard Error	DF	t Value	Pr > |t|	Adjustment	Adj P
Aircraft	A320 B737	0.009711	0.007475	19.6	1.30	0.2090	Bonferroni	0.6467
Aircraft	A320 B767	0.003567	0.007742	12.9	0.46	0.6527	Bonferroni	1.0000

---------- Category=Incident ----------

The Mixed Procedure

Differences of Least Squares Means

Standard

Effect	Aircraft_Aircraft	Estimate	Error	DF	t Value	Pr > |t|	Adjustment	Adj P
Aircraft	B737 B767	-0.00614	0.006023	8.73	-1.02	0.3351	Bonferroni	0.9766

Differences of Least Squares Means

Effect	Aircraft_Aircraft	Alpha	Lower	Upper	Adj Lower	Adj Upper
Aircraft	A320 B737	0.05	-0.00590	0.02532	-0.01069	0.03012
Aircraft	A320 B767	0.05	-0.01318	0.02031	-0.01757	0.02470
Aircraft	B737 B767	0.05	-0.01984	0.007547	\-0.02259	0.01030

---------- Category=Used ----------

The Mixed Procedure

Model Information

Data Set	WORK.FILTER
Dependent Variable	Phosphorus
Covariance Structure	Variance Components
Group Effect	Aircraft
Estimation Method	REML
Residual Variance Method	None
Fixed Effects SE Method	Model-Based
Degrees of Freedom Method	Satterthwaite

Class Level Information

Class	Levels	Values
Aircraft	5	A320 B737 B747 B767 B777

Dimensions

Covariance Parameters	5
Columns in X	6
Columns in Z	0
Subjects	99
Max Obs Per Subject	1

Number of Observations

Number of Observations Read	99
Number of Observations Used	99
Number of Observations Not Used	0

Iteration History

Iteration	Evaluations	-2 Res Log Like	Criterion
0	1	-400.70076896	
1	1	-423.33652668	0.00000000

Convergence criteria met.

---------- Category=Used ----------

The Mixed Procedure

Covariance Parameter Estimates

Cov Parm	Group	Estimate
Residual	Aircraft A320	0.000180
Residual	Aircraft B737	0.000905
Residual	Aircraft B747	0.000076
Residual	Aircraft B767	0.000405
Residual	Aircraft B777	0.000912

Fit Statistics

-2 Res Log Likelihood	-423.3
AIC (smaller is better)	-413.3
AICC (smaller is better)	-412.7
BIC (smaller is better)	-400.4

Null Model Likelihood Ratio Test

DF	Chi-Square	Pr > ChiSq
4	22.64	0.0001

Type 3 Tests of Fixed Effects

Effect	Num DF	Den DF	F Value	Pr > F
Aircraft	4	23.1	8.25	0.0003

Least Squares Means

Effect	Aircraft	Estimate	Standard Error	DF	t Value	Pr > |t|	Alpha	Lower	Upper
Aircraft	A320	0.03964	0.004042	10	9.81	<.0001	0.05	0.03063	0.04864
Aircraft	B737	0.05534	0.009072	10	6.10	0.0001	0.05	0.03512	0.07555
Aircraft	B747	0.03263	0.002634	10	12.39	<.0001	0.05	0.02676	0.03850
Aircraft	B767	0.04792	0.008214	5	5.83	0.0021	0.05	0.02680	0.06903
Aircraft	B777	0.05828	0.003899	59	14.95	<.0001	0.05	0.05047	0.06608

---------- Category=Used ----------

The Mixed Procedure

Differences of Least Squares Means

Effect	Aircraft_Aircraft	Estimate	Standard Error	DF	t Value	Pr > |t|	Adjustment	Adj P
Aircraft	A320 B737	-0.01570	0.009932	13.8	-1.58	0.1365	Bonferroni	1.0000
Aircraft	A320 B747	0.007009	0.004825	17.2	1.45	0.1643	Bonferroni	1.0000
Aircraft	A320 B767	-0.00828	0.009155	7.5	-0.90	0.3939	Bonferroni	1.0000
Aircraft	A320 B777	-0.01864	0.005616	32.5	-3.32	0.0022	Bonferroni	0.0298
Aircraft	B737 B747	0.02271	0.009447	11.7	2.40	0.0338	Bonferroni	0.2465
Aircraft	B737 B767	0.007420	0.01224	14.1	0.61	0.5540	Bonferroni	1.0000

Aircraft	B737	B777	-0.00294	0.009874	14	-0.30	0.7704	Bonferroni	1.0000
Aircraft	B747	B767	-0.01529	0.008626	6.05	-1.77	0.1263	Bonferroni	0.8953
Aircraft	B747	B777	-0.02565	0.004705	56.1	-5.45	<.0001	Bonferroni	0.0002
Aircraft	B767	B777	-0.01036	0.009092	7.47	-1.14	0.2898	Bonferroni	1.0000

Differences of Least Squares Means

Effect	Aircraft_Aircraft		Alpha	Lower	Upper	Adj Lower	Adj Upper
Aircraft	A320	B737	0.05	-0.03703	0.005628	-0.04652	0.01512
Aircraft	A320	B747	0.05	-0.00316	0.01718	-0.00796	0.02198
Aircraft	A320	B767	0.05	-0.02964	0.01308	-0.03669	0.02013
Aircraft	A320	B777	0.05	-0.03007	-0.00721	-0.03606	-0.00121
Aircraft	B737	B747	0.05	0.002063	0.04336	-0.00660	0.05202
Aircraft	B737	B767	0.05	-0.01881	0.03365	-0.03056	0.04540
Aircraft	B737	B777	0.05	-0.02412	0.01825	-0.03358	0.02770
Aircraft	B747	B767	0.05	-0.03636	0.005777	-0.04206	0.01148
Aircraft	B747	B777	0.05	-0.03507	-0.01622	-0.04025	-0.01105
Aircraft	B767	B777	0.05	-0.03159	0.01087	-0.03857	0.01786

---------- Category=Incident ----------

The Mixed Procedure

Model Information

Data Set	WORK.FILTER
Dependent Variable	Sulfur
Covariance Structure	Variance Components
Group Effect	Aircraft
Estimation Method	REML
Residual Variance Method	None
Fixed Effects SE Method	Model-Based
Degrees of Freedom Method	Satterthwaite

Class Level Information

Class	Levels	Values
Aircraft	3	A320 B737 B767

Dimensions

Covariance Parameters	3
Columns in X	4
Columns in Z	0
Subjects	34
Max Obs Per Subject	1

Number of Observations

Number of Observations Read	34
Number of Observations Used	34

Number of Observations Not Used 0

Iteration History

Iteration	Evaluations	-2 Res Log Like	Criterion
0	1	-13.02011035	
1	1	-18.21685778	0.00000000

Convergence criteria met.

---------- Category=Incident ----------

The Mixed Procedure

Covariance Parameter Estimates

Cov Parm	Group	Estimate
Residual	Aircraft A320	0.03225
Residual	Aircraft B737	0.03513
Residual	Aircraft B767	0.002281

Fit Statistics

-2 Res Log Likelihood	-18.2
AIC (smaller is better)	-12.2
AICC (smaller is better)	-11.3
BIC (smaller is better)	-7.6

Null Model Likelihood Ratio Test

DF	Chi-Square	Pr > ChiSq
2	5.20	0.0744

Type 3 Tests of Fixed Effects

Effect	Num DF	Den DF	F Value	Pr > F
Aircraft	2	20.8	6.66	0.0058

Least Squares Means

Effect	Aircraft	Estimate	Standard Error	DF	t Value	Pr > |t|	Alpha	Lower	Upper
Aircraft	A320	0.2860	0.05184	11	5.52	0.0002	0.05	0.1719	0.4001
Aircraft	B737	0.2653	0.04418	17	6.01	<.0001	0.05	0.1721	0.3585
Aircraft	B767	0.4240	0.02388	3	17.76	0.0004	0.05	0.3480	0.5000

Differences of Least Squares Means

Effect	Aircraft_Aircraft	Estimate	Standard Error	DF	t Value	Pr > |t|	Adjustment	Adj P
Aircraft	A320 B737	0.02068	0.06811	24.4	0.30	0.7640	Bonferroni	1.0000
Aircraft	A320 B767	-0.1380	0.05708	13.9	-2.42	0.0300	Bonferroni	0.0746

---------- Category=Incident ----------

The Mixed Procedure

Differences of Least Squares Means

Effect	Aircraft_Aircraft	Estimate	Standard Error	DF	t Value	Pr > |t|	Adjustment	Adj P
Aircraft	B737 B767	-0.1587	0.05022	19.1	-3.16	0.0051	Bonferroni	0.0143

Differences of Least Squares Means

Effect	Aircraft_Aircraft	Alpha	Lower	Upper	Adj Lower	Adj Upper
Aircraft	A320 B737	0.05	-0.1198	0.1611	-0.1566	0.1980
Aircraft	A320 B767	0.05	-0.2605	-0.01548	-0.2866	0.01058
Aircraft	B737 B767	0.05	-0.2637	-0.05362	-0.2894	-0.02796

---------- Category=Used ----------

The Mixed Procedure

Model Information

Data Set	WORK.FILTER
Dependent Variable	Sulfur
Covariance Structure	Variance Components
Group Effect	Aircraft
Estimation Method	REML
Residual Variance Method	None
Fixed Effects SE Method	Model-Based
Degrees of Freedom Method	Satterthwaite

Class Level Information

Class	Levels	Values
Aircraft	5	A320 B737 B747 B767 B777

Dimensions

Covariance Parameters	5
Columns in X	6
Columns in Z	0
Subjects	99
Max Obs Per Subject	1

Number of Observations

Number of Observations Read	99
Number of Observations Used	99
Number of Observations Not Used	0

Iteration History

Iteration	Evaluations	-2 Res Log Like	Criterion
0	1	-61.95664565	
1	1	-68.09019741	0.00000000

Convergence criteria met.

---------- Category=Used ----------

The Mixed Procedure

Covariance Parameter Estimates

Cov Parm	Group	Estimate
Residual	Aircraft A320	0.009531
Residual	Aircraft B737	0.02159
Residual	Aircraft B747	0.01576
Residual	Aircraft B767	0.03024
Residual	Aircraft B777	0.03148

Fit Statistics

-2 Res Log Likelihood	-68.1
AIC (smaller is better)	-58.1
AICC (smaller is better)	-57.4
BIC (smaller is better)	-45.1

Null Model Likelihood Ratio Test

DF	Chi-Square	Pr > ChiSq
4	6.13	0.1894

Type 3 Tests of Fixed Effects

Effect	Num DF	Den DF	F Value	Pr > F
Aircraft	4	15.8	3.18	0.0426

Least Squares Means

Effect	Aircraft	Estimate	Standard Error	DF	t Value	Pr > |t|	Alpha	Lower	Upper
Aircraft	A320	0.3693	0.02944	10	12.54	<.0001	0.05	0.3037	0.4349
Aircraft	B737	0.3874	0.04430	10	8.74	<.0001	0.05	0.2887	0.4862
Aircraft	B747	0.4509	0.03785	10	11.91	<.0001	0.05	0.3665	0.5352
Aircraft	B767	0.3980	0.07100	5	5.61	0.0025	0.05	0.2155	0.5805
Aircraft	B777	0.4919	0.02291	59	21.48	<.0001	0.05	0.4461	0.5377

---------- Category=Used ----------

The Mixed Procedure

Differences of Least Squares Means

Effect	Aircraft_Aircraft	Estimate	Standard Error	DF	t Value	Pr > |t|	Adjustment	Adj P
Aircraft	A320 B737	-0.01816	0.05319	17.4	-0.34	0.7368	Bonferroni	1.0000
Aircraft	A320 B747	-0.08161	0.04795	18.9	-1.70	0.1052	Bonferroni	1.0000
Aircraft	A320 B767	-0.02869	0.07686	6.77	-0.37	0.7203	Bonferroni	1.0000
Aircraft	A320 B777	-0.1226	0.03730	24.3	-3.29	0.0031	Bonferroni	0.0472
Aircraft	B737 B747	-0.06345	0.05827	19.5	-1.09	0.2895	Bonferroni	1.0000
Aircraft	B737 B767	-0.01053	0.08369	8.97	-0.13	0.9026	Bonferroni	1.0000

Aircraft	B737	B777	-0.1045	0.04988	15.9	-2.09	0.0526	Bonferroni	0.5275
Aircraft	B747	B767	0.05292	0.08046	7.93	0.66	0.5294	Bonferroni	1.0000
Aircraft	B747	B777	-0.04102	0.04424	18.3	-0.93	0.3660	Bonferroni	1.0000
Aircraft	B767	B777	-0.09393	0.07460	6.09	-1.26	0.2541	Bonferroni	1.0000

Differences of Least Squares Means

Effect	Aircraft_Aircraft		Alpha	Lower	Upper	Adj Lower	Adj Upper
Aircraft	A320	B737	0.05	-0.1302	0.09387	-0.1916	0.1552
Aircraft	A320	B747	0.05	-0.1820	0.01880	-0.2379	0.07470
Aircraft	A320	B767	0.05	-0.2117	0.1543	-0.2792	0.2219
Aircraft	A320	B777	0.05	-0.1996	-0.04569	-0.2442	-0.00104
Aircraft	B737	B747	0.05	-0.1852	0.05830	-0.2534	0.1265
Aircraft	B737	B767	0.05	-0.1999	0.1789	-0.2833	0.2623
Aircraft	B737	B777	0.05	-0.2103	0.001340	-0.2670	0.05812
Aircraft	B747	B767	0.05	-0.1329	0.2388	-0.2094	0.3152
Aircraft	B747	B777	0.05	-0.1339	0.05184	-0.1852	0.1032
Aircraft	B767	B777	0.05	-0.2758	0.08796	-0.3371	0.1493

---------- Category=Incident ----------

The Mixed Procedure

Model Information

Data Set	WORK.FILTER
Dependent Variable	Bromine
Covariance Structure	Variance Components
Group Effect	Aircraft
Estimation Method	REML
Residual Variance Method	None
Fixed Effects SE Method	Model-Based
Degrees of Freedom Method	Satterthwaite

Class Level Information

Class	Levels	Values
Aircraft	3	A320 B737 B767

Dimensions

Covariance Parameters	3
Columns in X	4
Columns in Z	0
Subjects	34
Max Obs Per Subject	1

Number of Observations

Number of Observations Read	34
Number of Observations Used	34
Number of Observations Not Used	0

Iteration History

Iteration	Evaluations	-2 Res Log Like	Criterion
0	1	-10.87597485	
1	1	-18.09178549	0.00000000

Convergence criteria met.

---------- Category=Incident ----------

The Mixed Procedure

Covariance Parameter Estimates

Cov Parm	Group	Estimate
Residual	Aircraft A320	0.01470
Residual	Aircraft B737	0.04991
Residual	Aircraft B767	0.005797

Fit Statistics

-2 Res Log Likelihood	-18.1
AIC (smaller is better)	-12.1
AICC (smaller is better)	-11.2
BIC (smaller is better)	-7.5

Null Model Likelihood Ratio Test

DF	Chi-Square	Pr > ChiSq
2	7.22	0.0271

Type 3 Tests of Fixed Effects

Effect	Num DF	Den DF	F Value	Pr > F
Aircraft	2	13.6	7.88	0.0053

Least Squares Means

Effect	Aircraft	Estimate	Standard Error	DF	t Value	Pr > |t|	Alpha	Lower	Upper
Aircraft	A320	0.2883	0.03500	11	8.24	<.0001	0.05	0.2112	0.3653
Aircraft	B737	0.4318	0.05266	17	8.20	<.0001	0.05	0.3208	0.5429
Aircraft	B767	0.4883	0.03807	3	12.83	0.0010	0.05	0.3672	0.6095

Differences of Least Squares Means

Effect	Aircraft_Aircraft	Estimate	Standard Error	DF	t Value	Pr > |t|	Adjustment	Adj P
Aircraft	A320 B737	-0.1436	0.06323	27.2	-2.27	0.0313	Bonferroni	0.1197
Aircraft	A320 B767	-0.2001	0.05172	8.55	-3.87	0.0042	Bonferroni	0.0053

---------- Category=Incident ----------

The Mixed Procedure

Differences of Least Squares Means

Effect	Aircraft_Aircraft	Estimate	Standard Error	DF	t Value	Pr > |t|	Adjustment	Adj P
Aircraft	B737 B767	-0.05648	0.06498	15.5	-0.87	0.3980	Bonferroni	1.0000

Differences of Least Squares Means

Effect	Aircraft	_Aircraft	Alpha	Lower	Upper	Adj Lower	Adj Upper
Aircraft	A320	B737	0.05	-0.2733	-0.01389	-0.3160	0.02885
Aircraft	A320	B767	0.05	-0.3180	-0.08213	-0.3411	-0.05903
Aircraft	B737	B767	0.05	-0.1946	0.08165	-0.2337	0.1207

---------- Category=Used ----------

The Mixed Procedure

Model Information

Data Set	WORK.FILTER
Dependent Variable	Bromine
Covariance Structure	Variance Components
Group Effect	Aircraft
Estimation Method	REML
Residual Variance Method	None
Fixed Effects SE Method	Model-Based
Degrees of Freedom Method	Satterthwaite

Class Level Information

Class	Levels	Values
Aircraft	5	A320 B737 B747 B767 B777

Dimensions

Covariance Parameters	5
Columns in X	6
Columns in Z	0
Subjects	99
Max Obs Per Subject	1

Number of Observations

Number of Observations Read	99
Number of Observations Used	99
Number of Observations Not Used	0

Iteration History

Iteration	Evaluations	-2 Res Log Like	Criterion
0	1	-14.90062385	
1	1	-28.60376311	0.00000000

Convergence criteria met.

---------- Category=Used ----------

The Mixed Procedure

Covariance Parameter Estimates

Cov Parm	Group	Estimate
Residual	Aircraft A320	0.01941
Residual	Aircraft B737	0.09163
Residual	Aircraft B747	0.01047
Residual	Aircraft B767	0.07475
Residual	Aircraft B777	0.04234

Fit Statistics

-2 Res Log Likelihood	-28.6
AIC (smaller is better)	-18.6
AICC (smaller is better)	-17.9
BIC (smaller is better)	-5.6

Null Model Likelihood Ratio Test

DF	Chi-Square	Pr > ChiSq
4	13.70	0.0083

Type 3 Tests of Fixed Effects

Effect	Num DF	Den DF	F Value	Pr > F
Aircraft	4	12	2.93	0.0665

Least Squares Means

Effect	Aircraft	Estimate	Standard Error	DF	t Value	Pr > |t|	Alpha	Lower	Upper
Aircraft	A320	0.3365	0.04200	10	8.01	<.0001	0.05	0.2429	0.4300
Aircraft	B737	0.4634	0.09127	10	5.08	0.0005	0.05	0.2601	0.6668
Aircraft	B747	0.3489	0.03085	10	11.31	<.0001	0.05	0.2801	0.4176
Aircraft	B767	0.2961	0.1116	5	2.65	0.0453	0.05	0.009203	0.5830
Aircraft	B777	0.4614	0.02656	59	17.37	<.0001	0.05	0.4083	0.5146

---------- Category=Used ----------

The Mixed Procedure

Differences of Least Squares Means

Effect	Aircraft	_Aircraft	Estimate	Standard Error	DF	t Value	Pr > |t|	Adjustment	AdjP
Aircraft	A320	B737	-0.1270	0.1005	14.1	-1.26	0.2269	Bonferroni	1.0000
Aircraft	A320	B747	-0.01240	0.05212	18.4	-0.24	0.8146	Bonferroni	1.0000
Aircraft	A320	B767	0.04034	0.1193	6.45	0.34	0.7459	Bonferroni	1.0000
Aircraft	A320	B777	-0.1250	0.04970	19.1	-2.51	0.0210	Bonferroni	0.2723
Aircraft	B737	B747	0.1146	0.09634	12.3	1.19	0.2569	Bonferroni	1.0000
Aircraft	B737	B767	0.1673	0.1442	11.4	1.16	0.2696	Bonferroni	1.0000

Aircraft	B737	B777	0.001986	0.09505	11.8	0.02	0.9837	Bonferroni	1.0000
Aircraft	B747	B767	0.05274	0.1158	5.78	0.46	0.6654	Bonferroni	1.0000
Aircraft	B747	B777	-0.1126	0.04071	27.7	-2.77	0.0100	Bonferroni	0.1716
Aircraft	B767	B777	-0.1653	0.1147	5.58	-1.44	0.2033	Bonferroni	1.0000

Differences of Least Squares Means

Effect	Aircraft_Aircraft		Alpha	Lower	Upper	Adj Lower	Adj Upper
Aircraft	A320	B737	0.05	-0.3424	0.08843	-0.4717	0.2178
Aircraft	A320	B747	0.05	-0.1217	0.09694	-0.1912	0.1664
Aircraft	A320	B767	0.05	-0.2466	0.3273	-0.3689	0.4496
Aircraft	A320	B777	0.05	-0.2290	-0.02100	-0.2955	0.04556
Aircraft	B737	B747	0.05	-0.09485	0.3240	-0.2160	0.4452
Aircraft	B737	B767	0.05	-0.1487	0.4834	-0.3274	0.6621
Aircraft	B737	B777	0.05	-0.2056	0.2096	-0.3242	0.3282
Aircraft	B747	B767	0.05	-0.2333	0.3388	-0.3446	0.4501
Aircraft	B747	B777	0.05	-0.1960	-0.02916	-0.2523	0.02711
Aircraft	B767	B777	0.05	-0.4513	0.1206	-0.5590	0.2284

Appendix B - Summarized GC/MS Analytical Report on Used Aircraft Cabin Air Recirculation Filters

Table B-1: GC/MS results for used filters

Filter Serial No.	Filter ID	m-TCP RT=21.9 minutes ng/cm^2 in filter	Unk Isomer1 RT=22.4 minutes ng/cm^2 in filter	Unk Isomer2 RT=22.4 minutes ng/cm^2 in filter	p-TCP RT=23.4 minutes ng/cm^2 in filter	Ratio of meta- to isomer1	Ratio of unk isomer1 unk isomer2	TCP Peak pattern of m/z 368 Synthetic hydrocarbon 113, 85amu	Filter Type	Aircraft Model
1.	11S754	25.9	32.3	14.8	0.6	0.80	0.46	YES/no	Keddeg	B777
2.	12HD94	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Keddeg	A320
3.	163B4J	7.6	9.4	2.3	0.0	0.81	0.24	No/no	Donaldson	B747
4.	17BDAR	14.5	5.2	0.0	0.0	0.86	0.0	No/no	Keddeg	B777
5.	1F3555	2.8	3.3	0.8	0.0	0.83	0.24	No/no	Pall	B777
6.	27QR6F	14.0	19.0	5.7	2.5	0.73	0.30	Maybe/no	Donaldson	B777
7.	2965CL	5.1	6.0	0.1	0.0	0.85	0.01	No/no	Keddeg	A320
8.	2D968E	4.1	5.0	0.8	0.0	0.83	0.15	No/no	Puralator	B777
9.	2U1KD6	25.8	31.6	7.4	4.1	0.82	0.23	Maybe/yes	Keddeg	A320
10.	3C297F	22.3	27.4	12.7	1.3	0.81	0.46	YES/YES	Pall	B737
11.	3Q5J9L	6.4	6.7	0.8	0.0	0.96	0.12	No/no	Pall	B767
12.	43RTYZ	4.4	5.1	0.8	0.0	0.86	0.16	No/no	Pall	B777
13.	46NKJF	4.4	4.2	0.5	0.0	1.04	0.11	No/no	Keddeg	B777
14.	4S190C	5.5	7.2	2.2	0.0	0.77	0.31	No/no	Puralator	B777
15.	584C32	7.8	8.9	2.7	0.0	0.88	0.31	No/no	Pall	B777
16.	5H2F01	6.8	7.5	1.9	0.0	0.91	0.25	No/no	Pall	B777
17.	6025ES	5.0	5.7	0.0	0.0	0.88	0.00	No/no	Keddeg	B777
18.	73J43M	4.0	5.4	1.9	0.0	0.75	0.35	No/no	Pall	B777
19.	75G8FW	3.2	4.0	0.0	0.0	0.81	0.00	No/no	Donaldson	B777
20.	77G4CJ	0.0	0.0	0.0	0.0	0.0	0.0	No/no	Donaldson	B777
21.	794TWZ	17.9	21.2	9.1	1.1	0.85	0.43	Yes/YES	Pall	B777
22.	7GH325	9.6	11.5	2.0	0.0	0.83	0.17	No/no	Donaldson	B777
23.	7WQF45	6.2	8.0	3.1	0.0	0.77	0.39	No/no	Pall	B777
24.	7YSE6N	4.0	4.3	0.0	0.0	0.94	0.00	No/no	Keddeg	B777
25.	7ZMK52	18.1	21.4	9.1	0.8	0.85	0.42	Yes/YES	Puralator	B777
26.	83MIA9	6.2	7.4	2.4	0.0	0.84	0.32	No/no	Puralator	B777
27.	85HXNS	7.4	10.4	2.4	4.8	0.71	0.23	No/no	Pall	B747
28.	883STV	11.1	11.6	2.5	0.4	0.96	0.21	Maybe/maybe	Keddeg	A320
29.	8P6G4X	5.7	7.3	2.2	0.0	0.78	0.30	No/no	Pall	B737
30.	907BVA	10.8	12.9	3.2	0.6	0.84	0.25	Maybe/	Donaldson	B777

31.	9E003T	3.6	3.9	0.0	0.0	0.91	0.00	No/no	Pall	B777
32.	9RZMC2	10.6	14.2	6.8	1.2	0.75	0.48	YES/no	Puralator	B777
33.	AA61L3	8.9	10.9	3.0	9.8	0.82	0.28	No/no	Donaldson	B747
34.	ADJ145	14.1	19.7	6.3	0.0	0.72	0.32	No/no	Donaldson	B777
35.	AO354G	2.9	3.3	0.0	0.0	0.89	0.00	No/no	Donaldson	B777
36.	AI644T	0.0	0.0	0.0	0.0	0.00	0.00	No/no	Pall	B777
37.	B322IJ	5.1	7.5	1.0	0.0	0.68	0.13	No/no	Keddeg	B737
38.	B92YNB	4.3	4.9	0.7	0.0	0.87	0.13	No/no	Pall	B777
39.	BHU548	251.7	357.4	183.8	26.8	0.70	0.51	YES/YES	Keddeg	B737
40.	BO14NE	35.6	42.1	19.7	1.0	0.85	0.47	Yes/maybe	Puralator	B777
41.	BRT6RD	8.1	10.4	4.0	0.0	0.77	0.38	No/no	Puralator	B777
42.	CE9B16	9.2	10.4	2.6	0.3	0.88	0.25	No/no	Keddeg	A320
43.	CP163W	0.0	2.5	0.0	0.0	0.00	0.00	No/no	Donaldson	B747
44.	CRH8ES	6.6	7.3	1.3	0.0	0.90	0.18	No/no	Keddeg	B777
45.	DAW454	3.1	3.8	0.0	0.0	0.83	0.00	No/no	Keddeg	B777
46.	DR87FE	10.0	10.9	2.2	0.1	0.92	0.20	Maybe/no	Keddeg	B777
47.	DSF6UE	6.9	8.6	1.7	0.0	0.80	0.20	no	Keddeg	B777
48.	E63JV3	116.3	155.8	69.9	7.5	0.75	0.45	YES/YES	Keddeg	B737
49.	ESF946	4.4	5.7	1.4	0.0	0.77	0.24	No/no	Pall	B777
50.	F1JH39	3.7	4.7	0.0	0.0	0.78	0.00	No/no	Keddeg	B737
51.	FTRT75	7.2	8.8	1.8	0.0	0.81	0.20	No/no	Keddeg	B737
52.	FWX130	16.0	25.1	10.8	1.2	0.64	0.43	Maybe/no	Keddeg	B777
53.	G48MJ6	15.4	19.5	8.1	0.0	0.79	0.41	No/no	Pall	B777
54.	G8UX4V	2.8	3.2	0.0	0.0	0.88	0.0	No/no	Donaldson	B777
55.	GF68X3	4.3	5.8	0.6	0.0	0.75	0.10	No/no	Puralator	B777
56.	GO9JVE	4.6	6.2	0.0	1.2	0.75	0.00	No/no	Keddeg	B747
57.	HFU84F	2.9	3.0	0.0	0.0	0.95	0.00	No/no	Pall	B767
58.	HGD63H	27.0	30.6	9.8	0.3	0.88	0.32	Maybe/no	Keddeg	B777
59.	HIDE4H	3.6	4.4	0.0	0.0	0.82	0.00	No/no	Keddeg	A320
60.	HFD9LM	4.2	4.2	0.0	0.0	1.01	0.00	No/no	Keddeg	B777
61.	HME4A8	3.7	4.8	0.0	0.0	0.77	0.00	No/no	Pall	B777
62.	I89VFS	3.7	5.3	0.5	0.0	0.69	0.08	No/no	Keddeg	B777
63.	IS78FS	11.1	13.7	5.9	0.6	0.81	0.43	YES/no	Puralator	B777
64.	IU74E2	8.5	10.3	3.3	0.0	0.82	0.32	No/no	Pall	B737
65.	IUY3T4	0.0	0.0	0.0	0.0	0.0	0.00	No/no	Pall	B767
66.	J9GF37	10.0	9.8	1.5	0.0	1.02	0.15	No/no	Pall	B767
67.	JD5RT2	10.2	12.8	5.3	0.5	0.80	0.41	YES/no	Pall	B777
68.	JGFD6G	13.1	18.1	6.5	1.5	0.72	0.36	YES/no	Pall	B747
69.	JHHCD2	5.2	6.1	1.1	0.0	0.86	0.18	No/no	Pall	B737
70.	JR3584	10.3	14.4	6.1	0.8	0.71	0.42	YES/no	Puralator	B777
71.	K76GHR	3.1	3.5	0.0	0.0	0.90	0.00	No/no	Keddeg	A320

72.	KI9846	4.4	4.9	0.5	0.0	0.90	0.09	No/no	Pall	B777
73.	L6159B	5.8	7.2	1.5	1.0	0.80	0.20	No/no	Donaldson	B747
74.	LF4EQ2	0.0	2.6	0.0	0.0	0.0	0.0	No/no	Keddeg	B767
75.	LM6524	9.7	12.1	3.5	0.6	0.80	0.29	No/no	Donaldson	B747
76.	LR8C66	6.9	7.9	1.5	0.0	0.87	0.19	No/no	Keddeg	B777
77.	M6AAM6	7.8	9.8	2.6	1.2	0.80	0.27	No/no	Donaldson	B747
78.	MA7ET3	16.0	25.0	11.7	1.0	0.64	0.47	Maybe/no	Keddeg	B777
79.	MB6LV1	5.8	7.3	1.1	0.0	0.79	0.14	No/no	Keddeg	B747
80.	MH64SL	8.1	10.2	1.8	0.0	0.79	0.18	No/no	Donaldson	B777
81.	MSU4TD	2.7	2.9	0.0	0.0	0.91	0.00	No/no	Puralator	B777
82.	MTCL37	4.5	5.5	1.2	0.0	0.82	0.22	No/no	Puralator	B777
83.	N6D5A7	3.4	4.3	0.6	0.0	0.79	0.13	No/no	Pall	B777
84.	NZ2T7W	7.5	8.5	1.5	0.0	0.89	0.18	No/no	Keddeg	A320
85.	NM81X7	6.8	7.7	1.2	0.0	0.88	0.15	No/no	Pall	B777
86.	PL2IX1	3.6	3.8	0.0	0.0	0.93	0.00	No/no	Donaldson	B747
87.	PN38IZ	3.6	4.3	0.4	0.0	0.85	0.08	No/no	Pall	B777
88.	QOX417	4.0	5.3	0.0	0.0	0.75	0.00	No/no	Keddeg	B737
89.	R5BH23	4.5	5.8	1.2	0.0	0.78	0.21	No/no	Pall	B777
90.	R67R85	3.9	4.3	0.0	0.0	0.90	0.00	No/no	Pall	B777
91.	RP14D3	4.7	6.4	0.6	0.0	0.73	0.09	No/no	Keddeg	B737
92.	SJA33J	0.0	0.0	0.0	0.0	0.0	0.0	No/no	Keddeg	A320
93.	STJH77	5.8	3.4	0.0	0.0	1.69	0.00	No/no	Puralator	B777
94.	T007ML	2.9	3.4	0.0	0.0	0.84	0.00	No/no	Keddeg	A320
95.	TBD533	8.0	10.6	4.2	0.0	0.76	0.39	No/no	Pall	B777
96.	TC66HR	7.3	7.6	1.9	0.0	0.97	0.25	No/no	Pall	B767
97.	TJ66RG	5.9	7.5	2.4	0.0	0.79	0.31	No/no	Puralator	B777
98.	TT15A5	0.7	0.0	0.0	0.0	0.0	0.00	No/no	Keddeg	B737
99.	U44MXV	8.8	8.4	2.4	0.0	1.04	0.28	No/no	Keddeg	A320
100.	U5D8UN	7.6	9.1	2.0	0.0	0.84	0.22	No/no	Pall	B767
101.	UGA145	21.0	25.9	11.9	0.5	0.81	0.46	YES/maybe	Puralator	B777
102.	VDSA46	9.2	10.4	2.5	0.0	0.89	0.24	No/no	Donaldson	B777
103.	VT23AC	2.2	2.2	0.0	0.0	1.02	0.00	No/no	Puralator	B777
104.	W9E578	10.0	12.2	3.8	0.7	0.82	0.31	Maybe/no	Donaldson	B747
105.	WAQE67	5.5	6.0	0.6	0.0	0.92	0.10	No/no	Keddeg	B777
106.	WBH9G4	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Keddeg	B777
107.	WH3JMZ	10.2	12.8	5.0	0.5	0.80	0.39	YES/no	Puralator	B777
108.	WR2F6B	4.0	4.3	0.0	0.0	0.92	0.00	No/no	Pall	B767
109.	YEK752	4.5	5.5	0.4	0.0	0.81	0.07	No/no	Keddeg	A320
110.	ZD15ZA	2.9	3.3	0.0	0.0	0.89	0.0	No/no	Donaldson	B747
111.	Blank	0.0	0.0	0.0	0.0	0.00	0.00	No/no	_	_

Table B-2: GC/MS results for incident filters

Filter Serial No.	Filter ID	m-TCP	Unk Isomer1	Unk Isomer2	p-TCP	Ratio of meta- to isomer1	Ratio of unk isomer1 unk isomer2	TCP Peak pattern of m/z 368	Filter Type	Aircraft Model
		RT=21.9 minutes	RT=22.4 minutes	RT=22.4 minutes	RT=23.4 minutes					
		ng/cm^2 in filter	ng/cm^2 in filter	ng/cm^2 in filter	ng/cm^2 in filter			Synthetic hydrocarbon 113, 85amu		
1.	23937	5.1	0.0	1.4	0.0	0.84	0.23	No/no	Keddeg	A320
2.	24034	5.4	6.9	2.1	0.0	0.78	0.30	No/no	Keddeg	A320
3.	26701	19.6	18.5	6.5	0.0	1.06	0.35	No/no	Keddeg	A320
4.	27055	10.0	12.7	4.7	0.0	0.79	0.37	No/no	Keddeg	A320
5.	27165	42.4	42.0	19.5	2.2	1.01	0.46	YES/yes	Keddeg	A320
6.	27200	38.3	48.8	25.0	2.0	0.78	0.51	YES/Maybe	Keddeg	A320
7.	27390	17.7	21.3	9.7	1.0	0.83	0.45	YES/no	Keddeg	A320
8.	27420	7.3	9.4	3.5	0.0	0.78	0.37	No/no	Keddeg	A320
9.	27428	35.7	46.1	23.4	1.7	0.77	0.51	YES/yes	Keddeg	A320
10.	27559	5.3	6.5	1.1	0.0	0.82	0.16	No/no	Keddeg	B737
11.	27571	14.1	17.7	6.7	1.0	0.80	0.38	YES/YES	Keddeg	B737
12.	27659	0.0	0.0	0.0	0.0	0.0	0.00	No/no	Keddeg	A320
13.	27660	0.0	0.0	0.0	0.0	0.0	0.00	No/no	Keddeg	A320
14.	27678	6.5	8.4	3.0	0.0	0.77	0.35	No/no	Keddeg	A320
15.	27694	6.4	8.5	3.2	0.0	0.76	0.37	No/no	Keddeg	A320
16.	28058	16.8	20.8	9.4	0.3	0.81	0.45	YES/no	Keddeg	A320
17.	28240	11.3	13.9	4.6	0.3	0.81	0.33	Maybe/yes	Keddeg	B737
18.	28297	4.5	5.3	0.9	0.0	0.86	0.16	No/no	Keddeg	B737
19.	28802	4.7	5.8	1.0	0.0	0.82	0.17	No/no	Keddeg	A320
20.	28825	9.0	10.2	3.5	0.0	0.88	0.34	No/no	Keddeg	A320
21.	28832	11.1	13.3	5.4	0.0	0.83	0.41	No/no	Keddeg	A320
22.	28936	12.8	15.8	6.3	0.0	0.81	0.40	No/no	Keddeg	A320
23.	28937	20.4	23.7	10.4	2.9	0.86	0.44	YES/No	Keddeg	A320
24.	28958	14.6	18.3	7.2	0.7	0.80	0.39	YES/maybe	Keddeg	A320
25.	29428	0.0	0.0	0.0	0.0	0.0	0.00	No/no	Keddeg	B737
26.	29432	59.8	76.4	33.1	4.4	0.78	0.43	YES/no	Keddeg	A320
27.	29434	5.4	6.5	1.3	0.0	0.83	0.19	No/no	Keddeg	B737
28.	29440	8.8	11.5	4.1	0.0	0.76	0.35	No/no	Pall	B737
29.	29442	2.3	0.0	0.0	0.0	0.0	0.00	No/no	Keddeg	B737
30.	29559	0.0	0.0	0.0	0.0	0.0	0.00	No/no	Keddeg	B737
31.	29606	0.0	0.0	0.0	0.0	0.0	0.00	No/no	Keddeg	B737
32.	29750	3.2	3.9	1.6	0.5	0.83	0.40	No/no	Keddeg	A320
33.	30103	0.0	2.5	0.0	0.0	0.00	0.00	No/no	Keddeg	B737
34.	30121	4.1	5.1	1.8	0.0	0.79	0.34	No/no	Keddeg	B737
35.	30335	16.8	21.7	11.3	2.0	0.77	0.52	YES/yes	Pall	B737

36.	30339	0.0	0.0	0.0	0.0	0.00	0.0	No/no	Keddeg	A320
37.	30343	4.4	5.6	0.4	0.0	0.79	0.07	No/no	Keddeg	A320
38.	30363	31.4	40.2	21.7	3.5	0.78	0.54	YES/yes	Pall	B777
39.	30598	16.2	20.8	7.6	1.0	0.78	0.37	YES/maybe	Pall	B777
40.	30670	6.5	7.6	1.8	0.0	0.86	0.23	No/no	Keddeg	B737
41.	30674	0.0	0.0	0.0	0.0	0.00	0.00	No/no	Keddeg	B737
42.	5100224	32.0	40.7	17.9	1.5	0.79	0.44	YES/YES	Pall	A320
43.	5100242	33.8	42.6	19.0	1.1	0.79	0.45	YES/YES	Pall	A320
44.	49372054	51.8	60.1	26.8	3.5	0.86	0.45	YES/yes	Pall	A320
45.	50131042	75.5	92.8	43.9	4.6	0.81	0.47	YES/maybe	Pall	A320
46.	60401016	12.0	15.5	6.1	0.7	0.77	0.39	YES/YES	Pall	A320
47.	60401041	10.5	13.5	5.3	0.5	0.78	0.39	YES/yes	Pall	A320
48.	650390-13	75.8	105.1	56.5	7.6	0.72	0.54	YES/YES	Keddeg	A320
49.	A21794HC	205.8	250.8	129.6	18.2	0.82	0.52	YES/YES	Pall	B737
50.	A21803HC	86.2	105.9	51.0	5.4	0.81	0.48	YES/YES	Pall	B737
51.	A22023HC	366.4	428.7	206.9	25.2	0.85	0.48	YES/YES	Pall	B737
52.	A22589HC	16.2	21.7	8.5	1.3	0.75	0.39	YES/YES	Pall	B737
53.	A22607HC	40.3	54.1	28.0	4.1	0.75	0.52	YES/YES	Pall	B737
54.	A22609HC	56.7	74.4	38.8	4.2	0.76	0.52	YES/YES	Pall	B737
55.	A22623HC	37.9	52.1	24.6	2.0	0.73	0.47	YES/yes	Pall	B737
56.	A24233HC	18.1	24.6	10.4	1.6	0.74	0.42	YES/YES	Pall	B737
57.	A24237HC	18.8	25.6	12.5	2.0	0.73	0.49	YES/no	Pall	B737
58.	A24246HC	31.4	42.1	20.7	1.0	0.75	0.49	YES/YES	Pall	B737
59.	A3740HC	9.8	10.0	2.4	0.0	0.98	0.24	No/no	Pall	B767
60.	A3745HC	11.5	13.2	4.8	0.3	0.87	0.36	YES/maybe	Pall	B767
61.	A3760HC	14.4	17.4	7.1	1.2	0.83	0.41	YES/YES	Pall	B767
62.	A3790HC	11.7	55.7	0.0	0.0	0.21	0.00	No/no	Pall	B767
63.	A3795HC	4.4	4.9	0.4	0.0	0.90	0.08	No/no	Pall	B767
64.	A3798HC	8.9	11.2	3.0	0.0	0.79	0.26	No/no	Pall	B767
65.	A3801HC	4.1	4.6	0.3	0.0	0.89	0.05	No/no	Pall	B767
66.	A3803HC	7.0	8.7	1.9	0.0	0.80	0.21	No/no	Pall	B767
67.	A3807HC	10.3	11.0	2.6	1.0	0.94	0.24	Maybe/no	Pall	B767
68.	A3809HC	3.9	4.9	0.0	0.0	0.80	0.00	No/no	Pall	B767
69.	A3854HC	0.0	2.4	0.0	0.0	0.00	0.00	No/no	Pall	B767
70.	A3861HC	5.1	6.0	0.0	0.0	0.00	0.00	No/no	Pall	B767
71.	A3871HC	4.0	4.6	0.0	0.0	0.86	0.00	No/no	Pall	B767
72.	A3873HC	4.8	5.7	2.2	0.0	0.83	0.39	No/no	Pall	B767
73.	AB0469685	26.2	34.5	15.2	1.0	0.76	0.44	YES/YES	Donaldson	B737
74.	S21070121	6.6	7.9	1.5	0.0	0.84	0.18	No/no	Donaldson	B737
75.	Blank	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-	-

Appendix C - Summarized NAA Data on Used HEPA Cabin Air Recirculation Filters

Table C-1: NAA data on used filters

Sample	Group	Sample Mass (mg)	Daughter Nuclide	Nuclide ID Confidence	Concentration	Nuclide Mass (micrograms)	Combined Uncertainty
27QR6F	B	74.2	CO-60	0.98	2.66E-06	0.197	0.012
27QR6F	B	74.2	ZN-65	0.99	7.75E-03	574.775	23.007
27QR6F	B	74.2	SE-75	0.75	1.44E-05	1.067	0.046
27QR6F	B	74.2	RU-103	0.82	2.54E-05	1.881	0.106
27QR6F	B	74.2	SB-124	0.78	2.03E-07	0.015	0.002
27QR6F	B	74.2	BA-131	0.92	8.92E-04	66.154	4.226
27QR6F	B	74.2	BA-133	0.41	7.79E-03	578.194	217.035
27QR6F	B	74.2	CE-141	0.97	4.05E-06	0.300	0.101
27QR6F	B	74.2	HG-203	0.98	4.06E-06	0.301	0.068
163B4J	A	69.9	CR-51	0.99	2.60E-05	1.816	0.323
163B4J	A	69.9	FE-59	0.96	6.26E-04	43.727	7.509
163B4J	A	69.9	CO-60	0.98	5.39E-06	0.377	0.020
163B4J	A	69.9	ZN-65	0.99	7.25E-03	507.086	20.313
163B4J	A	69.9	RU-103	0.82	2.15E-05	1.500	0.091
163B4J	A	69.9	SB-124	0.77	4.82E-07	0.034	0.002
163B4J	A	69.9	BA-131	0.93	8.23E-04	57.523	3.509
163B4J	A	69.9	BA-133	0.41	6.46E-04	45.163	219.072
163B4J	A	69.9	CE-141	0.99	5.35E-06	0.374	0.091
163B4J	A	69.9	HF-175	0.86	9.00E-06	0.629	0.110
163B4J	A	69.9	HG-203	0.99	2.66E-06	0.186	0.056
907BVA	B	101.3	FE-59	0.98	5.02E-04	50.864	8.785
907BVA	B	101.3	CO-60	0.98	1.77E-06	0.179	0.012
907BVA	B	101.3	ZN-65	0.98	7.23E-03	732.750	29.260
907BVA	B	101.3	RU-103	0.82	1.84E-05	1.861	0.112
907BVA	B	101.3	SB-124	0.78	2.04E-07	0.021	0.002
907BVA	B	101.3	BA-131	0.92	8.59E-04	86.987	5.598
907BVA	B	101.3	BA-133	0.41	8.78E-03	889.544	241.661
907BVA	B	101.3	HF-181	0.76	1.03E-06	0.105	0.008
27559	A	84.3	CR-51	0.99	1.60E-05	1.345	0.372
27559	A	84.3	FE-59	0.98	9.24E-04	77.885	9.102
27559	A	84.3	CO-60	0.98	2.08E-06	0.175	0.012
27559	A	84.3	ZN-65	0.98	6.33E-03	533.430	21.344
27559	A	84.3	RU-103	0.81	1.69E-05	1.421	0.091
27559	A	84.3	SB-124	0.95	1.12E-06	0.094	0.005
27559	A	84.3	BA-131	0.92	7.47E-04	62.948	4.057
27559	A	84.3	BA-133	0.40	5.56E-03	468.978	226.834
27559	A	84.3	CE-141	0.99	7.17E-06	0.604	0.104
27559	A	84.3	HF-181	0.76	1.27E-06	0.107	0.008
27559	A	84.3	OS-185	0.78	3.53E-06	0.298	0.441
27559	B	70.8	FE-59	0.96	6.86E-04	48.552	8.045

27559	B	70.8	CO-60	0.96	2.28E-06	0.161	0.011
27559	B	70.8	ZN-65	0.97	5.87E-03	415.593	16.669
27559	B	70.8	RU-103	0.80	1.56E-05	1.107	0.077
27559	B	70.8	SB-124	0.94	1.47E-06	0.104	0.005
27559	B	70.8	BA-131	0.91	7.47E-04	52.911	3.533
27559	B	70.8	CE-141	0.98	4.48E-06	0.317	0.092
27559	B	70.8	HF-181	0.76	1.17E-06	0.083	0.007
27559	B	70.8	OS-185	0.80	2.59E-06	0.183	0.391
27571	A	82.2	CR-51	0.98	1.76E-05	1.444	0.341
27571	A	82.2	FE-59	0.97	6.84E-04	56.248	7.999
27571	A	82.2	CO-60	0.96	3.74E-06	0.307	0.016
27571	A	82.2	ZN-65	0.97	5.53E-03	454.488	18.206
27571	A	82.2	RU-103	0.80	1.45E-05	1.191	0.082
27571	A	82.2	SB-124	0.76	4.24E-07	0.035	0.002
27571	A	82.2	BA-131	0.91	7.45E-04	61.208	4.054
27571	A	82.2	CE-141	0.98	6.73E-06	0.553	0.100
27571	A	82.2	HF-175	0.90	9.09E-06	0.748	0.117
27571	A	82.2	HF-181	0.76	1.11E-06	0.091	0.007
28958	A	82.9	CR-51	0.99	2.70E-05	2.242	0.344
28958	A	82.9	CO-60	0.98	2.84E-06	0.235	0.014
28958	A	82.9	ZN-65	0.98	6.26E-03	518.730	20.760
28958	A	82.9	RU-103	0.81	1.73E-05	1.437	0.090
28958	A	82.9	SB-124	0.77	5.83E-07	0.048	0.003
28958	A	82.9	BA-131	0.92	7.11E-04	58.908	3.742
28958	A	82.9	CE-141	0.98	8.41E-06	0.697	0.102
28958	A	82.9	HF-181	0.76	1.27E-06	0.105	0.007
30121	B	98.9	SC-46	0.95	3.40E-06	0.336	0.014
30121	B	98.9	CR-51	0.98	1.92E-05	1.895	0.373
30121	B	98.9	FE-59	0.96	4.54E-04	44.936	7.898
30121	B	98.9	CO-60	0.95	1.29E-06	0.127	0.011
30121	B	98.9	ZN-65	0.97	5.48E-03	541.532	21.647
30121	B	98.9	RU-103	0.80	1.33E-05	1.312	0.088
30121	B	98.9	SB-124	0.76	3.56E-07	0.035	0.002
30121	B	98.9	BA-131	0.91	6.30E-04	62.259	4.145
30121	B	98.9	BA-133	0.41	5.76E-03	569.699	210.848
30121	B	98.9	CE-141	0.99	3.40E-06	0.336	0.099
30121	B	98.9	HF-181	0.76	8.85E-07	0.088	0.007
604010-41	B	70.1	CR-51	0.98	4.66E-05	3.266	0.443
604010-41	B	70.1	FE-59	0.97	1.55E-03	108.721	12.087
604010-41	B	70.1	CO-60	0.96	7.55E-06	0.529	0.027
604010-41	B	70.1	ZN-65	0.97	6.26E-03	438.764	17.597
604010-41	B	70.1	RU-103	0.79	1.33E-05	0.936	0.079
604010-41	B	70.1	SB-124	0.94	1.09E-05	0.764	0.031
604010-41	B	70.1	BA-131	0.91	7.45E-04	52.255	3.536
604010-41	B	70.1	HF-181	0.76	1.32E-06	0.093	0.007
A3854H	A	111.5	SC-46	0.97	3.04E-06	0.339	0.016
A3854H	A	111.5	CR-51	0.98	2.46E-05	2.746	0.439
A3854H	A	111.5	CO-60	0.98	2.02E-06	0.226	0.014
A3854H	A	111.5	ZN-65	0.98	6.49E-03	723.183	28.881
A3854H	A	111.5	RU-103	0.81	1.87E-05	2.084	0.121

A3854H	A	111.5	SB-124	0.80	4.29E-07	0.048	0.003
A3854H	A	111.5	BA-131	0.92	8.14E-04	90.770	5.849
A3854H	A	111.5	BA-133	0.41	8.98E-03	1001.778	264.265
A3854H	A	111.5	CE-141	0.99	5.23E-06	0.583	0.112
A3854H	A	111.5	HF-175	0.86	8.96E-06	1.000	0.148
A3854H	A	111.5	HF-181	0.76	1.22E-06	0.136	0.009
A3854H	B	87.1	SC-46	0.97	3.11E-06	0.271	0.013
A3854H	B	87.1	CR-51	0.99	2.39E-05	2.079	0.397
A3854H	B	87.1	FE-59	0.95	7.40E-04	64.424	8.907
A3854H	B	87.1	CO-60	0.96	2.28E-06	0.198	0.013
A3854H	B	87.1	ZN-65	0.98	7.08E-03	616.983	24.674
A3854H	B	87.1	RU-103	0.81	1.83E-05	1.590	0.101
A3854H	B	87.1	SB-124	0.76	3.61E-07	0.031	0.002
A3854H	B	87.1	BA-131	0.92	8.54E-04	74.374	4.769
A3854H	B	87.1	CE-141	0.99	6.39E-06	0.557	0.106
A3854H	B	87.1	HF-181	0.76	1.42E-06	0.124	0.008
CP163W	A	104	CO-60	0.96	1.41E-06	0.147	0.011
CP163W	A	104	ZN-65	0.98	6.39E-03	664.589	26.550
CP163W	A	104	RU-103	0.81	1.57E-05	1.635	0.103
CP163W	A	104	SB-124	0.76	1.78E-07	0.018	0.002
CP163W	A	104	BA-131	0.92	7.49E-04	77.878	5.049
CP163W	A	104	BA-133	0.40	6.35E-03	660.518	238.371
CP163W	A	104	CE-141	0.99	4.79E-06	0.498	0.107
CP163W	A	104	HF-181	0.76	8.75E-07	0.091	0.007
GF68X3	A	76	CR-51	0.99	1.78E-05	1.349	0.390
GF68X3	A	76	FE-59	0.98	9.56E-04	72.628	8.691
GF68X3	A	76	CO-60	0.97	2.43E-06	0.184	0.012
GF68X3	A	76	ZN-65	0.98	8.34E-03	633.473	25.339
GF68X3	A	76	RU-103	0.82	2.23E-05	1.696	0.104
GF68X3	A	76	SB-124	0.76	4.15E-07	0.032	0.002
GF68X3	A	76	BA-131	0.92	1.07E-03	81.255	5.252
GF68X3	A	76	BA-133	0.41	7.81E-03	593.822	223.859
GF68X3	A	76	CE-141	0.99	3.15E-06	0.239	0.106
GF68X3	A	76	HF-181	0.76	1.04E-06	0.079	0.007
GFG8X3	B	83.2	CR-51	0.98	2.66E-05	2.212	0.392
GFG8X3	B	83.2	FE-59	0.97	6.99E-04	58.153	8.219
GFG8X3	B	83.2	CO-60	0.98	2.43E-06	0.202	0.013
GFG8X3	B	83.2	ZN-65	0.99	7.71E-03	641.327	25.641
GFG8X3	B	83.2	RU-103	0.82	2.29E-05	1.908	0.111
GFG8X3	B	83.2	SB-124	0.77	5.27E-07	0.044	0.003
GFG8X3	B	83.2	BA-131	0.92	9.44E-04	78.528	4.945
GFG8X3	B	83.2	CE-141	0.99	5.82E-06	0.484	0.104
GFG8X3	B	83.2	HF-181	0.76	9.94E-07	0.083	0.007
SJA33J	B	70	CR-51	0.98	2.48E-05	1.736	0.359
SJA33J	B	70	FE-59	0.97	1.03E-03	72.242	8.729
SJA33J	B	70	CO-60	0.99	3.59E-06	0.251	0.015
SJA33J	B	70	ZN-65	0.99	7.86E-03	550.060	22.031
SJA33J	B	70	RU-103	0.82	2.39E-05	1.674	0.100
SJA33J	B	70	SB-124	0.77	7.12E-07	0.050	0.003
SJA33J	B	70	BA-131	0.92	1.01E-03	71.037	4.479

SJA33J	B	70	BA-133	0.41	1.07E-02	750.763	226.892
SJA33J	B	70	CE-141	0.98	8.32E-06	0.582	0.099
SJA33J	B	70	HF-181	0.76	1.50E-06	0.105	0.008
TC66HR	A	72.2	CR-51	0.99	2.77E-05	2.002	0.328
TC66HR	A	72.2	CO-60	0.99	2.35E-06	0.170	0.011
TC66HR	A	72.2	ZN-65	0.99	7.73E-03	557.953	22.329
TC66HR	A	72.2	RU-103	0.81	2.24E-05	1.618	0.096
TC66HR	A	72.2	SB-124	0.77	6.99E-07	0.050	0.003
TC66HR	A	72.2	BA-131	0.94	8.49E-04	61.287	3.688
TC66HR	A	72.2	BA-133	0.41	8.80E-03	635.130	226.513
TC66HR	A	72.2	CE-141	0.98	7.71E-06	0.556	0.095
TC66HR	A	72.2	HF-181	0.76	2.03E-06	0.147	0.008
WAQE67	A	89.9	CR-51	0.98	4.31E-06	0.388	0.367
WAQE67	A	89.9	CO-60	0.97	1.30E-06	0.117	0.010
WAQE67	A	89.9	ZN-65	0.97	6.55E-03	588.942	23.547
WAQE67	A	89.9	RU-103	0.80	1.73E-05	1.553	0.097
WAQE67	A	89.9	SB-124	0.76	1.84E-07	0.017	0.002
WAQE67	A	89.9	BA-131	0.92	8.09E-04	72.747	4.730
WAQE67	A	89.9	BA-133	0.41	3.21E-03	288.623	224.334
WAQE67	A	89.9	CE-141	0.99	3.67E-06	0.330	0.101
WAQE67	A	89.9	HF-181	0.76	8.94E-07	0.080	0.007
WAQE67	B	100.4	CO-60	0.96	1.23E-06	0.123	0.010
WAQE67	B	100.4	ZN-65	0.98	6.42E-03	644.958	25.766
WAQE67	B	100.4	RU-103	0.80	1.74E-05	1.746	0.105
WAQE67	B	100.4	SB-124	0.77	2.06E-07	0.021	0.002
WAQE67	B	100.4	BA-131	0.92	8.11E-04	81.452	5.266
WAQE67	B	100.4	BA-133	0.41	9.74E-03	977.665	227.561
WAQE67	B	100.4	CE-141	0.99	3.60E-06	0.361	0.107
WAQE67	B	100.4	HF-181	0.76	7.08E-07	0.071	0.007
12HD94	A	85.4	SC-46	0.96	1.99E-06	0.170	0.009
12HD94	A	85.4	CR-51	0.97	2.92E-05	2.495	0.488
12HD94	A	85.4	FE-59	0.91	1.04E-03	88.809	10.691
12HD94	A	85.4	CO-60	0.92	3.92E-06	0.335	0.018
12HD94	A	85.4	ZN-65	0.95	5.13E-03	437.954	17.635
12HD94	A	85.4	SE-75	1.00	2.05E-05	1.752	0.072
12HD94	A	85.4	RU-103	0.79	6.77E-06	0.579	0.076
12HD94	A	85.4	SB-124	0.74	7.30E-07	0.062	0.004
12HD94	A	85.4	BA-131	0.86	7.05E-04	60.205	4.788
12HD94	A	85.4	CE-141	0.97	8.50E-06	0.726	0.148
12HD94	A	85.4	YB-169	0.36	5.70E-07	0.049	0.012
12HD94	A	85.4	TA-182	0.55	7.64E-08	0.007	0.001
12HD94	A	85.4	HG-203	0.98	1.75E-05	1.492	0.108
46NKJF	B	93.6	CR-51	0.97	1.76E-05	1.649	0.550
46NKJF	B	93.6	CO-60	0.92	2.41E-06	0.226	0.014
46NKJF	B	93.6	ZN-65	0.95	6.92E-03	648.078	26.018
46NKJF	B	93.6	RU-103	0.78	8.45E-06	0.791	0.090
46NKJF	B	93.6	SB-124	0.74	2.59E-07	0.024	0.002
46NKJF	B	93.6	BA-131	0.86	9.61E-04	89.971	7.309
46NKJF	B	93.6	BA-133	0.41	7.14E-03	667.856	231.706
46NKJF	B	93.6	HF-181	0.75	1.06E-06	0.099	0.009

77G4CJ	A	105.3	CO-60	0.97	2.83E-06	0.298	0.017
77G4CJ	A	105.3	ZN-65	0.98	7.92E-03	833.658	33.418
77G4CJ	A	105.3	RU-103	0.81	1.25E-05	1.318	0.111
77G4CJ	A	105.3	SB-124	0.76	2.96E-07	0.031	0.003
77G4CJ	A	105.3	BA-131	0.87	1.02E-03	107.669	8.448
77G4CJ	A	105.3	BA-133	0.41	4.19E-03	441.219	252.825
77G4CJ	A	105.3	CE-141	0.97	7.55E-06	0.795	0.158
77G4CJ	A	105.3	HF-181	0.75	8.26E-07	0.087	0.009
907BVA	A	95	CO-60	0.98	1.85E-06	0.176	0.012
907BVA	A	95	ZN-65	0.99	7.08E-03	672.292	26.976
907BVA	A	95	RU-103	0.83	9.84E-06	0.934	0.092
907BVA	A	95	SB-124	0.76	2.36E-07	0.022	0.002
907BVA	A	95	BA-131	0.88	9.04E-04	85.911	6.599
907BVA	A	95	BA-133	0.41	4.91E-03	466.092	227.324
907BVA	A	95	HF-181	0.76	8.13E-07	0.077	0.008
604010-16	B	56.3	CR-51	0.97	5.62E-05	3.165	0.501
604010-16	B	56.3	CO-60	0.97	6.76E-06	0.381	0.022
604010-16	B	56.3	ZN-65	0.98	6.81E-03	383.658	15.499
604010-16	B	56.3	RU-103	0.80	8.51E-06	0.479	0.075
604010-16	B	56.3	SB-124	0.98	1.32E-05	0.745	0.031
604010-16	B	56.3	BA-131	0.87	9.02E-04	50.783	4.196
604010-16	B	56.3	HF-175	0.86	1.15E-05	0.648	0.136
604010-16	B	56.3	HF-181	0.76	1.54E-06	0.087	0.008
604010-16	B	56.3	OS-185	0.79	6.45E-06	0.363	0.479
604010-41	A	68.9	CR-51	0.97	5.22E-05	3.594	0.549
604010-41	A	68.9	FE-59	0.33	1.15E-03	79.146	20.936
604010-41	A	68.9	CO-60	0.97	7.90E-06	0.545	0.027
604010-41	A	68.9	ZN-65	0.97	6.24E-03	429.656	17.319
604010-41	A	68.9	RU-103	0.79	1.01E-05	0.698	0.082
604010-41	A	68.9	SB-124	0.97	1.21E-05	0.831	0.034
604010-41	A	68.9	BA-131	0.86	8.03E-04	55.324	4.668
604010-41	A	68.9	HF-175	0.91	1.04E-05	0.717	0.144
604010-41	A	68.9	HF-181	0.76	1.35E-06	0.093	0.009
604010-41	A	68.9	OS-185	0.79	3.18E-06	0.219	0.516
A3871H	B	95.5	SC-46	0.97	2.44E-06	0.233	0.012
A3871H	B	95.5	CR-51	0.97	1.71E-05	1.633	0.489
A3871H	B	95.5	CO-60	0.95	1.83E-06	0.175	0.012
A3871H	B	95.5	ZN-65	0.94	5.08E-03	484.748	19.485
A3871H	B	95.5	RU-103	0.78	5.52E-06	0.527	0.078
A3871H	B	95.5	SB-124	0.45	5.69E-07	0.054	0.004
A3871H	B	95.5	BA-131	0.86	7.24E-04	69.130	5.801
A3871H	B	95.5	BA-133	0.41	1.99E-03	190.236	212.030
A3871H	B	95.5	HF-181	0.75	8.07E-07	0.077	0.008
A22589HC	B	80.1	CO-60	0.98	2.66E-06	0.213	0.014
A22589HC	B	80.1	ZN-65	0.98	6.96E-03	557.195	22.392
A22589HC	B	80.1	RU-103	0.81	9.26E-06	0.742	0.083
A22589HC	B	80.1	SB-124	0.76	9.77E-07	0.078	0.004
A22589HC	B	80.1	BA-131	0.87	9.42E-04	75.492	5.858
A22589HC	B	80.1	BA-133	0.41	7.14E-03	572.003	208.797
A22589HC	B	80.1	CE-141	0.97	8.87E-06	0.711	0.136

A22589HC	B	80.1	HF-175	0.94	6.06E-06	0.486	0.135
A22589HC	B	80.1	HF-181	0.76	8.65E-07	0.069	0.008
A22623HC	B	76.1	CR-51	0.97	1.74E-05	1.324	0.494
A22623HC	B	76.1	CO-60	0.93	3.73E-06	0.284	0.016
A22623HC	B	76.1	ZN-65	0.95	7.04E-03	536.006	21.553
A22623HC	B	76.1	RU-103	0.78	1.03E-05	0.783	0.084
A22623HC	B	76.1	SB-124	0.76	1.01E-06	0.077	0.004
A22623HC	B	76.1	BA-131	0.86	8.63E-04	65.680	5.487
A22623HC	B	76.1	BA-133	0.41	7.60E-03	578.024	215.311
A22623HC	B	76.1	CE-141	0.96	5.33E-06	0.405	0.139
A22623HC	B	76.1	HF-181	0.75	1.05E-06	0.080	0.008
A24246HC	A	83.2	CR-51	0.97	3.28E-05	2.726	0.475
A24246HC	A	83.2	FE-59	0.90	6.27E-04	52.161	9.918
A24246HC	A	83.2	CO-60	0.93	4.91E-06	0.409	0.021
A24246HC	A	83.2	ZN-65	0.95	5.41E-03	450.080	18.113
A24246HC	A	83.2	SB-124	0.74	8.32E-07	0.069	0.004
A24246HC	A	83.2	BA-131	0.86	7.60E-04	63.210	5.464
A24246HC	A	83.2	CE-141	0.95	8.49E-06	0.706	0.130
A24246HC	A	83.2	HF-181	0.75	1.22E-06	0.101	0.008
A24246HC	A	83.2	TA-182	0.32	5.84E-08	0.005	0.001
CRH8ES	A	80.1	CO-60	0.98	2.85E-06	0.228	0.013
CRH8ES	A	80.1	ZN-65	0.99	7.30E-03	584.587	23.493
CRH8ES	A	80.1	RU-103	0.82	1.34E-05	1.070	0.090
CRH8ES	A	80.1	SB-124	0.77	3.30E-07	0.026	0.002
CRH8ES	A	80.1	BA-131	0.87	9.21E-04	73.747	5.852
CRH8ES	A	80.1	CE-141	0.98	6.91E-06	0.553	0.136
CRH8ES	A	80.1	HF-181	0.76	9.56E-07	0.077	0.008
CRH8ES	B	96.2	CO-60	0.96	2.27E-06	0.219	0.014
CRH8ES	B	96.2	ZN-65	0.97	7.34E-03	706.399	28.351
CRH8ES	B	96.2	RU-103	0.79	1.23E-05	1.183	0.101
CRH8ES	B	96.2	SB-124	0.77	3.09E-07	0.030	0.003
CRH8ES	B	96.2	BA-131	0.87	9.37E-04	90.187	7.167
CRH8ES	B	96.2	BA-133	0.41	6.20E-03	596.073	242.853
CRH8ES	B	96.2	HF-181	0.75	1.00E-06	0.096	0.009
HIDE4H	A	96.1	CO-60	0.92	1.91E-06	0.183	0.012
HIDE4H	A	96.1	ZN-65	0.94	3.80E-03	365.376	14.718
HIDE4H	A	96.1	SB-124	0.75	1.57E-07	0.015	0.002
HIDE4H	A	96.1	BA-131	0.85	5.33E-04	51.239	4.565
HIDE4H	A	96.1	HF-181	0.75	3.96E-07	0.038	0.006
IUY3T4	B	67.8	SC-46	0.97	2.40E-06	0.163	0.009
IUY3T4	B	67.8	CR-51	0.98	1.72E-05	1.168	0.415
IUY3T4	B	67.8	FE-59	0.96	1.07E-03	72.421	9.455
IUY3T4	B	67.8	CO-60	0.97	2.06E-06	0.140	0.011
IUY3T4	B	67.8	ZN-65	0.98	5.18E-03	351.196	14.173
IUY3T4	B	67.8	RU-103	0.80	8.63E-06	0.585	0.068
IUY3T4	B	67.8	SB-124	0.77	4.18E-07	0.028	0.002
IUY3T4	B	67.8	BA-131	0.86	7.25E-04	49.152	4.156
IUY3T4	B	67.8	HF-175	0.94	3.84E-06	0.260	0.115
IUY3T4	B	67.8	HF-181	0.76	8.59E-07	0.058	0.007
MA7ET5	B	64.9	CO-60	0.94	3.52E-06	0.228	0.014

MA7ET5	B	64.9	ZN-65	0.96	8.04E-03	521.511	20.986
MA7ET5	B	64.9	RU-103	0.78	1.00E-05	0.652	0.077
MA7ET5	B	64.9	SB-124	0.76	2.33E-07	0.015	0.002
MA7ET5	B	64.9	BA-131	0.86	9.05E-04	58.735	4.967
MA7ET5	B	64.9	BA-133	0.41	9.69E-03	628.637	205.514
MA7ET5	B	64.9	HF-181	0.75	1.07E-06	0.069	0.008
NM81X7	A	104.5	CR-51	0.97	2.82E-05	2.946	0.585
NM81X7	A	104.5	CO-60	0.96	2.92E-06	0.305	0.017
NM81X7	A	104.5	ZN-65	0.97	7.25E-03	757.790	30.383
NM81X7	A	104.5	RU-103	0.79	9.43E-06	0.986	0.102
NM81X7	A	104.5	SB-124	0.77	3.16E-07	0.033	0.003
NM81X7	A	104.5	BA-131	0.87	8.62E-04	90.124	7.199
NM81X7	A	104.5	BA-133	0.41	6.07E-03	634.579	245.399
NM81X7	A	104.5	HF-181	0.76	1.33E-06	0.139	0.010
7GH325	A	88.1	CO-60	0.99	1.20E-06	0.106	0.009
7GH325	A	88.1	ZN-65	0.99	7.20E-03	633.923	25.451
7GH325	A	88.1	RU-103	0.80	7.43E-06	0.655	0.092
7GH325	A	88.1	SB-124	0.77	2.17E-07	0.019	0.002
7GH325	A	88.1	BA-131	0.84	8.99E-04	79.162	7.196
7GH325	A	88.1	BA-133	0.40	3.57E-03	314.115	222.804
7GH325	A	88.1	HF-181	0.75	7.26E-07	0.064	0.008
27QR6F	A	63.7	CO-60	0.97	1.56E-06	0.099	0.009
27QR6F	A	63.7	ZN-65	0.99	7.38E-03	470.404	18.938
27QR6F	A	63.7	SE-75	0.99	1.54E-05	0.982	0.042
27QR6F	A	63.7	RU-103	0.81	1.66E-05	1.060	0.088
27QR6F	A	63.7	BA-133	0.41	6.38E-03	406.197	189.057
27QR6F	A	63.7	HG-203	0.98	7.17E-06	0.456	0.084
29750	B	75.2	SC-46	0.97	3.39E-06	0.255	0.013
29750	B	75.2	CR-51	0.97	4.31E-05	3.243	0.573
29750	B	75.2	CO-60	0.98	3.55E-06	0.267	0.015
29750	B	75.2	ZN-65	0.99	6.53E-03	490.982	19.756
29750	B	75.2	RU-103	0.81	6.63E-06	0.499	0.085
29750	B	75.2	SB-124	0.77	4.71E-07	0.035	0.003
29750	B	75.2	BA-131	0.83	8.26E-04	62.079	6.054
29750	B	75.2	BA-133	0.41	5.12E-03	385.085	208.154
29750	B	75.2	HF-181	0.76	1.08E-06	0.081	0.009
A0354G	A	79.6	CO-60	0.98	1.81E-06	0.144	0.011
A0354G	A	79.6	ZN-65	0.99	6.79E-03	540.338	21.715
A0354G	A	79.6	RU-103	0.80	7.00E-06	0.557	0.085
A0354G	A	79.6	SB-124	0.45	3.14E-07	0.025	0.003
A0354G	A	79.6	BA-131	0.83	9.19E-04	73.121	6.837
A0354G	A	79.6	HF-181	0.75	7.76E-07	0.062	0.008
A0354G	B	85.9	CO-60	0.99	1.78E-06	0.153	0.011
A0354G	B	85.9	ZN-65	0.99	6.85E-03	588.294	23.630
A0354G	B	85.9	RU-103	0.81	7.39E-06	0.635	0.090
A0354G	B	85.9	SB-124	0.77	2.81E-07	0.024	0.003
A0354G	B	85.9	BA-131	0.84	8.81E-04	75.663	6.942
A0354G	B	85.9	BA-133	0.41	7.10E-03	610.104	219.534
A0354G	B	85.9	HF-181	0.75	1.02E-06	0.088	0.009
A3807H	A	87.3	SC-46	0.96	2.38E-06	0.208	0.011

A3807H	A	87.3	CR-51	0.96	2.02E-05	1.761	0.586
A3807H	A	87.3	CO-60	0.98	2.97E-06	0.259	0.015
A3807H	A	87.3	ZN-65	0.99	6.00E-03	523.693	21.042
A3807H	A	87.3	RU-103	0.81	5.44E-06	0.475	0.087
A3807H	A	87.3	SB-124	0.77	4.61E-07	0.040	0.003
A3807H	A	87.3	BA-131	0.83	7.80E-04	68.078	6.578
A3807H	A	87.3	BA-133	0.41	4.45E-03	388.455	203.654
A3807H	A	87.3	HF-181	0.75	9.04E-07	0.079	0.009
A3871H	A	67	SC-46	0.97	2.69E-06	0.180	0.010
A3871H	A	67	CR-51	0.97	3.25E-05	2.174	0.505
A3871H	A	67	CO-60	0.98	2.65E-06	0.178	0.011
A3871H	A	67	ZN-65	0.98	5.31E-03	355.975	14.367
A3871H	A	67	RU-103	0.81	6.21E-06	0.416	0.074
A3871H	A	67	SB-124	0.77	4.92E-07	0.033	0.003
A3871H	A	67	BA-131	0.82	7.60E-04	50.907	5.283
A3871H	A	67	HF-181	0.75	9.78E-07	0.066	0.008
A22607HC	A	81.8	CR-51	0.97	4.17E-05	3.414	0.557
A22607HC	A	81.8	FE-59	0.98	7.67E-04	62.720	11.039
A22607HC	A	81.8	CO-60	0.99	6.14E-06	0.502	0.024
A22607HC	A	81.8	ZN-65	0.99	6.32E-03	516.758	20.773
A22607HC	A	81.8	SE-75	1.00	4.39E-05	3.590	0.146
A22607HC	A	81.8	RU-103	0.81	1.30E-05	1.065	0.094
A22607HC	A	81.8	SB-124	0.78	8.11E-07	0.066	0.004
A22607HC	A	81.8	YB-169	0.36	1.06E-06	0.087	0.015
A22607HC	A	81.8	HG-203	0.97	4.84E-05	3.956	0.206
CE9B16	B	80.6	SC-46	0.96	3.36E-06	0.271	0.013
CE9B16	B	80.6	CR-51	0.97	4.60E-05	3.712	0.587
CE9B16	B	80.6	CO-60	0.98	5.44E-06	0.438	0.022
CE9B16	B	80.6	ZN-65	0.99	6.40E-03	515.721	20.735
CE9B16	B	80.6	RU-103	0.84	6.82E-06	0.550	0.084
CE9B16	B	80.6	SB-124	0.77	7.27E-07	0.059	0.004
CE9B16	B	80.6	BA-131	0.85	7.81E-04	62.968	5.750
CE9B16	B	80.6	BA-133	0.41	6.61E-03	532.590	217.243
CE9B16	B	80.6	CE-141	0.96	7.61E-06	0.614	0.156
CE9B16	B	80.6	HF-181	0.76	1.15E-06	0.093	0.009
DAW454	A	92.7	CO-60	0.98	3.61E-06	0.335	0.018
DAW454	A	92.7	ZN-65	0.99	7.59E-03	703.447	28.221
DAW454	A	92.7	RU-103	0.81	8.36E-06	0.775	0.099
DAW454	A	92.7	SB-124	0.77	2.94E-07	0.027	0.002
DAW454	A	92.7	BA-131	0.84	8.94E-04	82.854	7.536
DAW454	A	92.7	BA-133	0.39	1.05E-02	970.100	225.777
DAW454	A	92.7	CE-141	0.95	5.05E-06	0.468	0.170
DAW454	A	92.7	HF-175	0.95	7.81E-06	0.724	0.151
DAW454	A	92.7	HF-181	0.76	7.56E-07	0.070	0.009
GO9JVE	A	95.7	CO-60	0.99	2.70E-06	0.259	0.015
GO9JVE	A	95.7	ZN-65	0.99	6.05E-03	578.515	23.230
GO9JVE	A	95.7	RU-103	0.82	5.97E-06	0.571	0.088
GO9JVE	A	95.7	SB-124	0.77	2.21E-07	0.021	0.002
GO9JVE	A	95.7	BA-131	0.84	7.44E-04	71.154	6.454
GO9JVE	A	95.7	HF-181	0.76	6.16E-07	0.059	0.008

HGD63H	A	99.5	CR-51	0.96	3.45E-05	3.432	0.702
HGD63H	A	99.5	CO-60	0.99	4.13E-06	0.411	0.021
HGD63H	A	99.5	ZN-65	0.99	7.45E-03	741.748	29.757
HGD63H	A	99.5	RU-103	0.80	7.62E-06	0.758	0.104
HGD63H	A	99.5	SB-124	0.77	4.11E-07	0.041	0.003
HGD63H	A	99.5	BA-131	0.84	1.02E-03	101.081	8.947
HGD63H	A	99.5	BA-133	0.41	7.24E-03	720.560	250.306
HGD63H	A	99.5	CE-141	0.97	5.57E-06	0.554	0.179
HGD63H	A	99.5	HF-181	0.71	1.60E-06	0.160	0.012
HGD63H	A	99.5	HG-203	0.90	1.59E-06	0.158	0.093
MA7ET5	A	75.3	CR-51	0.97	1.55E-05	1.163	0.585
MA7ET5	A	75.3	CO-60	0.99	5.14E-06	0.387	0.020
MA7ET5	A	75.3	ZN-65	0.99	8.52E-03	641.642	25.767
MA7ET5	A	75.3	RU-103	0.83	6.67E-06	0.502	0.091
MA7ET5	A	75.3	SB-124	0.78	4.04E-07	0.030	0.003
MA7ET5	A	75.3	BA-131	0.84	1.07E-03	80.549	7.190
MA7ET5	A	75.3	BA-133	0.41	7.11E-03	535.719	226.748
MA7ET5	A	75.3	HF-175	0.89	7.79E-06	0.587	0.150
MA7ET5	A	75.3	HF-181	0.76	9.96E-07	0.075	0.009
MB6LV1	A	90.6	CO-60	0.98	2.60E-06	0.236	0.014
MB6LV1	A	90.6	ZN-65	0.99	6.80E-03	616.151	24.738
MB6LV1	A	90.6	RU-103	0.82	7.34E-06	0.665	0.091
MB6LV1	A	90.6	SB-124	0.78	2.04E-07	0.019	0.002
MB6LV1	A	90.6	BA-131	0.83	9.05E-04	81.966	7.538
MB6LV1	A	90.6	BA-133	0.41	7.98E-03	723.180	224.686
MB6LV1	A	90.6	CE-141	0.94	1.62E-06	0.147	0.166
MB6LV1	A	90.6	HF-181	0.75	9.03E-07	0.082	0.009
PL2IXI	A	82.1	CO-60	0.97	2.00E-06	0.164	0.011
PL2IXI	A	82.1	ZN-65	0.99	6.65E-03	545.883	21.944
PL2IXI	A	82.1	RU-103	0.82	6.60E-06	0.542	0.086
PL2IXI	A	82.1	SB-124	0.77	2.16E-07	0.018	0.002
PL2IXI	A	82.1	BA-131	0.83	8.70E-04	71.410	6.849
PL2IXI	A	82.1	BA-133	0.41	5.03E-03	412.934	208.997
PL2IXI	A	82.1	HF-181	0.75	1.01E-06	0.083	0.008
QOX417	B	105.5	CO-60	0.99	1.45E-06	0.153	0.011
QOX417	B	105.5	ZN-65	0.99	6.21E-03	655.138	26.293
QOX417	B	105.5	SE-75	0.67	1.54E-06	0.163	0.017
QOX417	B	105.5	RU-103	0.81	6.06E-06	0.640	0.097
QOX417	B	105.5	SB-124	0.76	2.48E-07	0.026	0.003
QOX417	B	105.5	BA-131	0.83	7.82E-04	82.456	7.866
QOX417	B	105.5	BA-133	0.41	8.20E-03	865.323	221.729
QOX417	B	105.5	HG-203	0.96	4.87E-07	0.051	0.087
RP14DE	A	70.3	CO-60	0.99	1.52E-06	0.107	0.009
RP14DE	A	70.3	ZN-65	0.99	6.57E-03	461.626	18.579
RP14DE	A	70.3	SE-75	0.45	1.53E-06	0.107	0.013
RP14DE	A	70.3	RU-103	0.82	9.26E-06	0.651	0.078
RP14DE	A	70.3	SB-124	0.77	1.83E-07	0.013	0.002
RP14DE	A	70.3	BA-131	0.84	8.15E-04	57.309	5.442
T007ML	A	82.3	CR-51	0.97	2.64E-05	2.176	0.605
T007ML	A	82.3	CO-60	0.96	2.24E-06	0.184	0.012

T007ML	A	82.3	ZN-65	0.98	6.83E-03	561.761	22.572
T007ML	A	82.3	RU-103	0.81	6.41E-06	0.527	0.089
T007ML	A	82.3	SB-124	0.46	3.88E-07	0.032	0.004
T007ML	A	82.3	BA-131	0.83	8.32E-04	68.466	6.583
T007ML	A	82.3	BA-133	0.40	7.87E-03	647.600	212.070
T007ML	A	82.3	HF-181	0.76	1.21E-06	0.100	0.009
TT15A5	B	96.3	CO-60	0.99	1.44E-06	0.138	0.011
TT15A5	B	96.3	ZN-65	0.99	5.31E-03	511.288	20.540
TT15A5	B	96.3	SE-75	0.50	1.47E-06	0.141	0.009
TT15A5	B	96.3	RU-103	0.82	5.58E-06	0.538	0.081
TT15A5	B	96.3	SB-124	0.78	2.04E-07	0.020	0.002
TT15A5	B	96.3	BA-131	0.85	7.18E-04	69.115	6.167
TT15A5	B	96.3	BA-133	0.41	8.06E-03	775.795	194.033
TT15A5	B	96.3	HF-181	0.85	7.31E-07	0.070	0.005
W9E578	A	90.2	CO-60	0.99	4.37E-06	0.394	0.020
W9E578	A	90.2	ZN-65	0.99	7.94E-03	716.521	28.744
W9E578	A	90.2	RU-103	0.81	9.97E-06	0.900	0.101
W9E578	A	90.2	SB-124	0.77	3.07E-07	0.028	0.003
W9E578	A	90.2	BA-131	0.84	9.91E-04	89.386	7.865
W9E578	A	90.2	BA-133	0.41	5.64E-03	508.574	241.168
W9E578	A	90.2	CE-141	0.97	7.33E-06	0.661	0.172
W9E578	A	90.2	HF-175	0.88	1.01E-05	0.912	0.161
W9E578	A	90.2	HF-181	0.76	1.01E-06	0.091	0.010
12HD49	B	98.4	CR-51	0.94	2.47E-05	2.431	0.669
12HD49	B	98.4	FE-59	0.96	1.14E-03	112.498	13.714
12HD49	B	98.4	CO-60	0.98	3.55E-06	0.349	0.018
12HD49	B	98.4	ZN-65	0.98	5.18E-03	509.915	20.452
12HD49	B	98.4	SE-75	0.99	7.93E-06	0.780	0.035
12HD49	B	98.4	RU-103	0.81	9.81E-06	0.965	0.098
12HD49	B	98.4	SB-124	0.88	7.27E-07	0.072	0.004
12HD49	B	98.4	BA-133	0.40	8.61E-03	847.237	211.971
12HD49	B	98.4	CE-141	0.97	8.86E-06	0.872	0.190
12HD49	B	98.4	TA-182	0.30	4.76E-08	0.005	0.001
12HD49	B	98.4	HG-203	0.97	4.82E-06	0.474	0.095
2965CL	B	69.9	FE-59	0.93	8.78E-04	61.390	11.368
2965CL	B	69.9	CO-60	0.98	4.02E-06	0.281	0.016
2965CL	B	69.9	ZN-65	0.99	6.37E-03	445.361	17.897
2965CL	B	69.9	SE-75	0.50	1.47E-06	0.102	0.008
2965CL	B	69.9	RU-103	0.80	3.57E-06	0.250	0.083
2965CL	B	69.9	SB-124	0.77	8.81E-07	0.062	0.004
2965CL	B	69.9	BA-131	0.81	9.43E-04	65.928	7.056
2965CL	B	69.9	HF-181	0.85	1.10E-06	0.077	0.006
LM6524	B	69.4	CO-60	0.98	5.24E-06	0.364	0.019
LM6524	B	69.4	ZN-65	0.98	1.13E-02	783.196	31.390
LM6524	B	69.4	RU-103	0.82	7.34E-06	0.509	0.113
LM6524	B	69.4	SB-124	0.76	3.72E-07	0.026	0.003
LM6524	B	69.4	BA-131	0.81	1.49E-03	103.688	10.270
LM6524	B	69.4	BA-133	0.41	1.42E-02	987.836	240.721
LM6524	B	69.4	HF-181	0.75	1.37E-06	0.095	0.011
PL21X1	B	92.7	CO-60	0.98	1.92E-06	0.178	0.012

PL21X1	B	92.7	ZN-65	0.99	6.69E-03	619.879	24.833
PL21X1	B	92.7	RU-103	0.81	3.25E-06	0.302	0.095
PL21X1	B	92.7	SB-124	0.77	2.60E-07	0.024	0.002
PL21X1	B	92.7	BA-131	0.81	9.00E-04	83.475	8.465
PL21X1	B	92.7	BA-133	0.41	5.45E-03	505.441	222.150
PL21X1	B	92.7	HF-181	0.75	7.83E-07	0.073	0.009
RP140E	B	107.9	CO-60	0.97	1.02E-06	0.110	0.010
RP140E	B	107.9	ZN-65	0.98	4.28E-03	461.609	18.513
RP140E	B	107.9	RU-103	0.78	1.57E-06	0.169	0.083
RP140E	B	107.9	SB-124	0.76	1.89E-07	0.020	0.002
RP140E	B	107.9	BA-131	0.81	6.20E-04	66.896	7.278
RP140E	B	107.9	BA-133	0.41	6.63E-03	715.545	193.944
RP140E	B	107.9	HF-181	0.75	4.39E-07	0.047	0.008
TT15A5	A	104.3	CO-60	0.97	8.79E-07	0.092	0.009
TT15A5	A	104.3	ZN-65	0.98	5.12E-03	534.003	21.395
TT15A5	A	104.3	SE-75	0.50	9.19E-07	0.096	0.008
TT15A5	A	104.3	RU-103	0.80	4.85E-06	0.506	0.086
TT15A5	A	104.3	SB-124	0.45	1.89E-07	0.020	0.004
TT15A5	A	104.3	BA-131	0.82	6.98E-04	72.831	7.488
TT15A5	A	104.3	HF-181	0.85	5.97E-07	0.062	0.005
U5D8UN	A	75	CO-60	0.98	1.99E-06	0.149	0.011
U5D8UN	A	75	ZN-65	0.98	6.09E-03	457.112	18.356
U5D8UN	A	75	RU-103	0.81	3.15E-06	0.237	0.072
U5D8UN	A	75	SB-124	0.76	4.64E-07	0.035	0.003
U5D8UN	A	75	BA-131	0.84	4.59E-04	34.416	3.790
U5D8UN	A	75	BA-133	0.41	6.48E-03	486.320	199.642
U5D8UN	A	75	CE-141	0.98	5.88E-06	0.441	0.138
U5D8UN	A	75	HF-181	0.75	1.54E-06	0.116	0.009
VDSA46	A	108.7	CO-60	0.95	1.31E-06	0.143	0.011
VDSA46	A	108.7	ZN-65	0.98	6.64E-03	722.309	28.909
VDSA46	A	108.7	RU-103	0.80	4.64E-06	0.505	0.105
VDSA46	A	108.7	SB-124	0.77	3.45E-07	0.038	0.003
VDSA46	A	108.7	BA-131	0.81	9.45E-04	102.723	10.269
VDSA46	A	108.7	BA-133	0.41	9.43E-03	1025.256	237.873
VDSA46	A	108.7	HF-175	0.85	5.75E-06	0.625	0.170
VDSA46	A	108.7	HF-181	0.75	6.56E-07	0.071	0.010
85HXNS	B	74	CO-60	1.00	2.70E-06	0.200	0.013
85HXNS	B	74	ZN-65	0.99	6.19E-03	458.267	18.437
85HXNS	B	74	RU-103	0.83	6.63E-06	0.491	0.096
85HXNS	B	74	SB-124	0.91	2.79E-06	0.207	0.009
85HXNS	B	74	BA-133	0.41	3.53E-03	261.106	210.230
85HXNS	B	74	CE-141	0.97	3.27E-05	2.420	0.235
85HXNS	B	74	EU-152x	0.53	1.95E-07	0.014	0.001
85HXNS	B	74	HF-181	0.75	1.08E-06	0.080	0.010
29440	A	94.3	SC-46	0.96	2.79E-06	0.263	0.013
29440	A	94.3	CO-60	1.00	1.86E-06	0.175	0.012
29440	A	94.3	ZN-65	1.00	5.25E-03	495.377	19.901
29440	A	94.3	RU-103	0.79	2.96E-06	0.279	0.098
29440	A	94.3	SB-124	0.77	4.51E-07	0.043	0.003
29440	A	94.3	BA-131	0.65	6.53E-04	61.593	8.930

29440	A	94.3	HF-181	0.75	8.87E-07	0.084	0.010
29440	B	88.9	SC-46	0.95	3.04E-06	0.270	0.013
29440	B	88.9	CO-60	0.99	1.87E-06	0.166	0.012
29440	B	88.9	ZN-65	0.99	6.13E-03	545.178	21.894
29440	B	88.9	RU-103	0.76	3.17E-06	0.282	0.104
29440	B	88.9	SB-124	0.77	4.74E-07	0.042	0.003
29440	B	88.9	BA-131	0.64	9.08E-04	80.677	10.571
29440	B	88.9	BA-133	0.40	3.01E-03	267.225	214.150
29440	B	88.9	HF-181	0.75	8.79E-07	0.078	0.010
29606	B	83.9	SC-46	0.96	2.66E-06	0.223	0.011
29606	B	83.9	CO-60	0.99	1.52E-06	0.128	0.010
29606	B	83.9	ZN-65	0.99	5.12E-03	429.431	17.275
29606	B	83.9	RU-103	0.80	2.31E-06	0.193	0.090
29606	B	83.9	SB-124	0.77	3.58E-07	0.030	0.003
29606	B	83.9	BA-131	0.66	8.02E-04	67.312	8.699
29606	B	83.9	BA-133	0.41	4.88E-03	409.664	192.563
29606	B	83.9	HF-175	0.88	7.04E-06	0.590	0.146
29606	B	83.9	HF-181	0.75	7.94E-07	0.067	0.009
A3798H	A	87.8	CO-60	1.00	3.18E-06	0.279	0.016
A3798H	A	87.8	ZN-65	1.00	5.09E-03	447.288	17.986
A3798H	A	87.8	RU-103	0.80	3.70E-06	0.325	0.090
A3798H	A	87.8	SB-124	0.77	3.12E-07	0.027	0.003
A3798H	A	87.8	BA-131	0.64	8.35E-04	73.297	9.361
A3798H	A	87.8	BA-133	0.40	2.20E-03	193.450	190.578
A3798H	A	87.8	HF-181	0.75	9.85E-07	0.086	0.010
A3798H	B	93.4	CO-60	1.00	2.65E-06	0.248	0.015
A3798H	B	93.4	ZN-65	0.99	5.01E-03	468.205	18.817
A3798H	B	93.4	RU-103	0.87	2.12E-06	0.198	0.093
A3798H	B	93.4	SB-124	0.77	3.05E-07	0.029	0.003
A3798H	B	93.4	BA-131	0.65	7.24E-04	67.578	9.040
A3798H	B	93.4	HF-181	0.75	1.04E-06	0.097	0.010
A3803H	A	77.1	SC-46	0.96	2.89E-06	0.222	0.012
A3803H	A	77.1	CO-60	0.98	6.91E-06	0.533	0.025
A3803H	A	77.1	ZN-65	0.98	6.29E-03	484.646	19.487
A3803H	A	77.1	RU-103	0.77	3.37E-06	0.260	0.097
A3803H	A	77.1	SB-124	0.77	4.44E-07	0.034	0.003
A3803H	A	77.1	BA-131	0.65	8.85E-04	68.245	8.920
A3803H	A	77.1	BA-133	0.41	3.09E-03	238.250	209.750
A3803H	A	77.1	HF-175	0.90	8.21E-06	0.633	0.160
A3803H	A	77.1	HF-181	0.75	1.00E-06	0.077	0.010
A3861H	B	101.7	CR-51	0.95	3.20E-05	3.255	0.981
A3861H	B	101.7	CO-60	0.99	3.08E-06	0.314	0.017
A3861H	B	101.7	ZN-65	0.99	7.27E-03	738.966	29.615
A3861H	B	101.7	RU-103	0.78	3.21E-06	0.326	0.122
A3861H	B	101.7	SB-124	0.77	3.84E-07	0.039	0.003
A3861H	B	101.7	BA-131	0.64	1.14E-03	116.140	13.989
A3861H	B	101.7	BA-133	0.41	5.38E-03	547.606	253.277
A3861H	B	101.7	CE-141	0.97	6.52E-06	0.663	0.228
A3861H	B	101.7	HF-181	0.75	1.12E-06	0.113	0.012
DSF6UE	A	78.4	CR-51	0.95	3.92E-05	3.076	0.869

DSF6UE	A	78.4	CO-60	0.99	2.36E-06	0.185	0.013
DSF6UE	A	78.4	ZN-65	0.99	7.61E-03	596.912	23.971
DSF6UE	A	78.4	SE-75	0.50	9.97E-07	0.078	0.008
DSF6UE	A	78.4	RU-103	0.83	5.69E-06	0.446	0.105
DSF6UE	A	78.4	SB-124	0.77	5.71E-07	0.045	0.003
DSF6UE	A	78.4	BA-133	0.41	7.81E-03	612.577	223.219
DSF6UE	A	78.4	CE-141	0.97	5.47E-06	0.429	0.208
DSF6UE	A	78.4	EU-152x	0.41	1.90E-07	0.015	0.001
DSF6UE	A	78.4	HF-175	0.86	5.24E-06	0.411	0.177
DSF6UE	A	78.4	HF-181	0.85	8.72E-07	0.068	0.006
F1JH39	A	74.9	CO-60	0.99	2.19E-06	0.164	0.012
F1JH39	A	74.9	ZN-65	1.00	7.06E-03	528.982	21.248
F1JH39	A	74.9	RU-103	0.83	2.67E-06	0.200	0.098
F1JH39	A	74.9	SB-124	0.77	2.74E-07	0.021	0.003
F1JH39	A	74.9	BA-131	0.65	1.12E-03	84.113	10.646
F1JH39	A	74.9	HF-181	0.75	6.21E-07	0.046	0.009
G09JVE	B	87	CO-60	0.99	4.05E-06	0.353	0.018
G09JVE	B	87	ZN-65	1.00	7.11E-03	618.998	24.835
G09JVE	B	87	SE-75	0.51	1.41E-06	0.123	0.016
G09JVE	B	87	RU-103	0.82	4.69E-07	0.041	0.106
G09JVE	B	87	SB-124	0.77	3.80E-07	0.033	0.003
G09JVE	B	87	BA-131	0.64	1.06E-03	91.966	11.268
MB6LV1	B	85.6	CO-60	0.99	2.72E-06	0.233	0.014
MB6LV1	B	85.6	ZN-65	0.99	7.02E-03	600.782	24.118
MB6LV1	B	85.6	RU-103	0.78	1.86E-06	0.160	0.103
MB6LV1	B	85.6	SB-124	0.77	2.37E-07	0.020	0.002
MB6LV1	B	85.6	BA-131	0.78	9.51E-04	81.379	10.001
MB6LV1	B	85.6	BA-133	0.41	9.36E-03	801.096	221.225
MB6LV1	B	85.6	HF-181	0.75	8.68E-07	0.074	0.010
SJA33J	A	62.3	CO-60	0.98	1.99E-06	0.124	0.010
SJA33J	A	62.3	ZN-65	0.98	5.61E-03	349.464	14.097
SJA33J	A	62.3	SE-75	0.99	5.22E-06	0.325	0.018
SJA33J	A	62.3	RU-103	0.79	8.26E-06	0.515	0.080
SJA33J	A	62.3	SB-124	0.76	6.22E-07	0.039	0.003
SJA33J	A	62.3	EU-152x	0.43	3.86E-08	0.002	0.001
SJA33J	A	62.3	HF-175	0.87	9.55E-06	0.595	0.141
SJA33J	A	62.3	HG-203	0.98	4.12E-06	0.257	0.082
U44MXB	A	96.1	CO-60	0.99	3.62E-06	0.348	0.018
U44MXB	A	96.1	ZN-65	0.99	5.62E-03	540.522	21.706
U44MXB	A	96.1	RU-103	0.79	7.10E-07	0.068	0.105
U44MXB	A	96.1	SB-124	0.78	5.02E-07	0.048	0.004
U44MXB	A	96.1	BA-131	0.64	7.99E-04	76.790	10.574
U44MXB	A	96.1	BA-133	0.41	6.11E-03	587.590	219.948
U44MXB	A	96.1	CE-141	0.96	7.47E-06	0.718	0.204
U44MXB	A	96.1	HF-181	0.75	1.08E-06	0.104	0.011
U44MXB	B	71	CO-60	0.99	3.83E-06	0.272	0.016
U44MXB	B	71	ZN-65	0.99	5.34E-03	379.190	15.280
U44MXB	B	71	RU-103	0.79	5.54E-06	0.393	0.086
U44MXB	B	71	SB-124	0.77	5.73E-07	0.041	0.003
U44MXB	B	71	HF-175	0.90	7.68E-06	0.545	0.149

U44MXB	B	71	HF-181	0.75	1.10E-06	0.078	0.009
2D152A	A	102	CO-60	0.99	1.25E-06	0.127	0.010
2D152A	A	102	ZN-65	1.00	5.90E-03	602.088	24.155
2D152A	A	102	RU-103	0.80	3.45E-06	0.352	0.103
2D152A	A	102	SB-124	0.45	1.43E-07	0.015	0.004
2D152A	A	102	BA-131	0.66	8.02E-04	81.805	10.274
2D152A	A	102	BA-133	0.41	1.13E-02	1147.950	218.748
2D152A	A	102	HF-175	0.86	8.21E-06	0.838	0.169
2D152A	A	102	HF-181	0.75	5.94E-07	0.061	0.010
17BDAR	B	68.4	CO-60	0.98	5.31E-06	0.363	0.019
17BDAR	B	68.4	ZN-65	0.99	7.99E-03	546.722	21.980
17BDAR	B	68.4	SB-124	0.77	4.43E-07	0.030	0.003
17BDAR	B	68.4	EU-154	0.32	3.42E-07	0.023	0.003
17BDAR	B	68.4	HF-181	0.75	5.63E-07	0.038	0.010
85HXNS	A	102.2	CO-60	0.98	1.83E-06	0.187	0.013
85HXNS	A	102.2	ZN-65	0.99	5.81E-03	593.688	23.835
85HXNS	A	102.2	RU-103	0.85	4.72E-06	0.482	0.113
85HXNS	A	102.2	SB-124	0.98	2.74E-06	0.280	0.012
85HXNS	A	102.2	BA-133	0.41	5.95E-03	608.539	222.016
85HXNS	A	102.2	CE-141	0.96	3.50E-05	3.576	0.296
85HXNS	A	102.2	EU-152x	0.53	1.66E-07	0.017	0.001
85HXNS	A	102.2	HF-175	0.87	9.75E-06	0.997	0.197
85HXNS	A	102.2	HF-181	0.75	1.11E-06	0.113	0.012
163B43	B	81.2	CR-51	0.95	2.05E-05	1.667	1.005
163B43	B	81.2	CO-60	0.99	6.38E-06	0.518	0.025
163B43	B	81.2	ZN-65	0.99	7.86E-03	638.239	25.624
163B43	B	81.2	SB-124	0.77	7.19E-07	0.058	0.004
163B43	B	81.2	BA-131	0.40	1.39E-03	112.485	38.714
163B43	B	81.2	BA-133	0.41	6.11E-03	495.778	226.663
163B43	B	81.2	EU-154	0.32	1.63E-08	0.001	0.009
115754	A	90.7	CO-60	0.99	1.49E-06	0.135	0.011
115754	A	90.7	ZN-65	1.00	7.61E-03	690.644	27.708
115754	A	90.7	RU-103	0.83	3.18E-06	0.289	0.125
115754	A	90.7	SB-124	0.77	2.67E-07	0.024	0.003
115754	A	90.7	BA-131	0.61	1.28E-03	116.232	16.792
115754	A	90.7	BA-133	0.41	8.80E-03	798.539	229.384
115754	A	90.7	HF-175	0.87	1.28E-05	1.163	0.195
115754	A	90.7	HF-181	0.75	1.25E-06	0.113	0.012
A3861H	A	89	SC-46	0.96	2.28E-06	0.203	0.011
A3861H	A	89	CO-60	0.99	2.20E-06	0.196	0.013
A3861H	A	89	ZN-65	0.99	5.55E-03	493.647	19.849
A3861H	A	89	RU-103	0.84	2.37E-06	0.211	0.106
A3861H	A	89	SB-124	0.77	3.13E-07	0.028	0.003
A3861H	A	89	BA-131	0.60	9.52E-04	84.745	12.978
A3861H	A	89	BA-133	0.40	1.01E-02	900.292	196.361
A3861H	A	89	HF-175	0.90	8.32E-06	0.740	0.161
A3861H	A	89	HF-181	0.75	1.12E-06	0.099	0.011
DSF6UE	B	71.1	CO-60	0.99	2.32E-06	0.165	0.011
DSF6UE	B	71.1	ZN-65	1.00	8.04E-03	571.937	22.987
DSF6UE	B	71.1	SB-124	0.77	3.91E-07	0.028	0.003

DSF6UE	B	71.1	BA-133	0.40	8.20E-03	583.226	200.238
DSF6UE	B	71.1	EU-152x	0.39	1.24E-07	0.009	0.001
DSF6UE	B	71.1	HF-175	0.91	1.01E-05	0.721	0.177
DSF6UE	B	71.1	HF-181	0.74	8.64E-07	0.061	0.011
CE9B16	A	68.2	SC-46	0.96	3.66E-06	0.250	0.013
CE9B16	A	68.2	CO-60	0.99	4.27E-06	0.291	0.016
CE9B16	A	68.2	ZN-65	0.99	6.93E-03	472.615	19.034
CE9B16	A	68.2	RU-103	0.80	2.36E-06	0.161	0.107
CE9B16	A	68.2	SB-124	0.76	5.34E-07	0.036	0.003
CE9B16	A	68.2	BA-131	0.62	9.73E-04	66.350	11.042
CE9B16	A	68.2	BA-133	0.41	5.99E-03	408.476	204.494
CE9B16	A	68.2	HF-181	0.75	9.99E-07	0.068	0.010
DR87FE	B	92.5	CO-60	0.99	3.47E-06	0.321	0.017
DR87FE	B	92.5	ZN-65	0.99	8.18E-03	756.425	30.328
DR87FE	B	92.5	RU-103	0.79	4.38E-06	0.406	0.128
DR87FE	B	92.5	SB-124	0.77	2.60E-07	0.024	0.003
DR87FE	B	92.5	BA-131	0.42	1.15E-03	106.753	15.828
DR87FE	B	92.5	BA-133	0.41	1.30E-02	1204.160	230.719
DR87FE	B	92.5	HF-181	0.75	6.92E-07	0.064	0.012
FTRT75	A	94.6	CO-60	0.99	2.83E-06	0.268	0.015
FTRT75	A	94.6	ZN-65	0.99	7.24E-03	684.802	27.473
FTRT75	A	94.6	RU-103	0.78	4.43E-06	0.419	0.111
FTRT75	A	94.6	SB-124	0.77	4.43E-07	0.042	0.003
FTRT75	A	94.6	BA-133	0.41	4.80E-03	453.629	224.311
FTRT75	A	94.6	EU-152x	0.51	1.22E-07	0.012	0.001
FTRT75	A	94.6	HF-181	0.75	9.03E-07	0.085	0.011
HGD63H	B	96.8	CO-60	1.00	3.76E-06	0.364	0.019
HGD63H	B	96.8	ZN-65	1.00	7.85E-03	759.581	30.457
HGD63H	B	96.8	SB-124	0.77	3.69E-07	0.036	0.003
HGD63H	B	96.8	BA-131	0.41	1.04E-03	100.927	42.085
HGD63H	B	96.8	BA-133	0.41	5.55E-03	537.118	247.888
HGD63H	B	96.8	EU-154	0.32	6.73E-08	0.007	0.010
HGD63H	B	96.8	HF-181	0.75	1.29E-06	0.124	0.013
K76G4R	A	62.9	CO-60	0.99	2.46E-06	0.155	0.011
K76G4R	A	62.9	ZN-65	0.99	6.93E-03	436.126	17.570
K76G4R	A	62.9	SE-75	1.00	4.41E-05	2.773	0.113
K76G4R	A	62.9	RU-103	0.81	5.65E-06	0.356	0.092
K76G4R	A	62.9	SB-124	0.77	5.97E-07	0.038	0.003
K76G4R	A	62.9	YB-169	0.35	1.04E-06	0.065	0.019
K76G4R	A	62.9	HF-175	0.89	9.89E-06	0.622	0.150
K76G4R	A	62.9	HG-203	0.97	4.71E-05	2.963	0.182
Q0XU17	A	103.4	CO-60	1.00	1.60E-06	0.166	0.011
Q0XU17	A	103.4	ZN-65	0.99	6.36E-03	658.065	26.404
Q0XU17	A	103.4	RU-103	0.83	1.50E-06	0.155	0.117
Q0XU17	A	103.4	SB-124	0.77	2.67E-07	0.028	0.003
Q0XU17	A	103.4	BA-131	0.41	9.64E-04	99.650	14.210
Q0XU17	A	103.4	BA-133	0.41	6.66E-03	688.701	226.936
Q0XU17	A	103.4	HF-181	0.75	5.08E-07	0.053	0.011
T007ML	B	87.8	CO-60	1.00	2.25E-06	0.198	0.013
T007ML	B	87.8	ZN-65	1.00	7.39E-03	649.269	26.059

T007ML	B	87.8	RU-103	0.80	3.07E-06	0.270	0.122
T007ML	B	87.8	SB-124	0.78	3.45E-07	0.030	0.003
T007ML	B	87.8	BA-131	0.41	1.28E-03	112.251	16.141
T007ML	B	87.8	BA-133	0.41	1.09E-02	954.051	218.186
T007ML	B	87.8	HF-175	0.93	1.15E-05	1.011	0.191
T007ML	B	87.8	HF-181	0.75	1.29E-06	0.113	0.012
WBH9G4	B	73.3	FE-59	0.97	1.17E-03	85.842	14.519
WBH9G4	B	73.3	CO-60	0.99	2.43E-06	0.178	0.012
WBH9G4	B	73.3	ZN-65	0.99	6.53E-03	478.404	19.250
WBH9G4	B	73.3	RU-103	0.79	1.54E-07	0.011	0.104
WBH9G4	B	73.3	SB-124	0.77	2.80E-07	0.021	0.002
WBH9G4	B	73.3	BA-131	0.40	1.02E-03	74.476	12.235
WBH9G4	B	73.3	BA-133	0.41	1.07E-02	783.785	187.681
WBH9G4	B	73.3	HF-181	0.75	7.87E-07	0.058	0.010
2D152A	B	86.3	FE-59	0.98	1.30E-03	111.818	14.360
2D152A	B	86.3	CO-60	0.99	2.79E-06	0.240	0.014
2D152A	B	86.3	ZN-65	0.99	7.49E-03	646.014	25.941
2D152A	B	86.3	RU-103	0.83	3.44E-06	0.297	0.114
2D152A	B	86.3	SB-124	0.77	3.45E-07	0.030	0.003
2D152A	B	86.3	BA-131	0.62	1.21E-03	104.350	14.165
2D152A	B	86.3	BA-133	0.41	8.03E-03	693.179	227.228
2D152A	B	86.3	HF-175	0.89	8.63E-06	0.744	0.176
2D152A	B	86.3	HF-181	0.75	9.19E-07	0.079	0.011
17BDAR	A	64.2	CO-60	0.98	7.10E-06	0.456	0.022
17BDAR	A	64.2	ZN-65	0.98	8.81E-03	565.684	22.720
17BDAR	A	64.2	SE-75	0.99	4.52E-06	0.290	0.019
17BDAR	A	64.2	SB-124	0.77	3.71E-07	0.024	0.003
17BDAR	A	64.2	BA-133	0.41	7.01E-03	450.160	207.542
17BDAR	A	64.2	EU-152x	0.54	6.02E-09	0.000	0.001
17BDAR	A	64.2	HF-175	0.89	9.17E-06	0.589	0.187
17BDAR	A	64.2	HG-203	0.98	2.55E-06	0.164	0.121
6025ES	B	69.7	CO-60	0.97	3.81E-06	0.266	0.015
6025ES	B	69.7	ZN-65	0.98	9.26E-03	645.407	25.893
6025ES	B	69.7	SB-124	0.77	3.90E-07	0.027	0.003
6025ES	B	69.7	BA-133	0.41	9.05E-03	630.476	216.889
6025ES	B	69.7	EU-152x	0.41	1.31E-07	0.009	0.001
6025ES	B	69.7	HF-175	0.89	1.52E-06	0.106	0.191
ADJ145	A	76.8	CO-60	0.99	1.88E-06	0.144	0.011
ADJ145	A	76.8	ZN-65	0.99	8.31E-03	638.089	25.597
ADJ145	A	76.8	RU-103	0.81	6.28E-06	0.482	0.132
ADJ145	A	76.8	SB-124	0.77	2.37E-07	0.018	0.003
ADJ145	A	76.8	BA-133	0.41	5.08E-03	390.443	220.557
ADJ145	A	76.8	EU-154	0.31	2.51E-07	0.019	0.003
ADJ145	A	76.8	HF-181	0.74	7.73E-07	0.059	0.013
ADJ145	B	77.7	CO-60	0.97	2.95E-06	0.229	0.014
ADJ145	B	77.7	ZN-65	0.99	8.86E-03	688.277	27.587
ADJ145	B	77.7	RU-103	0.76	7.41E-06	0.576	0.134
ADJ145	B	77.7	BA-133	0.41	9.44E-03	733.707	224.792
ADJ145	B	77.7	EU-152x	0.41	1.31E-07	0.010	0.001
ADJ145	B	77.7	HF-175	0.99	1.30E-06	0.101	0.197

ADJ145	B	77.7	HF-181	0.73	4.19E-07	0.033	0.013
FDRT75	B	72.5	CO-60	0.99	2.82E-06	0.204	0.013
FDRT75	B	72.5	ZN-65	0.99	8.62E-03	624.907	25.070
FDRT75	B	72.5	SB-124	0.78	4.65E-07	0.034	0.003
FDRT75	B	72.5	BA-133	0.41	5.57E-03	404.003	219.044
FDRT75	B	72.5	EU-152x	0.53	1.23E-07	0.009	0.001
FDRT75	B	72.5	HF-175	0.94	9.94E-06	0.721	0.183
FDRT75	B	72.5	HF-181	0.74	7.74E-07	0.056	0.011
G8UX4V	B	99.7	CO-60	0.97	1.86E-06	0.186	0.012
G8UX4V	B	99.7	ZN-65	0.98	6.56E-03	653.689	26.191
G8UX4V	B	99.7	SB-124	0.77	2.43E-07	0.024	0.003
G8UX4V	B	99.7	BA-133	0.41	6.78E-03	676.083	220.993
G8UX4V	B	99.7	EU-152x	0.40	9.61E-08	0.010	0.001
G8UX4V	B	99.7	HF-175	0.98	1.85E-06	0.184	0.193
LM6524	A	71.4	CO-60	0.98	3.80E-06	0.271	0.015
LM6524	A	71.4	ZN-65	0.98	8.02E-03	572.880	22.990
LM6524	A	71.4	SB-124	0.45	3.34E-07	0.024	0.005
LM6524	A	71.4	BA-133	0.41	5.64E-03	402.401	203.605
LM6524	A	71.4	EU-152x	0.42	1.18E-07	0.008	0.001
LM6524	A	71.4	HF-175	0.92	5.64E-06	0.403	0.184
LM6524	A	71.4	HF-181	0.74	1.04E-06	0.074	0.012
M6AAM6	B	68.3	CO-60	0.98	2.33E-06	0.159	0.012
M6AAM6	B	68.3	ZN-65	0.98	9.27E-03	633.283	25.412
M6AAM6	B	68.3	SB-124	0.77	4.31E-07	0.029	0.003
M6AAM6	B	68.3	BA-133	0.41	6.61E-03	451.183	216.008
M6AAM6	B	68.3	HF-181	0.74	8.35E-07	0.057	0.013
77G4CJ	B	84.4	CO-60	1.00	2.37E-06	0.200	0.013
77G4CJ	B	84.4	ZN-65	1.00	7.16E-03	604.277	24.267
77G4CJ	B	84.4	SB-124	0.77	2.87E-07	0.024	0.003
77G4CJ	B	84.4	BA-133	0.41	3.14E-03	264.937	204.320
2965CL	A	100.1	CO-60	0.99	4.35E-06	0.435	0.022
2965CL	A	100.1	ZN-65	0.99	6.48E-03	648.292	26.005
2965CL	A	100.1	SB-124	0.77	1.13E-06	0.113	0.006
2965CL	A	100.1	BA-133	0.40	8.60E-03	860.536	226.670
2965CL	A	100.1	EU-152x	0.55	9.53E-08	0.010	0.001
2965CL	A	100.1	HF-175	0.87	8.64E-06	0.865	0.215
2965CL	A	100.1	HF-181	0.74	9.42E-07	0.094	0.014
6025ES	A	69.4	CO-60	1.00	3.43E-06	0.238	0.014
6025ES	A	69.4	ZN-65	1.00	7.75E-03	537.702	21.622
6025ES	A	69.4	SB-124	0.45	3.11E-07	0.022	0.005
6025ES	A	69.4	BA-133	0.41	4.38E-03	304.241	204.873
DAW454	B	84.6	CO-60	1.00	3.92E-06	0.332	0.018
DAW454	B	84.6	ZN-65	1.00	7.95E-03	672.705	26.996
DAW454	B	84.6	SB-124	0.77	3.25E-07	0.027	0.003
DAW454	B	84.6	BA-133	0.41	4.47E-03	378.236	223.534
DAW454	B	84.6	EU-154	0.30	2.39E-07	0.020	0.003
DAW454	B	84.6	HF-181	0.74	8.64E-07	0.073	0.014
DR87FE	A	94.8	CO-60	1.00	3.18E-06	0.302	0.017
DR87FE	A	94.8	ZN-65	1.00	7.90E-03	748.553	30.018
DR87FE	A	94.8	SB-124	0.77	2.80E-07	0.027	0.003

DR87FE	A	94.8	BA-133	0.41	9.96E-03	943.971	235.936
DR87FE	A	94.8	EU-152x	0.40	8.80E-08	0.008	0.001
DR87FE	A	94.8	HF-175	0.86	7.27E-06	0.689	0.218
FWX130	B	90.4	CO-60	1.00	2.88E-06	0.260	0.015
FWX130	B	90.4	ZN-65	1.00	8.38E-03	757.334	30.373
FWX130	B	90.4	SB-124	0.76	3.09E-07	0.028	0.003
FWX130	B	90.4	BA-133	0.41	7.97E-03	720.865	236.363
FWX130	B	90.4	EU-152x	0.55	1.10E-07	0.010	0.001
FWX130	B	90.4	HF-175	0.87	3.47E-06	0.314	0.219
FWX130	B	90.4	HF-181	0.74	1.06E-06	0.096	0.015
GO9JVE	B	85	CO-60	1.00	5.57E-06	0.473	0.023
GO9JVE	B	85	ZN-65	1.00	6.90E-03	586.094	23.543
GO9JVE	B	85	SB-124	0.77	4.42E-07	0.038	0.004
GO9JVE	B	85	BA-133	0.41	4.45E-04	37.808	223.062
GO9JVE	B	85	HF-181	0.74	8.06E-07	0.068	0.013
M6AAM6	A	83	CO-60	1.00	3.18E-06	0.264	0.015
M6AAM6	A	83	ZN-65	1.00	9.10E-03	755.592	30.303
M6AAM6	A	83	SB-124	0.77	5.31E-07	0.044	0.004
M6AAM6	A	83	BA-133	0.41	1.09E-02	901.626	226.951
M6AAM6	A	83	EU-154	0.31	2.42E-07	0.020	0.003
M6AAM6	A	83	HF-181	0.74	1.20E-06	0.099	0.015
WAQE67	B	93.7	CO-60	0.99	3.49E-06	0.327	0.018
WAQE67	B	93.7	ZN-65	1.00	8.40E-03	787.409	31.571
WAQE67	B	93.7	SB-124	0.75	3.80E-07	0.036	0.003
WAQE67	B	93.7	BA-133	0.41	8.13E-03	761.522	233.566
WAQE67	B	93.7	EU-152x	0.54	9.24E-08	0.009	0.001
WAQE67	B	93.7	HF-175	0.91	9.38E-06	0.879	0.225
WAQE67	B	93.7	HF-181	0.74	8.21E-07	0.077	0.014
WR2F6B	A	65.5	CO-60	0.99	2.59E-06	0.170	0.012
WR2F6B	A	65.5	ZN-65	1.00	7.65E-03	501.279	20.174
WR2F6B	A	65.5	SB-124	0.77	4.51E-07	0.030	0.003
WR2F6B	A	65.5	BA-133	0.41	4.27E-03	279.863	199.575
WR2F6B	A	65.5	EU-154	0.31	2.53E-07	0.017	0.002
WR2F6B	A	65.5	HF-181	0.74	1.90E-06	0.125	0.014
WR2F6B	B	49.1	CO-60	0.99	3.82E-06	0.187	0.012
WR2F6B	B	49.1	ZN-65	1.00	7.83E-03	384.280	15.531
WR2F6B	B	49.1	SB-124	0.77	5.49E-07	0.027	0.003
WR2F6B	B	49.1	HF-175	0.93	1.64E-05	0.804	0.165
WR2F6B	B	49.1	HF-181	0.74	1.67E-06	0.082	0.012
DM3452216	B	100.7	CO-60	0.98	1.30E-06	0.130	0.010
DM3452216	B	100.7	ZN-65	0.99	4.98E-03	501.326	20.153
DM3452216	B	100.7	BA-133	0.41	5.59E-03	563.011	184.487
7Y536N	B	92.9	CO-60	0.99	3.47E-06	0.322	0.017
7Y536N	B	92.9	ZN-65	0.99	7.06E-03	656.135	26.349
7Y536N	B	92.9	SB-124	0.76	3.02E-07	0.028	0.003
7Y536N	B	92.9	BA-133	0.40	5.61E-03	520.822	208.032
7Y536N	B	92.9	EU-152x	0.42	7.40E-08	0.007	0.001
7Y536N	B	92.9	HF-181	0.74	6.88E-07	0.064	0.016
46NKJF	A	98.7	CO-60	0.98	1.73E-06	0.171	0.012
46NKJF	A	98.7	ZN-65	0.99	4.12E-03	407.058	16.396

46NKJF	A	98.7	SB-124	0.44	1.13E-07	0.011	0.005
46NKJF	A	98.7	BA-133	0.41	6.61E-03	652.094	86.803
29750	A	78	SC-46	0.95	3.19E-06	0.249	0.014
29750	A	78	CO-60	0.98	2.77E-06	0.216	0.013
29750	A	78	ZN-65	0.99	6.59E-03	514.075	20.690
29750	A	78	SB-124	0.76	4.69E-07	0.037	0.004
29750	A	78	BA-133	0.41	3.19E-03	248.541	200.927
29750	A	78	EU-152x	0.43	7.38E-08	0.006	0.001
29750	A	78	HF-175	0.89	7.39E-06	0.577	0.207
30103	A	83.2	SC-46	0.95	2.52E-06	0.210	0.012
30103	A	83.2	CO-60	0.98	1.04E-06	0.087	0.008
30103	A	83.2	ZN-65	0.99	4.89E-03	406.905	16.410
30103	A	83.2	SB-124	0.76	3.20E-07	0.027	0.003
30103	A	83.2	BA-133	0.41	6.22E-03	517.711	82.835
30124	A	63.5	SC-46	0.94	3.65E-06	0.232	0.013
30124	A	63.5	CO-60	1.00	1.96E-06	0.125	0.010
30124	A	63.5	ZN-65	1.00	7.16E-03	454.625	18.325
30124	A	63.5	SB-124	0.77	4.05E-07	0.026	0.004
30124	A	63.5	BA-133	0.41	3.48E-03	220.985	191.662
30334	B	57.6	CO-60	0.99	2.88E-06	0.166	0.012
30334	B	57.6	ZN-65	0.99	8.08E-03	465.486	18.773
30334	B	57.6	SB-124	0.77	3.68E-07	0.021	0.003
30334	B	57.6	BA-133	0.41	9.77E-03	562.510	179.325
30334	B	57.6	HF-181	0.74	1.33E-06	0.077	0.015
5100224	B	55	CO-60	0.99	1.12E-05	0.616	0.029
5100224	B	55	ZN-65	0.99	8.52E-03	468.454	18.903
5100224	B	55	SB-124	0.87	3.41E-06	0.187	0.009
5100224	B	55	BA-133	0.41	5.26E-03	289.486	199.312
5100224	B	55	CE-141	0.93	4.69E-05	2.581	0.412
5100224	B	55	EU-152x	0.54	1.32E-07	0.007	0.001
5100224	B	55	HF-175	0.91	9.68E-06	0.532	0.217
5100224	B	55	HF-181	0.74	2.27E-06	0.125	0.016
5100242	A	49	CO-60	0.99	9.09E-06	0.445	0.022
5100242	A	49	ZN-65	0.99	7.14E-03	349.935	14.164
5100242	A	49	SB-124	0.87	2.89E-06	0.141	0.007
5100242	A	49	CE-141	0.93	2.84E-05	1.392	0.368
5100242	A	49	EU-152x	0.42	1.16E-07	0.006	0.001
5100242	A	49	HF-175	0.93	1.30E-05	0.637	0.189
5100242	A	49	HF-181	0.74	1.02E-06	0.050	0.014
A3873H	A	90.8	CO-60	0.98	2.77E-06	0.252	0.015
A3873H	A	90.8	ZN-65	0.99	5.77E-03	523.860	21.070
A3873H	A	90.8	SB-124	0.76	7.48E-07	0.068	0.005
A3873H	A	90.8	EU-152x	0.42	4.80E-08	0.004	0.001
A3873H	A	90.8	HF-175	0.94	9.14E-06	0.830	0.212
A3873H	A	90.8	HF-181	0.74	7.10E-07	0.064	0.016
AA61L3	A	87.6	CO-60	1.00	3.06E-06	0.268	0.015
AA61L3	A	87.6	ZN-65	1.00	8.20E-03	718.239	28.825
AA61L3	A	87.6	BA-133	0.41	6.09E-03	533.200	214.875
AA61L3	A	87.6	HF-181	0.74	8.33E-07	0.073	0.018
DM3452216-0029	A	102	CO-60	1.00	1.13E-06	0.116	0.010

DM3452216-0029	A	102	ZN-65	1.00	3.92E-03	399.645	16.092
DM3452216	A	102	EU-152x	0.43	4.65E-08	0.005	0.001
DM3452216	A	102	HF-175	0.87	2.58E-06	0.263	0.187
E63JVE	B	74.3	CO-60	1.00	3.67E-06	0.273	0.015
E63JVE	B	74.3	ZN-65	1.00	8.60E-03	639.070	25.684
E63JVE	B	74.3	SB-124	0.44	3.73E-07	0.028	0.006
E63JVE	B	74.3	BA-133	0.41	7.20E-03	535.156	207.536
E63JVE	B	74.3	EU-152x	0.55	8.34E-08	0.006	0.001
E63JVE	B	74.3	HF-175	0.90	6.08E-06	0.452	0.224
E63JVE	B	74.3	HF-181	0.73	6.94E-07	0.052	0.017
HFU84F	B	97.7	CO-60	0.99	3.31E-06	0.323	0.017
HFU84F	B	97.7	ZN-65	0.99	7.49E-03	731.529	29.352
HFU84F	B	97.7	SB-124	0.76	2.98E-07	0.029	0.004
HFU84F	B	97.7	BA-133	0.41	8.82E-03	861.320	226.975
HFU84F	B	97.7	HF-181	0.74	8.46E-07	0.083	0.016
HFU84F	A	106	CO-60	1.00	2.05E-06	0.217	0.013
HFU84F	A	106	ZN-65	1.00	3.87E-03	410.309	16.521
HFU84F	A	106	SB-124	0.42	1.81E-07	0.019	0.005
J9GFE37	A	78.3	CO-60	0.99	3.17E-06	0.248	0.015
J9GFE37	A	78.3	ZN-65	0.99	8.26E-03	646.461	25.965
J9GFE37	A	78.3	BA-133	0.41	7.57E-03	592.524	205.572
J9GFE37	A	78.3	HF-175	0.87	1.28E-05	1.003	0.223
HIDE4H	B	94.1	CO-60	0.99	3.12E-06	0.293	0.016
HIDE4H	B	94.1	ZN-65	1.00	7.42E-03	698.112	28.018
HIDE4H	B	94.1	BA-133	0.40	9.20E-03	865.882	213.693
I89VFS	A	69.6	CO-60	0.99	1.44E-06	0.100	0.009
I89VFS	A	69.6	ZN-65	0.99	5.52E-03	384.417	15.503
I89VFS	A	69.6	HF-175	0.91	4.84E-06	0.337	0.173
I89VFS	B	71.9	CO-60	0.99	1.60E-06	0.115	0.010
I89VFS	B	71.9	ZN-65	0.99	5.36E-03	385.028	15.532
I89VFS	B	71.9	SB-124	0.44	2.14E-07	0.015	0.005
I89VFS	B	71.9	BA-133	0.41	1.87E-03	134.272	164.940
KK3050200	A	102.1	CO-60	0.99	1.82E-06	0.185	0.012
KK3050200	A	102.1	ZN-65	0.99	5.85E-03	597.647	24.007
KK3050200	A	102.1	SB-124	0.77	2.73E-07	0.028	0.004
KK3050200	A	102.1	BA-133	0.41	3.35E-03	341.736	199.451
KK3050200	A	102.1	EU-152x	0.42	5.49E-08	0.006	0.001
KK3050200	A	102.1	HF-175	0.93	5.53E-06	0.564	0.211
MH64SL	A	87.2	CO-60	0.97	1.27E-06	0.111	0.010
MH64SL	A	87.2	ZN-65	0.99	4.76E-03	414.880	16.713
MH64SL	A	87.2	SB-124	0.44	3.68E-07	0.032	0.005
WBH964	A	96	CO-60	0.99	2.31E-06	0.221	0.014
WBH964	A	96	ZN-65	0.99	8.07E-03	774.443	31.063
WBH964	A	96	SB-124	0.43	3.91E-07	0.038	0.007
WBH964	A	96	BA-133	0.41	5.08E-03	487.881	232.549
WBH964	A	96	EU-152x	0.55	7.44E-08	0.007	0.001
WBH964	A	96	HF-175	0.88	3.01E-06	0.289	0.239
WBH964	A	96	HF-181	0.74	5.57E-07	0.053	0.018
A3875H	A	110.9	CO-60	0.99	2.30E-06	0.256	0.015
A3875H	A	110.9	ZN-65	0.99	5.88E-03	652.226	26.199

A3875H	A	110.9	SB-124	0.76	2.96E-07	0.033	0.004
A3875H	A	110.9	BA-133	0.41	8.11E-03	899.923	206.314
A3875H	A	110.9	EU-152x	0.55	6.22E-08	0.007	0.001
A3875H	A	110.9	HF-175	0.84	7.62E-06	0.845	0.241
A3875H	A	110.9	HF-181	0.72	1.01E-06	0.112	0.020
AB0469658	A	50.1	CO-60	1.00	8.13E-06	0.408	0.021
AB0469658	A	50.1	ZN-65	0.99	6.68E-03	334.664	13.559
AB0469658	A	50.1	SB-124	0.44	6.30E-07	0.032	0.005
AB0469658	A	50.1	EU-152x	0.55	1.52E-07	0.008	0.001
AB0469658	A	50.1	HF-175	0.94	1.23E-05	0.615	0.190
AB0469658	A	50.1	HF-181	0.73	2.55E-06	0.128	0.016
CP163W	B	88.9	CO-60	0.99	1.79E-06	0.159	0.011
CP163W	B	88.9	ZN-65	0.99	6.08E-03	540.168	21.726
CP163W	B	88.9	EU-152x	0.42	4.10E-08	0.004	0.001
CP163W	B	88.9	HF-175	0.91	6.28E-06	0.558	0.211
F1JH39	B	78.4	CO-60	0.99	2.76E-06	0.216	0.014
F1JH39	B	78.4	ZN-65	0.99	7.13E-03	559.264	22.506
F1JH39	B	78.4	SE-75	0.75	1.60E-06	0.125	0.016
F1JH39	B	78.4	SB-124	0.75	4.05E-07	0.032	0.003
F1JH39	B	78.4	BA-133	0.41	5.57E-03	436.796	185.193
115754	B	94.3	CO-60	0.99	2.86E-06	0.269	0.016
115754	B	94.3	ZN-65	0.99	7.81E-03	736.352	29.562
115754	B	94.3	BA-133	0.41	5.86E-03	552.410	210.554
115754	B	94.3	HF-181	0.73	1.03E-06	0.098	0.019
A38098	A	68.9	CO-60	0.99	4.31E-06	0.297	0.016
A38098	A	68.9	ZN-65	0.99	5.37E-03	369.876	14.932
A38098	A	68.9	SB-124	0.76	4.67E-07	0.032	0.003
J9GFE37	B	97	CO-60	1.00	3.36E-06	0.326	0.018
J9GFE37	B	97	ZN-65	1.00	7.83E-03	759.951	30.498
J9GFE37	B	97	SB-124	0.76	3.65E-07	0.035	0.004
J9GFE37	B	97	BA-133	0.41	6.73E-03	652.415	212.721
J9GFE37	B	97	EU-152x	0.42	5.66E-08	0.005	0.001
J9GFE37	B	97	HF-175	0.96	9.54E-06	0.925	0.263
J9GFE37	B	97	HF-181	0.73	1.06E-06	0.103	0.020
822589HC	A	64.9	CO-60	0.99	1.87E-06	0.121	0.010
822589HC	A	64.9	ZN-65	0.99	6.69E-03	434.410	17.530
822589HC	A	64.9	SB-124	0.75	9.63E-07	0.062	0.005
A22623HC	A	73.6	CO-60	0.99	2.99E-06	0.220	0.014
A22623HC	A	73.6	ZN-65	0.99	6.43E-03	472.990	19.062
A22623HC	A	73.6	SB-124	0.76	9.46E-07	0.070	0.005
A22623HC	A	73.6	HF-181	0.74	1.04E-06	0.076	0.017
IUY3T4	A	83.3	CO-60	1.00	2.17E-06	0.181	0.012
IUY3T4	A	83.3	ZN-65	0.99	6.13E-03	510.624	20.551
IUY3T4	A	83.3	SB-124	0.75	4.14E-07	0.034	0.004
IUY3T4	A	83.3	BA-133	0.41	3.78E-03	315.193	181.104
IUY3T4	A	83.3	EU-152x	0.43	8.32E-08	0.007	0.001
IUY3T4	A	83.3	HF-175	0.92	4.11E-06	0.342	0.219
KK3050200	B	77.1	CO-60	1.00	1.25E-06	0.096	0.009
KK3050200	B	77.1	ZN-65	0.99	5.10E-03	393.408	15.874
KK3050200	B	77.1	SB-124	0.75	2.29E-07	0.018	0.003

KK3050200-0026	B	77.1	BA-133	0.41	6.01E-03	463.705	165.417
A3875H	B	124	CO-60	0.99	1.67E-06	0.207	0.013
A3875H	B	124	ZN-65	0.99	5.26E-03	651.879	26.177
A3875H	B	124	SB-124	0.76	2.55E-07	0.032	0.004
A3875H	B	124	BA-133	0.41	6.52E-03	808.317	203.538
A3875H	B	124	EU-152x	0.55	5.37E-08	0.007	0.001
A3875H	B	124	HF-181	0.73	9.60E-07	0.119	0.019
MH64SL	B	107	CO-60	0.99	9.36E-07	0.100	0.009
MH64SL	B	107	ZN-65	0.99	3.03E-03	324.410	13.094
MH64SL	B	107	SB-124	0.44	1.73E-07	0.018	0.004
MH64SL	B	107	BA-133	0.41	2.49E-03	266.275	147.797
U5D8UN	B	101.3	CO-60	0.99	2.30E-06	0.233	0.014
U5D8UN	B	101.3	ZN-65	0.99	5.65E-03	572.516	23.018
U5D8UN	B	101.3	SB-124	0.76	5.25E-07	0.053	0.004
U5D8UN	B	101.3	EU-152x	0.55	4.98E-08	0.005	0.001
U5D8UN	B	101.3	HF-175	0.90	8.09E-06	0.819	0.225
U5D8UN	B	101.3	HF-181	0.73	1.60E-06	0.162	0.019
25599	B	74.6	SC-46	0.95	3.45E-06	0.257	0.014
25599	B	74.6	CO-60	1.00	1.87E-06	0.140	0.011
25599	B	74.6	ZN-65	0.99	6.96E-03	518.892	20.892
25599	B	74.6	SB-124	0.76	4.73E-07	0.035	0.004
25599	B	74.6	BA-133	0.40	4.39E-03	327.719	183.760
25599	B	74.6	HF-181	0.73	9.15E-07	0.068	0.018
E63JVE	A	73.3	CO-60	1.00	3.64E-06	0.267	0.015
E63JVE	A	73.3	ZN-65	1.00	8.19E-03	600.284	24.151
E63JVE	A	73.3	SB-124	0.76	4.65E-07	0.034	0.004
E63JVE	A	73.3	BA-133	0.42	4.42E-03	324.253	192.360
3Q5J9L	B	82.9	CO-60	0.99	1.96E-06	0.163	0.011
3Q5J9L	B	82.9	ZN-65	1.00	5.04E-03	418.193	16.813
3Q5J9L	B	82.9	SB-124	0.76	3.25E-07	0.027	0.004
3Q5J9L	B	82.9	BA-133	0.40	2.62E-05	2.171	179.916
3Q5J9L	B	82.9	HF-181	0.73	1.22E-06	0.101	0.019
24IKD6	A	105.2	CR-51	0.88	1.02E-04	10.753	2.988
24IKD6	A	105.2	CO-60	0.98	4.10E-06	0.432	0.022
24IKD6	A	105.2	ZN-65	0.99	5.58E-03	587.337	23.544
24IKD6	A	105.2	SB-124	0.76	9.04E-07	0.095	0.006
24IKD6	A	105.2	BA-133	0.39	3.29E-03	346.534	200.063
24IKD6	A	105.2	EU-152x	0.55	6.38E-08	0.007	0.001
24IKD6	A	105.2	HF-175	0.92	9.59E-06	1.009	0.271
24IKD6	A	105.2	HF-181	0.73	9.51E-07	0.100	0.022
8835TV	A	105.5	CO-60	0.99	2.76E-06	0.291	0.016
8835TV	A	105.5	ZN-65	0.99	4.42E-03	466.716	18.736
8835TV	A	105.5	SB-124	0.76	3.56E-07	0.038	0.005
8835TV	A	105.5	BA-133	0.41	2.04E-03	214.798	189.192
8835TV	A	105.5	HF-175	0.88	7.01E-06	0.740	0.238
29599	A	93.8	CO-60	1.00	2.14E-06	0.201	0.013
29599	A	93.8	ZN-65	0.99	7.77E-03	728.930	29.188
29599	A	93.8	SB-124	0.76	5.61E-07	0.053	0.005
29599	A	93.8	BA-133	0.41	6.54E-03	613.488	228.481
29599	A	93.8	EU-152x	0.43	6.86E-08	0.006	0.001

29599	A	93.8	HF-175	0.84	1.02E-05	0.959	0.275
29599	A	93.8	HF-181	0.73	1.23E-06	0.115	0.023
30339	A	71.3	CO-60	0.99	3.69E-06	0.263	0.015
30339	A	71.3	ZN-65	0.99	8.86E-03	631.630	25.337
30339	A	71.3	SB-124	0.44	4.27E-07	0.030	0.007
30339	A	71.3	BA-133	0.41	1.16E-02	829.473	202.425
30339	A	71.3	HF-181	0.73	1.35E-06	0.096	0.020
30343	A	83.8	CO-60	0.97	3.90E-06	0.327	0.017
30343	A	83.8	ZN-65	0.98	8.41E-03	705.021	28.242
30343	A	83.8	SB-124	0.76	5.19E-07	0.044	0.004
30343	A	83.8	BA-133	0.41	6.02E-03	504.437	221.441
30343	A	83.8	EU-152x	0.42	5.98E-08	0.005	0.001
30343	A	83.8	HF-175	0.92	1.24E-05	1.037	0.276
30343	A	83.8	HF-181	0.72	9.67E-07	0.081	0.022
822607HC	B	95.2	CO-60	0.99	5.76E-06	0.549	0.026
822607HC	B	95.2	ZN-65	0.99	7.39E-03	703.368	28.161
822607HC	B	95.2	SB-124	0.77	7.68E-07	0.073	0.005
822607HC	B	95.2	BA-133	0.39	8.76E-03	833.685	215.694
5100224	A	80.3	CO-60	0.98	8.34E-06	0.669	0.031
5100224	A	80.3	ZN-65	0.98	6.76E-03	542.434	21.771
5100224	A	80.3	SB-124	0.75	2.55E-06	0.205	0.010
5100224	A	80.3	BA-133	0.41	4.46E-03	357.885	196.688
5100224	A	80.3	CE-141	0.91	3.75E-05	3.009	0.600
5100224	A	80.3	EU-152x	0.55	1.23E-07	0.010	0.001
5100224	A	80.3	HF-181	0.73	1.07E-06	0.086	0.022
A3809H	B	58.5	CO-60	0.99	2.46E-06	0.144	0.011
A3809H	B	58.5	ZN-65	0.99	5.03E-03	294.163	11.888
A3873H	B	107	CO-60	0.99	2.16E-06	0.231	0.014
A3873H	B	107	ZN-65	0.99	3.74E-03	400.593	16.098
A3873H	B	107	SB-124	0.76	4.28E-07	0.046	0.004
A3873H	B	107	BA-133	0.39	3.71E-03	397.216	170.425
A22609HC	A	91.1	CO-60	0.99	3.05E-06	0.278	0.016
A22609HC	A	91.1	ZN-65	0.99	4.57E-03	416.697	16.745
A22609HC	A	91.1	SB-124	0.76	5.76E-07	0.052	0.005
A24246HC	B	91.8	CO-60	0.99	5.40E-06	0.496	0.024
A24246HC	B	91.8	ZN-65	0.99	5.83E-03	535.194	21.465
A24246HC	B	91.8	SB-124	0.76	7.53E-07	0.069	0.005
A24246HC	B	91.8	BA-133	0.41	8.95E-03	821.779	188.866
A24246HC	B	91.8	EU-152x	0.54	5.58E-08	0.005	0.001
A24246HC	B	91.8	HF-175	0.97	5.55E-06	0.510	0.240
HFD9LM	A	104.3	CO-60	0.99	1.93E-06	0.201	0.012
HFD9LM	A	104.3	ZN-65	0.98	5.24E-03	546.973	21.928
HFD9LM	A	104.3	SB-124	0.76	4.86E-07	0.051	0.004
HFD9LM	A	104.3	BA-133	0.41	3.51E-03	365.908	198.767
HFE9LN	B	91.5	CO-60	0.98	2.36E-06	0.216	0.013
HFE9LN	B	91.5	ZN-65	0.98	4.58E-03	418.672	16.817
HFE9LN	B	91.5	SB-124	0.75	3.54E-07	0.032	0.004
HFE9LN	B	91.5	BA-133	0.41	4.27E-03	390.538	175.653
LR8C66	A	88.9	CO-60	0.99	1.78E-06	0.159	0.012
LR8C66	A	88.9	ZN-65	0.99	6.52E-03	579.773	23.240

LR8C66	A	88.9	BA-133	0.41	6.89E-03	612.788	194.166
K76GHR	B	88.2	CO-60	0.98	3.15E-06	0.278	0.015
K76GHR	B	88.2	ZN-65	0.99	6.67E-03	588.185	23.586
K76GHR	B	88.2	SB-124	0.76	6.03E-07	0.053	0.005
K76GHR	B	88.2	BA-133	0.41	8.05E-03	709.637	197.439
K76GHR	B	88.2	HF-175	0.90	1.06E-05	0.938	0.242
K76GHR	B	88.2	HF-181	0.72	1.28E-06	0.113	0.021
29606	A	110.2	CO-60	0.99	1.97E-06	0.217	0.014
29606	A	110.2	ZN-65	0.99	7.19E-03	792.025	31.693
29606	A	110.2	SB-124	0.76	4.12E-07	0.045	0.005
29606	A	110.2	BA-133	0.41	7.12E-03	784.222	227.655
29606	A	110.2	EU-152x	0.55	7.61E-08	0.008	0.001
29606	A	110.2	HF-175	0.89	6.21E-06	0.684	0.284
29606	A	110.2	HF-181	0.73	1.08E-06	0.119	0.023
TJ66HR	B	69.6	CO-60	0.98	2.24E-06	0.156	0.011
TJ66HR	B	69.6	ZN-65	0.99	5.24E-03	364.471	14.670
TJ66HR	B	69.6	SB-124	0.76	3.90E-07	0.027	0.003
TJ66HR	B	69.6	HF-175	0.98	1.23E-05	0.858	0.187
TJ66HR	B	69.6	HF-181	0.73	1.38E-06	0.096	0.016
J6FD6G	B	86	CO-60	0.99	1.62E-06	0.139	0.011
J6FD6G	B	86	ZN-65	0.99	4.36E-03	375.062	15.086
J6FD6G	B	86	SB-124	0.76	1.80E-06	0.155	0.008
J6FD6G	B	86	BA-133	0.40	6.52E-03	560.892	165.063
J6FD6G	B	86	CE-141	0.92	1.63E-05	1.405	0.512
J6FD6G	B	86	EU-152x	0.55	1.04E-07	0.009	0.001
J6FD6G	B	86	HF-175	0.89	9.17E-06	0.788	0.218
J6FD6G	B	86	HF-181	0.73	8.67E-07	0.075	0.018
VDSA46	B	95.9	CO-60	0.98	1.63E-06	0.157	0.011
VDSA46	B	95.9	ZN-65	0.99	6.59E-03	632.034	25.322
VDSA46	B	95.9	SB-124	0.76	3.66E-07	0.035	0.004
VDSA46	B	95.9	BA-133	0.41	7.86E-03	754.251	198.852
76H325	B	95.3	CO-60	0.93	1.34E-06	0.128	0.010
76H325	B	95.3	ZN-65	0.95	5.79E-03	551.644	22.167
76H325	B	95.3	BA-133	0.40	7.58E-03	721.990	193.934
76H325	B	95.3	EU-152x	0.42	5.46E-08	0.005	0.001
76H325	B	95.3	HF-175	0.92	3.64E-06	0.347	0.227
27571	B	121.2	CO-60	0.93	3.72E-06	0.451	0.022
27571	B	121.2	ZN-65	0.95	6.37E-03	772.630	30.983
27571	B	121.2	SB-124	0.73	6.52E-07	0.079	0.007
27571	B	121.2	BA-133	0.41	7.57E-03	917.546	239.536
27571	B	121.2	EU-152x	0.54	7.16E-08	0.009	0.001
27571	B	121.2	HF-181	0.72	8.60E-07	0.104	0.024
A3740H	A	87.6	CO-60	0.95	2.47E-06	0.217	0.014
A3740H	A	87.6	ZN-65	0.97	6.30E-03	551.768	22.180
A3740H	A	87.6	SB-124	0.44	5.34E-07	0.047	0.008
A3740H	A	87.6	EU-152x	0.42	5.69E-08	0.005	0.001
A3740H	A	87.6	HF-175	0.84	3.52E-06	0.308	0.271
A3740H	A	87.6	HF-181	0.72	1.16E-06	0.102	0.023
CR8C66	B	95.6	CO-60	0.95	2.16E-06	0.207	0.013
CR8C66	B	95.6	ZN-65	0.95	6.68E-03	638.268	25.631

CR8C66	B	95.6	SB-124	0.44	3.61E-07	0.035	0.008
CR8C66	B	95.6	BA-133	0.41	6.24E-03	596.415	208.483
CR8C66	B	95.6	EU-152x	0.42	4.05E-08	0.004	0.001
CR8C66	B	95.6	HF-175	0.91	4.52E-06	0.432	0.284
3Q5J9L	A	104	CO-60	0.99	1.94E-06	0.202	0.013
3Q5J9L	A	104	ZN-65	0.99	4.39E-03	456.064	18.359
3Q5J9L	A	104	SB-124	0.74	3.86E-07	0.040	0.005
3Q5J9L	A	104	BA-133	0.41	1.85E-03	192.642	176.747
7Y536NA	A	101.4	CO-60	0.99	3.27E-06	0.331	0.017
7Y536NA	A	101.4	ZN-65	0.99	8.17E-03	828.480	33.227
7Y536NA	A	101.4	SB-124	0.43	5.89E-07	0.060	0.012
7Y536NA	A	101.4	BA-133	0.41	8.99E-03	911.141	228.801
75G8FW	A	78.1	CO-60	1.00	3.55E-06	0.277	0.016
75G8FW	A	78.1	ZN-65	1.00	9.53E-03	744.411	29.892
75G8FW	A	78.1	SE-75	0.98	4.74E-06	0.370	0.028
75G8FW	A	78.1	BA-133	0.41	7.76E-03	605.970	217.087
75G8FW	A	78.1	EU-152x	0.42	4.12E-08	0.003	0.001
75G8FW	A	78.1	HF-175	0.85	1.58E-05	1.234	0.368
75G8FW	A	78.1	HG-203	0.90	1.19E-05	0.926	0.333
75G8FW	B	74.5	CO-60	0.99	5.48E-06	0.408	0.021
75G8FW	B	74.5	ZN-65	0.99	9.48E-03	706.005	28.368
75G8FW	B	74.5	BA-133	0.41	4.80E-03	357.229	211.751
75G8FW	B	74.5	EU-152x	0.42	8.64E-08	0.006	0.001
75G8FW	B	74.5	HF-175	0.91	1.05E-05	0.782	0.368
8835TV	B	93.8	CO-60	0.99	4.77E-06	0.447	0.022
8835TV	B	93.8	ZN-65	0.99	7.41E-03	695.393	27.919
8835TV	B	93.8	SB-124	0.74	9.07E-07	0.085	0.008
8835TV	B	93.8	BA-133	0.41	3.79E-03	355.521	212.702
8835TV	B	93.8	EU-152x	0.54	6.74E-08	0.006	0.001
8835TV	B	93.8	HF-175	0.90	1.21E-05	1.139	0.367
28958	B	89.9	CO-60	0.99	3.29E-06	0.296	0.016
28958	B	89.9	ZN-65	0.98	7.47E-03	671.763	26.981
28958	B	89.9	SB-124	0.74	8.79E-07	0.079	0.007
28958	B	89.9	BA-133	0.40	1.13E-02	1014.960	210.278
28958	B	89.9	EU-152x	0.43	5.89E-08	0.005	0.001
30103	B	92.1	CO-60	0.99	1.35E-06	0.124	0.009
30103	B	92.1	ZN-65	0.99	4.34E-03	399.608	16.111
30103	B	92.1	BA-133	0.41	8.30E-03	764.877	89.141
30343	B	74.2	CO-60	1.00	3.72E-06	0.276	0.016
30343	B	74.2	ZN-65	1.00	7.99E-03	593.060	23.856
30343	B	74.2	SB-124	0.75	5.90E-07	0.044	0.005
30343	B	74.2	BA-133	0.40	7.33E-03	543.932	194.874
A3740H	B	76.6	CO-60	0.97	2.79E-06	0.214	0.013
A3740H	B	76.6	ZN-65	0.98	7.16E-03	548.301	22.063
A3740H	B	76.6	SB-124	0.44	8.10E-07	0.062	0.010
A3740H	B	76.6	BA-133	0.41	9.34E-03	715.197	192.777
A3740H	B	76.6	EU-152x	0.54	7.74E-08	0.006	0.001
A3807H	A	70.7	CO-60	0.99	3.32E-06	0.235	0.014
A3807H	A	70.7	ZN-65	0.99	7.51E-03	531.206	21.385
A3807H	A	70.7	SB-124	0.44	6.87E-07	0.049	0.010

A3807H	A	70.7	BA-133	0.40	6.90E-03	487.708	196.484
A22609HC	B	81.2	CO-60	0.99	3.68E-06	0.299	0.017
A22609HC	B	81.2	ZN-65	0.99	3.98E-03	322.907	13.050
A22609HC	B	81.2	SB-124	0.75	7.69E-07	0.062	0.006
A24233HC	B	113.4	CO-60	0.99	1.49E-06	0.170	0.013
A24233HC	B	113.4	ZN-65	1.00	5.30E-03	601.477	24.164
A24233HC	B	113.4	SB-124	0.78	3.58E-06	0.406	0.019
A24233HC	B	113.4	BA-133	0.39	4.12E-03	467.424	206.636
A24233HC	B	113.4	EU-152x	0.42	5.05E-08	0.006	0.001
A242233HC	A	118.7	CO-60	0.98	1.77E-06	0.210	0.013
A242233HC	A	118.7	ZN-65	0.99	6.00E-03	712.309	28.579
A242233HC	A	118.7	SB-124	0.75	6.07E-07	0.072	0.007
A242233HC	A	118.7	BA-133	0.41	5.32E-03	631.745	211.528
AA61L3	B	87.6	CO-60	0.98	3.12E-06	0.274	0.015
AA61L3	B	87.6	ZN-65	0.99	7.45E-03	652.234	26.204
AA61L3	B	87.6	BA-133	0.41	1.16E-02	1020.007	107.598
ABD469658	A	66.4	CO-60	0.98	6.79E-06	0.451	0.022
ABD469658	A	66.4	ZN-65	0.99	5.39E-03	357.872	14.462
ABD469658	A	66.4	SB-124	0.44	4.31E-07	0.029	0.008
ABD469658	A	66.4	BA-133	0.41	4.92E-03	326.945	165.918
ABD469658	A	66.4	EU-152x	0.55	1.21E-07	0.008	0.001
ABD469658	A	66.4	HF-175	0.88	2.07E-05	1.376	0.302
B322IJ	A	86.8	CO-60	0.97	1.47E-06	0.128	0.010
B322IJ	A	86.8	ZN-65	0.98	6.24E-03	541.960	21.798
B322IJ	A	86.8	SB-124	0.38	3.46E-07	0.030	0.009
B322IJ	B	103.1	CO-60	0.98	1.04E-06	0.107	0.009
B322IJ	B	103.1	ZN-65	0.99	3.41E-03	352.082	14.202
FWX130	A	88.8	CO-60	0.98	3.57E-06	0.317	0.017
FWX130	A	88.8	ZN-65	0.99	7.84E-03	695.805	27.938
FWX130	A	88.8	BA-133	0.41	7.35E-03	652.259	207.365
G8UX4V	A	81.1	CO-60	0.99	2.58E-06	0.209	0.013
G8UX4V	A	81.1	ZN-65	0.99	7.43E-03	602.514	24.221
G8UX4V	A	81.1	BA-133	0.41	8.51E-03	690.468	193.390
G8UX4V	A	81.1	EU-152x	0.54	8.73E-08	0.007	0.001
JGFDGG	A	65.7	CO-60	0.97	1.80E-06	0.118	0.010
JGFDGG	A	65.7	ZN-65	0.99	4.16E-03	273.294	11.075
JGFDGG	A	65.7	SB-124	0.75	1.96E-06	0.129	0.008
JGFDGG	A	65.7	EU-152x	0.55	1.04E-07	0.007	0.001
L6159B	B	69.4	CO-60	0.97	3.19E-06	0.221	0.014
L6159B	B	69.4	ZN-65	0.98	8.53E-03	592.038	23.820
L6159B	B	69.4	BA-133	0.41	4.13E-03	286.614	197.547
L6159B	B	69.4	EU-152x	0.42	5.96E-08	0.004	0.001
L6159B	B	69.4	HF-175	0.93	1.19E-05	0.827	0.340
L6159B	A	68.8	CO-60	0.98	2.68E-06	0.184	0.012
L6159B	A	68.8	ZN-65	0.99	8.65E-03	595.325	23.955
L6159B	A	68.8	BA-133	0.41	9.49E-03	652.772	195.269
LF4EQ2	A	104	CO-60	0.98	3.12E-06	0.324	0.017
LF4EQ2	A	104	ZN-65	0.99	8.11E-03	843.451	33.822
LF4EQ2	A	104	BA-133	0.72	1.30E-02	1357.191	217.254
LF4EQ2	A	104	EU-152x	0.54	8.83E-08	0.009	0.001

LF4EQ2	A	104	HF-175	0.87	8.24E-08	0.009	0.406
LF4EQ2	B	70.7	CO-60	0.99	2.78E-06	0.196	0.013
LF4EQ2	B	70.7	ZN-65	0.99	8.03E-03	568.003	22.863
LF4EQ2	B	70.7	BA-133	0.41	1.21E-02	858.235	188.266
NM81X7	B	73.7	CO-60	0.99	2.94E-06	0.217	0.013
NM81X7	B	73.7	ZN-65	0.99	7.73E-03	569.402	22.907
NM81X7	B	73.7	BA-133	0.41	6.29E-03	463.488	193.048
BHU548	A	93.1	CO-60	0.98	3.81E-06	0.355	0.019
BHU548	A	93.1	ZN-65	0.99	8.62E-03	802.644	32.207
BHU548	A	93.1	SB-124	0.73	6.66E-07	0.062	0.007
BHU548	A	93.1	BA-133	0.41	9.28E-03	863.522	225.536
BHU548	A	93.1	EU-152x	0.54	9.49E-08	0.009	0.001
BHU548	A	93.1	HF-175	0.93	2.16E-06	0.201	0.418
BHU548	B	84.9	CO-60	0.99	5.40E-06	0.459	0.023
BHU548	B	84.9	ZN-65	0.99	7.99E-03	678.080	27.232
BHU548	B	84.9	SB-124	0.76	1.35E-06	0.115	0.008
BHU548	B	84.9	BA-133	0.40	9.91E-03	840.952	206.847
BHU548	B	84.9	EU-152x	0.43	8.20E-08	0.007	0.001
BHU548	B	84.9	HF-175	0.87	1.04E-05	0.884	0.359
YEK752	A	96.4	CO-60	0.98	2.36E-06	0.228	0.014
YEK752	A	96.4	ZN-65	0.99	6.52E-03	628.216	25.237
YEK752	A	96.4	SB-124	0.74	6.55E-07	0.063	0.007
YEK752	A	96.4	BA-133	0.41	6.98E-03	672.913	203.057
YEK752	A	96.4	EU-152x	0.54	5.48E-08	0.005	0.001
YEK752	B	83.9	CO-60	0.99	2.31E-06	0.194	0.012
YEK752	B	83.9	ZN-65	0.99	6.43E-03	539.170	21.690
YEK752	B	83.9	SB-124	0.75	4.61E-07	0.039	0.006
YEK752	B	83.9	BA-133	0.41	9.41E-03	789.298	190.292
YEK752	B	83.9	EU-152x	0.55	6.17E-08	0.005	0.001
YEK752	B	83.9	HF-175	0.86	5.84E-06	0.490	0.326
2UIKD6	B	71.4	CO-60	0.98	5.66E-06	0.404	0.020
2UIKD6	B	71.4	ZN-65	0.99	6.62E-03	472.410	19.036
2UIKD6	B	71.4	SE-75	0.74	1.49E-06	0.106	0.022
2UIKD6	B	71.4	SB-124	0.75	1.43E-06	0.102	0.008
2UIKD6	B	71.4	BA-133	0.41	4.07E-03	290.598	184.580
2UIKD6	B	71.4	EU-152x	0.43	4.01E-08	0.003	0.001
2UIKD6	B	71.4	HF-175	0.84	1.19E-05	0.846	0.319
3067	A	106.5	BA-131	0.89	4.45E-03	474.103	24.827
3067	A	106.5	BA-133	0.75	4.32E-02	4605.261	1203.169
3067	A	106.5	CR-51	0.95	9.85E-05	10.492	1.474
3067	A	106.5	CS-134	0.30	4.70E-07	0.050	0.005
3067	A	106.5	HF-175	0.89	2.28E-05	2.425	0.402
3067	A	106.5	HO-166	0.58	1.44E-05	1.529	1.630
3067	A	106.5	RU-103	0.91	1.40E-04	14.866	0.831
3067	A	106.5	RU-97	0.36	3.22E-03	343.447	219.415
3067	A	106.5	SB-122	0.41	1.19E-05	1.264	0.087
3067	A	106.5	SB-124	0.59	2.22E-06	0.237	0.037
3067	A	106.5	TA-182	0.50	7.84E-08	0.008	0.002
3067	A	106.5	ZR-95	1.00	3.87E-04	41.256	14.529
26701	B	172.6	BA-131	0.86	4.04E-03	697.335	42.068

26701	B	172.6	CE-141	0.99	1.67E-05	2.880	0.482
26701	B	172.6	CR-51	0.89	1.35E-04	23.229	2.340
26701	B	172.6	HF-181	0.67	5.10E-06	0.880	0.052
26701	B	172.6	RU-103	0.91	9.48E-05	16.359	0.922
26701	B	172.6	SB-124	0.44	2.49E-06	0.430	0.029
27055	A	126.8	AS-77	0.41	8.17E+00	1035651.153	169132.711
27055	A	126.8	BA-131	0.98	6.19E-03	784.634	33.294
27055	A	126.8	BA-133	0.55	1.29E-02	1641.560	450.481
27055	A	126.8	CE-141	0.99	3.49E-05	4.430	0.472
27055	A	126.8	CO-60	0.99	8.03E-06	1.018	0.077
27055	A	126.8	CR-51	0.99	9.57E-05	12.131	1.087
27055	A	126.8	HF-175	0.91	8.97E-06	1.138	0.436
27055	A	126.8	HF-181	0.76	6.39E-06	0.810	0.042
27055	A	126.8	HO-166	0.33	1.57E-05	1.994	3.135
27055	A	126.8	LU-177	0.89	9.49E-08	0.012	0.014
27055	A	126.8	RU-97	0.65	9.52E-04	120.769	29.637
27055	A	126.8	SB-122	0.74	2.63E-06	0.334	0.043
27055	A	126.8	SB-124	0.77	2.45E-06	0.311	0.015
27055	A	126.8	SC-46	0.99	3.99E-06	0.506	0.024
27055	A	126.8	TA-182	0.41	2.51E-08	0.003	0.003
27055	A	126.8	TE-123m	0.93	1.70E-05	2.156	0.296
27055	A	126.8	XE-127	0.39	7.14E-06	0.905	4.868
27055	A	126.8	ZN-65	1.00	1.66E-02	2104.151	77.437
27165	B	147	BA-131	0.88	5.08E-03	747.367	38.900
27165	B	147	BA-133	0.37	4.00E-02	5877.963	1589.031
27165	B	147	CE-141	0.94	3.65E-05	5.359	0.475
27165	B	147	CR-51	0.94	2.22E-04	32.633	2.375
27165	B	147	HF-181	0.68	7.61E-06	1.119	0.057
27165	B	147	RU-103	0.99	1.80E-04	26.491	1.304
27165	B	147	RU-97	0.36	7.40E-03	1088.208	421.584
27165	B	147	SB-124	0.57	4.65E-06	0.684	0.036
27165	B	147	TA-182	0.50	2.59E-07	0.038	0.007
27165	B	147	TE-123m	0.92	1.21E-06	0.178	0.143
27420	B	96.8	AS-77	0.71	4.74E-01	45897.209	7209.113
27420	B	96.8	BA-131	0.99	7.43E-03	718.740	27.856
27420	B	96.8	BA-133	0.37	4.96E-02	4797.751	745.750
27420	B	96.8	CE-141	1.00	4.47E-05	4.329	0.284
27420	B	96.8	CO-60	0.99	1.09E-05	1.058	0.094
27420	B	96.8	CR-51	1.00	1.49E-04	14.438	1.349
27420	B	96.8	HF-181	0.89	1.24E-05	1.197	0.080
27420	B	96.8	LU-177	0.98	6.33E-07	0.061	0.015
27420	B	96.8	RB-86	0.99	1.63E-05	1.575	0.258
27420	B	96.8	RU-103	0.83	5.34E-04	51.713	2.366
27420	B	96.8	RU-97	0.79	1.22E-05	1.181	2.452
27420	B	96.8	SB-122	0.89	6.35E-06	0.615	0.029
27420	B	96.8	SB-124	0.87	5.63E-06	0.545	0.027
27420	B	96.8	SC-46	1.00	8.24E-06	0.798	0.040
27420	B	96.8	TE-121	0.67	1.44E-03	139.328	139.103
27420	B	96.8	TE-123m	0.99	4.75E-05	4.597	0.295
27420	B	96.8	ZN-65	1.00	3.79E-02	3670.064	137.363

27659	A	148.8	AS-77	0.42	8.09E+00	1204209.333	190537.927
27659	A	148.8	BA-131	0.98	5.65E-03	840.035	35.370
27659	A	148.8	CR-51	0.99	5.38E-05	8.006	1.380
27659	A	148.8	FE-59	0.95	2.08E-03	309.797	33.594
27659	A	148.8	HF-181	0.75	1.04E-05	1.541	0.069
27659	A	148.8	RB-86	0.98	1.61E-05	2.400	0.495
27659	A	148.8	RU-103	0.81	3.10E-04	46.170	2.123
27659	A	148.8	RU-97	0.68	1.03E-04	15.364	13.274
27659	A	148.8	SB-124	0.77	2.59E-06	0.385	0.024
27659	A	148.8	SC-46	1.00	6.11E-06	0.909	0.045
27659	A	148.8	TE-123m	0.99	1.33E-05	1.983	0.173
27659	A	148.8	ZN-65	1.00	2.82E-02	4193.385	155.909
27660	A	205.8	AS-77	0.46	3.20E+00	657878.878	106795.821
27660	B	189.5	AS-77	0.50	2.25E+00	425705.311	68675.257
27660	A	205.8	BA-131	0.98	3.98E-03	819.062	34.105
27660	B	189.5	BA-131	0.98	4.12E-03	781.186	32.093
27660	B	189.5	BA-133	0.38	2.42E-02	4581.842	2449.323
27660	A	205.8	BA-133m	0.46	2.47E-01	50878.394	16777.180
27660	A	205.8	CE-139	0.91	8.42E-05	17.328	29.092
27660	B	189.5	CE-141	0.99	1.74E-05	3.304	0.344
27660	A	205.8	CE-141	1.00	1.67E-05	3.439	0.361
27660	A	205.8	CO-60	0.98	3.73E-06	0.768	0.036
27660	A	205.8	CR-51	0.97	3.85E-05	7.930	1.329
27660	B	189.5	CR-51	1.00	5.32E-05	10.086	1.286
27660	B	189.5	CS-134	0.79	5.45E-07	0.103	0.010
27660	A	205.8	FE-59	0.98	1.55E-03	318.785	41.788
27660	A	205.8	HF-175	0.98	5.86E-06	1.205	0.519
27660	B	189.5	HF-181	0.75	7.00E-06	1.327	0.060
27660	A	205.8	HF-181	0.75	7.11E-06	1.463	0.065
27660	A	205.8	HG-203	0.98	1.00E-06	0.206	0.080
27660	B	189.5	RB-86	0.93	2.69E-06	0.510	0.174
27660	B	189.5	RU-103	0.82	2.62E-04	49.571	2.233
27660	A	205.8	RU-103	0.83	2.28E-04	46.866	2.146
27660	A	205.8	RU-97	0.69	8.20E-05	16.876	11.037
27660	B	189.5	RU-97	0.71	1.10E-04	20.823	8.819
27660	A	205.8	SB-122	0.71	2.37E-06	0.488	0.080
27660	B	189.5	SB-122	0.78	1.76E-06	0.334	0.063
27660	A	205.8	SB-124	0.85	1.69E-06	0.348	0.022
27660	B	189.5	SB-124	0.86	2.87E-06	0.544	0.024
27660	A	205.8	SC-46	0.99	4.16E-06	0.855	0.043
27660	B	189.5	SC-46	0.99	4.84E-06	0.917	0.048
27660	B	189.5	TA-182	0.57	1.87E-08	0.004	0.001
27660	B	189.5	TE-123m	0.97	1.03E-05	1.960	0.234
27660	A	205.8	TE-123m	1.00	1.04E-05	2.141	0.190
27660	A	205.8	ZN-65	1.00	1.97E-02	4046.562	150.358
27660	B	189.5	ZN-65	1.00	1.90E-02	3601.542	134.002
28240	B	136.6	BA-131	0.85	5.46E-03	745.164	44.245
28240	B	136.6	BA-133	0.60	5.06E-02	6912.319	1371.304
28240	B	136.6	CE-139	0.93	3.09E-04	42.146	24.177
28240	B	136.6	CE-141	0.99	2.36E-05	3.225	0.878

28240	B	136.6	CR-51	0.94	6.62E-05	9.044	1.850
28240	B	136.6	HF-181	0.68	8.13E-06	1.110	0.057
28240	B	136.6	IN-114m	0.82	1.48E-06	0.202	1.046
28240	B	136.6	RU-103	0.99	1.52E-04	20.806	0.935
28240	B	136.6	SB-124	0.47	2.76E-06	0.378	0.028
28240	B	136.6	SN-125x	0.89	1.41E-01	19240.105	61402.107
28240	B	136.6	TE-121	0.66	4.36E-04	59.493	316.097
28297	A	166.2	AS-71	0.86	1.18E-07	0.020	0.147
28297	A	166.2	AS-77	0.67	4.37E-01	72643.753	11624.201
28297	B	120.2	BA-131	0.85	6.78E-03	814.427	48.996
28297	A	166.2	BA-131	0.99	4.61E-03	766.416	29.985
28297	A	166.2	BA-133	0.49	4.26E-02	7072.711	514.420
28297	B	120.2	CE-141	0.96	2.86E-05	3.432	0.523
28297	A	166.2	CE-141	0.98	1.64E-05	2.728	0.338
28297	A	166.2	CO-60	0.99	4.52E-06	0.752	0.072
28297	B	120.2	CR-51	0.86	1.76E-04	21.098	2.409
28297	A	166.2	CR-51	1.00	9.35E-05	15.543	1.466
28297	A	166.2	FE-59	0.98	2.19E-03	364.078	41.090
28297	A	166.2	HF-181	0.75	9.33E-06	1.551	0.069
28297	B	120.2	HF-181	0.76	1.05E-05	1.264	0.062
28297	A	166.2	IN-114m	0.70	1.54E-09	0.000	0.067
28297	A	166.2	RU-103	0.83	3.37E-04	55.985	2.524
28297	B	120.2	RU-103	0.91	1.41E-04	16.895	0.989
28297	A	166.2	RU-97	0.78	1.96E-05	3.263	3.278
28297	A	166.2	SB-122	0.87	2.36E-06	0.392	0.032
28297	A	166.2	SB-124	0.52	2.27E-06	0.377	0.024
28297	B	120.2	SB-124	0.52	2.88E-06	0.346	0.029
28297	A	166.2	SC-46	1.00	1.16E-05	1.928	0.078
28297	B	120.2	TE-123m	0.92	3.47E-07	0.042	0.090
28297	A	166.2	TE-123m	1.00	2.69E-05	4.472	0.301
28297	A	166.2	ZN-65	1.00	2.57E-02	4275.790	158.538
28802	A	163	AG-108m	0.51	7.15E-04	116.525	280.976
28802	B	141.8	AS-77	0.46	4.13E+00	586225.080	115242.719
28802	A	163	BA-131	0.87	5.33E-03	868.224	49.030
28802	B	141.8	BA-131	0.98	6.17E-03	874.807	36.341
28802	B	141.8	CE-139	1.00	2.00E-05	2.830	24.697
28802	A	163	CE-141	0.92	2.43E-05	3.954	0.708
28802	B	141.8	CE-141	0.99	3.04E-05	4.309	0.379
28802	B	141.8	CO-60	0.99	1.01E-05	1.434	0.107
28802	B	141.8	CR-51	0.93	4.64E-05	6.581	1.351
28802	A	163	HF-181	0.67	6.81E-06	1.109	0.059
28802	B	141.8	HF-181	0.75	1.15E-05	1.625	0.071
28802	A	163	HG-203	0.91	4.49E-07	0.073	0.182
28802	B	141.8	LU-177x	0.38	1.21E-07	0.017	0.013
28802	B	141.8	MO-99	0.67	5.58E-05	7.910	6.217
28802	B	141.8	OS-185	0.80	2.14E-05	3.028	2.988
28802	A	163	OS-185	0.81	6.80E-06	1.108	3.019
28802	B	141.8	RU-103	0.83	3.41E-04	48.422	2.231
28802	A	163	RU-103	0.99	1.07E-04	17.371	1.006
28802	B	141.8	RU-97	0.69	1.39E-04	19.733	11.344

28802	B	141.8	SB-122	0.77	4.30E-06	0.609	0.067
28802	A	163	SB-124	0.53	2.34E-06	0.381	0.028
28802	B	141.8	SB-124	0.98	2.82E-06	0.399	0.028
28802	B	141.8	SC-46	0.99	5.89E-06	0.835	0.043
28802	B	141.8	TA-182	0.54	2.84E-08	0.004	0.003
28802	A	163	TE-121	0.67	2.28E-03	371.067	616.188
28802	B	141.8	TE-123m	1.00	1.61E-05	2.287	0.242
28802	B	141.8	ZN-65	1.00	2.91E-02	4128.303	153.442
28958	B	167.5	AG-110m	0.40	3.37E-06	0.564	0.068
28958	A	115.5	AS-71	0.31	4.88E-01	56412.801	2945.527
28958	B	167.5	BA-131	0.86	5.87E-03	982.977	55.971
28958	A	115.5	BA-131	0.87	5.25E-03	606.723	33.652
28958	A	115.5	CE-141	0.89	1.76E-05	2.033	0.419
28958	B	167.5	CE-141	0.94	2.23E-05	3.732	0.465
28958	B	167.5	CR-51	0.97	7.57E-05	12.688	1.824
28958	B	167.5	CS-134	0.66	8.41E-07	0.141	0.017
28958	A	115.5	HF-181	0.72	6.99E-06	0.807	0.050
28958	B	167.5	HF-181	0.80	7.62E-06	1.277	0.067
28958	A	115.5	HG-203	0.86	9.06E-07	0.105	0.190
28958	A	115.5	ND-147	0.93	8.38E-05	9.676	9.119
28958	A	115.5	RB-86	0.97	7.57E-07	0.087	1.096
28958	B	167.5	RU-103	0.91	1.40E-04	23.482	1.256
28958	A	115.5	RU-103	0.99	1.33E-04	15.375	0.880
28958	A	115.5	SB-124	0.44	2.49E-06	0.288	0.024
28958	A	115.5	TE-121x	0.99	1.14E-02	1312.444	2086.607
29428	B	90.1	AG-110m	0.38	3.34E-07	0.030	0.041
29428	A	38.4	BA-131	0.85	1.28E-02	491.015	30.160
29428	B	90.1	BA-131	0.87	9.38E-03	845.076	45.688
29428	A	38.4	BA-133	0.46	3.14E-02	1207.439	507.450
29428	B	90.1	CE-141	0.94	2.32E-05	2.088	0.272
29428	A	38.4	CO-60	0.94	1.48E-05	0.570	0.069
29428	B	90.1	CR-51	0.90	1.60E-04	14.398	1.930
29428	A	38.4	CR-51	0.90	2.25E-04	8.656	0.692
29428	B	90.1	HF-175	0.90	1.81E-05	1.633	0.733
29428	B	90.1	HF-181	0.65	1.14E-05	1.025	0.054
29428	A	38.4	RU-103	0.99	2.52E-04	9.663	0.670
29428	B	90.1	RU-103	0.99	2.02E-04	18.221	1.026
29428	A	38.4	SB-124	0.46	5.13E-06	0.197	0.012
29428	A	38.4	Si-32	0.94	1.75E-01	6708.014	3139.624
29428	B	90.1	SN-125x	0.79	2.58E-01	23270.816	43561.388
29428	A	38.4	TA-182	0.42	1.17E-06	0.045	0.009
29428	B	90.1	TA-182	0.70	1.94E-07	0.017	0.003
29428	B	90.1	ZR-95	0.98	9.08E-05	8.178	15.349
29432	A	164.9	AG-108m	0.96	1.29E-03	212.190	245.497
29432	A	164.9	AS-77	0.47	3.35E+00	552721.740	90114.338
29432	B	102.1	AS-77	0.67	7.15E-01	73003.435	11640.623
29432	A	164.9	AU-198	0.73	9.48E-09	0.002	0.002
29432	A	164.9	BA-131	0.98	4.12E-03	680.041	28.322
29432	B	102.1	BA-131	0.99	6.92E-03	707.025	27.703
29432	B	102.1	BA-133	0.38	1.05E-01	10674.524	1152.259

29432	A	164.9	BA-133	0.85	3.27E-02	5388.625	1111.417
29432	B	102.1	CE-139	1.00	1.05E-05	1.077	21.490
29432	A	164.9	CE-141	0.96	1.27E-05	2.092	0.319
29432	B	102.1	CE-141	0.98	2.33E-05	2.377	0.309
29432	A	164.9	CR-51	0.99	9.20E-05	15.176	1.410
29432	B	102.1	CR-51	1.00	1.38E-04	14.100	1.287
29432	A	164.9	HF-175	0.96	1.60E-05	2.645	0.395
29432	B	102.1	HF-181	0.75	1.37E-05	1.397	0.062
29432	A	164.9	HF-181	0.88	7.03E-06	1.159	0.054
29432	A	164.9	LA-140	0.39	1.52E-05	2.514	0.576
29432	B	102.1	LU-177x	0.38	4.61E-07	0.047	0.006
29432	A	164.9	ND-147	0.98	8.44E-06	1.392	2.841
29432	B	102.1	RB-86	1.00	1.67E-05	1.705	0.376
29432	B	102.1	RU-103	0.81	5.05E-04	51.559	2.332
29432	A	164.9	RU-103	0.83	2.37E-04	39.002	1.811
29432	A	164.9	RU-97	0.70	7.50E-05	12.368	9.215
29432	B	102.1	RU-97	0.78	5.73E-05	5.849	3.150
29432	B	102.1	SB-122	0.87	3.34E-06	0.341	0.030
29432	B	102.1	SB-124	0.87	3.37E-06	0.344	0.021
29432	A	164.9	SB-124	0.97	1.91E-06	0.315	0.020
29432	A	164.9	SC-46	1.00	8.94E-06	1.475	0.062
29432	B	102.1	SC-46	1.00	1.40E-05	1.433	0.060
29432	A	164.9	Si-32	1.00	4.88E-02	8054.061	4696.309
29432	A	164.9	TE-123m	0.98	1.34E-05	2.204	0.256
29432	B	102.1	TE-123m	1.00	3.55E-05	3.625	0.265
29432	B	102.1	ZN-65	1.00	3.46E-02	3529.682	131.471
29432	A	164.9	ZN-65	1.00	2.14E-02	3530.196	131.382
29434	B	128.9	BA-131	0.52	7.04E-03	907.185	54.075
29434	A	164.3	BA-131	0.83	4.49E-03	737.484	45.184
29434	A	164.3	CE-141	0.90	1.76E-05	2.890	0.516
29434	B	128.9	CE-141	0.95	2.81E-05	3.623	0.411
29434	B	128.9	CO-60	0.91	1.36E-06	0.175	0.032
29434	B	128.9	CR-51	0.88	1.67E-04	21.509	2.344
29434	B	128.9	HF-181	0.72	7.40E-06	0.954	0.057
29434	A	164.3	LU-177	0.73	-3.94E-07	-0.065	-0.325
29434	A	164.3	RU-103	0.90	8.09E-05	13.297	0.878
29434	B	128.9	RU-103	0.90	3.88E-04	50.000	2.598
29434	B	128.9	SB-124	0.46	3.34E-06	0.431	0.031
29434	B	128.9	TA-182	0.33	5.25E-06	0.676	0.044
29462	A	113.9	BA-131	0.87	5.76E-03	655.604	35.856
29462	A	113.9	BA-133	0.49	2.20E-02	2504.397	624.347
29462	A	113.9	CE-141	0.91	2.32E-05	2.643	0.433
29462	A	113.9	CR-51	0.92	1.13E-04	12.834	1.857
29462	A	113.9	HF-181	0.79	7.82E-06	0.891	0.047
29462	A	113.9	RB-86	0.97	2.20E-06	0.251	0.462
29462	A	113.9	RU-103	0.91	1.54E-04	17.515	0.969
29462	A	113.9	SB-124	0.56	2.79E-06	0.318	0.025
30670	B	161	AS-71	0.88	6.54E-07	0.105	0.061
30670	B	161	AS-77	0.71	2.90E-01	46636.631	7430.477
30670	B	161	BA-131	0.99	4.41E-03	710.809	27.536

30670	B	161	BA-133m	0.65	6.53E-03	1051.350	1727.679
30670	B	161	CD-115	0.43	1.98E-06	0.318	0.250
30670	B	161	CE-141	0.95	1.20E-05	1.936	0.310
30670	B	161	CO-60	0.94	3.82E-06	0.615	0.075
30670	B	161	CR-51	1.00	8.74E-05	14.063	1.344
30670	B	161	HF-175	0.97	1.53E-05	2.464	0.430
30670	B	161	HF-181	0.89	6.32E-06	1.018	0.073
30670	B	161	HG-197	0.34	2.09E-03	336.435	57.832
30670	B	161	ND-147	0.96	2.82E-06	0.454	2.905
30670	B	161	RU-103	0.82	3.53E-04	56.754	2.531
30670	B	161	RU-97	0.79	5.90E-05	9.500	2.720
30670	B	161	SB-122	0.89	3.01E-06	0.485	0.024
30670	B	161	SB-124	0.59	2.70E-06	0.434	0.025
30670	B	161	SC-46	1.00	8.96E-06	1.442	0.061
30670	B	161	TE-123m	0.99	2.98E-05	4.804	0.314
30670	B	161	ZN-65	1.00	2.15E-02	3460.513	128.591
30674	B	150.5	BA-131	0.87	5.10E-03	768.132	41.971
30674	B	150.5	BA-133	0.64	4.59E-02	6909.814	1069.402
30674	B	150.5	CE-141	0.99	5.66E-06	0.852	0.609
30674	B	150.5	CR-51	0.87	1.27E-04	19.159	2.110
30674	B	150.5	HF-181	0.77	7.68E-06	1.155	0.056
30674	B	150.5	HO-166	0.73	1.12E-05	1.683	2.023
30674	B	150.5	RU-103	0.91	1.48E-04	22.226	1.154
30674	B	150.5	SB-124	0.44	2.60E-06	0.392	0.028
30674	B	150.5	TA-182	0.62	1.27E-07	0.019	0.003
271675	A	169.5	BA-131	0.86	4.52E-03	766.216	45.684
271675	A	169.5	CE-141	0.98	2.32E-05	3.924	0.522
271675	A	169.5	CR-51	0.90	1.58E-04	26.729	1.998
271675	A	169.5	HF-175	0.87	1.62E-05	2.748	0.390
271675	A	169.5	RU-103	0.91	9.94E-05	16.840	0.970
271675	A	169.5	SB-124	0.64	3.52E-06	0.596	0.033
271675	A	169.5	SE-75	0.71	5.35E-07	0.091	0.041
271675	A	169.5	XE-127	0.54	4.68E-03	793.424	103.001
422023HC	A	151.8	BA-131	0.89	4.38E-03	665.179	34.098
422023HC	A	151.8	CE-141	0.97	5.40E-05	8.204	0.522
422023HC	A	151.8	CR-51	0.90	1.53E-04	23.201	1.626
422023HC	A	151.8	HF-181	0.68	7.82E-06	1.187	0.058
422023HC	A	151.8	HG-203	0.97	1.26E-07	0.019	0.090
422023HC	A	151.8	RU-103	0.91	1.41E-04	21.404	1.117
422023HC	A	151.8	RU-97	0.43	3.35E-03	508.589	242.999
422023HC	A	151.8	SB-124	0.91	4.50E-06	0.683	0.034
493720-54	B	106.8	BA-131	0.85	7.44E-03	794.881	45.069
493720-54	A	175.6	BA-131	0.87	6.85E-03	1202.181	64.013
493720-54	B	106.8	BA-133	0.32	5.29E-02	5648.561	1364.057
493720-54	B	106.8	CE-141	0.98	1.44E-05	1.539	0.422
493720-54	B	106.8	CR-51	0.89	2.33E-04	24.850	2.095
493720-54	A	175.6	CR-51	0.90	2.88E-04	50.650	3.359
493720-54	B	106.8	HF-175	1.00	4.84E-07	0.052	0.197
493720-54	B	106.8	HF-181	0.66	6.97E-06	0.745	0.043
493720-54	A	175.6	HF-181	0.75	8.63E-06	1.516	0.061

493720-54	B	106.8	HO-166	0.50	2.82E-04	30.101	16.722
493720-54	B	106.8	IN-114m	0.71	5.37E-08	0.006	0.071
493720-54	B	106.8	RU-103	0.91	1.33E-04	14.219	0.840
493720-54	A	175.6	RU-103	0.91	1.37E-04	24.017	1.348
493720-54	B	106.8	SB-124	0.51	4.48E-05	4.784	0.184
493720-54	A	175.6	SB-124	0.65	3.80E-05	6.668	0.255
493720-54	A	175.6	SE-75	0.72	6.97E-07	0.122	0.037
501310-42	B	94.4	BA-131	0.85	6.96E-03	657.284	39.426
501310-42	A	162.9	BA-131	0.86	4.55E-03	741.010	44.380
501310-42	A	162.9	BA-133	0.42	4.73E-02	7700.418	1225.607
501310-42	B	94.4	CE-141	0.88	3.02E-05	2.847	0.565
501310-42	A	162.9	CE-141	0.99	1.45E-05	2.362	0.587
501310-42	B	94.4	CR-51	0.91	4.01E-04	37.895	3.168
501310-42	B	94.4	HF-181	0.73	8.38E-06	0.792	0.055
501310-42	B	94.4	RU-103	0.91	1.46E-04	13.811	0.900
501310-42	A	162.9	RU-103	0.91	9.59E-05	15.616	1.225
501310-42	B	94.4	SB-124	0.52	1.38E-04	13.050	0.491
501310-42	A	162.9	SB-124	0.52	9.15E-05	14.901	0.562
501310-42	B	94.4	SR-85x	0.99	2.99E-03	281.817	15.901
501310-42	B	94.4	TA-182	0.33	4.13E-07	0.039	0.032
650390-13	B	103.4	AG-110m	0.43	7.77E-07	0.080	0.010
650390-13	B	103.4	BA-131	0.85	8.11E-03	838.303	49.977
650390-13	B	103.4	CE-141	0.96	2.06E-05	2.133	0.506
650390-13	B	103.4	CR-51	0.88	4.51E-04	46.678	3.423
650390-13	B	103.4	IN-114m	0.83	1.53E-07	0.016	0.118
650390-13	B	103.4	OS-185	0.76	2.46E-04	25.394	7.346
650390-13	B	103.4	RU-103	0.90	1.69E-04	17.430	1.043
650390-13	B	103.4	SB-124	0.63	9.53E-05	9.851	0.371
650390-13	B	103.4	TB-160	0.34	9.73E-08	0.010	0.002
650390-46	A	99.1	AS-77	0.49	4.01E+00	397154.788	66268.411
650390-46	A	99.1	AU-198	0.77	2.65E-07	0.026	0.005
650390-46	B	193.9	BA-131	0.83	5.79E-03	1122.736	67.689
650390-46	A	99.1	BA-131	0.99	7.72E-03	764.751	31.576
650390-46	B	193.9	BA-133	0.44	5.58E-02	10820.808	2304.073
650390-46	B	193.9	CE-141	0.92	2.27E-05	4.410	0.704
650390-46	A	99.1	CE-141	0.99	2.26E-05	2.242	0.300
650390-46	A	99.1	CO-60	0.99	3.41E-05	3.379	0.203
650390-46	B	193.9	CR-51	0.90	2.01E-04	39.068	3.737
650390-46	A	99.1	CR-51	1.00	3.11E-04	30.803	2.191
650390-46	A	99.1	HF-181	0.89	1.16E-05	1.145	0.057
650390-46	A	99.1	NB-94x	0.88	1.57E-01	15540.349	27934.668
650390-46	B	193.9	ND-147	0.91	2.10E-04	40.701	35.014
650390-46	B	193.9	OS-185	0.90	7.26E-04	140.769	7.924
650390-46	A	99.1	RB-86	0.95	1.52E-06	0.151	0.446
650390-46	A	99.1	RU-103	0.83	4.61E-04	45.721	2.122
650390-46	B	193.9	RU-103	0.90	1.14E-04	22.160	1.301
650390-46	A	99.1	RU-97	0.71	1.82E-04	18.026	9.183
650390-46	A	99.1	SB-122	0.78	9.56E-05	9.474	0.419
650390-46	B	193.9	SB-124	0.44	7.29E-05	14.130	0.539
650390-46	A	99.1	SB-124	1.00	8.90E-05	8.824	0.332

650390-46	B	193.9	SB-125	0.58	1.90E+00	367499.055	126717.727
650390-46	A	99.1	Si-32	1.00	1.13E-01	11213.516	5425.002
650390-46	A	99.1	TE-123m	1.00	1.54E-05	1.530	0.270
650390-46	A	99.1	ZN-65	1.00	4.46E-02	4418.783	164.503
650390-46	B	193.9	ZR-95	0.98	1.59E-02	3087.350	138.645
650390-B	A	133.8	AG-108m	0.34	2.47E-01	33003.189	1796.107
650390-B	A	133.8	BA-131	0.71	6.29E-03	841.373	51.643
650390-B	A	133.8	CR-51	0.87	5.68E-04	75.975	3.667
650390-B	A	133.8	HF-181	0.80	1.19E-05	1.591	0.061
650390-B	A	133.8	HG-203	0.98	3.75E-07	0.050	0.109
650390-B	A	133.8	OS-185	0.73	8.73E-04	116.788	6.727
650390-B	A	133.8	RB-86	0.87	1.23E-05	1.639	0.552
650390-B	A	133.8	RU-103	0.91	1.14E-04	15.194	1.015
650390-B	A	133.8	SB-124	0.43	7.99E-05	10.696	0.410
650390-B	A	133.8	TA-182	0.54	3.43E-08	0.005	0.006
650390-B	A	133.8	TE-121	0.88	5.31E-03	711.038	921.314
A21794HC	A	266.6	BA-131	0.59	1.43E+00	380832.079	47533.547
A21794HC	A	266.6	BA-133	0.78	1.93E-02	5135.195	1512.966
A21794HC	A	266.6	CE-139	0.87	1.12E-04	29.855	53.588
A21794HC	A	266.6	CE-141	0.93	2.92E-04	77.783	4.010
A21794HC	A	266.6	CO-60	0.98	8.32E-06	2.217	0.144
A21794HC	A	266.6	CR-51	0.91	1.19E-03	317.329	24.049
A21794HC	A	266.6	HF-181	0.72	3.15E-05	8.403	0.385
A21794HC	A	266.6	RU-103	0.87	1.30E-03	347.676	15.744
A21794HC	A	266.6	SB-124	0.97	6.95E-06	1.852	0.095
A21794HC	A	266.6	SC-46	0.99	1.30E-05	3.471	0.148
A21794HC	A	266.6	TE-123m	0.99	2.95E-05	7.871	0.454
A21794HC	A	266.6	ZN-65	1.00	2.01E-02	5369.271	199.793
A21803HC	A	93	AG-108m	0.50	5.61E-03	521.327	255.289
A21803HC	A	93	BA-131	0.35	6.63E-03	616.817	40.485
A21803HC	A	93	CE-141	0.99	2.40E-05	2.228	0.642
A21803HC	A	93	HG-203	0.99	2.17E-07	0.020	0.044
A21803HC	A	93	SN-125x	0.85	7.83E-02	7286.383	18206.349
A21803HC	A	93	TE-123m	0.98	1.70E-06	0.158	0.167
A21803HC	B	113.2	BA-131	0.87	5.36E-03	607.286	33.078
A21803HC	B	113.2	BA-133	0.79	2.13E-02	2413.713	1155.317
A21803HC	B	113.2	CE-139	1.00	6.48E-05	7.331	25.301
A21803HC	B	113.2	CE-141	0.96	3.45E-05	3.903	0.432
A21803HC	B	113.2	CR-51	0.97	1.25E-04	14.120	1.772
A21803HC	B	113.2	HF-181	0.81	6.93E-06	0.785	0.046
A21803HC	B	113.2	HG-203	0.98	1.90E-06	0.215	0.199
A21803HC	B	113.2	RU-103	0.91	1.46E-04	16.558	0.928
A21803HC	B	113.2	RU-97	0.31	3.84E-03	434.550	452.749
A21803HC	B	113.2	SB-124	0.55	3.13E-06	0.354	0.025
A21803HL	B	113.2	SN-125x	0.82	2.65E-01	30013.380	52545.927
A220023HC	B	128.2	BA-131	0.89	5.00E-03	641.384	33.267
A220023HC	B	128.2	CE-141	0.96	4.99E-05	6.396	0.471
A220023HC	B	128.2	CR-51	0.91	1.45E-04	18.590	1.786
A220023HC	B	128.2	HF-181	0.82	8.91E-06	1.142	0.055
A220023HC	B	128.2	RU-103	1.00	1.49E-04	19.165	1.018

A220023HC	B	128.2	RU-97	0.36	4.56E-03	584.103	283.551
A220023HC	B	128.2	SB-124	0.58	5.82E-06	0.746	0.036
A220023HC	B	128.2	TA-182	0.34	1.32E-07	0.017	0.004
A2237HC	B	266.6	BA-131	0.60	1.61E+00	429219.990	53524.085
A2237HC	B	266.6	CR-51	0.90	7.33E-04	195.449	19.821
A2237HC	B	266.6	FE-59	0.94	8.03E-03	2140.617	285.254
A2237HC	B	266.6	HF-181	0.72	3.23E-05	8.613	0.387
A2237HC	B	266.6	RB-86	0.70	1.13E-04	30.112	9.084
A2237HC	B	266.6	RU-103	0.78	1.38E-03	368.045	16.834
A2237HC	B	266.6	SB-124	0.76	6.18E-06	1.647	0.091
A2237HC	B	266.6	SC-46	0.97	7.45E-06	1.986	0.112
A2237HC	B	266.6	TE-123m	1.00	2.12E-05	5.648	0.514
A2237HC	B	266.6	ZN-65	1.00	1.86E-02	4968.037	185.109
A24237HC	A	99.9	AS-77	0.50	3.83E+00	383007.268	60322.538
A24237HC	A	99.9	BA-131	0.98	6.60E-03	659.342	27.153
A24237HC	A	99.9	BA-133	0.34	2.83E-02	2825.919	1333.984
A24237HC	A	99.9	CR-51	1.00	1.24E-04	12.430	1.821
A24237HC	A	99.9	RB-86	0.96	4.06E-06	0.405	0.159
A24237HC	A	99.9	RU-103	0.90	3.48E-04	34.803	1.645
A24237HC	A	99.9	RU-97	0.71	7.00E-05	6.998	7.224
A24237HC	A	99.9	SB-122	0.79	4.75E-06	0.475	0.049
A24237HC	A	99.9	SB-124	0.52	4.64E-06	0.463	0.042
A24237HC	A	99.9	SC-46	1.00	8.93E-06	0.892	0.033
A24237HC	A	99.9	TE-123m	0.99	9.43E-06	0.942	0.153
A24237HC	A	99.9	ZN-65	1.00	3.57E-02	3566.875	132.860
A3745H	A	95.4	AS-76	0.49	3.08E-06	0.294	0.211
A3745H	B	90.7	AS-77	0.71	3.55E-01	32226.604	5176.583
A3745H	A	95.4	AS-77	0.78	1.97E-01	18771.021	2999.295
A3745H	A	95.4	AU-198	0.92	1.49E-08	0.001	0.000
A3745H	B	90.7	BA-131	0.99	5.70E-03	516.963	20.071
A3745H	A	95.4	BA-131	0.99	6.56E-03	626.173	23.911
A3745H	A	95.4	BA-133	0.34	3.25E-02	3098.792	1482.838
A3745H	A	95.4	CE-141	0.98	3.22E-05	3.069	0.311
A3745H	B	90.7	CE-141	0.98	2.42E-05	2.196	0.272
A3745H	A	95.4	CE-143	0.63	4.25E-04	40.540	18.320
A3745H	A	95.4	CR-51	0.99	9.88E-05	9.423	1.146
A3745H	B	90.7	CR-51	0.99	7.17E-05	6.506	1.004
A3745H	B	90.7	FE-59	0.99	1.98E-03	179.911	27.056
A3745H	A	95.4	HF-181	0.89	7.14E-06	0.682	0.063
A3745H	B	90.7	HF-181	0.89	8.42E-06	0.763	0.061
A3745H	B	90.7	OS-185	0.79	7.57E-06	0.686	2.212
A3745H	A	95.4	RB-86	0.89	1.49E-05	1.422	0.204
A3745H	B	90.7	RB-86	0.95	7.94E-06	0.720	0.197
A3745H	A	95.4	RU-103	0.82	5.20E-04	49.583	2.260
A3745H	B	90.7	RU-103	0.82	4.38E-04	39.687	1.815
A3745H	B	90.7	RU-97	0.79	2.40E-06	0.218	1.830
A3745H	A	95.4	RU-97	0.81	1.50E-05	1.426	1.530
A3745H	B	90.7	SB-122	0.89	3.73E-06	0.338	0.017
A3745H	A	95.4	SB-122	0.92	3.80E-06	0.362	0.017
A3745H	B	90.7	SB-124	0.59	2.91E-06	0.264	0.018

A3745H	A	95.4	SB-124	0.63	3.93E-06	0.375	0.035
A3745H	B	90.7	SC-46	0.99	5.86E-06	0.532	0.028
A3745H	A	95.4	SC-46	1.00	6.55E-06	0.625	0.034
A3745H	B	90.7	TA-182	0.33	5.42E-08	0.005	0.002
A3745H	B	90.7	TE-121	0.69	2.51E-03	228.057	72.177
A3745H	A	95.4	TE-123m	0.99	4.61E-05	4.402	0.280
A3745H	B	90.7	TE-123m	1.00	2.59E-05	2.350	0.217
A3745H	A	95.4	ZN-65	1.00	3.14E-02	2995.399	111.836
A3745H	B	90.7	ZN-65	1.00	2.65E-02	2402.814	89.965
A3760	A	74.4	AS-77	0.40	1.09E+01	811309.830	135908.614
A3760	A	74.4	AU-198m	0.33	5.98E-09	0.000	0.003
A3760	A	74.4	BA-131	0.98	5.76E-03	428.445	18.409
A3760	A	74.4	CE-139	1.00	2.12E-04	15.771	21.811
A3760	A	74.4	CE-141	0.99	2.38E-05	1.771	0.271
A3760	A	74.4	CR-51	0.94	4.69E-05	3.491	0.561
A3760	A	74.4	HF-175	1.00	1.90E-05	1.413	0.255
A3760	A	74.4	HF-181	0.89	9.57E-06	0.712	0.037
A3760	A	74.4	RB-86	0.97	1.18E-05	0.874	0.292
A3760	A	74.4	RU-103	0.82	3.42E-04	25.422	1.198
A3760	A	74.4	RU-97	0.75	2.70E-04	20.096	9.834
A3760	A	74.4	SB-122	0.72	5.49E-06	0.409	0.074
A3760	A	74.4	SB-124	0.51	4.08E-06	0.303	0.019
A3760	A	74.4	SC-46	0.99	6.42E-06	0.478	0.025
A3760	A	74.4	TA-182	0.54	6.93E-08	0.005	0.003
A3760	A	74.4	TE-121	0.59	2.33E-03	173.533	83.015
A3760	A	74.4	TE-123m	1.00	5.80E-06	0.431	0.089
A3760	A	74.4	ZN-65	1.00	2.85E-02	2117.095	79.436
CFSD	7	365.6	AG-108m	0.53	4.23E-04	154.802	20.086
CFSD	1	306.3	AS-77	0.68	2.33E-01	71297.901	11351.983
CFSD	3	300	BA-131	0.38	2.45E-03	733.686	47.420
CFSD	6	388	BA-131	0.84	2.79E-03	1082.908	65.600
CFSD	7	365.6	BA-131	0.86	2.38E-03	870.662	52.177
CFSD	5	353.8	BA-131	0.86	7.10E-03	2512.412	142.130
CFSD	1	306.3	BA-131	0.99	2.71E-03	830.515	32.390
CFSD	1	306.3	BA-133	0.51	1.20E-02	3681.235	1510.410
CFSD	5	353.8	BA-133	0.67	5.93E-02	20996.050	4079.618
CFSD	6	388	CE-141	0.95	2.56E-06	0.992	1.720
CFSD	1	306.3	CE-141	0.99	7.89E-06	2.415	0.321
CFSD	1	306.3	CR-51	0.98	2.90E-05	8.881	3.553
CFSD	7	365.6	FE-59	0.35	3.81E-05	13.920	55.478
CFSD	1	306.3	HF-175	0.92	8.17E-06	2.503	0.674
CFSD	1	306.3	HF-181	0.68	1.44E-06	0.441	0.069
CFSD	7	365.6	HF-181	0.68	1.39E-06	0.507	0.039
CFSD	5	353.8	HG-203	0.94	1.01E-06	0.356	0.376
CFSD	1	306.3	LA-140	0.48	4.16E-06	1.276	0.068
CFSD	1	306.3	RH-105	0.58	2.69E-04	82.368	70.435
CFSD	1	306.3	RU-103	0.82	1.95E-04	59.806	2.693
CFSD	3	300	RU-103	0.85	9.26E-05	27.773	1.522
CFSD	6	388	RU-103	0.90	5.24E-05	20.326	1.163
CFSD	7	365.6	RU-103	0.91	4.33E-05	15.826	0.882

CFSD	5	353.8	RU-103	0.91	1.60E-04	56.434	3.079
CFSD	1	306.3	RU-97	0.78	1.05E-05	3.228	3.335
CFSD	1	306.3	SB-122	0.86	2.57E-07	0.079	0.015
CFSD	7	365.6	SB-124	0.47	2.77E-07	0.101	0.021
CFSD	1	306.3	SB-124	0.79	3.63E-07	0.111	0.014
CFSD	1	306.3	SC-46	1.00	3.10E-06	0.948	0.050
CFSD	1	306.3	TA-182	0.41	2.30E-08	0.007	0.003
CFSD	1	306.3	TE-123m	0.99	9.73E-06	2.980	0.207
CFSD	1	306.3	ZN-65	1.00	1.38E-02	4235.606	157.423
CFSK	3	97.9	AG-108m	0.37	3.40E-04	33.286	381.424
CFSK	2	100.4	AS-77	0.52	3.45E+00	346635.633	55633.178
CFSK	3	97.9	AS-77	0.68	7.56E-01	73965.366	11787.864
CFSK	2	100.4	AU-198m	0.68	1.50E-09	0.000	0.001
CFSK	4	127.7	BA-131	0.85	7.50E-03	957.752	56.446
CFSK	6	80.8	BA-131	0.85	1.02E-02	824.713	49.143
CFSK	5	135.8	BA-131	0.88	6.19E-03	841.007	45.394
CFSK	2	100.4	BA-131	0.98	8.04E-03	806.940	32.673
CFSK	3	97.9	BA-131	0.99	8.86E-03	867.568	33.627
CFSK	6	80.8	BA-133	0.47	1.03E-01	8314.749	1476.100
CFSK	5	135.8	BA-133	0.50	2.37E-02	3214.185	1663.495
CFSK	5	135.8	CE-139	1.00	2.55E-05	3.464	22.431
CFSK	3	97.9	CE-141	0.98	2.71E-05	2.651	0.583
CFSK	4	127.7	CE-141	0.99	2.24E-05	2.863	0.495
CFSK	5	135.8	CE-141	0.99	6.65E-06	0.903	0.172
CFSK	5	135.8	CO-60	1.00	1.40E-06	0.190	0.036
CFSK	6	80.8	CR-51	0.96	1.47E-05	1.186	1.770
CFSK	6	80.8	CS-134	0.72	1.20E-06	0.097	0.016
CFSK	6	80.8	HF-181	0.70	1.09E-05	0.885	0.055
CFSK	3	97.9	HF-181	0.85	6.49E-06	0.635	0.049
CFSK	2	100.4	HF-181	0.89	1.21E-05	1.214	0.056
CFSK	5	135.8	HF-181	0.90	7.80E-06	1.059	0.051
CFSK	3	97.9	IN-114m	0.67	1.25E-06	0.123	0.099
CFSK	5	135.8	IN-114m	0.83	1.59E-05	2.164	1.810
CFSK	2	100.4	RB-86	0.99	4.72E-06	0.474	0.359
CFSK	3	97.9	RU-103	0.90	3.88E-04	37.966	1.847
CFSK	4	127.7	RU-103	0.91	1.48E-04	18.925	1.309
CFSK	6	80.8	RU-103	0.91	2.13E-04	17.223	0.991
CFSK	2	100.4	RU-103	0.91	5.05E-04	50.693	2.287
CFSK	5	135.8	RU-103	0.91	1.69E-04	22.970	1.205
CFSK	5	135.8	RU-97	0.32	1.43E-03	194.718	508.092
CFSK	3	97.9	SB-122	0.87	2.23E-06	0.218	0.018
CFSK	6	80.8	SB-124	0.59	1.31E-06	0.106	0.017
CFSK	4	127.7	SB-124	0.68	1.29E-06	0.165	0.019
CFSK	3	97.9	SB-124	0.88	1.75E-06	0.172	0.011
CFSK	2	100.4	SC-46	0.99	7.95E-06	0.798	0.046
CFSK	3	97.9	SC-46	0.99	5.86E-06	0.573	0.037
CFSK	6	80.8	TA-182	0.44	8.70E-08	0.007	0.005
CFSK	5	135.8	TA-182	0.64	2.45E-08	0.003	0.010
CFSK	5	135.8	TE-121	0.66	1.01E-03	137.592	489.890
CFSK	3	97.9	TE-123m	0.98	2.53E-05	2.481	0.254

CFSK	2	100.4	ZN-65	1.00	4.44E-02	4459.701	165.750
CFSK	3	97.9	ZN-65	1.00	4.62E-02	4523.862	168.271
CFSP	1	389.8	AG-108m	0.96	1.93E-03	750.878	538.299
CFSP	5	396.9	AG-110m	0.38	1.97E-07	0.078	0.032
CFSP	1a	389.8	AS-71	0.43	3.19E-02	12435.750	618.777
CFSP	6	387.7	BA-131	0.86	2.38E-03	920.893	55.171
CFSP	5	396.9	BA-131	0.86	2.51E-03	997.310	54.841
CFSP	1	389.8	BA-131	0.88	2.11E-03	822.068	40.799
CFSP	1a	389.8	BA-131	0.89	2.08E-03	811.910	40.899
CFSP	3	405.4	BA-131	0.89	1.96E-03	794.580	41.226
CFSP	6	387.7	CE-141	0.95	1.23E-05	4.783	0.565
CFSP	1	389.8	CE-141	0.96	1.52E-05	5.906	0.485
CFSP	5	396.9	CE-141	0.96	1.75E-05	6.935	0.264
CFSP	3	405.4	CE-141	0.98	9.85E-06	3.992	1.302
CFSP	1a	389.8	CE-141	0.99	1.21E-05	4.709	0.473
CFSP	3	405.4	CO-60	0.88	2.41E-06	0.977	0.087
CFSP	5	396.9	CR-51	0.89	6.36E-05	25.239	3.442
CFSP	1a	389.8	CR-51	0.90	5.14E-05	20.040	2.931
CFSP	6	387.7	CR-51	0.91	5.17E-05	20.037	2.492
CFSP	3	405.4	CR-51	0.91	4.76E-05	19.305	2.008
CFSP	1	389.8	CR-51	0.92	5.35E-05	20.847	1.995
CFSP	5	396.9	CS-134	0.73	1.41E-06	0.558	0.037
CFSP	1	389.8	FE-59	0.35	4.28E-04	166.870	111.169
CFSP	6	387.7	HF-181	0.66	2.06E-06	0.799	0.052
CFSP	1	389.8	HF-181	0.72	1.33E-06	0.520	0.048
CFSP	5	396.9	HF-181	0.78	2.31E-06	0.917	0.055
CFSP	1a	389.8	HF-181	0.80	2.21E-06	0.863	0.048
CFSP	3	405.4	HF-181	0.85	2.13E-06	0.865	0.050
CFSP	1a	389.8	HG-203	0.88	4.95E-08	0.019	0.079
CFSP	3	405.4	HO-166	0.39	1.21E-04	49.219	43.640
CFSP	6	387.7	IR-192	0.38	1.64E-09	0.001	0.000
CFSP	1	389.8	LU-177	0.86	3.06E-08	0.012	0.081
CFSP	1a	389.8	LU-177	0.87	7.04E-08	0.027	0.083
CFSP	5	396.9	OS-185	0.88	1.05E-05	4.182	3.672
CFSP	5	396.9	RB-86	0.88	1.20E-06	0.478	1.045
CFSP	3	405.4	RB-86	0.96	2.12E-06	0.858	0.747
CFSP	1a	389.8	RB-86	0.97	6.21E-06	2.420	0.849
CFSP	5	396.9	RU-103	0.91	6.12E-05	24.300	1.293
CFSP	1	389.8	RU-103	0.91	7.25E-05	28.261	1.411
CFSP	1a	389.8	RU-103	0.91	7.25E-05	28.271	1.398
CFSP	3	405.4	RU-103	0.91	6.40E-05	25.954	1.305
CFSP	6	387.7	RU-103	0.99	4.18E-05	16.199	0.977
CFSP	3	405.4	RU-97	0.36	3.08E-03	1249.362	464.746
CFSP	1a	389.8	RU-97	0.38	1.37E-03	532.978	237.627
CFSP	1	389.8	RU-97	0.39	1.46E-03	570.924	217.303
CFSP	6	387.7	SB-124	0.44	1.48E-06	0.575	0.025
CFSP	1	389.8	SB-124	0.56	9.62E-07	0.375	0.029
CFSP	1	389.8	SB-124	0.78	1.17E-06	0.455	0.039
CFSP	3	405.4	SB-124	0.81	1.04E-06	0.421	0.028
CFSP	1	389.8	SN-125x	0.94	5.65E-02	22023.761	31951.804

CFSP	1	389.8	TA-182	0.30	5.69E-08	0.022	0.005
CFSP	1	389.8	TA-182	0.54	8.31E-09	0.003	0.001
CFSP	6	387.7	TE-123m	0.87	2.59E-07	0.101	0.153
JET OIL	1	220.4	CO-60	1.00	1.76E-04	38.894	1.478
JET OIL	1	220.4	CR-51	1.00	8.99E-05	19.807	1.557
JET OIL	1	220.4	FE-59	1.00	4.44E-01	97859.548	4009.518
JET OIL	1	220.4	ND-147	0.96	1.64E-05	3.620	1.200
JET OIL	1	220.4	RU-103	0.88	3.85E-07	0.085	0.215
JET OIL	1	220.4	SB-124	0.95	1.17E-06	0.259	0.021
JET OIL	1	220.4	SR-85x	0.88	1.58E-04	34.916	16.032
JET OIL	1	220.4	ZN-65	0.98	3.04E-06	0.670	2.548
CFSK	2	317.7	BA-131	0.86	2.58E-03	819.400	48.908
CFSK	4	345.5	BA-131	0.87	2.07E-03	714.764	42.714
CFSK	4	345.5	CE-139	0.86	6.36E-05	21.966	1.587
CFSK	2	317.7	CE-141	0.88	6.91E-06	2.196	0.089
CFSK	4	345.5	CE-141	0.95	4.46E-06	1.541	0.422
CFSK	4	345.5	CR-51	0.88	3.09E-05	10.692	1.966
CFSK	2	317.7	CR-51	0.91	5.55E-05	17.628	2.193
CFSK	4	345.5	HF-181	0.76	1.42E-06	0.490	0.035
CFSK	4	345.5	RU-103	0.91	3.43E-05	11.867	0.782
CFSK	2	317.7	RU-103	0.99	5.75E-05	18.277	1.021
CFSK	4	345.5	TA-182	0.37	5.86E-08	0.020	0.003
CFSK	4	345.5	TE-121	0.67	7.88E-04	272.105	712.931
CFSK	2	317.7	TE-123m	0.86	2.59E-07	0.082	0.136
CFSK	7	119.4	BA-131	0.86	8.21E-03	980.086	54.050
CFSK	7	119.4	CE-139	1.00	1.49E-04	17.764	27.404
CFSK	7	119.4	CE-141	0.92	4.46E-06	0.533	0.487
CFSK	7	119.4	HF-181	0.69	7.98E-06	0.953	0.058
CFSK	7	119.4	HG-203	0.98	1.00E-08	0.001	0.118
CFSK	7	119.4	RU-103	0.91	1.97E-04	23.482	1.251
CFSK	7	119.4	SB-122	0.31	1.49E-04	17.770	5.329
CFSK	7	119.4	SB-124	0.43	1.40E-06	0.167	0.025
4S19OC	A	57.5	BA-133	0.38	3.30E-01	18955.740	2832.250
4S19OC	A	57.5	CO-60	0.90	2.18E-04	12.515	0.410
4S19OC	A	57.5	EU-152x	0.48	4.54E-06	0.261	0.027
4S19OC	A	57.5	SB-124	0.50	2.04E-05	1.176	0.183
4S19OC	A	57.5	ZN-65	0.92	3.58E-01	20605.132	454.419
2D968E	A	116.1	CE-139	0.98	1.13E-03	130.976	61.144
2D968E	A	116.1	CE-139	0.98	1.13E-03	130.976	61.144
2D968E	A	116.1	CO-60	0.95	4.51E-05	5.240	0.229
2D968E	A	116.1	CO-60	0.95	4.51E-05	5.240	0.229
2D968E	A	116.1	FE-59	0.94	2.39E-03	277.631	163.916
2D968E	A	116.1	FE-59	0.94	2.39E-03	277.631	163.916
2D968E	A	116.1	SC-46	0.94	9.40E-06	1.092	0.064
2D968E	A	116.1	SC-46	0.94	9.40E-06	1.092	0.064
2D968E	A	116.1	ZN-65	0.95	4.66E-02	5410.438	118.466
2D968E	A	116.1	ZN-65	0.95	4.66E-02	5410.438	118.466
2D968E	B	142	BA-131	0.95	1.27E-02	1809.828	230.163
2D968E	B	142	BA-133	0.40	8.36E-02	11873.568	2656.003
2D968E	B	142	CE-141	0.97	8.30E-05	11.791	1.710

2D968E	B	142	CO-60	0.96	2.99E-05	4.243	0.565
2D968E	B	142	CR-51	0.99	1.54E-04	21.826	3.920
2D968E	B	142	HF-175	0.95	2.90E-05	4.121	0.865
2D968E	B	142	HF-181	0.87	1.54E-05	2.184	0.284
2D968E	B	142	RU-103	0.98	1.24E-06	0.177	1.112
2D968E	B	142	RU-97	0.55	3.50E-03	497.512	146.347
2D968E	B	142	SB-124	0.56	2.58E-06	0.367	0.052
2D968E	B	142	SC-46	0.96	1.04E-05	1.477	0.189
2D968E	B	142	SN-125x	0.89	3.49E-02	4962.503	19630.399
2D968E	B	142	ZN-65	0.99	3.89E-02	5528.304	689.019
3C297F	A	205.4	BA-131	0.93	1.43E-02	2942.754	116.540
3C297F	A	205.4	CE-141	0.98	2.24E-04	46.011	2.221
3C297F	A	205.4	CO-60	0.99	2.33E-05	4.788	0.224
3C297F	A	205.4	CR-51	0.93	2.75E-04	56.548	4.346
3C297F	A	205.4	HF-175	0.93	6.01E-05	12.339	0.319
3C297F	A	205.4	HF-181	0.87	2.04E-05	4.188	0.104
3C297F	A	205.4	RB-86	0.96	1.82E-06	0.374	0.796
3C297F	A	205.4	RU-97	0.40	1.72E-02	3535.796	1197.553
3C297F	A	205.4	SB-124	0.75	7.06E-06	1.450	0.048
3C297F	A	205.4	SC-46	0.98	1.90E-05	3.911	0.105
3C297F	A	205.4	TE-121	0.67	3.72E-04	76.403	373.405
3C297F	A	205.4	TE-123m	0.95	1.51E-05	3.096	0.492
3C297F	A	205.4	XE-129m	0.91	1.31E-04	26.882	39.239
3C297F	A	205.4	ZN-65	0.98	4.36E-02	8963.746	190.409
3C297F	B	207.3	BA-133	0.70	7.34E-02	15220.754	3184.939
3C297F	B	207.3	CO-60	0.99	2.89E-05	5.990	0.319
3C297F	B	207.3	EU-152x	0.67	2.27E-06	0.470	0.031
3C297F	B	207.3	EU-154	0.56	2.49E-06	0.515	0.058
3C297F	B	207.3	HF-175	0.93	3.46E-05	7.173	2.940
3C297F	B	207.3	HF-181	0.89	1.73E-05	3.582	0.212
3C297F	B	207.3	SB-124	0.87	9.39E-06	1.947	0.064
3C297F	B	207.3	SC-46	0.98	2.17E-05	4.507	0.142
3C297F	B	207.3	TE-121	0.54	2.96E-02	6133.995	6844.773
3C297F	B	207.3	TE-121x	0.95	4.59E-03	950.532	3727.825
3C297F	B	207.3	ZN-65	0.99	5.05E-02	10477.506	224.264
43RTY2	A	155.4	BA-131	0.94	2.24E-02	3474.647	120.220
43RTY2	A	155.4	CE-141	0.98	3.27E-04	50.810	1.922
43RTY2	A	155.4	CO-60	0.99	5.25E-05	8.165	0.333
43RTY2	A	155.4	CR-51	0.96	4.23E-04	65.706	4.862
43RTY2	A	155.4	HF-175	0.89	5.24E-05	8.150	1.908
43RTY2	A	155.4	HF-181	0.78	2.66E-05	4.130	0.137
43RTY2	A	155.4	IN-114m	0.55	4.53E-06	0.705	0.448
43RTY2	A	155.4	RE-186	0.75	2.86E-06	0.445	0.142
43RTY2	A	155.4	RU-97	0.50	9.91E-03	1540.725	437.572
43RTY2	A	155.4	SB-124	0.87	1.33E-05	2.061	0.063
43RTY2	A	155.4	SC-46	0.99	2.83E-05	4.400	0.118
43RTY2	A	155.4	SN-125x	0.86	5.24E-02	8139.569	52464.633
43RTY2	A	155.4	TE-123m	0.97	3.49E-06	0.543	0.876
43RTY2	A	155.4	ZN-65	0.99	6.63E-02	10301.644	219.088
43RTY2	A	155.4	ZR-95	0.94	1.39E-04	21.613	30.071

43RTY2	B	140	BA-133	0.41	1.18E-01	16555.616	3263.783
43RTY2	B	140	CE-141	0.96	2.28E-04	31.862	6.418
43RTY2	B	140	CO-60	0.98	5.22E-05	7.303	0.314
43RTY2	B	140	HF-175	0.98	7.41E-05	10.378	2.800
43RTY2	B	140	HF-181	0.74	2.14E-05	2.993	0.284
43RTY2	B	140	SB-124	0.79	1.45E-05	2.029	0.080
43RTY2	B	140	SC-46	0.98	3.42E-05	4.786	0.102
43RTY2	B	140	XE-129m	0.52	5.50E-03	770.677	4191.224
43RTY2	B	140	ZN-65	0.99	6.97E-02	9760.656	209.292
4S19OC	B	16.2	AU-198	0.56	9.97E-07	0.016	0.021
4S19OC	B	16.2	BA-131	0.95	1.15E-01	1865.722	69.024
4S19OC	B	16.2	BA-133	0.64	1.04E-01	1687.629	1447.912
4S19OC	B	16.2	CR-51	0.95	1.03E-03	16.637	2.195
4S19OC	B	16.2	RU-97	0.51	4.04E-02	654.640	211.628
4S19OC	B	16.2	SB-124	0.79	9.53E-06	0.154	0.016
4S19OC	B	16.2	Si-32	0.89	3.44E-01	5572.902	9471.588
4S19OC	B	16.2	TE-121	0.69	3.52E-02	569.933	350.480
4S19OC	B	16.2	XE-127	0.78	8.63E-04	13.987	17.274
4S19OC	B	16.2	YB-169	0.61	4.47E-07	0.007	0.090
4S19OC	B	16.2	ZN-65	1.00	3.51E-01	5687.835	141.803
584C32	B	94.3	BA-131	0.93	2.12E-02	2000.621	81.603
584C32	B	94.3	CE-141	0.97	3.83E-04	36.102	1.853
584C32	B	94.3	CO-60	0.99	5.96E-05	5.620	0.232
584C32	B	94.3	CR-51	0.95	4.12E-04	38.866	3.473
584C32	B	94.3	HF-181	0.71	2.92E-05	2.755	0.111
584C32	B	94.3	RU-97	0.39	3.68E-02	3470.909	1163.409
584C32	B	94.3	SB-124	0.84	7.43E-06	0.700	0.030
584C32	B	94.3	SC-46	0.98	2.94E-05	2.769	0.079
584C32	B	94.3	SN-125x	0.90	5.35E-01	50430.829	54943.446
584C32	B	94.3	XE-127	0.38	2.52E-04	23.735	3.293
584C32	B	94.3	ZN-65	0.98	6.33E-02	5966.740	128.388
5H2F01	A	129.1	BA-131	0.73	1.76E-02	2271.845	254.549
5H2F01	A	129.1	BA-133	0.87	9.37E-02	12100.204	2246.951
5H2F01	A	129.1	CE-141	0.95	3.62E-04	46.771	3.127
5H2F01	A	129.1	CO-60	1.00	5.08E-05	6.565	0.255
5H2F01	A	129.1	EU-154	0.54	2.57E-06	0.332	0.092
5H2F01	A	129.1	SB-124	0.94	5.83E-06	0.752	0.055
5H2F01	A	129.1	SC-46	0.99	2.73E-05	3.526	0.099
5H2F01	A	129.1	SE-75	0.89	4.67E-06	0.603	0.146
5H2F01	A	129.1	XE-127	0.57	1.40E-05	1.812	1.119
5H2F01	A	129.1	ZN-65	1.00	5.61E-02	7236.343	131.730
7ZMK52	B	163.6	BA-133	0.66	1.07E-01	17425.953	1106.906
7ZMK52	B	163.6	CO-60	0.90	1.19E-04	19.446	0.730
7ZMK52	B	163.6	EU-152x	0.61	1.44E-06	0.236	0.015
7ZMK52	B	163.6	HF-181	0.69	3.14E-05	5.143	0.676
7ZMK52	B	163.6	IN-114m	0.61	1.34E-05	2.194	1.318
7ZMK52	B	163.6	SB-124	0.83	2.57E-05	4.207	0.294
7ZMK52	B	163.6	TE-121x	0.88	4.64E-01	75984.080	15267.310
7ZMK52	B	163.6	ZN-65	0.93	2.37E-01	38804.343	839.445
73J43M	A	147.7	CE-141	0.92	3.90E-04	57.593	9.532

73J43M	A	147.7	CO-60	0.95	5.97E-05	8.818	1.137
73J43M	A	147.7	CR-51	0.94	3.27E-04	48.339	16.782
73J43M	A	147.7	HF-181	0.87	2.66E-05	3.932	0.556
73J43M	A	147.7	IN-114m	0.72	3.84E-06	0.568	0.785
73J43M	A	147.7	RU-103	0.83	4.26E-05	6.298	1.818
73J43M	A	147.7	SB-124	0.72	7.02E-06	1.036	0.142
73J43M	A	147.7	SC-46	0.92	2.74E-05	4.042	0.514
73J43M	A	147.7	TA-182	0.49	7.39E-08	0.011	0.012
73J43M	A	147.7	TE-121x	0.99	3.86E-02	5695.369	8123.961
73J43M	A	147.7	TE-123m	1.00	4.10E-06	0.606	0.670
73J43M	A	147.7	ZN-65	0.92	6.54E-02	9665.014	1204.203
73J43M	B	184.7	BA-131	0.91	1.90E-02	3508.243	184.136
73J43M	B	184.7	CE-141	0.96	2.95E-04	54.567	2.864
73J43M	B	184.7	CO-60	0.99	4.91E-05	9.063	0.345
73J43M	B	184.7	CR-51	0.96	3.56E-04	65.773	5.693
73J43M	B	184.7	HF-181	0.72	1.91E-05	3.535	0.091
73J43M	B	184.7	RB-86	0.95	1.96E-05	3.617	1.724
73J43M	B	184.7	SB-124	0.83	6.18E-06	1.141	0.046
73J43M	B	184.7	SC-46	0.98	2.42E-05	4.477	0.120
73J43M	B	184.7	ZN-65	0.97	5.27E-02	9739.229	207.674
794TWZ	A	245.7	AG-108m	0.49	2.35E-03	576.404	235.286
794TWZ	A	245.7	BA-133	0.87	1.40E-01	34378.319	3099.039
794TWZ	A	245.7	CO-60	0.91	7.03E-05	17.274	0.598
794TWZ	A	245.7	CR-51	0.76	-1.00E-05	-2.458	-92.663
794TWZ	A	245.7	EU-152x	0.78	2.54E-06	0.624	0.029
794TWZ	A	245.7	FE-59	0.31	1.31E-02	3223.437	1157.520
794TWZ	A	245.7	HF-175	0.91	1.07E-04	26.181	6.035
794TWZ	A	245.7	SB-124	0.62	1.14E-05	2.802	1.040
794TWZ	A	245.7	SC-46	0.89	6.60E-05	16.224	0.393
794TWZ	A	245.7	TE-121	0.36	6.73E-01	165258.411	210866.146
794TWZ	A	245.7	TE-123m	0.99	3.93E-06	0.966	0.420
794TWZ	A	245.7	ZN-65	0.93	9.00E-02	22119.483	480.990
794TWZ	B	237.3	BA-131	0.32	3.44E-03	815.877	318.379
794TWZ	B	237.3	BA-133	0.53	6.85E-02	16247.523	4905.117
794TWZ	B	237.3	CE-141	0.94	1.63E-04	38.580	6.054
794TWZ	B	237.3	CO-60	0.98	3.35E-05	7.955	1.053
794TWZ	B	237.3	CR-51	0.95	1.55E-04	36.743	8.082
794TWZ	B	237.3	EU-152x	0.39	1.67E-06	0.396	0.064
794TWZ	B	237.3	HF-181	0.68	5.25E-06	1.246	0.258
794TWZ	B	237.3	RU-103	0.85	3.07E-05	7.283	2.021
794TWZ	B	237.3	SB-124	0.84	3.63E-06	0.861	0.118
794TWZ	B	237.3	SC-46	0.99	2.28E-05	5.409	0.681
794TWZ	B	237.3	ZN-65	1.00	4.00E-02	9482.383	1181.377
7WQF45	A	235.3	BA-133	0.40	6.97E-02	16388.840	3124.861
7WQF45	A	235.3	CE-141	0.86	1.76E-04	41.362	10.980
7WQF45	A	235.3	CO-60	0.98	2.96E-05	6.973	0.302
7WQF45	A	235.3	EU-152x	0.38	7.50E-07	0.176	0.043
7WQF45	A	235.3	EU-154	0.34	1.83E-06	0.430	0.092
7WQF45	A	235.3	FE-59	0.31	2.59E-03	609.423	207.368
7WQF45	A	235.3	RU-103	0.85	2.83E-06	0.667	0.172

7WQF45	A	235.3	SB-124	0.74	4.61E-06	1.084	0.073
7WQF45	A	235.3	SC-46	0.95	1.94E-05	4.567	0.147
7WQF45	A	235.3	ZN-65	0.96	3.94E-02	9271.253	198.736
7WQF45	B	202.7	AG-108m	0.48	2.43E-04	49.170	602.180
7WQF45	B	202.7	BA-131	0.93	1.49E-02	3012.507	122.418
7WQF45	B	202.7	CE-141	0.96	1.74E-04	35.221	1.789
7WQF45	B	202.7	CO-60	0.94	3.21E-05	6.498	0.283
7WQF45	B	202.7	CR-51	0.96	2.04E-04	41.374	3.265
7WQF45	B	202.7	HF-181	0.74	1.46E-05	2.964	0.182
7WQF45	B	202.7	LU-177	0.86	2.17E-06	0.441	0.414
7WQF45	B	202.7	RU-97	0.39	2.25E-02	4559.520	1581.302
7WQF45	B	202.7	SB-124	0.86	8.11E-06	1.643	0.057
7WQF45	B	202.7	SC-46	0.98	2.27E-05	4.599	0.121
7WQF45	B	202.7	TE-121	0.68	1.61E-03	326.560	157.051
7WQF45	B	202.7	ZN-65	0.98	4.34E-02	8801.841	187.561
7ZMK52	A	144.9	BA-133	0.70	2.46E-01	35655.030	3572.008
7ZMK52	A	144.9	CE-141	0.87	1.69E-04	24.535	9.757
7ZMK52	A	144.9	CO-60	0.90	1.22E-04	17.655	0.650
7ZMK52	A	144.9	EU-152x	0.71	3.14E-06	0.455	0.052
7ZMK52	A	144.9	FE-59	0.91	1.35E-02	1952.929	1192.106
7ZMK52	A	144.9	HF-175	0.86	1.54E-04	22.308	7.176
7ZMK52	A	144.9	HF-181	0.77	1.37E-05	1.990	0.498
7ZMK52	A	144.9	RU-103	0.82	3.79E-06	0.549	6.091
7ZMK52	A	144.9	SB-124	0.61	2.90E-05	4.201	0.276
7ZMK52	A	144.9	ZN-65	0.92	2.40E-01	34767.357	752.420
83MIA9	A	141.7	BA-133	0.85	4.34E-01	61472.749	8756.189
83MIA9	A	141.7	CO-60	0.92	2.29E-04	32.499	0.884
83MIA9	A	141.7	EU-152x	0.61	2.73E-06	0.387	0.056
83MIA9	A	141.7	HF-175	0.87	3.79E-04	53.760	22.312
83MIA9	A	141.7	HF-181	0.69	4.50E-05	6.380	1.133
83MIA9	A	141.7	Si-32	0.92	1.28E-01	18140.364	16208.755
83MIA9	A	141.7	ZN-65	0.93	3.43E-01	48662.920	1037.348
9RZMC2	A	212.6	BA-131	0.59	9.43E-03	2005.582	444.506
9RZMC2	A	212.6	CO-60	0.96	3.00E-05	6.375	0.275
9RZMC2	A	212.6	EU-154	0.32	7.04E-07	0.150	0.116
9RZMC2	A	212.6	LU-177	0.37	5.60E-04	119.153	59.417
9RZMC2	A	212.6	OS-191	0.82	2.63E-05	5.583	8.735
9RZMC2	A	212.6	RU-103	0.93	2.25E-06	0.478	1.473
9RZMC2	A	212.6	SC-46	0.95	3.20E-06	0.681	0.101
9RZMC2	A	212.6	TA-182	0.40	2.65E-07	0.056	0.029
9RZMC2	A	212.6	XE-127	0.32	2.55E-04	54.205	32.081
9RZMC2	A	212.6	ZN-65	0.98	4.83E-02	10271.791	219.436
9RZMC2	B	85.5	BA-133	0.41	1.44E-01	12289.982	2673.740
9RZMC2	B	85.5	CE-139	0.86	2.64E-03	225.511	137.408
9RZMC2	B	85.5	CO-60	0.92	6.87E-05	5.873	0.257
9RZMC2	B	85.5	IN-114m	0.57	-1.91E-06	-0.163	-0.344
9RZMC2	B	85.5	TE-121x	0.94	5.89E-02	5035.752	8887.018
9RZMC2	B	85.5	TE-123m	0.91	4.31E-06	0.369	0.859
9RZMC2	B	85.5	ZN-65	0.92	1.11E-01	9492.054	203.513
AI644T	A	91.6	BA-133	0.87	3.65E-01	33403.703	3036.419

AI644T	A	91.6	CE-141	0.87	5.37E-04	49.234	25.381
AI644T	A	91.6	CO-60	0.89	4.52E-05	4.139	0.242
AI644T	A	91.6	EU-152x	0.65	4.23E-06	0.388	0.038
AI644T	A	91.6	HF-175	0.86	3.80E-04	34.850	6.653
AI644T	A	91.6	HF-181	0.69	2.29E-05	2.101	0.611
AI644T	A	91.6	SB-124	0.47	9.39E-06	0.860	0.136
AI644T	A	91.6	SC-46	0.89	1.19E-04	10.874	0.311
AI644T	A	91.6	ZN-65	0.93	1.89E-01	17292.624	381.250
AI644T	B	137	BA-133	0.39	4.64E-02	6355.804	241.986
AI644T	B	137	CR-51	0.88	1.25E-04	17.130	15.029
AI644T	B	137	EU-152x	0.70	3.73E-06	0.511	0.025
AI644T	B	137	HF-175	0.99	2.32E-05	3.182	1.286
AI644T	B	137	OS-191	0.77	6.04E-06	0.828	10.655
AI644T	B	137	RU-103	0.85	6.90E-06	0.945	0.794
AI644T	B	137	SB-124	0.48	1.68E-06	0.230	0.027
AI644T	B	137	SB-125	0.51	7.06E-01	96665.270	56171.098
AI644T	B	137	SC-46	0.94	1.36E-05	1.858	0.082
AI644T	B	137	SN-125x	0.58	1.46E+01	2006121.159	6312769.373
AI644T	B	137	TE-123m	0.97	-1.52E-06	-0.209	-0.425
AI644T	B	137	XE-129m	0.53	1.78E-02	2438.366	4434.379
AI644T	B	137	ZN-65	0.93	3.71E-02	5088.920	111.397
BO14NE	A	191.2	BA-133	0.86	1.77E-01	33853.485	5280.111
BO14NE	A	191.2	CE-141	0.85	7.70E-05	14.726	22.274
BO14NE	A	191.2	CO-60	0.90	7.85E-05	15.011	1.913
BO14NE	A	191.2	EU-152x	0.57	2.04E-06	0.390	0.066
BO14NE	A	191.2	HF-175	0.85	5.77E-05	11.027	6.465
BO14NE	A	191.2	HF-181	0.69	1.46E-05	2.795	1.016
BO14NE	A	191.2	SB-124	0.49	1.66E-05	3.165	0.461
BO14NE	A	191.2	SC-46	0.87	8.10E-05	15.496	1.947
BO14NE	A	191.2	Si-32	0.88	8.87E-02	16954.862	43526.207
BO14NE	A	191.2	ZN-65	0.93	1.51E-01	28878.821	3599.339
BO14NE	A	191.2	ZR-95	0.96	1.90E-03	363.279	259.284
BO14NE	B	111.8	AS-77	0.91	8.87E-05	9.914	1.546
BO14NE	B	111.8	AU-198	0.98	6.64E-11	0.000	0.000
BO14NE	B	111.8	BA-131	0.99	3.66E-03	408.653	8.346
BO14NE	B	111.8	BA-133	0.71	1.26E-01	14048.352	1692.090
BO14NE	B	111.8	Ca-47	0.70	2.49E-03	278.910	70.246
BO14NE	B	111.8	CE-139	0.86	1.76E-03	197.057	77.618
BO14NE	B	111.8	CE-141	0.98	4.56E-05	5.103	0.502
BO14NE	B	111.8	CO-60	1.00	3.76E-05	4.205	0.164
BO14NE	B	111.8	CR-51	1.00	1.94E-04	21.633	1.354
BO14NE	B	111.8	FE-59	1.00	3.83E-03	428.684	56.304
BO14NE	B	111.8	HF-175	0.90	4.16E-05	4.646	0.616
BO14NE	B	111.8	HF-181	0.82	1.48E-05	1.653	0.071
BO14NE	B	111.8	HG-197	0.83	3.43E-09	0.000	0.000
BO14NE	B	111.8	IR-194	0.95	5.37E-13	0.000	0.000
BO14NE	B	111.8	LA-140	0.69	1.09E-09	0.000	0.000
BO14NE	B	111.8	LU-177	0.98	4.04E-08	0.005	0.002
BO14NE	B	111.8	OS-185	0.79	1.30E-05	1.449	0.981
BO14NE	B	111.8	RE-186	0.96	4.12E-09	0.000	0.000

BO14NE	B	111.8	RU-103	0.84	1.76E-04	19.671	1.705
BO14NE	B	111.8	SB-122	0.99	2.33E-09	0.000	0.000
BO14NE	B	111.8	SB-124	0.96	3.63E-06	0.406	0.019
BO14NE	B	111.8	SB-125	0.39	5.03E+00	562437.021	128890.771
BO14NE	B	111.8	SC-46	0.99	1.19E-05	1.325	0.036
BO14NE	B	111.8	SN-125x	0.99	1.54E-02	1726.426	4104.777
BO14NE	B	111.8	TE-123m	0.93	3.71E-05	4.147	0.467
BO14NE	B	111.8	XE-127	0.39	2.81E-05	3.137	3.028
BO14NE	B	111.8	XE-133m	0.94	4.52E-07	0.051	0.045
BO14NE	B	111.8	ZN-65	1.00	8.15E-02	9117.053	169.707
B92YNB	A	228.7	CE-141	0.93	2.67E-05	6.115	17.552
B92YNB	A	228.7	CO-60	0.95	3.53E-05	8.066	1.052
B92YNB	A	228.7	FE-59	0.31	5.06E-03	1158.176	196.626
B92YNB	A	228.7	HF-175	0.93	8.72E-05	19.943	6.182
B92YNB	A	228.7	HF-181	0.74	1.65E-05	3.780	0.609
B92YNB	A	228.7	HG-203	0.87	3.18E-06	0.728	1.659
B92YNB	A	228.7	RU-103	0.89	4.50E-05	10.291	2.370
B92YNB	A	228.7	SB-124	0.75	1.23E-05	2.806	0.361
B92YNB	A	228.7	SC-46	0.97	2.43E-05	5.550	0.704
B92YNB	A	228.7	ZN-65	0.98	5.60E-02	12807.931	1595.600
B92YNB	B	261.6	CE-141	0.93	1.63E-04	42.724	6.087
B92YNB	B	261.6	CO-60	0.99	2.85E-05	7.456	0.316
B92YNB	B	261.6	EU-154	0.42	3.63E-06	0.949	0.105
B92YNB	B	261.6	FE-59	0.97	3.67E-03	960.496	173.789
B92YNB	B	261.6	HF-181	0.74	1.45E-05	3.789	0.329
B92YNB	B	261.6	HG-203	0.87	2.23E-06	0.584	1.426
B92YNB	B	261.6	OS-185	0.78	5.87E-05	15.364	8.695
B92YNB	B	261.6	SB-124	0.94	8.47E-06	2.216	0.085
B92YNB	B	261.6	SC-46	0.98	1.87E-05	4.904	0.151
B92YNB	B	261.6	SN-125x	0.64	2.09E+01	5465456.338	4803411.220
B92YNB	B	261.6	TA-182	0.53	5.61E-08	0.015	0.011
B92YNB	B	261.6	ZN-65	1.00	4.32E-02	11299.797	241.278
B9ZYNB	B	261.6	ZR-95	0.93	3.71E-04	97.101	71.844
BRT6RD	A	104.4	BA-133	0.51	1.98E-01	20713.937	2600.843
BRT6RD	A	104.4	CO-60	0.87	1.13E-04	11.763	0.401
BRT6RD	A	104.4	EU-152x	0.61	2.78E-06	0.290	0.030
BRT6RD	A	104.4	HF-181	0.70	3.34E-05	3.488	0.579
BRT6RD	A	104.4	SB-124	0.89	4.93E-05	5.146	0.223
BRT6RD	A	104.4	ZN-65	0.91	1.70E-01	17707.947	386.393
BRT6RD	B	140.7	AU-198	0.63	7.62E-08	0.011	0.014
BRT6RD	B	140.7	BA-131	0.95	1.79E-02	2522.135	320.518
BRT6RD	B	140.7	CE-141	0.98	1.11E-04	15.580	2.498
BRT6RD	B	140.7	CR-51	0.89	2.47E-04	34.757	5.508
BRT6RD	B	140.7	HF-175	0.86	3.69E-05	5.193	1.075
BRT6RD	B	140.7	HF-181	0.88	2.22E-05	3.125	0.407
BRT6RD	B	140.7	ND-147	0.95	6.17E-05	8.679	4.122
BRT6RD	B	140.7	RU-97	0.54	5.50E-03	773.687	226.719
BRT6RD	B	140.7	SB-124	0.74	3.96E-06	0.557	0.074
BRT6RD	B	140.7	SC-46	0.97	1.46E-05	2.060	0.262
BRT6RD	B	140.7	TA-182	0.72	7.30E-08	0.010	0.006

BRT6RD	B	140.7	TE-123m	0.93	3.23E-05	4.548	1.086
BRT6RD	B	140.7	XE-127	0.39	1.28E-04	18.063	8.257
BRT6RD	B	140.7	ZN-65	0.99	5.25E-02	7393.330	921.238
PN38IZ	B	228	BA-133	1.00	2.16E-01	49216.020	4559.791
PN38IZ	B	228	CE-141	0.86	3.87E-05	8.814	38.423
PN38IZ	B	228	CO-60	0.92	2.41E-04	55.023	1.264
PN38IZ	B	228	EU-152x	0.64	4.72E-06	1.075	0.094
PN38IZ	B	228	HF-175	0.90	2.62E-04	59.771	23.572
PN38IZ	B	228	HF-181	0.66	1.59E-05	3.636	1.460
PN38IZ	B	228	SB-124	0.61	2.46E-05	5.613	0.391
PN38IZ	B	228	SC-46	0.89	1.49E-04	33.993	0.846
PN38IZ	B	228	ZN-65	0.94	2.00E-01	45488.021	971.528
PN38IZ	B	228	BA-133	0.38	6.77E-02	15432.040	3207.205
PN38IZ	B	228	CE-141	0.94	1.47E-04	33.510	5.704
PN38IZ	B	228	CO-60	0.98	6.04E-05	13.774	0.442
PN38IZ	B	228	CR-51	0.88	1.58E-04	35.967	15.766
PN38IZ	B	228	EU-152x	0.53	1.83E-06	0.418	0.035
PN38IZ	B	228	EU-154	0.33	4.24E-07	0.097	0.054
PN38IZ	B	228	SB-124	0.53	3.75E-06	0.854	0.068
PN38IZ	B	228	SC-46	0.97	2.03E-05	4.628	0.141
PN38IZ	B	228	ZN-65	0.98	4.48E-02	10209.583	217.917
ESF946	B	70.3	BA-131	0.61	2.41E-02	1695.468	241.225
ESF946	B	70.3	CE-141	0.85	1.41E-04	9.881	3.356
ESF946	B	70.3	CO-60	1.00	3.22E-05	2.262	0.127
ESF946	B	70.3	EU-154	0.40	1.89E-06	0.133	0.064
ESF946	B	70.3	HF-175	0.99	8.38E-05	5.891	1.650
ESF946	B	70.3	OS-185	0.84	6.43E-05	4.522	2.018
ESF946	B	70.3	SB-124	0.61	1.09E-06	0.077	0.027
ESF946	B	70.3	SC-46	0.99	2.39E-05	1.683	0.073
ESF946	B	70.3	TE-123m	0.96	1.56E-05	1.099	0.713
ESF946	B	70.3	ZN-65	1.00	6.58E-02	4626.886	101.818
G48MJ6	A	214.3	BA-131	0.34	1.03E-02	2198.736	513.097
G48MJ6	A	214.3	CE-141	0.96	1.50E-04	32.167	4.453
G48MJ6	A	214.3	CO-60	0.99	3.36E-05	7.202	0.275
G48MJ6	A	214.3	EU-152x	0.56	2.06E-06	0.442	0.030
G48MJ6	A	214.3	EU-154	0.39	9.80E-07	0.210	0.197
G48MJ6	A	214.3	FE-59	0.32	1.82E-03	390.492	144.555
G48MJ6	A	214.3	HF-181	0.88	4.97E-06	1.066	0.184
G48MJ6	A	214.3	IR-192	0.59	2.88E-08	0.006	0.005
G48MJ6	A	214.3	SB-124	0.45	4.04E-06	0.866	0.057
G48MJ6	A	214.3	SC-46	0.98	1.92E-05	4.116	0.110
G48MJ6	A	214.3	TE-123m	0.90	1.61E-06	0.345	0.543
G48MJ6	A	214.3	YB-169	0.72	8.71E-09	0.002	0.085
G48MJ6	A	214.3	ZN-65	0.99	3.79E-02	8116.315	146.880
G48MJ6	B	145.8	BA-133	0.86	2.04E-01	29727.118	4812.979
G48MJ6	B	145.8	CE-141	0.88	2.64E-04	38.563	16.727
G48MJ6	B	145.8	CO-60	0.87	1.02E-04	14.801	0.503
G48MJ6	B	145.8	EU-152x	0.70	3.42E-06	0.499	0.042
G48MJ6	B	145.8	HF-175	0.91	2.42E-04	35.212	6.424
G48MJ6	B	145.8	HF-181	0.66	3.33E-05	4.854	1.096

G48MJ6	B	145.8	RB-86	0.59	2.05E-03	298.874	134.878
G48MJ6	B	145.8	SB-124	0.49	1.78E-05	2.596	0.195
G48MJ6	B	145.8	SC-46	0.88	1.20E-04	17.491	0.386
G48MJ6	B	145.8	TE-123m	0.89	1.86E-06	0.271	0.961
G48MJ6	B	145.8	ZN-65	0.92	1.47E-01	21451.767	396.851
UGA145	A	96.7	BA-131	0.55	3.05E-02	2951.995	402.604
UGA145	A	96.7	BA-133	0.32	5.05E-02	4883.680	2744.330
UGA145	A	96.7	CO-60	0.98	5.61E-05	5.422	0.262
UGA145	A	96.7	CR-51	0.94	4.43E-04	42.849	14.296
UGA145	A	96.7	IN-114m	0.53	9.78E-06	0.946	0.390
UGA145	A	96.7	SB-124	0.45	9.13E-06	0.882	0.067
UGA145	A	96.7	SC-46	0.97	2.48E-05	2.398	0.125
UGA145	A	96.7	Si-32	0.96	6.11E-02	5909.837	14076.824
UGA145	A	96.7	ZN-65	0.98	9.37E-02	9064.825	195.012
IF3555	A	153.8	BA-133	0.71	2.15E-01	33048.770	2985.113
IF3555	A	153.8	CE-141	0.88	4.62E-04	71.044	25.236
IF3555	A	153.8	CO-60	0.89	1.29E-04	19.890	0.634
IF3555	A	153.8	EU-152x	0.86	3.98E-06	0.612	0.026
IF3555	A	153.8	HF-175	0.91	8.09E-05	12.445	5.175
IF3555	A	153.8	HF-181	0.70	2.44E-05	3.751	0.478
IF3555	A	153.8	OS-191	0.52	4.24E-03	652.246	186.210
IF3555	A	153.8	SB-124	0.50	1.92E-05	2.955	0.203
IF3555	A	153.8	SC-46	0.87	9.78E-05	15.044	0.361
IF3555	A	153.8	TE-121x	0.88	1.04E-01	16048.618	6133.482
IF3555	A	153.8	ZN-65	0.92	1.46E-01	22503.206	487.712
IF3555	B	171.2	CE-141	0.95	3.23E-04	55.289	8.664
IF3555	B	171.2	CO-60	1.00	5.29E-05	9.058	1.163
IF3555	B	171.2	CR-51	0.95	4.53E-04	77.483	12.968
IF3555	B	171.2	EU-152x	0.68	2.25E-06	0.384	0.058
IF3555	B	171.2	HF-175	0.91	5.52E-05	9.443	2.781
IF3555	B	171.2	HF-181	0.89	2.52E-05	4.309	0.582
IF3555	B	171.2	OS-185	0.99	5.07E-05	8.674	6.760
IF3555	B	171.2	SB-124	0.81	6.50E-06	1.113	0.154
IF3555	B	171.2	SC-46	0.99	2.69E-05	4.608	0.582
IF3555	B	171.2	ZN-65	1.00	5.94E-02	10164.803	1266.322
IF3555	B	171.2	ZR-95	0.93	4.16E-04	71.297	75.387
IS78FS	A	48.2	AG-110m	0.54	7.76E-07	0.037	0.006
IS78FS	A	48.2	BA-131	0.35	3.66E-02	1761.961	258.717
IS78FS	A	48.2	CO-60	1.00	7.81E-05	3.763	0.200
IS78FS	A	48.2	SB-124	0.44	4.57E-07	0.022	0.026
IS78FS	A	48.2	ZN-65	1.00	1.10E-01	5279.930	116.780
IS78FS	B	67.6	BA-133	0.47	7.34E-02	4962.781	3624.105
IS78FS	B	67.6	CE-141	0.95	4.44E-05	3.000	5.247
IS78FS	B	67.6	CO-60	0.92	1.03E-04	6.996	0.280
IS78FS	B	67.6	CR-51	0.89	5.75E-04	38.868	5.302
IS78FS	B	67.6	HF-181	0.87	8.90E-06	0.601	0.105
IS78FS	B	67.6	RU-103	0.86	8.35E-05	5.642	1.301
IS78FS	B	67.6	SB-124	0.42	1.98E-06	0.134	0.029
IS78FS	B	67.6	TB-160	0.61	3.08E-11	0.000	0.000
IS78FS	B	67.6	TE-123m	0.99	6.77E-06	0.457	0.624

IS78FS	B	67.6	ZN-65	0.93	1.01E-01	6851.387	148.458
JD5RT2	A	210.9	BA-131	0.61	1.79E-02	3772.758	650.136
JD5RT2	A	210.9	BA-133	0.37	6.23E-02	13129.344	3704.710
JD5RT2	A	210.9	CO-60	1.00	3.98E-05	8.390	1.083
JD5RT2	A	210.9	EU-152x	0.42	2.93E-06	0.618	0.092
JD5RT2	A	210.9	HF-175	0.92	5.27E-06	1.111	3.449
JD5RT2	A	210.9	LU-177	0.40	1.30E-05	2.748	47.613
JD5RT2	A	210.9	RU-103	0.82	1.83E-05	3.850	1.873
JD5RT2	A	210.9	SB-124	0.75	4.14E-06	0.872	0.130
JD5RT2	A	210.9	SC-46	0.99	2.37E-05	5.003	0.632
JD5RT2	A	210.9	TA-182	0.65	5.21E-08	0.011	0.010
JD5RT2	A	210.9	TE-121x	0.90	3.78E-02	7964.197	6862.236
JD5RT2	A	210.9	ZN-65	1.00	5.64E-02	11902.422	1482.652
JD5RT2	B	165	BA-133	0.40	5.31E-02	8763.930	1512.832
JD5RT2	B	165	CE-141	0.95	1.62E-04	26.747	4.127
JD5RT2	B	165	CO-60	0.99	3.23E-05	5.333	0.225
JD5RT2	B	165	CR-51	0.93	2.85E-04	46.956	6.495
JD5RT2	B	165	OS-185	0.82	1.31E-06	0.216	2.308
JD5RT2	B	165	SB-124	0.84	3.84E-06	0.634	0.042
JD5RT2	B	165	SC-46	0.99	1.91E-05	3.144	0.098
JD5RT2	B	165	ZN-65	0.99	4.50E-02	7426.650	158.715
JHHCD2	B	104.5	CR-51	0.89	7.32E-06	0.765	7.799
JHHCD2	B	104.5	SB-124	0.48	4.46E-06	0.466	0.065
JHHCD2	B	104.5	Si-32	0.92	2.28E-02	2386.397	17505.484
JHHCD2	B	104.5	TE-123m	1.00	4.02E-06	0.420	0.812
JHHCD2	B	104.5	ZN-65	0.92	8.15E-02	8514.957	184.283
JR3584	B	191.7	BA-133	0.52	2.03E-01	38980.793	3469.392
JR3584	B	191.7	CE-141	0.87	1.78E-04	34.103	10.570
JR3584	B	191.7	CO-60	0.90	9.00E-05	17.253	0.549
JR3584	B	191.7	EU-152x	0.57	2.24E-06	0.429	0.021
JR3584	B	191.7	HF-175	0.93	8.08E-05	15.481	5.965
JR3584	B	191.7	HF-181	0.78	2.06E-05	3.948	0.480
JR3584	B	191.7	OS-191	0.55	3.45E-03	661.194	211.721
JR3584	B	191.7	SB-124	0.49	1.80E-05	3.456	0.249
JR3584	B	191.7	TE-121x	0.99	1.69E-01	32375.713	21319.991
JR3584	B	191.7	ZN-65	0.93	1.51E-01	28856.736	624.162
JR3584	A	161.5	BA-131	0.60	1.55E-02	2502.952	467.491
JR3584	A	161.5	BA-133	0.52	8.14E-02	13145.683	3263.046
JR3584	A	161.5	CO-60	0.97	3.81E-05	6.152	0.803
JR3584	A	161.5	HF-181	0.81	1.55E-05	2.505	0.398
JR3584	A	161.5	IR-192	0.34	2.15E-08	0.003	0.002
JR3584	A	161.5	RB-86	0.88	4.82E-05	7.778	7.940
JR3584	A	161.5	RU-103	0.82	2.03E-06	0.328	1.606
JR3584	A	161.5	SB-124	0.54	4.40E-06	0.711	0.105
JR3584	A	161.5	SC-46	0.99	1.02E-05	1.650	0.222
JR3584	A	161.5	ZN-65	0.99	5.11E-02	8250.794	1028.087
KI9846	A	159.6	BA-131	0.60	1.75E-02	2785.507	684.556
KI9846	A	159.6	BA-133	0.87	9.79E-02	15619.218	3802.887
KI9846	A	159.6	CE-141	0.96	2.10E-04	33.548	5.394
KI9846	A	159.6	CO-60	0.99	8.86E-05	14.146	1.795

KI9846	A	159.6	CR-51	0.92	3.16E-04	50.478	14.994
KI9846	A	159.6	EU-152x	0.51	2.33E-06	0.373	0.054
KI9846	A	159.6	EU-154	0.31	3.10E-06	0.494	0.190
KI9846	A	159.6	HF-175	0.86	6.28E-05	10.023	4.726
KI9846	A	159.6	LU-177	0.44	1.29E-04	20.607	67.630
KI9846	A	159.6	RU-103	0.90	2.72E-05	4.339	2.676
KI9846	A	159.6	SB-124	0.77	5.02E-06	0.802	0.112
KI9846	A	159.6	SC-46	0.99	2.80E-05	4.464	0.565
KI9846	A	159.6	XE-127	0.77	4.87E-05	7.771	39.064
KI9846	A	159.6	ZN-65	1.00	6.80E-02	10855.771	1352.372
KI9846	B	178.3	BA-133	0.68	9.52E-02	16979.047	3698.950
KI9846	B	178.3	CE-141	0.89	1.96E-04	34.997	6.631
KI9846	B	178.3	CO-60	0.90	7.22E-05	12.877	1.638
KI9846	B	178.3	HF-181	0.75	1.10E-05	1.957	0.368
KI9846	B	178.3	NB-94x	0.93	1.16E-01	20674.402	41285.763
KI9846	B	178.3	SB-124	0.82	4.94E-06	0.880	0.124
KI9846	B	178.3	SC-46	0.92	2.57E-05	4.587	0.581
KI9846	B	178.3	ZN-65	0.90	6.07E-02	10814.575	1347.301
MSU4TD	A	140.4	CE-141	0.95	1.37E-04	19.241	4.161
MSU4TD	A	140.4	CO-60	0.98	1.55E-05	2.174	0.310
MSU4TD	A	140.4	CR-51	0.93	2.09E-04	29.378	12.743
MSU4TD	A	140.4	FE-59	0.30	1.16E-03	162.981	298.296
MSU4TD	A	140.4	HF-181	0.82	1.57E-05	2.209	0.320
MSU4TD	A	140.4	LU-177	0.41	1.70E-04	23.896	49.593
MSU4TD	A	140.4	SB-124	0.80	4.00E-06	0.562	0.082
MSU4TD	A	140.4	SC-46	0.98	1.49E-05	2.088	0.271
MSU4TD	A	140.4	TE-121	0.51	1.76E-02	2465.611	4248.082
MSU4TD	A	140.4	ZN-65	1.00	6.08E-02	8532.954	1063.206
MSU4TD	B	225	BA-133	0.53	1.74E-01	39139.129	6056.999
MSU4TD	B	225	CE-141	0.81	8.29E-05	18.648	35.759
MSU4TD	B	225	CO-60	0.91	2.80E-05	6.311	0.876
MSU4TD	B	225	EU-152x	0.78	2.56E-06	0.576	0.082
MSU4TD	B	225	HF-181	0.62	2.80E-05	6.301	0.996
MSU4TD	B	225	IR-192	0.33	5.76E-08	0.013	0.008
MSU4TD	B	225	OS-185	0.79	6.48E-05	14.583	9.591
MSU4TD	B	225	SB-124	0.68	2.03E-05	4.559	0.638
MSU4TD	B	225	ZN-65	0.94	1.71E-01	38552.737	4800.988
MTCL37	A	125.8	AU-198	0.52	1.90E-07	0.024	0.070
MTCL37	A	125.8	BA-131	0.95	8.66E-03	1089.154	41.842
MTCL37	A	125.8	BA-133	0.32	1.96E-01	24663.851	4118.807
MTCL37	A	125.8	CE-141	0.92	1.31E-04	16.514	1.968
MTCL37	A	125.8	CO-60	1.00	1.08E-04	13.648	0.484
MTCL37	A	125.8	CR-51	0.98	2.59E-04	32.541	4.419
MTCL37	A	125.8	HF-181	0.89	2.19E-05	2.753	0.139
MTCL37	A	125.8	RU-97	0.47	5.04E-03	633.805	243.979
MTCL37	A	125.8	SB-124	0.76	5.67E-06	0.713	0.039
MTCL37	A	125.8	SC-46	0.97	1.97E-05	2.482	0.094
MTCL37	A	125.8	YB-169	0.65	1.27E-06	0.159	0.077
MTCL37	A	125.8	ZN-65	1.00	8.57E-02	10776.701	230.993
MTCL37	B	119.9	AU-198	0.67	5.34E-08	0.006	0.009

MTCL37	B	119.9	BA-131	0.98	2.76E-02	3306.305	106.830
MTCL37	B	119.9	BA-133	0.54	2.18E-01	26079.297	3039.181
MTCL37	B	119.9	CE-141	0.99	1.16E-04	13.949	1.358
MTCL37	B	119.9	CO-60	1.00	1.24E-04	14.850	0.506
MTCL37	B	119.9	CR-51	0.99	4.15E-04	49.793	3.278
MTCL37	B	119.9	EU-154	0.50	2.98E-07	0.036	0.058
MTCL37	B	119.9	FE-59	1.00	1.01E-02	1215.425	73.315
MTCL37	B	119.9	HF-175	0.99	5.30E-05	6.351	1.904
MTCL37	B	119.9	HF-181	0.91	8.37E-06	1.004	0.039
MTCL37	B	119.9	LU-177	0.91	4.53E-06	0.544	0.125
MTCL37	B	119.9	RB-86	0.98	2.93E-05	3.509	0.834
MTCL37	B	119.9	RU-97	0.59	7.61E-03	912.272	230.048
MTCL37	B	119.9	SB-122	0.68	1.36E-07	0.016	0.684
MTCL37	B	119.9	SB-124	0.92	8.47E-06	1.016	0.052
MTCL37	B	119.9	SC-46	1.00	4.17E-05	4.996	0.114
MTCL37	B	119.9	TE-123m	1.00	5.79E-05	6.937	0.794
MTCL37	B	119.9	YB-169	0.65	1.70E-06	0.204	0.107
MTCL37	B	119.9	ZN-65	1.00	1.07E-01	12876.439	270.508
N6D5A7	B	131.9	BA-131	0.95	1.74E-02	2293.225	69.615
N6D5A7	B	131.9	BA-133	0.51	6.74E-02	8886.512	4062.865
N6D5A7	B	131.9	CE-141	0.97	1.66E-04	21.848	1.483
N6D5A7	B	131.9	CO-60	0.97	6.62E-05	8.735	0.292
N6D5A7	B	131.9	CR-51	0.96	2.55E-04	33.599	3.049
N6D5A7	B	131.9	FE-59	0.99	5.33E-03	702.798	77.016
N6D5A7	B	131.9	HF-181	0.69	1.19E-05	1.565	0.090
N6D5A7	B	131.9	RB-86	0.96	7.60E-06	1.002	0.412
N6D5A7	B	131.9	RU-97	0.54	5.60E-03	738.974	181.719
N6D5A7	B	131.9	SB-124	0.79	3.70E-06	0.489	0.024
N6D5A7	B	131.9	SC-46	0.98	2.06E-05	2.711	0.071
N6D5A7	B	131.9	TA-182	0.56	1.36E-07	0.018	0.007
N6D5A7	B	131.9	XE-129m	0.83	1.98E-04	26.092	4.819
N6D5A7	B	131.9	ZN-65	0.98	4.99E-02	6578.351	119.614
N6D5A7	A	216.1	AG-108m	0.40	3.03E-04	65.381	460.745
N6D5A7	A	216.1	BA-131	0.74	8.78E-03	1898.239	281.348
N6D5A7	A	216.1	BA-133	0.86	7.81E-02	16874.190	2304.342
N6D5A7	A	216.1	CO-60	1.00	7.27E-05	15.706	0.485
N6D5A7	A	216.1	CR-51	0.85	1.36E-04	29.433	12.090
N6D5A7	A	216.1	EU-154	0.63	4.96E-07	0.107	0.056
N6D5A7	A	216.1	FE-59	0.33	4.02E-03	868.319	422.584
N6D5A7	A	216.1	HF-175	0.91	1.05E-04	22.785	4.590
N6D5A7	A	216.1	RU-103	0.79	1.82E-05	3.939	1.562
N6D5A7	A	216.1	SB-124	0.95	4.31E-06	0.931	0.051
N6D5A7	A	216.1	SC-46	0.99	2.21E-05	4.771	0.143
N6D5A7	A	216.1	TA-182	0.66	3.32E-08	0.007	0.008
N6D5A7	A	216.1	ZN-65	1.00	4.88E-02	10556.342	224.934
PN38IZ	A	149.2	BA-131	0.91	2.26E-02	3371.520	192.505
PN38IZ	A	149.2	BA-133	0.54	1.28E-01	19083.664	3362.101
PN38IZ	A	149.2	CE-141	0.98	1.96E-04	29.194	2.559
PN38IZ	A	149.2	CO-60	0.98	7.11E-05	10.607	0.402
PN38IZ	A	149.2	CR-51	0.95	3.21E-04	47.838	3.807

PN38IZ	A	149.2	SB-124	0.83	6.95E-06	1.037	0.049
PN38IZ	A	149.2	SB-125	0.35	5.89E+00	878941.446	180749.399
PN38IZ	A	149.2	SC-46	0.99	2.58E-05	3.846	0.112
PN38IZ	A	149.2	TA-182	0.51	4.99E-08	0.007	0.012
PN38IZ	A	149.2	ZN-65	1.00	5.79E-02	8643.718	184.786
R67R85	A	278.9	BA-131	0.34	1.31E-02	3657.540	434.080
R67R85	A	278.9	BA-133	0.41	6.78E-02	18910.138	3312.113
R67R85	A	278.9	CE-141	0.95	1.68E-04	46.854	5.259
R67R85	A	278.9	CO-60	0.98	2.59E-05	7.212	0.292
R67R85	A	278.9	CR-51	0.95	2.15E-04	60.060	14.008
R67R85	A	278.9	EU-152x	0.51	1.87E-06	0.521	0.039
R67R85	A	278.9	HF-175	0.99	5.34E-05	14.891	3.067
R67R85	A	278.9	HF-181	0.74	1.30E-05	3.615	0.170
R67R85	A	278.9	OS-185	0.89	4.92E-04	137.181	98.989
R67R85	A	278.9	OS-191	0.80	1.05E-05	2.931	6.566
R67R85	A	278.9	SB-124	0.77	7.89E-06	2.200	0.081
R67R85	A	278.9	SC-46	0.98	1.58E-05	4.393	0.130
R67R85	A	278.9	SN-125x	0.66	2.79E+00	778384.522	2939145.978
R67R85	A	278.9	TB-160	0.47	1.02E-07	0.029	0.021
R67R85	A	278.9	ZN-65	0.99	3.83E-02	10691.078	227.536
SA4132	A	155.3	BA-131	0.95	1.88E-02	2924.394	371.797
SA4132	A	155.3	BA-133	0.83	7.58E-02	11772.888	3138.026
SA4132	A	155.3	Ca-47	0.57	9.27E-03	1439.726	10393.006
SA4132	A	155.3	CE-141	0.98	3.70E-04	57.468	7.471
SA4132	A	155.3	CO-60	0.98	5.07E-05	7.874	1.017
SA4132	A	155.3	CR-51	0.98	2.99E-04	46.470	7.027
SA4132	A	155.3	FE-59	0.92	8.76E-03	1361.117	186.886
SA4132	A	155.3	HF-181	0.72	2.31E-05	3.581	0.459
SA4132	A	155.3	OS-185	0.85	9.41E-04	146.088	320.797
SA4132	A	155.3	RU-97	0.53	5.73E-03	890.568	267.752
SA4132	A	155.3	SB-124	0.93	6.67E-06	1.035	0.133
SA4132	A	155.3	SC-46	0.99	2.73E-05	4.245	0.533
SA4132	A	155.3	TA-182	0.66	1.84E-07	0.029	0.008
SA4132	A	155.3	YB-175	0.82	#N/A	#N/A	#N/A
SA4132	A	155.3	ZN-65	0.99	5.57E-02	8655.955	1078.417
5H2F01	B	184.5	BA-133	0.47	8.41E-02	15513.325	3851.777
5H2F01	B	184.5	CE-141	0.93	2.84E-04	52.347	16.229
5H2F01	B	184.5	CO-60	0.87	5.87E-05	10.828	1.382
5H2F01	B	184.5	CR-51	0.85	2.27E-04	41.816	18.196
5H2F01	B	184.5	HF-181	0.69	2.62E-05	4.838	0.679
5H2F01	B	184.5	IR-192	0.32	6.06E-09	0.001	0.000
5H2F01	B	184.5	ND-147	0.68	1.72E-03	317.598	638.254
5H2F01	B	184.5	RU-103	0.88	6.30E-05	11.622	2.464
5H2F01	B	184.5	SB-124	0.49	7.82E-06	1.444	0.194
5H2F01	B	184.5	SC-46	0.92	3.26E-05	6.007	0.758
5H2F01	B	184.5	TA-182	0.39	1.13E-07	0.021	0.010
5H2F01	B	184.5	YB-169	0.60	1.39E-06	0.256	0.294
5H2F01	B	184.5	ZN-65	0.91	6.99E-02	12896.892	1606.572
TJ66RG	B	170	HF-175	0.90	5.68E-01	96603.821	117085.494
TJ66RG	B	170	IN-114m	0.55	3.44E-02	5847.024	32295.983

TJ66RG	A	136.5	AG-108m	0.41	7.75E-03	1057.822	412.373
TJ66RG	A	136.5	BA-131	0.57	1.37E-02	1870.308	405.213
TJ66RG	A	136.5	CO-60	0.91	4.19E-05	5.724	0.249
TJ66RG	A	136.5	LU-177	0.32	1.58E-04	21.577	166.748
TJ66RG	A	136.5	RU-103	0.92	7.03E-04	95.902	25.583
TJ66RG	A	136.5	SN-125x	0.58	6.76E+01	9227867.540	7227551.366
TJ66RG	A	136.5	ZN-65	0.92	6.68E-02	9111.640	194.689
UGA145	A	96.7	BA-133	0.64	3.09E-01	29875.366	3603.168
UGA145	A	96.7	CO-60	0.89	1.45E-04	13.979	0.508
UGA145	A	96.7	CR-51	0.79	1.51E-03	145.544	70.346
UGA145	A	96.7	EU-152x	0.60	3.56E-06	0.344	0.047
UGA145	A	96.7	HF-175	0.93	1.48E-04	14.292	6.442
UGA145	A	96.7	HF-181	0.70	4.91E-05	4.744	1.202
UGA145	A	96.7	SB-124	0.72	3.49E-05	3.378	0.223
UGA145	A	96.7	SC-46	0.87	1.11E-04	10.771	0.271
UGA145	A	96.7	TE-121x	0.92	5.69E-01	55005.656	10423.685
UGA145	A	96.7	XE-127	0.37	2.45E-03	237.204	146.017
UGA145	A	96.7	ZN-65	0.92	2.69E-01	26003.015	550.126
UGA145	B	70.6	BA-133	0.72	8.43E-02	5951.890	1842.686
UGA145	B	70.6	CE-139	0.96	7.83E-04	55.246	13.316
UGA145	B	70.6	CO-60	0.95	3.60E-05	2.540	0.167
UGA145	B	70.6	CR-51	0.80	5.05E-05	3.565	12.638
UGA145	B	70.6	RU-103	0.94	4.29E-05	3.029	1.124
UGA145	B	70.6	SB-124	0.71	5.59E-06	0.395	0.041
UGA145	B	70.6	TE-121x	0.86	2.30E-05	1.627	1.404
UGA145	B	70.6	ZN-65	0.95	7.82E-02	5521.500	120.945
VT23AC	A	190.9	BA-131	0.93	1.21E-02	2301.921	99.139
VT23AC	A	190.9	CE-141	0.99	7.77E-05	14.828	1.993
VT23AC	A	190.9	CR-51	0.97	1.19E-04	22.732	3.698
VT23AC	A	190.9	CS-134	0.32	1.30E-08	0.002	0.002
VT23AC	A	190.9	HF-181	0.74	5.24E-06	1.001	0.045
VT23AC	A	190.9	IN-114m	0.58	1.33E-07	0.025	0.351
VT23AC	A	190.9	RU-103	0.97	1.64E-05	3.138	0.689
VT23AC	A	190.9	RU-97	0.36	2.90E-02	5528.912	2014.178
VT23AC	A	190.9	SB-124	0.86	3.32E-06	0.635	0.016
VT23AC	A	190.9	SC-46	0.96	7.65E-06	1.461	0.065
VT23AC	A	190.9	ZN-65	0.99	3.68E-02	7018.402	151.894
VT23AC	B	152.7	BA-133	0.40	7.96E-02	12149.789	3505.877
VT23AC	B	152.7	CE-141	0.96	2.00E-04	30.504	6.121
VT23AC	B	152.7	CO-60	0.97	9.83E-06	1.501	0.187
VT23AC	B	152.7	EU-154	0.36	1.01E-05	1.536	0.109
VT23AC	B	152.7	HF-181	0.73	2.64E-05	4.038	0.295
VT23AC	B	152.7	SB-124	0.77	6.91E-06	1.055	0.066
VT23AC	B	152.7	SC-46	0.99	1.94E-05	2.968	0.154
VT23AC	B	152.7	TA-182	0.36	1.84E-07	0.028	0.015
VT23AC	B	152.7	ZN-65	1.00	8.92E-02	13625.740	290.473
WH3JMZ	A	200.3	BA-131	0.32	2.08E-02	4165.474	721.551
WH3JMZ	A	200.3	CE-141	0.96	6.31E-05	12.632	6.245
WH3JMZ	A	200.3	CO-60	0.99	9.63E-06	1.928	0.248
WH3JMZ	A	200.3	CR-51	0.89	7.75E-05	15.514	15.218

WH3JMZ	A	200.3	CS-134	0.87	1.40E-06	0.280	0.066
WH3JMZ	A	200.3	IN-114m	0.56	1.94E-06	0.389	1.020
WH3JMZ	A	200.3	SB-124	0.45	3.98E-06	0.797	0.111
WH3JMZ	A	200.3	SC-46	0.93	1.41E-05	2.814	0.145
WH3JMZ	A	200.3	ZN-65	0.92	5.61E-02	11231.904	239.728
WH3JMZ	B	75.1	BA-133	0.72	1.87E-01	14029.768	2264.993
WH3JMZ	B	75.1	CO-60	0.93	7.08E-05	5.314	0.353
WH3JMZ	B	75.1	EU-152x	0.58	2.88E-06	0.216	0.032
WH3JMZ	B	75.1	HF-175	0.94	6.63E-08	0.005	4.708
WH3JMZ	B	75.1	HF-181	0.67	3.03E-05	2.275	1.147
WH3JMZ	B	75.1	SB-124	0.49	2.49E-05	1.869	0.125
WH3JMZ	B	75.1	ZN-65	0.92	2.37E-01	17776.232	392.639

Table C-2 NAA data on clean filters

Serial Number	Spot	Element	ID Confidence	Specific Activity [µCi/mg]	Specific Activity Uncertainty [µCi/mg]	Specific Activity [Bq/mg]	Sample Mass [mg]	Activity [Bq]	*A*[g/moll]	Parent Element	Element Mass [g]	Element % Sample Mass	% Uncertainty	
CFSD	1	BA-131	0.99	0.02400919	0.00037959	888.34	306.3	272098.551	137.33	BA	0.004224	1.379187	0.11927405	
CFSD	1	BA-133	0.506	0.01474968	0.0060289	545.7382	306.3	167159.598	137.33	BA	0.01784	5.824437	0.42550112	Low Confidence
CFSD	1	CE-141	0.99	0.0002954	3.7816E-05	10.92972	306.3	3347.77394	140.12	CE	1.13E-05	0.003697	0.1742541	
CFSD	1	CR-51	0.982	0.00320029	0.00127506	118.4107	306.3	36269.1839	52	CR	4.09E-05	0.013366	0.41559102	
CFSD	1	AS-77	0.678	0.8890241	0.1379555	32893.89	306.3	10075399	72.64	GE	0.11681	38.13567	0.19507956	Low Confidence
CFSD	1	HF-181	0.678	0.00075623	0.00011455	27.98064	306.3	8570.47101	178.49	HF	2.16E-06	0.000704	0.19214354	Low Confidence
CFSD	1	HF-175	0.924	0.00039035	0.00010413	14.44299	306.3	4423.88918	178.49	HF	1.3E-05	0.004239	0.29177915	
CFSD	1	HG-197	0.362	0.6758418	0.05806146	25006.15	306.3	7659382.7	200.59	HG	2.33E-26	7.6E-24	0.1461398	Low Confidence
CFSD	1	LA-140	0.477	0.00350823	0.00014083	129.8043	306.3	39759.0647	138.91	LA	6.09E-06	0.001988	0.12485087	Low Confidence
CFSD	1	RH-105	0.581	0.01704906	0.01456644	630.8152	306.3	193218.702	92.90638	RB	0.000178	0.057955	0.86252417	Low Confidence
CFSD	1	RU-97	0.781	0.00023098	0.00023844	8.546423	306.3	2617.7693	92.90638	RU	2.41E-06	0.000785	1.03902468	
CFSD	1	RU-103	0.822	0.02027342	0.00055758	750.1165	306.3	229760.696	92.90638	RU	0.000211	0.068915	0.12137859	
CFSD	1	SB-124	0.786	0.00094171	0.00011464	34.8431	306.3	10672.4426	92.90638	SB	9.81E-06	0.003201	0.16969164	
CFSD	1	SB-122	0.857	0.00137107	0.00025049	50.72941	306.3	15538.4168	92.90638	SB	1.43E-05	0.004661	0.21761038	
CFSD	1	SC-46	0.996	0.00928887	0.00035675	343.688	306.3	105271.647	92.90638	SC	9.67E-05	0.031576	0.1243036	
CFSD	1	TA-182	0.405	0.00047743	0.00019388	17.66495	306.3	5410.77553	92.90638	TA	4.97E-06	0.001623	0.42295184	Low Confidence
CFSD	1	TE-123m	0.987	0.00090061	5.3746E-05	33.32273	306.3	10206.7508	92.90638	TE	9.38E-06	0.003061	0.13242974	
CFSD	1	YB-175	0.876	0.00042256	0.00037615	15.63466	306.3	4788.89547	92.90638	YB	4.4E-06	0.001436	0.89798249	
CFSD	1	ZN-65	0.999	1.301273	0.01366996	48147.1	306.3	14747457	92.90638	ZN	0.013549	4.423413	0.11868739	
CFSD	2	BA-131	0.855	0.02283788	0.00109328	845.0016	317.7	268456.996	137.33	BA	0.004168	1.311902	0.12754607	
CFSD	2	CE-141	0.881	0.0002589	5.0392E-06	9.579378	317.7	3043.3683	140.12	CE	1.03E-05	0.00324	0.11981312	
CFSD	2	CR-51	0.905	0.00612392	0.00072973	226.5851	317.7	71986.0907	52	CR	8.13E-05	0.025576	0.167856	
CFSD	2	RU-103	0.991	0.00597328	0.00025709	221.0113	317.7	70215.2973	92.90638	RU	6.45E-05	0.020305	0.12581226	
CFSD	2	TE-123m	0.855	2.3954E-05	3.9633E-05	0.886287	317.7	281.573466	92.90638	TE	2.59E-07	8.14E-05	1.65880484	
CFSD	2	XE-127	0.505	0.0071934	0.00062806	266.1557	317.7	84557.6624	92.90638	XE	7.77E-05	0.024452	0.14696734	
CFSD	3	BA-131	0.378	0.0216554	0.00116744	801.2498	300	240374.94	137.33	BA	0.003732	1.243975	0.12993315	Low Confidence
CFSD	3	HO-166	0.4	0.1388686	0.07783014	5138.138	300	1541441.46	200.59	HG	4.69E-27	1.56E-24	0.57279184	Low Confidence
CFSD	3	RU-103	0.852	0.0096123	0.00040012	355.6552	300	106696.552	92.90638	RU	9.8E-05	0.032675	0.12533587	
CFSD	3	YB-169	0.641	0.00012884	4.3273E-05	4.767165	300	1430.14953	92.90638	YB	1.31E-06	0.000438	0.35605854	Low Confidence
CFSD	4	BA-131	0.866	0.01831856	0.00087857	677.7867	345.5	234175.312	137.33	BA	0.003636	1.052293	0.12757956	
CFSD	4	CE-139	0.856	3.8158E-05	2.3987E-06	1.411857	345.5	487.796628	140.12	CE	3.35E-07	9.71E-05	0.13389521	
CFSD	4	CE-141	0.952	0.00016706	4.5394E-05	6.18132	345.5	2135.64603	140.12	CE	7.22E-06	0.002091	0.29632202	
CFSD	4	CR-51	0.881	0.00341571	0.00061613	126.3813	345.5	43664.7288	52	CR	4.93E-05	0.014266	0.21566991	
CFSD	4	HF-181	0.763	0.00074603	4.6586E-05	27.60293	345.5	9536.81059	178.49	HF	2.4E-06	0.000695	0.13370052	
CFSD	4	RU-103	0.907	0.00356642	0.00019767	131.9577	345.5	45591.3684	92.90638	RU	4.19E-05	0.012123	0.13056935	
CFSD	4	TA-182	0.372	0.00121482	0.0001973	44.94816	345.5	15529.5876	92.90638	TA	1.43E-05	0.00413	0.20088575	Low Confidence
CFSD	4	TE-121	0.668	6.2978E-05	0.00016499	2.33018	345.5	805.07709	92.90638	TE	7.4E-07	0.000214	2.62248641	Low Confidence
CFSD	5	BA-131	0.861	0.06287964	0.00276192	2326.547	353.8	823132.215	137.33	BA	0.012779	3.612065	0.12611758	

CFSD	5	BA-133	0.669	0.07283092	0.0139111	2694.744	353.8	953400.441	137.33	BA	0.101752	28.75988	0.22463172	Low Confidence
CFSD	5	HG-203	0.944	7.779E-05	8.215E-05	2.878225	353.8	1018.31594	200.59	HG	3.1E-30	8.75E-28	1.06264588	
CFSD	5	RU-103	0.908	0.01656218	0.00068389	612.8007	353.8	216808.874	92.90638	RU	0.000199	0.0563	0.12522541	
CFSD	5	XE-129m	0.849	0.00494356	0.00208313	182.9116	353.8	64714.1404	92.90638	XE	5.95E-05	0.016805	0.43765196	
CFSD	6	BA-131	0.842	0.02471364	0.00121039	914.4047	388	354789.016	137.33	BA	0.005508	1.419653	0.12796498	
CFSD	6	CE-141	0.949	9.5732E-05	0.00016601	3.542067	388	1374.32199	140.12	CE	4.65E-06	0.001198	1.73816829	
CFSD	6	IR-192	0.36	0.00014991	0.00022981	5.546589	388	2152.07638	192.217	IR	5.81E-09	1.5E-06	1.53756865	Low Confidence
CFSD	6	RU-103	0.904	0.00543942	0.00024344	201.2587	388	78088.3566	92.90638	RU	7.17E-05	0.01849	0.12640914	
CFSD	6	YB-175	0.449	0.01069249	0.1032274	395.6221	388	153501.386	92.90638	YB	0.000141	0.036347	9.65492036	Low Confidence
CFSD	7	BA-131	0.855	0.02108726	0.00101577	780.2286	365.6	285251.583	137.33	BA	0.004429	1.211339	0.12765839	
CFSD	7	FE-59	0.346	2.6882E-05	0.00010713	0.994645	365.6	363.642384	55.84	FE	6.55E-05	0.017924	3.98697613	Low Confidence
CFSD	7	HF-181	0.681	0.00072848	4.9898E-05	26.95371	365.6	9854.27572	178.49	HF	2.48E-06	0.000678	0.13663109	Low Confidence
CFSD	7	RU-103	0.907	0.00449475	0.00019256	166.3057	365.6	60801.3687	92.90638	RU	5.59E-05	0.015279	0.12574455	
CFSD	7	SB-124	0.471	0.00071844	0.00014665	26.58234	365.6	9718.50456	92.90638	SB	8.93E-06	0.002442	0.23589095	Low Confidence
CFSD	7	XE-129m	0.844	0.00146652	0.00084873	54.26128	365.6	19837.9229	92.90638	XE	1.82E-05	0.004985	0.59069029	
CFSD	7	AG-108m	0.528	0.01748839	0.00218182	647.0704	365.6	236568.949	107.868	#N/A	0.000763	0.208776	0.17187472	Low Confidence
CFSK	2	AU-198m	0.683	6.4654E-05	0.00034968	2.392193	100.4	240.176196	196.97	AU	7.12E-10	7.09E-07	5.40984981	Low Confidence
CFSK	2	BA-131	0.983	0.07116793	0.00136603	2633.213	100.4	264374.626	137.33	BA	0.004105	4.088179	0.11976965	
CFSK	2	Ca-47	0.704	0.00121882	0.00019096	45.09641	100.4	4527.67997	40.08	CA	0.065489	65.22829	0.19627447	
CFSK	2	AS-77	0.518	13.18631	2.063459	487893.5	100.4	48984504.4	72.64	GE	0.567904	565.6414	0.1961221	Low Confidence
CFSK	2	HF-181	0.893	0.00635344	0.00018811	235.0774	100.4	23601.7701	178.49	HF	5.94E-06	0.005917	0.12187269	
CFSK	2	RB-86	0.994	0.00185624	0.00140474	68.68073	100.4	6895.54549	92.90638	RB	6.34E-06	0.00631	0.76594444	
CFSK	2	RU-103	0.907	0.05242591	0.0014493	1939.759	100.4	194751.77	92.90638	RU	0.000179	0.178211	0.12141074	
CFSK	2	SC-46	0.985	0.0238508	0.00108466	882.4796	100.4	88600.9518	92.90638	SC	8.14E-05	0.081076	0.12666689	
CFSK	2	ZN-65	0.997	4.179958	0.043903	154658.4	100.4	15527708	92.90638	ZN	0.014266	14.20892	0.11868722	
CFSK	3	AG-108m	0.374	0.01404312	0.1609178	519.5954	97.9	50868.3936	107.868	#N/A	0.000164	0.167647	11.4594452	Low Confidence
CFSK	3	BA-131	0.99	0.07846896	0.00119353	2903.352	97.9	284238.114	137.33	BA	0.004413	4.50758	0.11919602	
CFSK	3	Ca-47	0.661	0.00082729	0.00013876	30.60978	97.9	2996.69728	40.08	CA	0.043345	44.27455	0.20520886	Low Confidence
CFSK	3	CE-141	0.983	0.00101435	0.00022026	37.5311	97.9	3674.29449	140.12	CE	1.24E-05	0.012694	0.24724145	
CFSK	3	AS-77	0.683	2.885556	0.4482171	106765.6	97.9	10452349.5	72.64	GE	0.12118	123.7791	0.19520283	Low Confidence
CFSK	3	HF-181	0.849	0.00340997	0.00023448	126.169	97.9	12351.9488	178.49	HF	3.11E-06	0.003176	0.13676554	
CFSK	3	IN-114m	0.665	0.00067197	0.0005406	24.86292	97.9	2434.07983	114.818	IN	6.19E-07	0.000632	0.81313479	Low Confidence
CFSK	3	RU-103	0.903	0.04026613	0.00133335	1489.847	97.9	145856.003	92.90638	RU	0.000134	0.136877	0.12277147	
CFSK	3	SB-124	0.884	0.00454633	0.000229	168.2143	97.9	16468.182	92.90638	SB	1.51E-05	0.015454	0.12850469	
CFSK	3	SB-122	0.873	0.01189185	0.00086139	439.9985	97.9	43075.8483	92.90638	SB	3.96E-05	0.040424	0.13864799	
CFSK	3	SC-46	0.994	0.0175751	0.00093601	650.2787	97.9	63662.2847	92.90638	SC	5.85E-05	0.059743	0.12966394	
CFSK	3	TE-123m	0.982	0.00234572	0.00022532	86.79157	97.9	8496.89431	92.90638	TE	7.81E-06	0.007974	0.1523257	
CFSK	3	YB-169	0.349	0.00010525	0.00015873	3.89425	97.9	381.247075	92.90638	YB	3.5E-07	0.000358	1.51278326	Low Confidence
CFSK	3	ZN-65	0.998	4.348371	0.0461318	160889.7	97.9	15751104.3	92.90638	ZN	0.014471	14.7814	0.11869663	
CFSK	4	BA-131	0.845	0.06641088	0.00311664	2457.203	127.7	313784.767	137.33	BA	0.004872	3.814914	0.12719566	
CFSK	4	CE-141	0.989	0.00083973	0.00014214	31.06986	127.7	3967.62138	140.12	CE	1.34E-05	0.010509	0.20646886	
CFSK	4	HF-181	0.73	0.00318404	0.00017357	117.8093	127.7	15044.2517	178.49	HF	3.79E-06	0.002965	0.13018441	

CFSK	4	RU-103	0.905	0.01538806	0.00091205	569.3582	127.7	72707.0447	92.90638	RU	6.68E-05	0.052309	0.13224713	
CFSK	4	SB-124	0.681	0.00334739	0.00036399	123.8532	127.7	15816.0594	92.90638	SB	1.45E-05	0.011379	0.16062584	Low Confidence
CFSK	5	BA-131	0.876	0.05483739	0.00222232	2028.983	135.8	275535.95	137.33	BA	0.004278	3.150085	0.12497465	
CFSK	5	BA-133	0.503	0.02904739	0.01499771	1074.753	135.8	145951.516	137.33	BA	0.015577	11.4704	0.52968039	Low Confidence
CFSK	5	CE-139	0.998	1.5309E-05	9.9134E-05	0.566451	135.8	76.9240132	140.12	CE	5.29E-08	3.9E-05	6.47641073	
CFSK	5	CE-141	0.991	0.00024905	4.6746E-05	9.214795	135.8	1251.36909	140.12	CE	4.23E-06	0.003117	0.22182771	
CFSK	5	CO-60	0.996	0.0067289	0.00123645	248.9692	135.8	33810.0108	58.93	CO	9.23E-07	0.00068	0.21849769	
CFSK	5	HF-181	0.898	0.00409799	0.00013501	151.6256	135.8	20590.7606	178.49	HF	5.18E-06	0.003817	0.12272614	
CFSK	5	IN-114m	0.828	0.00854914	0.00714677	316.3183	135.8	42956.0289	114.818	IN	1.09E-05	0.008039	0.84428161	
CFSK	5	MO-99	0.332	1.57557	1.478918	58296.09	135.8	7916609.02	95.94	MO	0.01103	8.121932	0.94607143	Low Confidence
CFSK	5	RU-103	0.909	0.01756246	0.00067628	649.811	135.8	88244.3365	92.90638	RU	8.11E-05	0.0597	0.12433475	
CFSK	5	RU-97	0.317	0.03142354	0.08198815	1162.671	135.8	157890.719	92.90638	RU	0.000145	0.106818	2.61180854	Low Confidence
CFSK	5	TA-182	0.635	0.00050698	0.00147872	18.75839	135.8	2547.38879	92.90638	TA	2.34E-06	0.001723	2.91909004	Low Confidence
CFSK	5	TE-121	0.664	8.102E-05	0.00028845	2.997757	135.8	407.095454	92.90638	TE	3.74E-07	0.000275	3.56222428	Low Confidence
CFSK	5	YB-175	0.634	0.03263066	0.03827558	1207.334	135.8	163956.014	92.90638	YB	0.000151	0.110921	1.17893685	Low Confidence
CFSK	6	BA-131	0.852	0.09037917	0.00431522	3344.029	80.8	270197.567	137.33	BA	0.004195	5.191751	0.12749901	
CFSK	6	BA-133	0.471	0.1262914	0.02196351	4672.782	80.8	377560.769	137.33	BA	0.040295	49.87066	0.21028909	Low Confidence
CFSK	6	CR-51	0.96	0.00162016	0.00241705	59.94574	80.8	4843.61539	52	CR	5.47E-06	0.006767	1.49654275	
CFSK	6	CS-134	0.719	0.02073358	0.00330115	767.1425	80.8	61985.1108	132.9055	CS	4.9E-07	0.000606	0.1983092	
CFSK	6	HF-181	0.697	0.00575445	0.00029451	212.9146	80.8	17203.4977	178.49	HF	4.33E-06	0.005359	0.12882436	Low Confidence
CFSK	6	RU-103	0.905	0.02213261	0.00099992	818.9066	80.8	66167.6509	92.90638	RU	6.08E-05	0.075235	0.1265601	
CFSK	6	SB-124	0.593	0.00339948	0.00051766	125.7806	80.8	10163.0705	92.90638	SB	9.34E-06	0.011556	0.19278	Low Confidence
CFSK	6	TA-182	0.443	0.00180216	0.00130545	66.67992	80.8	5387.73754	92.90638	TA	4.95E-06	0.006126	0.73396335	Low Confidence
CFSK	6	XE-129m	0.823	5.5723E-05	0.00589952	2.061739	80.8	166.588524	92.90638	XE	1.53E-07	0.000189	105.872917	
CFSK	6	YB-175	0.535	0.5414399	0.3925143	20033.28	80.8	1618688.73	92.90638	YB	0.001487	1.840515	0.73452161	Low Confidence
CFSK	7	BA-131	0.859	0.07268369	0.00305819	2689.297	119.4	321102.006	137.33	BA	0.004985	4.17525	0.12548575	
CFSK	7	CE-139	1	8.9293E-05	0.00013771	3.303858	119.4	394.480648	140.12	CE	2.71E-07	0.000227	1.54679195	
CFSK	7	CE-141	0.916	0.00016716	0.00015255	6.185005	119.4	738.489609	140.12	CE	2.5E-06	0.002092	0.92022726	
CFSK	7	HF-181	0.687	0.00419435	0.00020642	155.1911	119.4	18529.8127	178.49	HF	4.66E-06	0.003906	0.12805572	Low Confidence
CFSK	7	HG-203	0.984	7.7687E-07	7.6681E-05	0.028744	119.4	3.43204966	200.59	HG	1.04E-32	8.74E-30	98.7059393	
CFSK	7	RU-103	0.907	0.02042066	0.00080878	755.5644	119.4	90214.3917	92.90638	RU	8.29E-05	0.069416	0.12467943	
CFSK	7	SB-124	0.43	0.00362989	0.00052817	134.3058	119.4	16036.1148	92.90638	SB	1.47E-05	0.012339	0.1874791	Low Confidence
CFSK	7	SB-122	0.309	0.7951361	0.2367724	29420.04	119.4	3512752.26	92.90638	SB	0.003227	2.702904	0.32038547	Low Confidence
CFSK	7	YB-169	0.63	0.00013181	8.0339E-05	4.877107	119.4	582.326564	92.90638	YB	5.35E-07	0.000448	0.62084511	Low Confidence
CFSP	1	AG-108m	0.957	0.07956245	0.05696715	2943.811	389.8	1147497.39	107.868	AG	0.003702	0.949817	0.72569979	
CFSP	1	BA-131	0.885	0.01844348	0.00065637	682.4088	389.8	266002.935	137.33	BA	0.00413	1.059469	0.1234619	
CFSP	1	BA-131	0.88	0.01867424	0.00064475	690.9469	389.8	269331.094	137.33	BA	0.004181	1.072725	0.12316003	
CFSP	1	CE-141	0.992	0.00045249	4.2481E-05	16.74222	389.8	6526.11689	140.12	CE	2.21E-05	0.005663	0.15096427	
CFSP	1	CE-141	0.957	0.00056758	4.2E-05	21.00031	389.8	8185.92018	140.12	CE	2.77E-05	0.007103	0.13947111	
CFSP	1	CR-51	0.904	0.00567435	0.00080495	209.9508	389.8	81838.8226	52	CR	9.24E-05	0.023699	0.18466225	
CFSP	1	CR-51	0.919	0.00590277	0.00052425	218.4026	389.8	85133.3483	52	CR	9.61E-05	0.024653	0.14786576	
CFSP	1	FE-59	0.347	0.00030224	0.00020107	11.18299	389.8	4359.12845	55.84	FE	0.000786	0.201521	0.67566775	Low Confidence

CFSP	1	AS-71	0.426	2.560622	0.0888814	94743.01	389.8	36930826.9	72.64	GE	0.898132	230.4084	0.12321195	Low Confidence
CFSP	1	HF-181	0.718	0.00070126	5.9409E-05	25.94648	389.8	10113.9391	178.49	HF	2.55E-06	0.000653	0.14544246	
CFSP	1	HF-181	0.798	0.00116399	4.9794E-05	43.06774	389.8	16787.8054	178.49	HF	4.23E-06	0.001084	0.12572338	
CFSP	1	HG-203	0.879	3.8268E-06	1.5575E-05	0.141593	389.8	55.1928672	200.59	HG	1.68E-31	4.3E-29	4.07165231	
CFSP	1	LU-177	0.859	8.907E-05	0.000601	3.295576	389.8	1284.6155	174.967	LU	5.5E-08	1.41E-05	6.74853603	
CFSP	1	LU-177	0.866	0.00020474	0.00062255	7.575469	389.8	2952.91774	174.967	LU	1.27E-07	3.25E-05	3.04295285	
CFSP	1	RB-86	0.974	0.00244093	0.00085205	90.31423	389.8	35204.4849	92.90638	RB	3.23E-05	0.008297	0.36854363	
CFSP	1	RU-103	0.909	0.00752805	0.00026312	278.5378	389.8	108574.04	92.90638	RU	9.98E-05	0.02559	0.12328019	
CFSP	1	RU-103	0.909	0.0075306	0.00025787	278.6323	389.8	108610.86	92.90638	RU	9.98E-05	0.025599	0.12308096	
CFSP	1	RU-97	0.383	0.02996513	0.01331708	1108.71	389.8	432175.084	92.90638	RU	0.000397	0.10186	0.45987476	Low Confidence
CFSP	1	RU-97	0.394	0.03209853	0.01216351	1187.646	389.8	462944.259	92.90638	RU	0.000425	0.109112	0.39695599	Low Confidence
CFSP	1	SB-124	0.563	0.00249215	0.00016757	92.20959	389.8	35943.297	92.90638	SB	3.3E-05	0.008472	0.13600473	Low Confidence
CFSP	1	SB-124	0.778	0.00302384	0.00023276	111.8819	389.8	43611.5771	92.90638	SB	4.01E-05	0.010279	0.14107209	
CFSP	1	SN-125x	0.935	0.00059385	0.00086129	21.97245	389.8	8564.85957	92.90638	SN	7.87E-06	0.002019	1.45515995	
CFSP	1	TA-182	0.536	0.00017221	4.7033E-05	6.371822	389.8	2483.73614	92.90638	TA	2.28E-06	0.000585	0.29760072	Low Confidence
CFSP	1	TA-182	0.304	0.00117817	0.00028826	43.59233	389.8	16992.2891	92.90638	TA	1.56E-05	0.004005	0.27173203	Low Confidence
CFSP	1	YB-169	0.353	0.00016784	6.6915E-05	6.209925	389.8	2420.62861	92.90638	YB	2.22E-06	0.000571	0.41584942	Low Confidence
CFSP	2	BA-133	0.709	0.02767072	0.00292015	1023.817	337.6	345640.498	137.33	BA	0.036889	10.92677	0.15847189	
CFSP	2	CE-141	0.927	0.000922	0.00017442	34.11414	337.6	11516.9326	140.12	CE	3.9E-05	0.011539	0.22308019	
CFSP	2	CR-51	0.952	0.00686815	0.00091199	254.1215	337.6	85791.4103	52	CR	9.68E-05	0.028685	0.17778709	
CFSP	2	EU-152x	0.599	0.1137739	0.04179981	4209.634	337.6	1421172.54	151.964	EU	1.02E-06	0.000303	0.38594617	Low Confidence
CFSP	2	EU-154	0.364	0.01899172	0.01908276	702.6936	337.6	237229.373	151.964	EU	9.64E-06	0.002855	1.01172459	Low Confidence
CFSP	2	HF-181	0.719	0.00065671	0.00014046	24.29823	337.6	8203.08096	178.49	HF	2.06E-06	0.000612	0.24438748	
CFSP	2	HF-175	0.931	0.0005491	0.00042884	20.31676	337.6	6858.93666	178.49	HF	2.01E-05	0.005962	0.78987639	
CFSP	2	SB-124	0.618	0.00174702	0.00195113	64.63963	337.6	21822.3388	92.90638	SB	2E-05	0.005939	1.12307484	Low Confidence
CFSP	2	ZN-65	0.877	1.799296	0.01708211	66573.95	337.6	22475366.2	92.90638	ZN	0.020649	6.116341	0.11860216	
CFSP	3	BA-131	0.886	0.01735524	0.00065422	642.1439	405.4	260325.129	137.33	BA	0.004042	0.996956	0.12408585	
CFSP	3	CE-141	0.975	0.00036888	0.00011957	13.64868	405.4	5533.17572	140.12	CE	1.87E-05	0.004617	0.34501695	
CFSP	3	CO-60	0.884	0.01159003	0.00094859	428.8311	405.4	173848.132	58.93	CO	4.75E-06	0.001171	0.14378805	
CFSP	3	CR-51	0.911	0.00525587	0.00051367	194.467	405.4	78836.9388	52	CR	8.9E-05	0.021951	0.1533884	
CFSP	3	HF-181	0.845	0.00112099	5.072E-05	41.47656	405.4	16814.5958	178.49	HF	4.23E-06	0.001044	0.12658421	
CFSP	3	HO-166	0.39	2.941324	2.605819	108829	405.4	44119271.7	200.59	HG	1.34E-25	3.31E-23	0.89378713	Low Confidence
CFSP	3	RB-86	0.956	0.0008319	0.00072419	30.78017	405.4	12478.2796	92.90638	RB	1.15E-05	0.002828	0.87851846	
CFSP	3	RU-103	0.91	0.00664745	0.00023582	245.9557	405.4	99710.4355	92.90638	RU	9.16E-05	0.022597	0.12342937	
CFSP	3	RU-97	0.355	0.06753878	0.0250079	2498.935	405.4	1013068.19	92.90638	RU	0.000931	0.229584	0.38868969	Low Confidence
CFSP	3	SB-124	0.814	0.0026924	0.00015081	99.61876	405.4	40385.4465	92.90638	SB	3.71E-05	0.009152	0.13081906	
CFSP	3	YB-175	0.653	0.00182739	0.00756338	67.6135	405.4	27410.5145	92.90638	YB	2.52E-05	0.006212	4.14058274	Low Confidence
CFSP	5	AG-110m	0.378	0.00040288	0.00016272	14.90655	396.9	5916.40926	107.868	AG	1.91E-05	0.00481	0.4208312	Low Confidence
CFSP	5	BA-131	0.858	0.02224979	0.00093153	823.2422	396.9	326744.841	137.33	BA	0.005073	1.278119	0.12541596	
CFSP	5	CE-141	0.957	0.00065455	8.7355E-06	24.21852	396.9	9612.3292	140.12	CE	3.25E-05	0.008192	0.11897248	
CFSP	5	CR-51	0.886	0.00701847	0.00092397	259.6835	396.9	103068.367	52	CR	0.000116	0.029312	0.17693911	
CFSP	5	CS-134	0.727	0.02435808	0.00137001	901.249	396.9	357705.712	132.9055	CS	2.83E-06	0.000712	0.13091907	

CFSP	5	HF-181	0.776	0.0012138	5.8343E-05	44.91067	396.9	17825.0465	178.49	HF	4.49E-06	0.00113	0.12761929	
CFSP	5	HO-166	0.32	0.2546551	1.123612	9422.239	396.9	3739686.54	200.59	HG	1.14E-26	2.86E-24	4.41387292	Low Confidence
CFSP	5	MO-99	0.33	0.5648316	0.341207	20898.77	396.9	8294721.5	95.94	MO	0.011556	2.91166	0.61554572	Low Confidence
CFSP	5	OS-185	0.884	0.00027381	0.00024025	10.13098	396.9	4020.98493	92.90638	OS	3.69E-06	0.000931	0.88536005	
CFSP	5	RB-86	0.879	0.00047378	0.00103547	17.52988	396.9	6957.61025	92.90638	RB	6.39E-06	0.001611	2.18873838	
CFSP	5	RU-103	0.906	0.00635706	0.00025106	235.2113	396.9	93355.3626	92.90638	RU	8.58E-05	0.02161	0.12464385	
CFSP	6	BA-131	0.855	0.02103247	0.00101268	778.2014	387.7	301708.679	137.33	BA	0.004684	1.208192	0.12765038	
CFSP	6	CE-141	0.947	0.00046216	5.2025E-05	17.09992	387.7	6629.64042	140.12	CE	2.24E-05	0.005784	0.16324235	
CFSP	6	CR-51	0.908	0.00570418	0.00067975	211.0546	387.7	81825.863	52	CR	9.24E-05	0.023823	0.16786025	
CFSP	6	HF-181	0.658	0.00108373	5.9397E-05	40.09816	387.7	15546.0559	178.49	HF	3.91E-06	0.001009	0.13030806	Low Confidence
CFSP	6	IR-192	0.383	8.2128E-05	5.6019E-05	3.038727	387.7	1178.11465	192.217	IR	3.18E-09	8.21E-07	0.69226793	Low Confidence
CFSP	6	RU-103	0.993	0.00433841	0.0002112	160.5212	387.7	62234.0576	92.90638	RU	5.72E-05	0.014748	0.12785261	
CFSP	6	SB-124	0.441	0.00384133	9.4626E-05	142.1293	387.7	55103.5234	92.90638	SB	5.06E-05	0.013058	0.12076072	Low Confidence
CFSP	6	TE-123m	0.871	2.4023E-05	3.66E-05	0.888837	387.7	344.602082	92.90638	TE	3.17E-07	8.17E-05	1.52815592	
CFSP	6	XE-127	0.544	2.4044E-05	3.1049E-05	0.889643	387.7	344.914514	92.90638	XE	3.17E-07	8.17E-05	1.29672638	Low Confidence

Table C-3 NAA data for jet engine lubricating oil (Mobil Jet Oil II)

Serial Number	Number	FE Letter	FE Flux	Flux Uncertainty	Isotope	ID Confidence	Specific Activity [µCi/mg]	Specific Activity Uncertainty [µCi/mg]	Specific Activity [Bq/mg]	Sample Mass [mg]	Activity [Bq]	*A*[g/moll]	σ_{th}	σ_{ri}	p_i	α	$\sigma_{th}+\alpha\sigma_{ri}$	Parent Element	Element Mass [g]	Element % of Sample Mass	% Uncertainty
Jet Engine Oil	1	FEA	7.93E+10	9.38E+09	CE-137x	0.384	0.0160964	0.0910787	595.56754	220.4	131263.0858	140.12	2.6E-24	3.1E-23	0.15	0.8333333	2.843E-23	CE	9.026E-05	0.0409549	5.659555188
Jet Engine Oil	1	FEA	7.93E+10	9.38E+09	CO-60	1	0.8490152	0.01118158	31413.562	220.4	6923549.153	58.93	1.6E-23	3.5E-23	1	0.8333333	4.517E-23	CO	0.0001891	0.0857887	0.118952891
Jet Engine Oil	1	FEA	7.93E+10	9.38E+09	CR-51	0.997	9.92E-03	6.95E-04	3.67E+02	220.4	8.09E+04	52	1.55E-23	8E-24	0.0435	0.8333333	2.217E-23	CR	9.13E-05	0.0414265	0.137432949
Jet Engine Oil	1	FEA	7.93E+10	9.38E+09	EU-152x	0.356	2.77E-03	7.97E-03	1.02E+02	220.4	2.26E+04	151.964	5.9E-21	4E-21	0.4781	0.8333333	9.233E-21	EU	1.63E-08	7.385E-06	2.879538104
Jet Engine Oil	1	FEA	7.93E+10	9.38E+09	FE-59	0.999	3.13E-01	6.33E-03	1.16E+04	220.4	2.56E+06	55.84	1.3E-24	1.2E-24	0.00282	0.8333333	2.3E-24	FE	4.61E-01	209.01415	0.119933527
Jet Engine Oil	1	FEA	7.93E+10	9.38E+09	ND-147	0.962	0.0004576	0.000150854	16.931759	220.4	3731.759617	22.98977	5.3E-25	3.2E-25	1	0.8333333	7.967E-25	ND	2.254E-06	0.0010227	0.350209145
Jet Engine Oil	1	FEA	7.93E+10	9.38E+09	RU-103	0.884	4E-05	0.000101123	1.4800059	220.4	326.1933048	22.98977	5.3E-25	3.2E-25	1	0.8333333	7.967E-25	RU	1.97E-07	8.94E-05	2.530825118
Jet Engine Oil	1	FEA	7.93E+10	9.38E+09	SB-124	0.952	0.0030402	0.000224402	112.48562	220.4	24791.83153	22.98977	5.3E-25	3.2E-25	1	0.8333333	7.967E-25	SB	1.497E-05	0.0067944	0.139372424
Jet Engine Oil	1	FEA	7.93E+10	9.38E+09	SR-85x	0.879	0.0005693	0.000260612	21.063626	220.4	4642.423259	22.98977	5.3E-25	3.2E-25	1	0.8333333	7.967E-25	SR	2.804E-06	0.0012723	0.472805955
Jet Engine Oil	1	FEA	7.93E+10	9.38E+09	ZN-65	0.982	0.0002861	0.00108804	10.585019	220.4	2332.938232	22.98977	5.3E-25	3.2E-25	1	0.8333333	7.967E-25	ZN	1.409E-06	0.0006394	3.805087518

Appendix D - Operating procedures for BAS

Figure D.1 shows the operating panel for LabVIEW. The panel allows entry of sampling flow rate and starting and stopping the operations. It also displays particulate count versus time in graph format and a digital reading of various parameters as shown in Figure D.1. To start the operation, the desktop computer was switched on and Magoha DAQ folder opened. To start the LabVIEW program, "HEPA Filter" folder was double-clicked. This folder contains icons for the control setup and a folder for the storage of the data from the experimental runs. The HEPA DAQ folder was opened by placing the mouse pointer over the appropriate file, and double-clicking the left mouse button to open LabVIEW program. After opening the HEPA DAQ file, the start button was clicked followed by force CSV format on the screen panel to activate the OPC. After this operation the OPC started counting aerosol particles and register counts. At this point the OPC should register some readings otherwise the previous procedures might have not been correct.

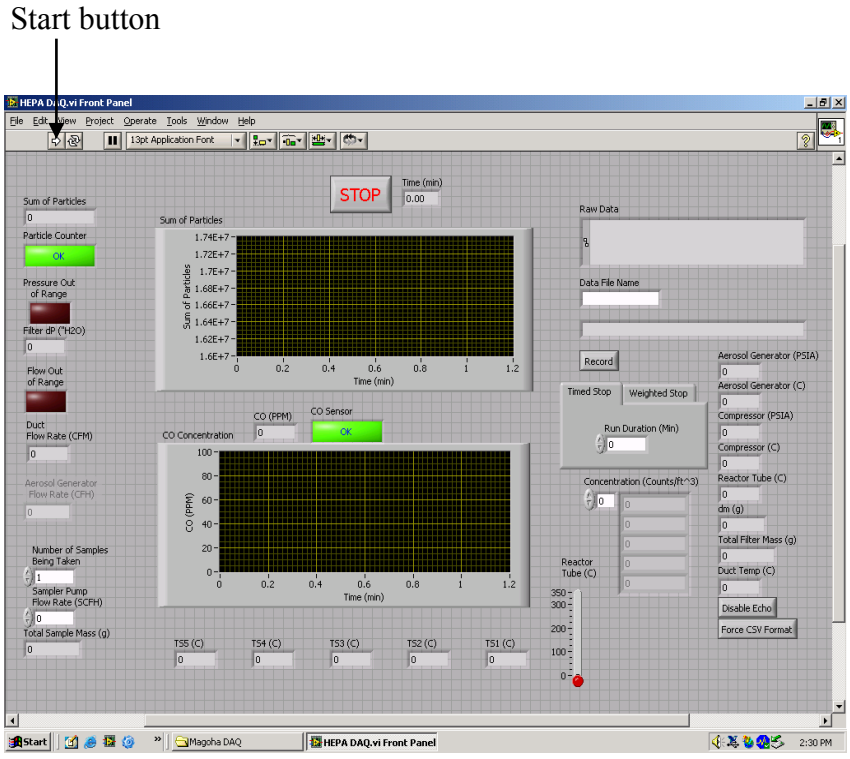


Figure D.1 Pop-up menu from the LabVIEW software at the start of experiment

Agilent, sensor power control system, the OPC, and the blower were switched on. The door cover to the blower reduced noise level. At this point, the yellow hose pipe from aerosol

generator was attached to the speedaire compressor, and the switch knob on the compressor was set to AUTO. From the desktop computer, the control program file was opened by double-clicking on the “control.vi" icon, and the LabVIEW software system started data acquisition and control functions. The control system was switched on by clicking on the control master knob. All lower LED indicators showed GREEN. To initiate control connections the start button located on the left most position of the menu bar (refer to Figure D.1 for details) was clicked using the mouse. The setup produced a display screen with the values for all the sensor outputs on the screen. To stop the data acquisition, the red button with “STOP” sign mark was clicked. The knob labeled AIR was clicked to turn on air. The regulator control knob on top of aerosol generator was adjusted to read to 20 PSIG. The adjustment was locked by pushing down on the control knob. The brass needle valve located just below the control knob was opened to allow air to get into the AG. Click on the knob labeled compressor to switch on compressor number 2. These operations allowed the system to run on air only. The knob labeled “Aerosol Generator” was clicked to activate AG and to start generating polydispersed jet oil aerosols. The system was then run for about 30 minutes to allow the OPC to reach steady-state.

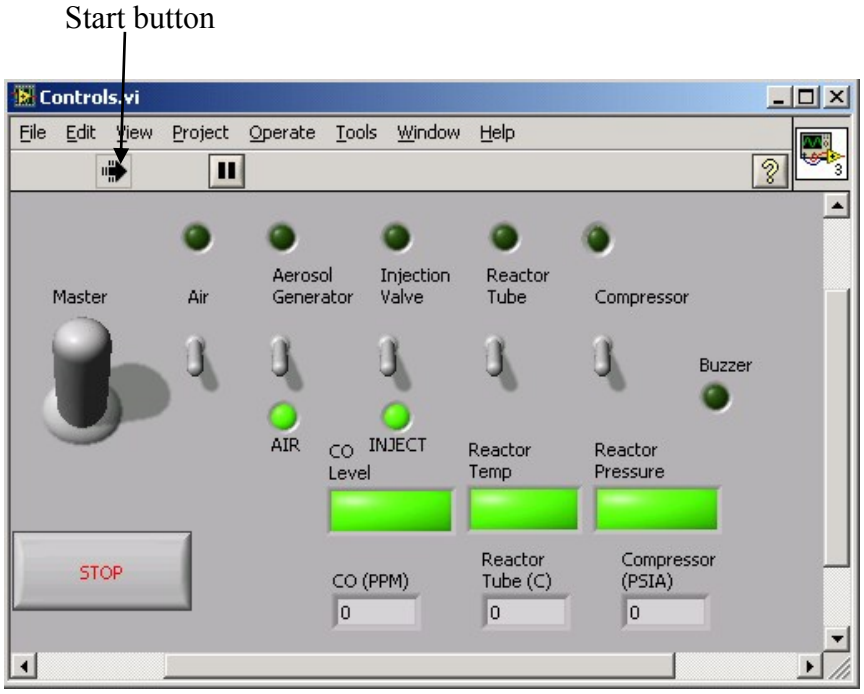


Figure D.2 Control panel pop-up menu from LabVIEW system software

From the LabVIEW pop-up menu (see Figure D.1), the program was prepared for the desired test run by inserting on the screen under the heading: Date File Name: the name of the file, desired experimental run time, and number of samples required. Clean circular filters were prepared, fitted into sampling cassettes, and sample cassettes with clean cut filters installed to the sampling train. The sampler pump was switched on, and with the knob fitted to the rotameter, the pump flow rate was adjusted to read 4.0 SCFH: calibrated pump flow rate. This pump flow rate value was entered on LabVIEW user interface window as shown in Figure D.1. Clicking "RECORD" started data collection on the screen. Before the program began recording data, it automatically requested the user to enter the amount of air going into the reactor. The total airflow rate reading from both rotameters connected to compressors 1 and 2 was entered in a small window that popped up on the LabVIEW menu. The computer did not have this information, which must be manually entered. The system automatically switched off when the sampling time was up. Hot tests required the knob labeled "tape heater" be clicked to switch on the heater. The heater was left to run until steady state was achieved at about 300^{o}C. The rheostat allowed control over temperatures of pyrolysis reaction without any disruptions to the fluid flow. The use of temperature control systems was vital for many applications, including desired aerosol generation and controlled reactions.

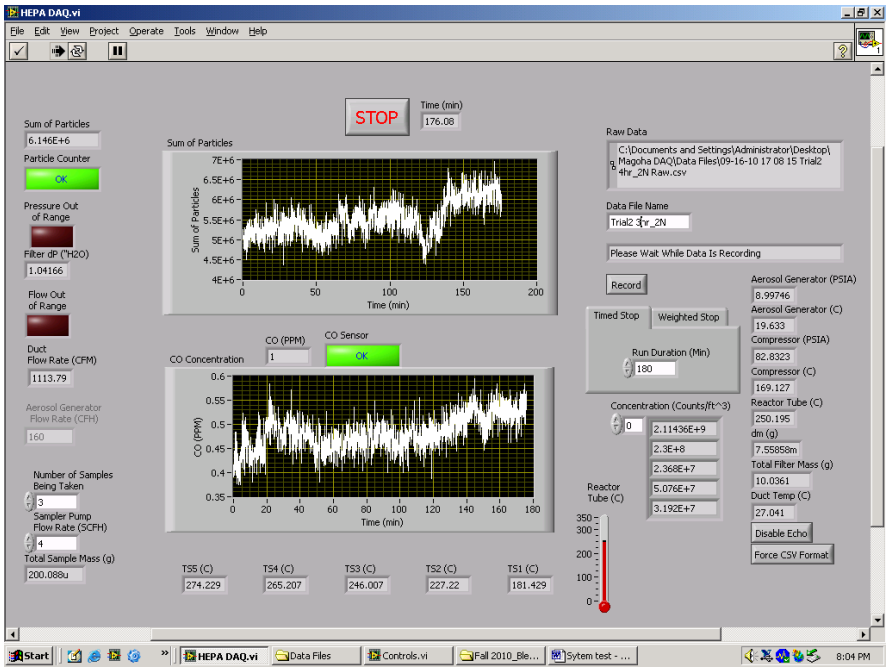


Figure D.3 User interface for aerosol particle counting and CO monitoring

The variac heater enabled the user to heat fluids (aerosol and air mixture) operating over a wide temperature range up to 350^{o}C, the heater had a knob that could be adjusted to maintain the reactor at constant temperatures. Maintaining different temperatures and pressures was important for analytical studies on aerosol production. Whenever the experiment was running, the fan speed, temperature and pressure measurements, and particulate counts were automatically recorded and displayed at 7 second intervals by the desktop computer. All test runs were conducted in duplicate to determine the reproducibility of observations. A new file was generated each time the start button was pressed. When the experiment was running, a file with a csv (comma separated values) extension was generated every time the data acquisition program was invoked. The data written to the file were calculated averages of the values read over the previous 7 seconds. To retrieve these files at the end of the experiment, double-click on the "DATA" file in the "Magoha DAG" folder. The files list was sorted by date with the most recently created file at the top of the list. The files can be recognized by their creation date and time and by the file name assigned in the user interface window.

Shut-down procedures: Switch-off the sampler pump power supply and then disconnect sampling cassettes from the sampling train. From the control panel screen**,** click on the knob labeled tape heater to switch off heater if a hot test was being conducted. Click on the knob labeled Aerosol Generator to turn off oil. This step stops the oil flow, but air still flows through the reactor. The air will clear the reactor of traces of pyrolysis products that might be present in the reactor. The system is left to run in this mode until the reactor temperature falls below 100^{o}C, then the knob labeled AIR is clicked on to turn off air flow. Click on the knob labeled compressor to switch-off the compressor. Click on the master control knob to switch-off the control system. Close control.vi front panel file to exit control system. From HEPA DAQ File screen, click on STOP key to stop the LabVIEW program from running (OPC should beep). Close HEPA DAQ file to exit LabVIEW program. Close any remaining screen and turn-off the experimental system. Finally, turn the knob on the speedaire compressor to off position. This will switch off the compressor, the blower, the OPC, the sensor power control supply, the DAQ unit – Agilent, the power supply (lambda)) and the computer.

Appendix E - Simulated Operational Conditions of Bleed Air Simulator and Aerosol Data

Table E-1 Aerosol counts at simulated ground operations (Test 1: 14.1 PSI, 170.4°C)

Time (sec)	Flow (CFM)	Filter dP ("H2O)	0.3 µm	0.4 µm	0.5 µm	0.55 µm	0.7 µm	1.0 µm	1.3 µm	1.6 µm	2.0 µm	2.2 µm	3.0 µm	4.0 µm	5.0 µm	5.5 µm	7.0 µm	10.0 µm	dm (pg)	Total Mass (pg)	Aerosol Generator (PSIA)	Aerosol Generator Temp (°C)	Compressor (PSIA)	Compressor Temp (°C)	Reactor Tube Temp (°C)	Duct Temp (°C)	Aero. Gen.Flow (CFH)	Sum of Particles	Total Sample Mass (pg)	Sample Filter Flow Rate (SCFH)	Temp S1 (°C)	Temp S2 (°C)	Temp S3 (°C)	Temp S4 (°C)	Temp S5 (°C)	CO (PPM)	RH (%)
0.609375	1100.21441	0.585476	225240000	34240000	2320000	4360000	2240000	160000	0	40000	0	0	0	0	0	0	0	0	877337536.8	0	5.363103	24.73	14.36593	95.362	170.039	29.605	90	671500	0	1.333333	146.058	171.531	175.824	188.92	191.04	-0.247431	45.2
15.609375	1098.025987	0.584262	181760000	27080000	2200000	3160000	1760000	160000	40000	0	0	0	0	0	0	0	0	0	1194331111	1194331111	5.364179	24.711	14.376164	95.384	170.019	29.585	90	540400	24123.19918	1.333333	146.068	171.511	175.801	188.946	191.05	-0.326988	45.6
22.640625	1101.282132	0.582819	208760000	29720000	2360000	4040000	2200000	240000	0	40000	0	0	0	0	0	0	0	0	651115771.7	1845446883	5.380972	24.649	14.412505	95.182	170.12	29.566	90	618400	37300.70093	1.333333	146.188	171.505	175.883	188.972	190.886	-0.340106	45.6
29.625	1100.427615	0.585525	208720000	30280000	2160000	3760000	2120000	200000	40000	40000	0	0	0	0	0	0	0	0	647593165.3	2493040048	5.401072	24.707	13.837862	95.286	170.016	29.566	90	618300	50368.16004	1.333333	146.224	171.397	175.939	189.035	191.093	-0.370444	46
36.59375	1101.873851	0.586	235480000	35200000	2480000	4480000	3040000	160000	80000	40000	0	0	0	0	0	0	0	0	750082285.1	3243122333	5.376538	24.659	14.496472	95.444	170.111	29.572	90	702400	65515.44915	1.333333	146.162	171.646	175.916	188.93	190.939	-0.291713	46
43.578125	1100.133257	0.581605	189400000	27760000	1760000	3680000	2080000	200000	0	0	0	0	0	0	0	0	0	0	579997968.1	3823120301	5.38929	24.633	14.231453	95.097	170.176	29.579	90	562200	77212.65363	1.333333	146.23	171.547	175.896	189.012	190.86	-0.324525	45.6
50.609375	1100.066139	0.583032	153960000	21640000	1440000	2760000	1800000	40000	120000	0	0	0	0	0	0	0	0	0	479416421.4	4302536723	5.376669	24.714	14.292066	95.476	170.084	29.556	90	454400	86896.66071	1.333333	146.133	171.524	175.811	188.969	191.103	-0.266294	45.6
57.59375	1099.023611	0.585377	201320000	29280000	2480000	4440000	1640000	280000	0	0	0	0	0	0	0	0	0	0	616905441.5	4919442164	5.380369	24.607	14.026261	95.138	170.219	29.585	90	598600	99358.64761	1.333333	146.243	171.587	175.893	189.012	190.84	-0.32125	45.6
64.578125	1099.143622	0.584115	211720000	30160000	2360000	4560000	2200000	240000	0	80000	0	0	0	0	0	0	0	0	671372645.3	5590814809	5.399419	24.711	13.940327	95.441	170.068	29.598	90	628300	112933.781	1.333333	146.282	171.42	175.85	189.074	191.129	-0.308131	45.2
71.5625	1099.588313	0.583951	173320000	25080000	2280000	3480000	2280000	80000	0	0	0	0	0	0	0	0	0	0	536666444.8	6127481254	5.4165	24.652	13.431412	95.463	170.232	29.585	90	516300	123783.9745	1.333333	146.227	171.711	175.975	188.999	190.824	-0.365525	44.8
78.609375	1098.289182	0.582803	198960000	28120000	1920000	3040000	2200000	200000	160000	0	0	40000	0	0	0	0	0	0	652492111.6	6779973366	5.411095	24.711	14.172283	95.482	170.058	29.559	90	586600	136970.5685	1.333333	146.26	171.446	175.87	189.09	191.158	-0.377006	44.8
85.546875	1100.178903	0.584918	211320000	30680000	2360000	4680000	1400000	160000	80000	0	0	40000	40000	0	0	0	0	0	735708436.9	7515681803	5.415005	24.633	13.532696	95.34	170.255	29.54	90	626900	151856.5172	1.333333	146.279	171.695	175.926	189.005	190.821	-0.337644	44.8
92.578125	1100.014957	0.584787	215080000	31520000	1960000	4560000	2400000	160000	80000	0	0	0	0	0	0	0	0	0	674188466.7	8189870269	5.410885	24.707	14.305317	95.453	170.094	29.547	90	639400	165474.2714	1.333333	146.295	171.518	176.001	189.035	191.047	-0.355688	45.2
99.5625	1100.48558	0.585164	208640000	31360000	1960000	3880000	2200000	120000	0	0	0	0	0	0	0	0	0	0	630599064	8820469333	5.413142	24.665	13.509212	95.457	170.212	29.534	90	620400	178213.4733	1.333333	146.253	171.737	175.995	188.979	190.877	-0.360606	45.2
106.546875	1097.773478	0.584902	194680000	29320000	2280000	3480000	2040000	160000	40000	0	0	0	40000	0	0	0	0	0	672386133.4	9492855467	5.414821	24.698	14.417622	95.457	170.104	29.547	90	580100	191791.0379	1.333333	146.299	171.492	176.044	189.035	191.014	-0.349125	45.2
113.53125	1097.23458	0.584442	192240000	28720000	2040000	3480000	1880000	200000	0	40000	0	0	0	0	0	0	0	0	593569053.1	10086424520	5.407684	24.691	14.44701	95.583	170.183	29.527	90	571500	203806.6528	1.333333	146.227	171.623	175.945	188.989	191.047	-0.319606	45.6
120.578125	1101.361406	0.584803	193880000	29280000	2120000	3680000	2040000	160000	40000	0	0	0	0	0	0	0	0	0	602791351.5	10689215871	5.410754	24.659	14.651022	95.412	170.156	29.566	90	578000	216014.9478	1.333333	146.273	171.547	176.004	189.035	190.962	-0.342569	45.6
127.5625	1097.557688	0.585115	213720000	32040000	2240000	3880000	2480000	360000	120000	0	0	0	0	0	0	0	0	0	686104555.4	11375320427	5.381445	24.717	14.305973	95.586	170.137	29.585	90	637100	229858.5125	1.333333	146.208	171.636	175.926	189.023	191.094	-0.4016	45.6
134.546875	1096.967313	0.582671	203640000	30520000	2360000	4080000	2280000	80000	40000	0	0	40000	0	0	0	0	0	0	655664955.9	12030985383	5.389185	24.633	14.441631	95.295	170.193	29.581	90	607600	243133.7439	1.333333	146.267	171.614	175.953	189.049	190.934	-0.367163	46
141.53125	1098.649397	0.585607	207400000	29280000	2480000	3880000	2920000	320000	40000	40000	0	0	0	0	0	0	0	0	668772933.5	12699758316	5.383806	24.688	14.447929	95.498	170.153	29.598	90	615900	256681.6597	1.333333	146.201	171.691	175.932	189.005	191.07	-0.335188	46
148.53125	1099.766523	0.583278	182120000	29080000	1720000	3400000	2600000	200000	80000	40000	0	0	0	0	0	0	0	0	603372120.9	13303130437	5.409652	24.717	13.890734	95.346	170.084	29.621	90	548100	268885.9802	1.333333	146.354	171.511	176.05	189.045	191.126	-0.253175	46
155.515625	1101.137832	0.587886	216960000	33400000	2320000	3920000	2040000	200000	80000	0	0	40000	0	0	0	0	0	0	699743529	14002873966	5.397634	24.614	13.586094	95.305	170.261	29.579	90	647400	283025.2142	1.333333	146.276	171.786	176.057	189.009	190.896	-0.3893	46
162.5	1098.555755	0.585148	217000000	34120000	1720000	4680000	2680000	320000	280000	0	0	0	0	0	0	0	0	0	730925306.5	14733799273	5.401229	24.694	14.247984	95.299	170.114	29.605	90	652000	297776.1238	1.333333	146.318	171.511	176.063	189.064	191.073	-0.306488	46
169.5	1098.112556	0.579884	180880000	26120000	2040000	3560000	1400000	280000	160000	0	0	0	0	0	0	0	0	0	571379126.1	15305178399	5.398369	24.704	13.578615	95.235	170.271	29.569	90	536100	309334.3117	1.333333	146.299	171.744	176.031	189.012	190.922	-0.31715	45.6
176.484375	1101.118231	0.580868	197680000	31600000	1840000	4000000	1800000	80000	40000	0	0	0	0	0	0	0	0	0	605084671.2	15910263070	5.405217	24.698	14.286819	95.201	170.107	29.553	90	592600	321579.2551	1.333333	146.328	171.541	176.057	189.097	191.106	-0.298288	45.6
183.484375	1095.564948	0.58441	186840000	25000000	2160000	4000000	1880000	160000	0	40000	0	0	0	0	0	0	0	0	575026117.1	16485289187	5.421801	24.643	13.420129	95.128	170.297	29.508	90	550200	333184.1471	1.333333	146.308	171.79	176.073	189.035	190.867	-0.273669	45.6
190.515625	1096.642337	0.584147	196720000	28520000	1920000	3520000	2200000	160000	40000	0	0	0	0	0	0	0	0	0	602643648.5	17087932836	5.415267	24.688	14.059716	95.232	170.137	29.517	90	582700	345408.0514	1.333333	146.337	171.583	176.031	189.117	191.171	-0.305669	45.6
197.5	1101.544375	0.585607	191000000	29040000	2400000	3640000	2160000	80000	0	0	0	0	0	0	0	0	0	0	584322981.2	17672255817	5.41036	24.652	13.403205	95.223	170.3	29.55	90	570800	357248.6987	1.333333	146.341	171.793	176.083	189.068	190.929	-0.295006	45.6
204.5	1097.944783	0.583541	185080000	27160000	2360000	3720000	2000000	160000	80000	0	0	0	0	0	0	0	0	0	583472446.8	18255728263	5.396795	24.656	13.935866	95.239	170.143	29.569	90	551400	369019.4949	1.333333	146.337	171.501	176.044	189.136	191.178	-0.316325	45.6
211.484375	1096.521973	0.583344	205200000	30480000	1960000	4280000	2240000	80000	80000	40000	0	0	0	0	0	0	0	0	644848725.9	18900576989	5.405978	24.626	13.49911	95.362	170.336	29.534	90	610900	382071.1273	1.333333	146.344	171.803	176.054	189.045	190.936	-0.313869	45.6
218.484375	1100.536845	0.583524	192280000	28160000	2080000	3520000	1840000	280000	0	0	0	0	0	0	0	0	0	0	586136272.7	19486713262	5.395614	24.688	13.837862	95.343	170.183	29.563	90	570400	393949.8227	1.333333	146.367	171.619	175.985	189.149	191.214	-0.262194	45.6
225.46875	1097.815811	0.583016	186560000	27640000	2080000	3640000	1520000	280000	0	40000	0	0	0	0	0	0	0	0	579344176	20066057438	5.380211	24.685	14.324866	95.523	170.285	29.556	90	554400	405648.0362	1.333333	146.296	171.744	176.044	189.026	191.094	-0.298288	45.2
232.5	1096.297093	0.582425	200400000	27880000	2480000	4200000	2320000	40000	40000	0	0	0	0	0	0	0	0	0	614841113.4	20680898551	5.394066	24.659	14.534387	95.286	170.249	29.562	90	593400	418093.7814	1.333333	146.364	171.587	176.123	189.131	191.117	-0.266294	45.2
239.5	1092.637724	0.582311	207200000	31920000	1960000	3760000	2120000	200000	80000	0	0	0	0	0	0	0	0	0	643623449.9	21324522001	5.422982	24.645	13.762291	95.388	170.344	29.557	90	618100	431140.1932	1.333333	146.332	171.859	176.121	189.05	191.039	-0.310588	44.8
246.484375	1098.495803	0.583737	189760000	27120000	1800000	3440000	2040000	120000	80000	0	0	0	0	0	0	0	0	0	576193195.3	21900715197	5.423847	24.698	14.623208	95.251	170.19	29.546	90	560900	442858.8928	1.333333	146.393	171.656	176.153	189.141	191.15	-0.326169	44.4

253.46875	1097.852931	0.583688	212440000	27960000	1960000	4120000	2280000	80000	40000	0	0	0	0	0	0	0	0	0	629744925.7	22530460122	5.403276	24.701	14.444386	95.381	170.245	29.547	90	622200	455598.4332	1.333333	146.282	171.806	176.096	189.081	191.122	-0.299106	44.4
260.46875	1095.380192	0.580786	187040000	27040000	2080000	4040000	1720000	200000	40000	0	0	0	0	0	0	0	0	0	576122511.3	23106582634	5.409494	24.633	14.647742	95.207	170.235	29.569	90	555400	467260.0339	1.333333	146.393	171.665	176.142	189.149	191.106	-0.286794	44.8
267.4375	1099.477099	0.582737	183120000	25480000	1640000	3520000	2000000	120000	0	40000	0	0	0	0	0	0	0	0	555259080.9	23661841715	5.409573	24.685	14.292066	95.273	170.239	29.562	90	539800	478524.6987	1.333333	146.345	171.699	175.989	189.187	191.311	-0.303206	44.8
274.421875	1096.509233	0.582655	169320000	23040000	1400000	3560000	1760000	160000	40000	0	0	0	0	0	0	0	0	0	513660753.7	24175502468	5.42899	24.669	13.44978	95.251	170.34	29.582	90	498200	488906.6188	1.333333	146.38	171.842	176.129	189.117	191.024	-0.310588	44.8
281.421875	1093.329703	0.584033	188240000	27200000	2120000	3080000	2720000	80000	80000	0	0	0	0	0	0	0	0	0	588733385.1	24764235853	5.416369	24.672	14.415785	95.258	170.183	29.562	90	558800	500838.0861	1.333333	146.413	171.63	176.202	189.174	191.206	-0.276131	44.8
288.421875	1096.31115	0.582409	193200000	27200000	2240000	3640000	2040000	120000	80000	0	0	0	0	0	0	0	0	0	590288824.6	25354524678	5.416317	24.614	13.845603	95.065	170.373	29.575	90	571300	512835.8663	1.333333	146.423	171.807	176.025	189.177	190.976	-0.32535	45.2
295.40625	1096.250784	0.584492	213520000	33600000	2280000	5120000	1760000	280000	40000	0	0	40000	0	0	0	0	0	0	698256631.1	26052781309	5.402541	24.691	14.0689	95.261	170.251	29.601	90	641600	526989.5252	1.333333	146.37	171.659	176.04	189.241	191.348	-0.317969	45.2
302.390625	1095.605002	0.584442	204240000	31240000	2320000	4120000	2200000	120000	80000	40000	0	0	0	0	0	0	0	0	648355907.8	26701137217	5.406556	24.646	13.475888	95.229	170.379	29.576	90	610900	540132.4203	1.333333	146.367	171.878	176.142	189.149	191.07	-0.27695	45.2
309.390625	1100.847085	0.583557	197640000	28160000	1920000	3400000	2160000	80000	0	40000	0	0	0	0	0	0	0	0	597582825.3	27298720042	5.399996	24.636	14.513265	95.147	170.268	29.579	90	583500	552253.2287	1.333333	146.393	171.672	176.162	189.189	191.208	-0.29335	45.2
316.421875	1095.575088	0.583688	206680000	28560000	1920000	4440000	1520000	120000	40000	40000	0	0	0	0	0	0	0	0	626836364.3	27925556406	5.384908	24.698	14.319487	95.242	170.297	29.559	90	608300	564906.8454	1.333333	146.292	171.767	176.047	189.166	191.316	-0.220375	45.2
323.40625	1099.277732	0.581589	201400000	28800000	2000000	4480000	1880000	200000	0	40000	0	0	0	0	0	0	0	0	620013075.9	28545569482	5.402594	24.633	13.898213	94.929	170.412	29.539	90	597000	577482.9513	1.333333	146.426	171.803	176.071	189.233	191.042	-0.258913	45.6
330.390625	1096.730393	0.583655	223720000	35320000	2600000	4560000	2680000	200000	80000	40000	0	0	0	0	0	0	0	0	726522439.1	29272091921	5.396244	24.727	14.252838	95.22	170.274	29.572	90	673000	592169.8158	1.333333	146.318	171.754	176.001	189.212	191.358	-0.298288	45.6
337.421875	1100.95276	0.582294	212680000	29800000	2080000	5040000	2320000	80000	200000	80000	0	0	0	0	0	0	0	0	699252793.9	29971344715	5.404194	24.584	13.812279	94.986	170.408	29.569	90	630700	606338.2487	1.333333	146.445	171.835	176.06	189.251	191.027	-0.298288	45.6
344.421875	1100.600314	0.581884	199080000	30800000	2240000	3520000	2160000	240000	40000	0	0	0	0	0	0	0	0	0	624162451.5	30595507167	5.40115	24.675	13.921566	95.16	170.238	29.569	90	595200	618936.679	1.333333	146.402	171.652	176.145	189.274	191.355	-0.258094	45.6
351.359375	1100.105013	0.584967	205400000	28840000	2200000	4160000	2480000	200000	80000	0	0	0	0	0	0	0	0	0	638668862.2	31234176029	5.411935	24.588	13.492419	95.093	170.429	29.578	90	608400	631832.0428	1.333333	146.452	171.895	176.185	189.216	191.048	-0.253175	45.6
358.34375	1099.524713	0.581622	249160000	36960000	2760000	5120000	2240000	80000	160000	0	40000	0	0	0	0	0	0	0	791841700.5	32026017730	5.379923	24.688	14.264253	95.292	170.32	29.559	90	741300	647827.3178	1.333333	146.305	171.727	176.024	189.228	191.404	-0.254813	45.2
365.390625	1099.579358	0.58682	201680000	30560000	2440000	3400000	1760000	120000	80000	0	0	0	0	0	0	0	0	0	620126863.9	32646144593	5.38685	24.607	14.166248	95.078	170.369	29.54	90	600100	660360.5486	1.333333	146.415	171.793	176.149	189.228	191.142	-0.234313	44.8
372.375	1096.288469	0.583721	187600000	27120000	1520000	3680000	1760000	200000	0	40000	0	0	0	0	0	0	0	0	574401766.5	33220546360	5.372681	24.701	14.250477	95.232	170.255	29.537	90	554800	671969.0638	1.333333	146.38	171.747	176.077	189.281	191.411	-0.195775	44.8
379.359375	1094.248583	0.582065	187840000	27000000	1920000	3560000	1760000	280000	40000	80000	0	0	0	0	0	0	0	0	596774574.6	33817320935	5.396558	24.607	14.073754	94.976	170.448	29.54	90	556200	684065.9321	1.333333	146.438	171.862	176.162	189.264	191.112	-0.185119	44.8
386.359375	1098.672381	0.588378	189520000	27120000	1800000	4200000	1880000	80000	40000	40000	0	0	0	0	0	0	0	0	585087827.2	34402408762	5.398474	24.694	14.293247	95.261	170.323	29.556	90	561700	695948.0144	1.333333	146.386	171.701	176.05	189.303	191.404	-0.194956	44.8
393.34375	1099.311221	0.582442	210720000	30400000	2520000	3680000	2120000	280000	160000	0	40000	0	0	0	0	0	0	0	685779733.5	35088188495	5.397897	24.607	14.135155	95.119	170.452	29.543	90	624800	709818.8915	1.333333	146.41	171.859	176.179	189.269	191.183	-0.242513	44.8
400.328125	1095.844252	0.579802	216880000	31400000	1800000	5000000	2400000	360000	80000	0	0	0	0	0	0	0	0	0	688873025	35777061520	5.419203	24.701	14.06339	95.333	170.282	29.546	90	644800	723744.2378	1.333333	146.442	171.702	176.133	189.331	191.435	-0.203975	44.8
407.3125	1096.325477	0.585098	217040000	32040000	2440000	4360000	2920000	200000	0	0	0	0	0	0	0	0	0	0	677443125.1	36454504645	5.430014	24.623	13.423803	95.245	170.458	29.553	90	647500	737481.8576	1.333333	146.415	171.966	176.263	189.238	191.139	-0.176919	44.8
414.34375	1098.449862	0.582114	186520000	28440000	2400000	4280000	2080000	320000	80000	40000	0	0	0	0	0	0	0	0	621661057	37076165702	5.434999	24.678	14.126496	95.289	170.298	29.575	90	560400	750082.7598	1.333333	146.423	171.771	176.284	189.305	191.386	-0.178556	44.8
421.34375	1099.567121	0.583311	197880000	30440000	2560000	3720000	1920000	200000	40000	0	0	0	0	0	0	0	0	0	615732491.3	37691898194	5.420489	24.668	13.998447	95.321	170.439	29.573	90	591900	762539.3541	1.333333	146.384	171.977	176.248	189.23	191.187	-0.161338	44.8
428.34375	1094.570554	0.583491	209760000	29840000	2800000	3920000	2240000	160000	80000	80000	0	0	0	0	0	0	0	0	672172961.6	38364071155	5.399786	24.661	14.329851	95.388	170.314	29.577	90	622200	776123.9518	1.333333	146.355	171.771	176.075	189.309	191.426	-0.189219	44.8
435.328125	1100.556451	0.584705	232200000	33600000	2240000	4800000	2320000	160000	40000	80000	0	0	0	0	0	0	0	0	725165341	39089236496	5.413194	24.604	14.09737	95.109	170.419	29.604	90	688600	790846.4247	1.333333	146.41	171.866	176.179	189.298	191.183	-0.219556	44.8
442.328125	1099.284799	0.586197	207280000	30480000	1960000	4600000	2000000	200000	0	0	0	0	0	0	0	0	0	0	634885706.3	39724122202	5.400022	24.736	14.243655	95.34	170.297	29.598	90	616300	803665.9136	1.333333	146.399	171.757	176.067	189.323	191.424	-0.235956	44.8
449.3125	1098.991838	0.580048	215400000	32440000	2160000	4720000	2280000	120000	40000	0	0	0	0	0	0	0	0	0	665806243.7	40389928446	5.407238	24.626	13.669535	95.1	170.467	29.592	90	642900	817125.2959	1.333333	146.454	171.927	176.139	189.281	191.135	-0.166256	44.8
456.296875	1099.642993	0.582409	219800000	31480000	2520000	5400000	2560000	160000	120000	0	0	0	0	0	0	0	0	0	700948996.3	41090877442	5.384095	24.662	13.842585	95.33	170.304	29.601	90	655100	831298.8719	1.333333	146.432	171.751	176.136	189.325	191.442	-0.204794	45.2
463.296875	1098.363384	0.581851	194040000	27920000	2240000	4120000	2200000	320000	40000	80000	0	0	0	0	0	0	0	0	636909997.9	41727787440	5.401308	24.604	13.709288	95.194	170.49	29.566	90	577400	844169.9179	1.333333	146.445	171.979	176.168	189.254	191.126	-0.186756	45.2
470.28125	1099.215978	0.58441	196640000	28920000	2480000	3760000	2080000	200000	0	40000	0	0	0	0	0	0	0	0	614091145.1	42341878585	5.405217	24.662	14.464984	95.324	170.33	29.569	90	585300	856594.285	1.333333	146.435	171.776	176.283	189.281	191.322	-0.220375	45.2
477.3125	1104.642853	0.585492	180200000	27320000	1960000	3600000	1960000	40000	40000	0	0	0	0	0	0	0	0	0	556977046	42898855631	5.384541	24.724	14.375901	95.504	170.38	29.562	90	537800	867854.3721	1.333333	146.338	171.924	176.189	189.259	191.343	-0.190038	45.2
484.3125	1098.831253	0.584164	203040000	29760000	2040000	3840000	2400000	320000	40000	0	0	0	0	0	0	0	0	0	641836676.4	43540692308	5.379319	24.632	14.346776	95.252	170.448	29.541	90	603600	880766.2714	1.333333	146.417	171.875	176.193	189.322	191.223	-0.169538	45.2
491.3125	1098.008427	0.581589	208480000	30800000	2040000	3560000	1880000	200000	80000	40000	0	0	0	0	0	0	0	0	646529216.1	44187221524	5.378138	24.72	14.426806	95.505	170.393	29.535	90	617700	893841.3599	1.333333	146.326	171.898	176.16	189.26	191.403	-0.1761	45.2
498.25	1098.790628	0.584	219120000	32120000	2520000	4400000	2040000	200000	80000	40000	0	0	0	0	0	0	0	0	681916209.6	44869137734	5.409547	24.678	14.129644	95.406	170.327	29.533	90	651300	907642.4321	1.333333	146.432	171.761	176.258	189.308	191.379	-0.142481	45.2
505.296875	1096.00343	0.585312	211280000	30560000	2400000	4120000	2200000	240000	0	80000	0	0	0	0	0	0	0	0	673555262.3	45542692996	5.401255	24.665	14.134761	95.561	170.458	29.556	90	627200	921264.5857	1.333333	146.358	171.983	176.225	189.23	191.278	-0.099025	45.2
512.28125	1097.436017	0.580622	208640000	30640000	1960000	4240000	2240000	80000	0	0	0	0	0	0	0	0	0	0	627466717.7	46170159714	5.378506	24.649	14.380624	95.324	170.458	29.536	90	619500	933986.9043	1.333333	146.419	171.869	176.189	189.272	191.242	-0.131	44.8
519.265625	1097.135387	0.585771	183600000	25920000	2320000	4600000	1880000	200000	0	0	0	0	0	0	0	0	0	0	569642360.9	46739802074	5.389657	24.707	14.243392	95.419	170.353	29.556	90	546300	945521.7172	1.333333	146.376	171.796	176.073	189.32	191.486	-0.063763	45.2
526.265625	1100.150731	0.583967	200240000	28480000	1480000	3720000	2200000	240000	120000	40000	0	40000	0	0	0	0	0	0	662234175.3	47402036250	5.397713	24.649	13.902542	95.172	170.478	29.539	90	591400	958935.1165	1.333333	146.468	171.98	176.169	189.312	191.176	-0.117063	45.2
533.25	1098.711197	0.583541	159720000	21360000	1440000	3160000	1520000	200000	120000	0	0	0	0	0	0	0	0	0	494205824.4	47896242074	5.404824	24.714	13.940721	95.362	170.327	29.513	90	468800	968917.7046	1.333333	146.461	171.748	176.277	189.328	191.432	-0.085906	45.2
540.234375	1096.571808	0.581917	173720000	26320000	2240000	3880000	1880000	280000	0	0	0	0	0	0	0	0	0	0	550820322.1	48447062396	5.393069	24.681	14.084775	95.45	170.48	29.492	90	520800	980058.4408	1.333333	146.406	172.032	176.277	189.254	191.244	-0.027688	45.2
547.28125	1099.492917	0.58213	199800000	30640000	1800000	4600000	2200000	40000	80000	40000	0	0	0	0	0	0	0	0	639283135.4	49086345532	5.408917	24.659	13.930094	95.33	170.354	29.526	90	598000	993013.627	1.333333	146.442	171.754	176.307	189.354	191.438	-0.092463	45.6

554.265625	1099.595153	0.583787	207760000	32360000	2000000	5040000	2240000	320000	80000	40000	0	0	0	0	0	0	0	0	683345286	49769690818	5.399838	24.698	14.367898	95.482	170.458	29.504	90	624600	1006824.949	1.333333	146.393	171.94	176.24	189.274	191.335	-0.113781	45.6
561.25	1095.777431	0.580622	190600000	27760000	2000000	3800000	2160000	240000	80000	0	40000	40000	0	0	0	0	0	0	650609993.5	50420300811	5.40241	24.675	14.641969	95.217	170.372	29.498	90	566800	1019973.424	1.333333	146.451	171.826	176.273	189.34	191.306	-0.112963	45.6
568.25	1103.571965	0.585918	227360000	33120000	2640000	4040000	2480000	240000	40000	0	0	0	0	0	0	0	0	0	698762808	51119063619	5.411856	24.665	14.380756	95.333	170.467	29.498	90	674800	1034144.242	1.333333	146.389	171.943	176.26	189.258	191.306	-0.055563	45.6
575.234375	1096.093929	0.581589	201120000	30440000	2120000	3880000	2280000	120000	0	0	0	0	0	0	0	0	0	0	618211622.1	51737275241	5.418337	24.669	14.635803	95.119	170.376	29.527	90	599900	1046592.942	1.333333	146.419	171.822	176.263	189.323	191.316	-0.103944	45.2
582.234375	1096.054548	0.580753	222360000	32600000	2360000	4120000	2960000	280000	0	40000	0	0	0	0	0	0	0	0	705032908.4	52442308150	5.392754	24.693	14.363306	95.221	170.358	29.575	90	661800	1060886.788	1.333333	146.315	171.977	176.185	189.285	191.434	-0.049825	45.2
589.21875	1094.290512	0.582147	167840000	25920000	2120000	3920000	1640000	80000	0	40000	0	0	0	0	0	0	0	0	528699831.8	52971007981	5.414559	24.623	14.49739	94.945	170.402	29.579	90	503900	1071606.04	1.333333	146.412	171.871	176.237	189.33	191.244	-0.056388	45.6
596.203125	1102.264515	0.584115	165800000	26280000	1480000	4200000	1560000	280000	80000	0	0	0	0	0	0	0	0	0	535787553.5	53506795535	5.414874	24.688	14.138828	95.046	170.294	29.569	90	499200	1082486.506	1.333333	146.383	171.747	176.129	189.379	191.486	-0.104763	45.6
603.234375	1092.780553	0.582901	190080000	28040000	2080000	3720000	1680000	320000	80000	0	0	0	0	0	0	0	0	0	600430885.6	54107226421	5.411804	24.683	13.599738	94.997	170.43	29.603	90	565000	1094591.503	1.333333	146.384	171.997	176.252	189.279	191.189	-0.104763	45.6
610.21875	1100.94571	0.587345	226320000	31760000	2360000	4080000	2560000	320000	40000	40000	0	0	0	0	0	0	0	0	703809404.3	54811035825	5.41713	24.707	14.035445	95.005	170.291	29.575	90	668700	1108903.808	1.333333	146.393	171.738	176.241	189.348	191.412	-0.127719	45.6
617.21875	1098.771241	0.580999	202520000	29280000	2400000	4040000	2200000	200000	80000	0	0	0	0	0	0	0	0	0	635168770.8	55446204596	5.410911	24.681	13.720702	95.1	170.429	29.562	90	601800	1121724.478	1.333333	146.309	171.96	176.215	189.256	191.225	-0.126081	45.6
624.203125	1098.490509	0.583393	163920000	24560000	1840000	3960000	1960000	160000	0	0	0	0	0	0	0	0	0	0	516930640	55963135236	5.403617	24.639	14.672407	94.995	170.288	29.543	90	491000	1132179.2	1.333333	146.367	171.731	176.192	189.302	191.258	-0.137563	45.6
631.203125	1099.069494	0.584393	176000000	26120000	1960000	3200000	2000000	80000	40000	0	0	0	0	0	0	0	0	0	540511712.8	56503646949	5.405742	24.656	14.051844	94.872	170.399	29.521	90	523500	1143113.633	1.333333	146.289	171.829	176.136	189.294	191.168	-0.099844	45.6
638.203125	1097.105659	0.582589	195960000	27160000	2120000	3720000	2000000	160000	40000	40000	0	0	0	0	0	0	0	0	604969772.4	57108616721	5.393331	24.724	14.338117	95.299	170.304	29.504	90	578000	1155345.592	1.333333	146.227	171.839	176.126	189.241	191.345	-0.077706	45.6
645.1875	1094.564556	0.583442	211880000	31000000	2400000	4120000	2440000	200000	120000	0	0	0	0	0	0	0	0	0	668071568.5	57776688289	5.391547	24.626	14.161525	95.093	170.382	29.498	90	630400	1168877.593	1.333333	146.286	171.799	176.096	189.277	191.168	-0.067044	46
652.171875	1096.442731	0.585049	196760000	28600000	1880000	4320000	2080000	240000	0	0	0	0	0	0	0	0	0	0	603767428.2	58380455718	5.386299	24.724	14.23329	95.46	170.259	29.484	90	584700	1181135.485	1.333333	146.26	171.731	175.976	189.305	191.432	-0.104763	45.6
659.171875	1096.787492	0.58277	203680000	29760000	1800000	3200000	2520000	80000	0	40000	0	40000	0	0	0	0	0	0	649385327.3	59029841045	5.380526	24.632	14.23434	95.419	170.383	29.489	90	602800	1194296.943	1.333333	146.284	171.784	176.101	189.234	191.21	-0.031788	45.6
666.15625	1096.300972	0.583393	220000000	32960000	1880000	4400000	2080000	200000	0	80000	0	0	0	0	0	0	0	0	685714911.3	59715555956	5.374649	24.681	14.435202	95.75	170.343	29.524	90	654000	1208190.345	1.333333	146.208	171.816	176.09	189.159	191.289	-0.070325	45.6
673.15625	1095.001658	0.582442	205880000	28280000	2280000	3880000	1960000	280000	160000	0	0	0	0	0	0	0	0	0	643106381.2	60358662337	5.407448	24.711	14.156671	95.564	170.242	29.53	90	606800	1221226.229	1.333333	146.279	171.688	176.181	189.261	191.316	-0.091644	45.6
680.140625	1098.179767	0.583688	172320000	25240000	1920000	3440000	2080000	120000	40000	40000	0	0	0	0	0	0	0	0	544969189.6	60903631527	5.403669	24.665	14.046597	95.64	170.382	29.537	90	513000	1232285.963	1.333333	146.25	171.891	176.172	189.153	191.158	-0.060488	45.2
687.140625	1100.784994	0.583114	194600000	29680000	2200000	4320000	2080000	360000	0	0	0	0	0	0	0	0	0	0	618574713.3	61522206240	5.38908	24.691	14.685527	95.469	170.314	29.514	90	583100	1244803.134	1.333333	146.305	171.75	176.145	189.208	191.221	-0.108044	44.8
694.125	1097.542114	0.584278	187600000	28280000	1720000	3600000	2320000	80000	80000	0	0	0	0	0	0	0	0	0	586432689.3	62108638930	5.380106	24.717	14.359764	95.618	170.346	29.521	90	559200	1256641.811	1.333333	146.185	171.826	176.057	189.166	191.316	-0.117063	44.8
701.125	1096.414297	0.581966	192840000	27720000	1920000	4160000	2320000	400000	40000	40000	0	0	0	0	0	0	0	0	627565641.1	62736204571	5.408314	24.717	13.881682	95.428	170.291	29.508	90	573600	1269348.297	1.333333	146.331	171.678	176.086	189.267	191.398	-0.1064	44.8
708.125	1096.205778	0.580113	197920000	28680000	1800000	3920000	2240000	240000	40000	0	0	0	0	0	0	0	0	0	613015848.1	63349220419	5.429331	24.623	13.522332	95.343	170.458	29.475	90	587100	1281772.956	1.333333	146.328	171.907	176.103	189.205	191.093	-0.112963	44.8
715.125	1100.538084	0.582671	198760000	31440000	1720000	4640000	1840000	160000	40000	160000	0	0	0	0	0	0	0	0	662939003.4	64012159422	5.409941	24.73	14.337067	95.567	170.346	29.469	90	596900	1295212.019	1.333333	146.221	171.891	176.024	189.176	191.329	-0.103944	45.2
722.109375	1096.769871	0.581983	184240000	25920000	2160000	3240000	1840000	80000	120000	0	0	0	0	0	0	0	0	0	564607124.5	64576766547	5.404981	24.646	14.25953	95.289	170.369	29.479	90	544000	1306612.646	1.333333	146.311	171.783	176.09	189.225	191.145	-0.056388	45.2
729.109375	1101.256863	0.584606	224160000	33000000	2440000	5000000	2440000	240000	120000	0	0	0	0	0	0	0	0	0	712974800.4	65289741347	5.402462	24.759	14.253626	95.463	170.287	29.492	90	668500	1321058.598	1.333333	146.25	171.763	175.998	189.222	191.384	-0.052288	45.2
736.09375	1097.056084	0.582983	211760000	30160000	2720000	4840000	2040000	240000	0	0	0	0	0	0	0	0	0	0	653278624.3	65943019971	5.414847	24.669	14.525335	95.299	170.353	29.511	90	629400	1334241.084	1.333333	146.315	171.76	176.119	189.185	191.171	-0.058025	44.8
743.140625	1097.618034	0.584524	177480000	28320000	1400000	4280000	1760000	40000	0	0	0	0	0	0	0	0	0	0	548834333.3	66491854305	5.404509	24.759	14.287999	95.507	170.281	29.534	90	533200	1345358.399	1.333333	146.26	171.744	175.985	189.225	191.411	-0.068688	44.8
750.125	1099.078357	0.583311	181080000	25720000	1680000	3440000	2000000	160000	80000	40000	40000	0	0	0	0	0	0	0	590270124.1	67082124429	5.430197	24.652	13.561691	95.283	170.441	29.556	90	535600	1357308.926	1.333333	146.402	171.927	176.168	189.228	191.083	-0.101481	44.4
757.109375	1098.347458	0.581884	200920000	29200000	2240000	4760000	2240000	40000	0	0	0	0	0	0	0	0	0	0	614550839	67696675268	5.426603	24.733	13.997922	95.362	170.281	29.582	90	598500	1369734.505	1.333333	146.367	171.724	176.214	189.261	191.332	-0.082625	44.8
764.109375	1095.86857	0.584557	199840000	29960000	2240000	4000000	2680000	240000	80000	80000	0	0	0	0	0	0	0	0	665661966.2	68362337234	5.425815	24.675	13.416456	95.349	170.405	29.595	90	597800	1383202.455	1.333333	146.373	171.953	176.204	189.169	191.112	-0.062125	44.8
771.109375	1096.551724	0.583934	207040000	30480000	2320000	3920000	2160000	120000	40000	0	0	0	0	0	0	0	0	0	631387768.4	68993725002	5.406923	24.743	14.171365	95.441	170.268	29.576	90	615200	1396005.851	1.333333	146.341	171.727	176.024	189.244	191.43	-0.028506	44.8
778.09375	1097.826292	0.584639	195200000	27680000	1920000	3600000	2520000	200000	160000	0	0	0	0	0	0	0	0	0	621348416.5	69615073419	5.425842	24.662	13.4772	95.33	170.428	29.592	90	578200	1408597.817	1.333333	146.419	171.943	176.113	189.202	191.099	-0.084263	44.8
785.078125	1096.99392	0.58318	212240000	30960000	2640000	3720000	2480000	240000	120000	40000	0	0	0	0	0	0	0	0	681101353.8	70296174773	5.419439	24.704	14.072705	95.45	170.271	29.566	90	631100	1422384.685	1.333333	146.383	171.721	176.185	189.231	191.329	-0.035069	44.8
792.078125	1096.79244	0.585853	203440000	30440000	2360000	3320000	2480000	280000	120000	0	0	0	0	0	0	0	0	0	648851684.6	70945026457	5.399182	24.656	13.743661	95.409	170.425	29.547	90	606100	1435528.72	1.333333	146.354	171.924	176.227	189.159	191.181	-0.062944	44.8
799.078125	1096.66323	0.580605	192720000	27720000	2120000	3960000	2200000	200000	0	0	0	0	0	0	0	0	0	0	593342903.1	71538369360	5.417288	24.724	13.905428	95.349	170.264	29.569	90	572300	1447550.5	1.333333	146.389	171.724	176.162	189.267	191.355	-0.103125	44.4
806.0625	1100.316497	0.585033	180800000	26360000	2080000	3720000	2160000	160000	40000	0	0	0	0	0	0	0	0	0	563898567.3	72102267928	5.419256	24.636	13.632931	95.138	170.454	29.553	90	538300	1458977.052	1.333333	146.419	171.914	176.093	189.205	191.073	-0.055563	44.4
813.046875	1099.265324	0.583475	213400000	31680000	1960000	3960000	2160000	200000	0	40000	0	0	0	0	0	0	0	0	657090038.8	72759357966	5.411489	24.727	14.135417	95.264	170.245	29.537	90	633500	1472247.78	1.333333	146.399	171.721	176.234	189.251	191.335	-0.058025	44
820.046875	1098.937174	0.58523	224080000	34200000	2720000	4200000	2240000	320000	40000	0	0	0	0	0	0	0	0	0	701984845.1	73461342812	5.413011	24.672	13.434167	95.299	170.454	29.556	90	669500	1486438.77	1.333333	146.396	171.947	176.221	189.146	191.112	-0.093281	44
827.03125	1097.815725	0.585049	197480000	29440000	2000000	3320000	1360000	320000	40000	0	0	0	0	0	0	0	0	0	595646382.7	74056989194	5.391153	24.662	14.555773	95.365	170.307	29.576	90	584900	1498483.668	1.333333	146.425	171.75	176.218	189.248	191.283	-0.091644	44
834.03125	1095.673939	0.581671	201920000	28520000	2640000	4640000	2440000	80000	80000	0	0	0	0	0	0	0	0	0	635194109	74692183303	5.401072	24.675	13.783153	95.517	170.454	29.585	90	600800	1511341.404	1.333333	146.354	171.94	176.218	189.153	191.211	-0.030969	44.4
841.015625	1098.485155	0.581294	217480000	32920000	1960000	4440000	2040000	200000	0	0	0	0	0	0	0	0	0	0	658616977.3	75350800280	5.403958	24.775	14.079002	95.428	170.314	29.605	90	647600	1524699.331	1.333333	146.393	171.701	176.077	189.294	191.443	-0.043269	44.4
848	1098.993639	0.583754	182560000	27000000	2320000	4040000	1840000	160000	80000	0	0	0	0	0	0	0	0	0	574867607.5	75925667888	5.390943	24.707	13.653004	95.46	170.458	29.608	90	545000	1536328.834	1.333333	146.373	171.963	176.208	189.169	191.191	-0.049006	44.8

855.046875	1102.442466	0.58277	222040000	32000000	2520000	4880000	2560000	280000	40000	0	0	0	0	0	0	0	0	0	703943828.2	76629611716	5.404194	24.72	14.118624	95.416	170.323	29.585	90	660800	1550562.943	1.333333	146.428	171.744	176.263	189.277	191.362	-0.090825	44.8
862.03125	1098.896537	0.584147	207680000	30440000	1880000	4160000	2600000	120000	120000	40000	0	0	0	0	0	0	0	0	666694045.4	77296305762	5.39501	24.73	14.149062	95.545	170.48	29.598	90	617600	1564001.67	1.333333	146.386	171.898	176.218	189.202	191.247	-0.051469	44.8
869.015625	1097.835203	0.581999	190880000	29640000	1760000	3720000	2200000	480000	80000	0	0	0	0	0	0	0	0	0	622894421.4	77919200183	5.417734	24.756	13.862921	95.393	170.33	29.572	90	571900	1576598.032	1.333333	146.438	171.747	176.24	189.281	191.404	-0.068688	44.8
876.015625	1100.119088	0.583032	204880000	30960000	2640000	3920000	2240000	280000	80000	40000	0	0	0	0	0	0	0	0	662803789.2	78582003972	5.422798	24.707	13.44217	95.321	170.5	29.566	90	612600	1590014.411	1.333333	146.432	171.947	176.221	189.235	191.175	-0.071144	44.4
883	1096.135959	0.584098	260520000	34120000	2680000	4880000	2280000	240000	80000	80000	0	0	0	0	0	0	0	0	797260952.7	79379264925	5.4165	24.772	13.985459	95.324	170.333	29.576	90	762200	1606118.949	1.333333	146.428	171.734	176.067	189.307	191.457	-0.012106	44.4
890	1099.750393	0.585705	210560000	31360000	2400000	4720000	2640000	200000	200000	0	0	0	0	0	0	0	0	0	691176970.9	80070441896	5.400521	24.672	14.129382	95.049	170.451	29.517	90	630200	1620131.343	1.333333	146.428	171.868	176.175	189.287	191.221	-0.066225	44
896.984375	1095.102434	0.582655	170920000	24120000	1840000	3600000	2480000	160000	0	0	0	0	0	0	0	0	0	0	536113101	80606554997	5.405139	24.714	14.517201	95.393	170.386	29.547	90	507800	1630964.369	1.333333	146.383	171.937	176.191	189.218	191.339	-0.112144	43.6
903.984375	1098.967154	0.582114	190840000	28680000	2440000	4000000	1920000	160000	80000	0	0	0	0	0	0	0	0	0	598921235	81205476232	5.412617	24.785	14.239063	95.248	170.291	29.563	90	570300	1643117.899	1.333333	146.393	171.76	176.09	189.323	191.47	-0.059663	44
910.96875	1095.825967	0.584377	187040000	27560000	2000000	3320000	2240000	280000	40000	40000	0	0	0	0	0	0	0	0	597235375.3	81802711607	5.400652	24.694	14.147618	95.122	170.464	29.601	90	556300	1655194.6	1.333333	146.445	171.884	176.155	189.287	191.178	-0.044088	44
917.984375	1098.938903	0.583885	210480000	32000000	2520000	4440000	2120000	160000	40000	80000	0	0	0	0	0	0	0	0	676758818.5	82479470426	5.384751	24.743	14.612843	95.416	170.336	29.627	90	629600	1668918.571	1.333333	146.461	171.76	176.254	189.3	191.319	-0.077706	44
924.984375	1099.944714	0.585082	221280000	32280000	2000000	3880000	2440000	160000	0	80000	0	0	0	0	0	0	0	0	688798753.3	83168269179	5.398763	24.762	13.769245	95.513	170.474	29.627	90	655300	1682847.134	1.333333	146.432	171.999	176.267	189.215	191.224	-0.101481	44
931.96875	1099.304261	0.586312	178240000	25600000	2000000	3840000	2280000	120000	80000	40000	0	0	0	0	0	0	0	0	575312651.4	83743581830	5.41078	24.769	13.855574	95.416	170.323	29.644	90	530500	1694470.196	1.333333	146.458	171.773	176.227	189.343	191.457	-0.121981	44
938.96875	1097.285111	0.58623	195760000	30040000	2680000	3120000	1440000	240000	80000	40000	0	0	0	0	0	0	0	0	613486030.8	84357067861	5.371946	24.701	14.094352	95.217	170.487	29.656	90	583500	1706871.697	1.333333	146.448	171.878	176.181	189.303	191.201	-0.057206	44
945.96875	1100.142209	0.582852	179320000	26600000	2240000	3720000	1680000	120000	80000	0	0	0	0	0	0	0	0	0	557345888.7	84914413750	5.394118	24.665	13.99871	95.175	170.48	29.614	90	534400	1718159.068	1.333333	146.474	171.891	176.195	189.271	191.168	-0.053106	44.4
952.96875	1099.087195	0.585262	156040000	21680000	1440000	3280000	1840000	200000	120000	0	0	0	0	0	0	0	0	0	498724573.9	85413138324	5.368561	24.772	14.358977	95.507	170.408	29.611	90	461500	1728233.009	1.333333	146.36	171.852	176.165	189.244	191.417	-0.058025	44
959.953125	1103.636639	0.586738	199920000	30720000	1880000	3960000	1960000	120000	120000	40000	0	0	0	0	0	0	0	0	634895148.4	86048033472	5.392386	24.701	14.627275	95.286	170.372	29.589	90	596800	1741069.826	1.333333	146.454	171.839	176.231	189.307	191.27	-0.101481	44
966.9375	1096.599611	0.582507	162480000	24320000	2000000	3840000	1720000	80000	0	0	0	0	0	0	0	0	0	0	504654674.3	86552688146	5.399392	24.749	13.821594	95.387	170.484	29.563	90	486100	1751231.276	1.333333	146.432	172.022	176.25	189.218	191.244	-0.127719	44.4
973.9375	1098.841792	0.588017	227160000	33640000	2560000	4360000	2560000	200000	40000	0	40000	40000	0	0	0	0	0	0	753177172.2	87305865319	5.38887	24.746	13.821069	95.245	170.314	29.582	90	676500	1766494.158	1.333333	146.483	171.803	176.165	189.323	191.417	-0.053106	44.4
980.921875	1098.357979	0.588296	203480000	30520000	2280000	3840000	2480000	160000	0	40000	0	0	0	0	0	0	0	0	639312685.1	87945178004	5.388503	24.694	13.728967	95.065	170.503	29.598	90	607000	1779423.179	1.333333	146.513	171.94	176.155	189.294	191.198	-0.076063	44.4
987.90625	1100.115583	0.58482	173040000	24840000	1720000	3440000	1760000	280000	120000	0	0	0	0	0	0	0	0	0	548714888.6	88493892892	5.387742	24.759	14.267664	95.289	170.353	29.579	90	513000	1790524.9	1.333333	146.422	171.796	176.086	189.313	191.506	-0.1105	44.4
994.953125	1095.852805	0.582606	183640000	27360000	1720000	4560000	1360000	200000	40000	0	0	0	0	0	0	0	0	0	570805726.8	89064698619	5.380001	24.714	14.554198	95.226	170.395	29.576	90	547200	1802055.118	1.333333	146.451	171.809	176.267	189.294	191.293	-0.095744	44.4
1001.9375	1097.856451	0.582852	156280000	24760000	1840000	3120000	2040000	120000	40000	40000	0	0	0	0	0	0	0	0	509274128.6	89573972748	5.387506	24.743	14.027967	95.472	170.464	29.559	90	470600	1812382.42	1.333333	146.419	172.002	176.244	189.241	191.27	-0.053925	44.4
1008.9375	1100.628599	0.58805	158040000	24200000	1400000	2560000	1800000	40000	80000	0	0	0	0	0	0	0	0	0	486213016.2	90060185764	5.38538	24.791	13.803226	95.434	170.343	29.585	90	470300	1822224.083	1.333333	146.438	171.783	176.211	189.343	191.443	-0.033425	44.4
1015.921875	1101.308615	0.583737	196440000	29120000	2320000	3440000	2040000	120000	160000	0	0	0	0	0	0	0	0	0	617244006.5	90677429770	5.408156	24.691	13.710731	95.273	170.497	29.576	90	584100	1834686.537	1.333333	146.509	171.963	176.136	189.31	191.214	-0.090006	44.4
1022.90625	1100.73241	0.582507	187680000	30080000	1560000	4000000	2080000	120000	0	0	0	0	0	0	0	0	0	0	583075485.1	91260505255	5.413667	24.811	14.101568	95.551	170.356	29.559	90	563800	1846451.843	1.333333	146.412	171.793	176.1	189.33	191.499	-0.059663	44.4
1029.90625	1099.935712	0.583262	226960000	32880000	2880000	5160000	2080000	360000	40000	0	0	0	0	0	0	0	0	0	713553693.5	91974058949	5.401964	24.683	13.980342	95.319	170.493	29.567	90	675900	1860857.478	1.333333	146.473	171.933	176.138	189.303	191.185	-0.041625	44.4
1036.890625	1100.66555	0.584459	208360000	33280000	1600000	4360000	2360000	200000	120000	0	40000	0	0	0	0	0	0	0	688792385.4	92662851334	5.418232	24.811	13.985065	95.513	170.327	29.576	90	625800	1874773.289	1.333333	146.438	171.767	176.139	189.343	191.532	-0.084263	44.4
1043.875	1098.116083	0.584229	207680000	30000000	2520000	3440000	2040000	120000	120000	0	0	0	0	0	0	0	0	0	637183830.7	93300035165	5.386456	24.698	14.14775	95.333	170.428	29.576	90	614800	1887637.906	1.333333	146.422	171.894	176.188	189.317	191.257	-0.011288	44.4
1050.875	1098.534682	0.585771	210640000	31160000	1560000	4280000	2560000	80000	80000	40000	0	40000	0	0	0	0	0	0	691743684.2	93991778849	5.397319	24.762	14.350843	95.731	170.428	29.563	90	626100	1901636.5	1.333333	146.422	171.986	176.208	189.222	191.342	-0.090006	44.4
1057.859375	1098.370423	0.584688	180400000	27560000	2200000	3600000	1640000	160000	80000	0	0	0	40000	0	0	0	0	0	635201687.8	94626980537	5.405349	24.675	14.482958	95.403	170.425	29.55	90	539200	1914485.975	1.333333	146.464	171.842	176.214	189.294	191.289	-0.035888	44.4
1064.90625	1093.622202	0.582196	210720000	31000000	2400000	4440000	2000000	240000	0	40000	0	0	0	0	0	0	0	0	662074411.9	95289054949	5.413614	24.749	13.736183	95.51	170.454	29.572	90	627100	1927881.059	1.333333	146.464	172.028	176.28	189.228	191.234	-0.057206	44.8
1071.890625	1105.085269	0.584574	193080000	28520000	2400000	3880000	2360000	120000	80000	0	0	0	0	0	0	0	0	0	605854888.5	95894909838	5.417839	24.777	13.999759	95.509	170.323	29.564	90	576100	1940191.93	1.333333	146.486	171.786	176.155	189.34	191.493	-0.078525	44.8
1078.875	1099.235382	0.585754	210120000	31120000	2120000	4320000	1880000	40000	120000	0	0	0	0	0	0	0	0	0	646416660.5	96541326498	5.407815	24.706	13.518396	95.421	170.471	29.575	90	624300	1953190.759	1.333333	146.455	171.983	176.258	189.253	191.18	-0.042444	45.2
1085.875	1100.519407	0.586181	187200000	27840000	2120000	3760000	2400000	200000	40000	0	0	0	0	0	0	0	0	0	593445405.5	97134771904	5.37213	24.777	14.254675	95.648	170.382	29.593	90	558900	1965187.895	1.333333	146.421	171.828	176.059	189.297	191.483	-0.020306	45.2
1092.859375	1099.914616	0.584475	149600000	20320000	2080000	3520000	1880000	160000	40000	0	0	0	0	0	0	0	0	0	474772591.9	97609544496	5.387899	24.657	14.034133	95.38	170.481	29.585	90	444000	1974774.734	1.333333	146.474	171.927	176.202	189.312	191.18	-0.044906	45.2
1099.84375	1100.78343	0.58564	174400000	26000000	1480000	3680000	2160000	160000	0	0	40000	0	0	0	0	0	0	0	562528474	98172072970	5.387926	24.777	14.260448	95.548	170.324	29.543	90	519800	1986139.827	1.333333	146.39	171.852	176.087	189.345	191.504	-0.065406	44.8
1106.828125	1098.716534	0.584131	184520000	28560000	2240000	3480000	1920000	80000	80000	40000	0	0	0	0	0	0	0	0	586863599	98758936569	5.413247	24.679	13.590948	95.28	170.511	29.506	90	552300	1997987.22	1.333333	146.495	171.991	176.158	189.285	191.14	-0.073606	44.8
1113.8125	1099.101269	0.584902	207560000	28840000	2160000	3840000	2400000	200000	40000	0	0	0	0	0	0	0	0	0	634166392.1	99393102961	5.394276	24.721	13.877615	95.385	170.341	29.519	90	612600	2010813.628	1.333333	146.476	171.756	176.178	189.36	191.454	-0.055563	44.8
1120.8125	1099.355212	0.586279	202760000	30960000	2520000	3640000	1840000	240000	120000	40000	0	40000	0	0	0	0	0	0	678189633.9	1.00071E+11	5.400993	24.668	13.721752	95.156	170.494	29.488	90	605400	2024525.632	1.333333	146.52	172	176.193	189.291	191.179	-0.071144	44.8
1127.796875	1100.409417	0.58436	200880000	29480000	1560000	2640000	2280000	80000	80000	40000	0	0	0	0	0	0	0	0	612859295.5	1.00684E+11	5.39648	24.723	14.232765	95.403	170.321	29.466	90	592600	2036913.889	1.333333	146.408	171.792	176.058	189.306	191.512	-0.046544	44.8
1134.84375	1097.291349	0.585377	206280000	29920000	2080000	3200000	2400000	280000	40000	0	40000	0	0	0	0	0	0	0	662351691.2	1.01347E+11	5.397293	24.645	14.284195	95.251	170.442	29.479	90	610600	2050289.753	1.333333	146.476	171.867	176.192	189.293	191.207	-0.052288	44.8
1141.78125	1098.74473	0.585197	195440000	28480000	1880000	4520000	1840000	200000	0	0	0	0	0	0	0	0	0	0	592416146.1	1.01939E+11	5.386273	24.763	14.283014	95.581	170.362	29.482	90	580900	2062287.299	1.333333	146.393	171.875	176.117	189.301	191.444	-0.097381	44.8
1148.828125	1102.217781	0.588755	207080000	31360000	1800000	5080000	2680000	280000	200000	40000	40000	0	0	0	0	0	0	0	729116631.4	1.02668E+11	5.376223	24.605	14.494241	95.486	170.395	29.478	90	621400	2077033.756	1.333333	146.506	171.862	176.285	189.317	191.316	-0.044906	44.4

1155.8125	1097.674806	0.580999	188440000	26760000	2080000	3440000	2200000	120000	80000	40000	0	0	0	0	0	0	0	0	594348014.2	1.03262E+11	5.38887	24.702	14.393875	95.827	170.404	29.456	90	557900	2089016.627	1.333333	146.409	171.937	176.239	189.268	191.398	-0.007188	44.4
1162.8125	1096.644444	0.580605	175400000	25000000	2000000	3480000	2080000	40000	0	0	0	0	0	0	0	0	0	0	530941835.5	1.03793E+11	5.399917	24.616	14.337198	95.453	170.482	29.463	90	520000	2099765.445	1.333333	146.502	171.897	176.222	189.329	191.233	-0.060488	44.4
1169.78125	1094.076079	0.581622	225240000	32880000	2440000	4400000	2000000	160000	40000	80000	0	40000	0	0	0	0	0	0	727622276.2	1.04521E+11	5.399445	24.713	13.824742	95.611	170.315	29.457	90	668200	2114509.863	1.333333	146.531	171.789	176.267	189.365	191.476	-0.126081	44
1176.78125	1091.320768	0.581491	165280000	25680000	1720000	3600000	1400000	360000	80000	40000	0	0	0	0	0	0	0	0	541338404.9	1.05062E+11	5.419439	24.648	13.522463	95.573	170.534	29.444	90	495400	2125505.207	1.333333	146.522	172.047	176.271	189.316	191.207	-0.078525	44
1183.796875	1090.924851	0.581064	184160000	28080000	2040000	4080000	2600000	80000	160000	40000	0	0	0	0	0	0	0	0	614046196.8	1.05676E+11	5.427888	24.655	13.544111	95.377	170.518	29.431	90	553100	2138008.837	1.333333	146.554	172.038	176.202	189.349	191.171	-0.065406	44
1190.796875	1094.853944	0.582639	195160000	28920000	2440000	3840000	1880000	320000	80000	0	0	0	0	0	0	0	0	0	613407303	1.0629E+11	5.411305	24.726	14.177531	95.545	170.331	29.441	90	581600	2150503.99	1.333333	146.535	171.838	176.205	189.411	191.502	-0.071144	44
1197.78125	1097.849619	0.584672	173760000	24800000	2320000	3320000	1920000	240000	40000	40000	0	0	0	0	0	0	0	0	551960875.3	1.06842E+11	5.424635	24.65	13.58675	95.388	170.512	29.475	90	516100	2161707.126	1.333333	146.6	172.051	176.357	189.327	191.214	-0.030969	43.6
1204.78125	1100.629673	0.583737	214200000	29520000	2240000	3240000	2240000	280000	80000	40000	0	40000	0	0	0	0	0	0	691131195.5	1.07533E+11	5.425947	24.729	14.211643	95.478	170.344	29.466	90	629700	2175696.72	1.333333	146.544	171.835	176.202	189.401	191.525	-0.1023	43.6
1211.78125	1100.12934	0.584246	195640000	29400000	1760000	3960000	2000000	120000	0	40000	0	40000	0	0	0	0	0	0	634583710.2	1.08167E+11	5.4292	24.671	14.684871	95.324	170.4	29.492	90	582400	2188509.259	1.333333	146.567	171.89	176.248	189.362	191.286	-0.021125	43.6
1218.78125	1096.290652	0.584278	194560000	27840000	2080000	4240000	2920000	160000	80000	80000	0	0	0	0	0	0	0	0	649538574.2	1.08817E+11	5.420436	24.665	13.55723	95.346	170.501	29.483	90	579900	2201629.708	1.333333	146.554	172.06	176.333	189.303	191.21	-0.012931	43.6
1225.765625	1097.923763	0.584967	196080000	29600000	2120000	3520000	2360000	240000	40000	40000	0	0	0	0	0	0	0	0	624117136.9	1.09441E+11	5.421565	24.742	14.143682	95.384	170.347	29.492	90	585000	2214280.796	1.333333	146.551	171.828	176.195	189.408	191.525	-0.061306	43.6
1232.765625	1102.232577	0.589854	167520000	24480000	1440000	3800000	1600000	120000	80000	0	0	0	0	0	0	0	0	0	519547961.8	1.09961E+11	5.410675	24.632	14.005138	95.169	170.531	29.541	90	497600	2224796.563	1.333333	146.574	172.018	176.254	189.369	191.201	-0.091644	43.2
1239.765625	1098.282212	0.584688	186440000	27800000	2080000	3880000	1760000	40000	120000	80000	0	40000	0	0	0	0	0	0	631538692.3	1.10592E+11	5.389159	24.736	14.279078	95.475	170.351	29.505	90	555600	2237529.078	1.333333	146.473	171.864	176.149	189.356	191.509	-0.073606	43.2
1246.75	1100.293409	0.586082	195320000	28440000	1920000	4080000	1840000	160000	80000	40000	0	0	0	0	0	0	0	0	612058967.9	1.11204E+11	5.39829	24.661	14.188683	95.289	170.419	29.525	90	579700	2249913.245	1.333333	146.57	171.91	176.264	189.349	191.263	-0.021125	43.2
1253.734375	1097.545659	0.585246	193000000	27800000	1960000	3800000	1840000	320000	40000	0	0	0	0	0	0	0	0	0	597292206.2	1.11802E+11	5.385459	24.723	14.374065	95.586	170.396	29.508	90	571900	2261976.536	1.333333	146.457	171.966	176.166	189.313	191.427	-0.062944	43.2
1260.734375	1102.210983	0.58728	211400000	31000000	2320000	4400000	2000000	80000	80000	0	0	40000	0	0	0	0	0	0	675918690.2	1.12477E+11	5.385276	24.616	14.611925	95.399	170.449	29.499	90	628300	2275661.995	1.333333	146.583	171.897	176.251	189.342	191.263	-0.016206	43.2
1267.734375	1096.177376	0.583311	157440000	24200000	1640000	2680000	1240000	40000	120000	0	0	0	0	0	0	0	0	0	483399123.5	1.12961E+11	5.367249	24.713	14.43271	95.712	170.436	29.489	90	468400	2285408.044	1.333333	146.463	172.031	176.248	189.31	191.404	-0.070325	43.6
1274.703125	1097.658776	0.585	177480000	26720000	1480000	3160000	1880000	160000	0	0	0	0	0	0	0	0	0	0	534476766.3	1.13495E+11	5.409757	24.642	13.545029	95.5	170.55	29.502	90	527200	2296243.208	1.333333	146.583	172.031	176.29	189.346	191.194	-0.051469	43.6
1281.6875	1093.430387	0.581851	181160000	27520000	1800000	4160000	1200000	160000	80000	40000	0	0	0	0	0	0	0	0	567394657.5	1.14063E+11	5.392832	24.687	13.989395	95.639	170.341	29.483	90	540300	2307730.175	1.333333	146.561	171.825	176.336	189.382	191.446	-0.063763	43.6
1288.734375	1098.481741	0.582491	228720000	35160000	2160000	4920000	2400000	160000	80000	0	0	40000	0	0	0	0	0	0	746317837.7	1.14809E+11	5.398133	24.674	14.095402	95.706	170.475	29.463	90	684100	2322897.89	1.333333	146.525	172.074	176.323	189.29	191.296	-0.028506	43.6
1295.71875	1099.558007	0.584246	213400000	30560000	2200000	4520000	2600000	200000	0	0	0	0	0	0	0	0	0	0	658576718	1.15468E+11	5.400888	24.648	14.567449	95.548	170.416	29.463	90	633700	2336220.859	1.333333	146.574	171.799	176.34	189.356	191.368	-0.032606	43.6
1302.71875	1095.728272	0.583754	212480000	30200000	2240000	3880000	2120000	240000	120000	0	0	0	0	0	0	0	0	0	660000883	1.16128E+11	5.413772	24.642	13.776854	95.403	170.557	29.46	90	628200	2349559.57	1.333333	146.577	172.018	176.222	189.349	191.191	-0.049006	43.2
1309.71875	1099.395673	0.582934	219080000	33080000	3160000	4680000	2320000	280000	40000	120000	0	0	0	0	0	0	0	0	726977705.5	1.16855E+11	5.398028	24.736	13.951741	95.56	170.383	29.441	90	656900	2364303.244	1.333333	146.567	171.858	176.205	189.437	191.522	-0.044088	43.2
1316.703125	1095.18129	0.585213	182480000	26600000	2360000	3120000	1720000	160000	40000	40000	0	0	0	0	0	0	0	0	565894254	1.1742E+11	5.403748	24.629	13.502521	95.384	170.547	29.466	90	541300	2375741.735	1.333333	146.609	172.06	176.199	189.375	191.197	0.011669	42.8
1323.703125	1097.614766	0.584475	204240000	27400000	2520000	3600000	2160000	200000	80000	80000	0	0	0	0	0	0	0	0	644010689.4	1.18064E+11	5.384856	24.736	14.219908	95.51	170.416	29.457	90	600700	2388809.297	1.333333	146.557	171.825	176.208	189.405	191.555	-0.051469	42.8
1330.6875	1101.353264	0.585935	203480000	32280000	2240000	3760000	1920000	80000	40000	0	0	0	0	0	0	0	0	0	621625644.3	1.18686E+11	5.381208	24.623	14.133974	95.27	170.501	29.437	90	609500	2401394.68	1.333333	146.528	171.985	176.258	189.359	191.22	-0.023588	42.8
1337.6875	1096.260709	0.580113	195680000	30240000	2000000	4440000	1440000	160000	0	0	0	0	0	0	0	0	0	0	596172172.8	1.19282E+11	5.393698	24.742	14.326965	95.567	170.432	29.466	90	584900	2413423.764	1.333333	146.441	171.949	176.199	189.316	191.473	-0.014569	43.2
1344.671875	1097.372753	0.584147	200480000	28920000	1600000	4360000	2920000	200000	40000	40000	0	0	0	0	0	0	0	0	644286592.2	1.19927E+11	5.418337	24.713	14.680672	95.434	170.416	29.45	90	596400	2426484.051	1.333333	146.596	171.884	176.346	189.346	191.368	-0.015388	43.2
1351.671875	1098.730623	0.584869	169440000	25360000	1520000	3560000	1840000	160000	40000	0	0	0	0	0	0	0	0	0	526840016.6	1.20453E+11	5.429515	24.681	14.038856	95.699	170.508	29.479	90	504800	2437152.765	1.333333	146.486	172.047	176.313	189.303	191.296	-0.055563	43.6
1358.6875	1095.552665	0.582147	176760000	24640000	1760000	3120000	2360000	40000	80000	0	0	0	0	0	0	0	0	0	545795313.3	1.20999E+11	5.434894	24.694	13.70299	95.535	170.518	29.496	90	521900	2448191.672	1.333333	146.544	172.077	176.353	189.316	191.24	-0.006369	44
1365.671875	1095.844493	0.585672	163400000	23040000	2240000	3000000	960000	80000	40000	0	0	0	0	0	0	0	0	0	478279325.5	1.21477E+11	5.418783	24.729	13.900181	95.491	170.36	29.521	90	481900	2457893.104	1.333333	146.57	171.815	176.372	189.405	191.479	0.015769	44
1372.671875	1098.539968	0.586919	178480000	26920000	2120000	3480000	1840000	120000	40000	0	0	0	0	0	0	0	0	0	550580730.9	1.22028E+11	5.424635	24.671	13.60984	95.459	170.524	29.521	90	532500	2469058.125	1.333333	146.541	172.067	176.32	189.336	191.246	-0.012931	44
1379.671875	1095.377357	0.583655	212960000	28480000	2360000	3680000	2000000	200000	0	120000	0	0	0	0	0	0	0	0	661491908.1	1.2269E+11	5.391022	24.768	14.256381	95.583	170.41	29.502	90	624500	2482439.359	1.333333	146.431	171.894	176.13	189.349	191.466	0.004294	44
1386.65625	1099.792596	0.583836	237760000	35360000	2720000	5000000	2440000	280000	0	40000	0	0	0	0	0	0	0	0	743423880.5	1.23433E+11	5.394958	24.655	14.594738	95.412	170.416	29.486	90	709000	2497521.404	1.333333	146.541	171.923	176.32	189.339	191.335	0.034631	43.6
1393.65625	1097.62863	0.583081	206240000	30120000	1760000	3360000	2320000	160000	40000	40000	0	0	0	0	0	0	0	0	637068869	1.2407E+11	5.408891	24.671	13.408584	95.447	170.504	29.525	90	610100	2510393.909	1.333333	146.544	172.074	176.336	189.316	191.224	0.019869	43.6
1400.65625	1098.688289	0.584426	202680000	29880000	2520000	3880000	2040000	80000	160000	0	0	0	0	0	0	0	0	0	635399316.7	1.24705E+11	5.410702	24.765	14.14893	95.475	170.321	29.515	90	603100	2523257.991	1.333333	146.528	171.828	176.166	189.434	191.512	0.001012	43.6
1407.65625	1097.179813	0.585	188640000	27680000	2080000	4000000	1960000	240000	80000	0	0	0	0	0	0	0	0	0	595870219	1.25301E+11	5.402803	24.668	14.681328	95.38	170.38	29.521	90	561700	2535310.145	1.333333	146.561	171.874	176.346	189.369	191.355	0.03545	43.6
1414.65625	1097.731078	0.584065	184600000	25560000	1640000	3360000	1640000	80000	40000	0	0	0	0	0	0	0	0	0	543854648.1	1.25845E+11	5.39278	24.674	13.943082	95.45	170.478	29.538	90	542300	2546325.349	1.333333	146.509	172.024	176.333	189.293	191.283	0.06005	44
1421.640625	1099.755604	0.585525	208760000	31080000	2120000	4760000	1680000	240000	40000	40000	0	0	0	0	0	0	0	0	652378698.9	1.26498E+11	5.420699	24.72	13.966042	95.276	170.331	29.505	90	621800	2559531.957	1.333333	146.554	171.805	176.225	189.415	191.499	0.092025	44
1428.640625	1099.646312	0.584787	198360000	28600000	2160000	3880000	1800000	320000	40000	0	0	40000	0	0	0	0	0	0	641763158.4	1.27139E+11	5.399497	24.648	13.898213	95.061	170.485	29.508	90	588000	2572499.751	1.333333	146.522	171.962	176.244	189.375	191.178	0.061687	44
1435.640625	1100.527816	0.584033	180920000	26920000	2120000	3880000	2520000	160000	40000	40000	40000	0	0	0	0	0	0	0	612242426.6	1.27752E+11	5.383255	24.723	14.337854	95.444	170.416	29.518	90	541600	2584872.263	1.333333	146.444	171.956	176.14	189.339	191.486	0.034631	44
1442.625	1099.926638	0.585771	187800000	27440000	1760000	3680000	2360000	80000	80000	40000	0	0	0	0	0	0	0	0	596190261.4	1.28348E+11	5.400127	24.7	14.211905	95.099	170.495	29.502	90	558100	2596910.734	1.333333	146.512	171.939	176.264	189.365	191.26	0.029706	44
1449.625	1100.579087	0.584705	199520000	30960000	2680000	4440000	2440000	80000	160000	0	0	0	0	0	0	0	0	0	652463640.8	1.29E+11	5.386483	24.726	14.495816	95.494	170.455	29.547	90	600700	2610092.697	1.333333	146.467	172.008	176.261	189.293	191.378	0.061687	44

1456.609375	1098.605296	0.584278	189400000	26560000	1840000	4200000	1920000	240000	0	0	40000	0	0	0	0	0	0	0	601106526.3	1.29601E+11	5.398972	24.716	14.300201	95.314	170.36	29.508	90	560500	2622229.873	1.333333	146.541	171.822	176.333	189.388	191.423	0.063325	43.6
1463.609375	1100.406024	0.582983	179960000	28000000	2200000	3440000	2080000	200000	120000	0	0	0	0	0	0	0	0	0	582201211.2	1.30184E+11	5.398185	24.639	13.513017	95.289	170.531	29.489	90	540000	2634006.446	1.333333	146.509	172.07	176.281	189.323	191.214	-0.020306	43.6
1470.59375	1097.660626	0.586361	202480000	28720000	2040000	4480000	2000000	40000	80000	40000	40000	0	0	0	0	0	0	0	649974733.2	1.30833E+11	5.399471	24.745	13.952922	95.324	170.341	29.463	90	599800	2647132.403	1.333333	146.528	171.782	176.202	189.408	191.509	0.029706	44
1477.59375	1094.522301	0.584115	178280000	25840000	1560000	3440000	2080000	160000	160000	40000	0	0	0	0	0	0	0	0	578221915.5	1.31412E+11	5.40771	24.623	13.563921	95.191	170.557	29.479	90	528900	2658838.55	1.333333	146.551	171.992	176.222	189.356	191.194	0.062506	44
1484.59375	1100.788316	0.58459	180200000	24960000	1680000	3520000	1960000	40000	40000	0	40000	0	0	0	0	0	0	0	560200584.8	1.31972E+11	5.371867	24.778	14.336673	95.523	170.426	29.486	90	531100	2670212.372	1.333333	146.385	171.9	176.208	189.31	191.469	0.046925	44
1491.578125	1097.257639	0.585558	156600000	23160000	1360000	2840000	1480000	120000	80000	0	0	0	0	0	0	0	0	0	480142337.2	1.32452E+11	5.398841	24.7	14.445567	95.254	170.432	29.505	90	464100	2679905.271	1.333333	146.492	171.854	176.231	189.349	191.286	0.02315	44
1498.53125	1095.063988	0.582491	184400000	27520000	2000000	4720000	2040000	200000	80000	0	40000	0	0	0	0	0	0	0	610584270.8	1.33063E+11	5.429673	24.71	13.552376	95.453	170.498	29.505	90	552500	2692271.135	1.333333	146.489	171.988	176.274	189.297	191.246	0.078906	44
1505.53125	1099.998991	0.583245	198000000	28880000	2480000	4480000	2400000	160000	120000	0	0	0	0	0	0	0	0	0	635256908.6	1.33698E+11	5.406241	24.726	14.286163	95.51	170.351	29.518	90	591300	2705162.455	1.333333	146.447	171.825	176.13	189.359	191.551	0.021512	44
1512.515625	1098.626469	0.581113	193560000	28000000	2000000	3440000	1840000	160000	80000	0	0	0	0	0	0	0	0	0	590488545.5	1.34288E+11	5.406083	24.665	14.11823	95.264	170.452	29.55	90	572700	2717091.528	1.333333	146.46	171.926	176.225	189.329	191.263	0.056769	44
1519.5625	1097.525958	0.582606	239440000	35240000	2160000	4280000	2440000	200000	0	80000	0	0	0	0	0	0	0	0	747688954.7	1.35036E+11	5.393672	24.749	14.401354	95.583	170.38	29.567	90	709600	2732215.239	1.333333	146.395	171.92	176.208	189.29	191.43	0.072344	44
1526.5625	1098.158479	0.586181	223400000	33000000	2320000	4520000	2200000	120000	40000	0	0	0	0	0	0	0	0	0	680382753.1	1.35716E+11	5.432926	24.755	14.576895	95.431	170.338	29.56	90	664000	2745991.33	1.333333	146.541	171.808	176.323	189.365	191.387	0.061687	44
1533.5625	1095.029437	0.58254	212240000	29720000	2560000	4160000	2480000	120000	0	0	0	0	0	0	0	0	0	0	645021474.5	1.36361E+11	5.398972	24.629	13.541487	95.308	170.498	29.576	90	628200	2759043.918	1.333333	146.496	171.975	176.244	189.336	191.197	0.074806	44
1540.5	1096.820543	0.581113	186280000	28320000	1920000	3760000	2400000	120000	40000	0	0	0	0	0	0	0	0	0	579325300.8	1.36941E+11	5.401885	24.768	14.225549	95.488	170.328	29.583	90	557100	2770800.584	1.333333	146.463	171.812	176.113	189.385	191.505	0.018231	44
1547.5	1099.902266	0.581835	197440000	29320000	2240000	3760000	1720000	160000	160000	0	0	0	0	0	0	0	0	0	617374263	1.37558E+11	5.389238	24.71	14.343627	95.327	170.403	29.593	90	587000	2783308.946	1.333333	146.476	171.871	176.218	189.333	191.299	0.067425	44.4
1554.5	1097.90407	0.58318	178080000	28000000	1920000	3520000	1720000	200000	40000	0	0	0	0	0	0	0	0	0	557914978.8	1.38116E+11	5.417314	24.713	13.966042	95.586	170.449	29.576	90	533700	2794580.957	1.333333	146.47	171.982	176.267	189.264	191.286	0.045287	44.4
1561.546875	1097.18852	0.583787	210280000	30600000	2200000	3680000	1960000	240000	80000	0	0	0	0	0	0	0	0	0	648916266.7	1.38765E+11	5.410675	24.723	13.862002	95.488	170.308	29.541	90	622600	2807715.403	1.333333	146.512	171.782	176.294	189.342	191.473	0.041187	44.4
1568.53125	1099.323623	0.583327	231120000	34960000	2880000	4480000	2600000	320000	40000	40000	0	40000	0	0	0	0	0	0	767208640.8	1.39532E+11	5.411016	24.668	13.861084	95.144	170.465	29.56	90	691200	2823254.283	1.333333	146.509	171.854	176.166	189.342	191.187	0.073987	44.8
1575.53125	1099.073056	0.584131	171520000	27600000	1400000	3560000	1480000	120000	0	80000	0	0	0	0	0	0	0	0	545293026.3	1.40078E+11	5.393961	24.765	14.263728	95.38	170.292	29.573	90	514400	2834277.082	1.333333	146.46	171.795	176.107	189.342	191.522	0.086287	44.8
1582.515625	1093.874436	0.582803	180640000	26400000	2320000	4560000	2640000	80000	0	80000	0	0	0	0	0	0	0	0	598125262.8	1.40676E+11	5.386273	24.671	14.241687	95.232	170.41	29.544	90	541800	2846370.611	1.333333	146.483	171.884	176.222	189.329	191.292	0.03955	44.8
1589.515625	1102.630378	0.585787	191640000	27560000	1640000	4560000	1640000	120000	0	160000	0	0	0	0	0	0	0	0	617403867.4	1.41293E+11	5.39459	24.739	14.295084	95.564	170.41	29.557	90	568300	2858913.263	1.333333	146.431	171.988	176.244	189.247	191.368	0.072344	44.8
1596.515625	1096.942685	0.580786	231320000	36080000	2120000	4360000	2240000	160000	80000	0	0	0	0	0	0	0	0	0	717288349.1	1.4201E+11	5.419649	24.726	13.905166	95.339	170.311	29.557	90	690900	2873369.368	1.333333	146.505	171.74	176.254	189.362	191.456	0.074806	44.8
1603.515625	1099.339523	0.583951	200840000	28400000	1680000	3440000	2440000	240000	160000	40000	0	0	0	0	0	0	0	0	644278544.1	1.42655E+11	5.374386	24.645	13.413569	95.207	170.475	29.589	90	593100	2886421.373	1.333333	146.515	171.995	176.222	189.319	191.23	0.062506	44.8
1610.5	1098.997134	0.581392	186560000	28280000	1960000	3440000	2160000	240000	0	0	0	0	0	0	0	0	0	0	579274378.6	1.43234E+11	5.410308	24.791	13.876434	95.33	170.338	29.57	90	556600	2898130.916	1.333333	146.525	171.753	176.199	189.385	191.489	0.04365	44.8
1617.484375	1100.864766	0.584606	192280000	28880000	2160000	3680000	1560000	200000	80000	0	0	0	0	0	0	0	0	0	591668881.3	1.43826E+11	5.398238	24.711	13.427083	95.279	170.474	29.589	90	572100	2910094.73	1.333333	146.497	172	176.285	189.29	191.221	0.012487	44.8
1624.484375	1096.04737	0.582409	176520000	25680000	1640000	3280000	2080000	160000	80000	0	0	0	0	0	0	0	0	0	552070453.4	1.44378E+11	5.397346	24.759	14.006057	95.368	170.337	29.591	90	523600	2921238.908	1.333333	146.52	171.755	176.135	189.387	191.533	0.097762	44.8
1631.484375	1099.664057	0.584508	183800000	27440000	1440000	3760000	1520000	200000	0	0	0	0	0	0	0	0	0	0	552079651.1	1.4493E+11	5.375987	24.716	14.151685	95.166	170.413	29.558	90	545400	2932432.253	1.333333	146.495	171.886	176.237	189.322	191.278	0.05185	44.8
1638.484375	1097.19894	0.584524	222080000	33960000	2320000	4400000	2960000	200000	80000	0	0	0	0	0	0	0	0	0	710888546.3	1.45641E+11	5.400888	24.732	13.709157	95.264	170.491	29.577	90	665000	2946798.025	1.333333	146.498	171.952	176.296	189.289	191.239	0.060869	44.8
1645.46875	1102.218813	0.586427	218800000	32720000	2560000	4520000	2200000	240000	160000	0	0	0	0	0	0	0	0	0	696819521.8	1.46337E+11	5.391704	24.746	14.133711	95.273	170.291	29.573	90	653000	2960911.125	1.333333	146.533	171.817	176.242	189.356	191.463	0.013312	44.8
1652.46875	1099.776954	0.584328	224040000	33360000	2520000	4080000	2360000	200000	120000	80000	0	0	0	0	0	0	0	0	725739606.5	1.47063E+11	5.401859	24.732	13.558542	95.251	170.446	29.567	90	666900	2975543.017	1.333333	146.511	172.027	176.27	189.286	191.229	0.048569	44.8
1659.46875	1095.904097	0.581835	200440000	32280000	2040000	4960000	2000000	120000	40000	120000	0	0	0	0	0	0	0	0	668014379.4	1.47731E+11	5.398474	24.813	14.316075	95.333	170.305	29.58	90	605000	2989040.994	1.333333	146.405	171.858	176.143	189.342	191.522	0.032987	44.8
1666.46875	1099.328859	0.584508	202720000	29960000	2560000	4120000	2560000	120000	40000	0	0	0	0	0	0	0	0	0	634792640.6	1.48366E+11	5.393462	24.681	14.593951	95.125	170.357	29.548	90	605200	3001913.018	1.333333	146.463	171.903	176.208	189.335	191.278	0.014131	44.8
1673.421875	1098.686458	0.584311	207600000	33240000	2240000	4160000	1520000	240000	120000	0	0	0	0	0	0	0	0	0	649013298	1.49015E+11	5.439486	24.733	13.440334	95.229	170.428	29.579	90	622800	3015032.402	1.333333	146.481	172.016	176.259	189.271	191.237	0.001012	44.4
1680.40625	1096.650518	0.582097	205280000	29720000	2040000	4960000	2000000	120000	80000	0	0	0	0	0	0	0	0	0	636612010.2	1.49652E+11	5.42104	24.785	13.856754	95.133	170.251	29.612	90	610500	3027908.626	1.333333	146.526	171.764	176.166	189.355	191.495	0.032987	44.4
1687.40625	1092.767914	0.583032	206400000	31760000	2120000	3840000	1920000	200000	80000	0	0	0	0	0	0	0	0	0	639333865.1	1.50291E+11	5.431457	24.682	13.860559	94.938	170.408	29.616	90	615800	3040863.911	1.333333	146.496	171.943	176.149	189.308	191.192	0.032169	44.4
1694.40625	1099.267195	0.583573	200840000	28120000	2080000	4200000	2200000	240000	80000	0	0	0	0	0	0	0	0	0	624244023.6	1.50915E+11	5.417314	24.792	14.415129	95.282	170.326	29.603	90	594400	3053558.362	1.333333	146.386	171.907	176.179	189.268	191.441	0.011669	44.4
1701.40625	1098.892972	0.58518	241640000	37000000	2720000	5600000	3240000	120000	40000	0	0	0	0	0	0	0	0	0	771100264.9	1.51686E+11	5.40304	24.707	14.658238	95.096	170.324	29.611	90	725900	3069146.53	1.333333	146.465	171.854	176.227	189.315	191.33	0.070706	44.4
1708.40625	1095.05235	0.582278	202560000	29560000	1720000	4120000	1760000	80000	0	0	0	0	0	0	0	0	0	0	600462998.7	1.52287E+11	5.413876	24.722	13.447287	95.177	170.404	29.584	90	599500	3081289.316	1.333333	146.454	172.026	176.228	189.274	191.221	0.079725	44.4
1715.390625	1098.68645	0.583606	168240000	24560000	1720000	3400000	1760000	160000	40000	0	0	0	0	0	0	0	0	0	517033176.7	1.52804E+11	5.410859	24.769	13.864495	95.203	170.231	29.619	90	499700	3091781.624	1.333333	146.444	171.799	176.11	189.37	191.477	0.072344	44.4
1722.390625	1103.383485	0.583819	181640000	25720000	2040000	3880000	2240000	200000	80000	0	0	0	0	0	0	0	0	0	576851197.4	1.53381E+11	5.385748	24.727	14.293772	95.045	170.372	29.59	90	539500	3103449.116	1.333333	146.429	171.885	176.169	189.293	191.269	0.052669	44
1729.390625	1099.769952	0.583475	205000000	29240000	2680000	4160000	2040000	160000	80000	0	40000	0	0	0	0	0	0	0	659794127.3	1.5404E+11	5.41797	24.763	14.052238	95.37	170.384	29.588	90	608500	3116737.417	1.333333	146.376	172.031	176.191	189.228	191.218	0.045287	44
1736.390625	1099.408367	0.585115	199120000	30120000	1880000	3720000	2320000	240000	80000	0	0	0	0	0	0	0	0	0	629443794.5	1.5467E+11	5.400284	24.75	14.081495	95.364	170.237	29.588	90	593700	3129456.113	1.333333	146.477	171.759	176.224	189.297	191.381	0.092844	44
1743.390625	1098.882393	0.584984	193440000	27160000	2000000	3760000	2200000	200000	0	40000	0	0	0	0	0	0	0	0	601417893.3	1.55271E+11	5.397109	24.727	14.188421	95.171	170.378	29.61	90	572000	3141612.508	1.333333	146.434	171.854	176.142	189.274	191.175	0.05185	44.4
1750.390625	1098.204405	0.585508	165040000	25360000	1560000	3600000	1840000	200000	40000	40000	0	40000	0	0	0	0	0	0	562646310.6	1.55834E+11	5.417786	24.702	13.728443	95.231	170.411	29.581	90	494300	3152990.66	1.333333	146.49	171.936	176.103	189.268	191.156	0.037906	44.8

1757.390625	1097.93581	0.584557	203360000	29040000	2400000	4160000	2040000	40000	120000	0	0	0	0	0	0	0	0	0	626897800	1.56461E+11	5.378086	24.812	14.151554	95.443	170.244	29.594	90	602900	3165675.969	1.333333	146.405	171.792	176.064	189.334	191.464	0.085462	44.4
1764.390625	1096.496729	0.580622	217280000	31800000	2040000	4080000	1920000	80000	40000	40000	0	0	0	0	0	0	0	0	659010740	1.5712E+11	5.38992	24.727	14.470494	95.355	170.337	29.595	90	643200	3179014.347	1.333333	146.423	171.846	176.16	189.297	191.234	0.063325	44
1771.375	1099.819363	0.584147	173400000	22640000	1400000	2880000	2000000	80000	120000	0	0	80000	0	0	0	0	0	0	579189916.3	1.57699E+11	5.395483	24.786	14.278028	95.677	170.356	29.581	90	506500	3190752.537	1.333333	146.344	172.012	176.185	189.193	191.232	0.046106	44
1778.375	1101.41939	0.586837	167400000	23560000	1840000	3440000	1720000	120000	120000	0	0	0	0	0	0	0	0	0	524276153.1	1.58223E+11	5.404378	24.776	14.024162	95.534	170.234	29.549	90	495500	3201345.714	1.333333	146.454	171.788	176.076	189.34	191.437	0.03955	44
1785.375	1102.616282	0.584229	194280000	28400000	1960000	4280000	2040000	400000	80000	40000	0	0	0	0	0	0	0	0	636457334.7	1.5886E+11	5.392334	24.694	13.91212	95.332	170.398	29.554	90	578700	3214186.869	1.333333	146.468	171.924	176.117	189.309	191.131	0.029706	44
1792.359375	1099.667579	0.58523	161960000	24200000	1560000	3280000	1600000	120000	80000	0	0	0	0	0	0	0	0	0	504504634.5	1.59364E+11	5.370581	24.808	14.261366	95.512	170.294	29.545	90	482000	3224354.698	1.333333	146.363	171.842	176.008	189.278	191.461	0.078087	44
1799.359375	1099.856279	0.585016	180240000	24720000	2000000	3520000	2000000	160000	40000	0	0	0	0	0	0	0	0	0	552048454.4	1.59916E+11	5.38378	24.761	14.627013	95.388	170.316	29.557	90	531700	3235510.563	1.333333	146.411	171.851	176.18	189.283	191.266	0.085462	44

Table E-2 Aerosol counts at simulated top climb (take-off) conditions (Test 1: 103.2 PSI, 308.0°C)

Time (sec)	Flow (CFM)	Filter dP ("H2O)	0.3 µm	0.4 µm	0.5 µm	0.55 µm	0.7 µm	1.0 µm	1.3 µm	1.6 µm	2.0 µm	2.2 µm	3.0 µm	4.0 µm	5.0 µm	5.5 µm	7.0 µm	10.0 µm	dm (pg)	Total Mass (pg)	Aerosol Generator (PSIA)	Aerosol Generator Temp (°C)	Compressor (PSIA)	Compressor Temp (°C)	Reactor Tube Temp (°C)	Duct Temp (°C)	Aero. Gen.Flow (CFH)	Sum of Particles	Total Sample Mass (pg)	Sample Filter Flow Rate (SCFH)	Temp S1 (°C)	Temp S2 (°C)	Temp S3 (°C)	Temp S4 (°C)	Temp S5 (°C)	CO (PPM)	RH (%)
0.609375	1108.081351	0.59784	12040000	1680000	40000	40000	0	0	0	0	0	0	0	0	0	0	0	0	37901841.8	0	8.457815	24.578	99.69303	176.013	307.849	30.189	90	34500	0	1.333333	262.772	302.145	319.665	333.479	339.925	0.345388	55.2
14.59375	1104.131134	0.591527	20480000	3680000	280000	480000	120000	0	0	0	0	0	0	0	0	0	0	0	127721509.3	127721509.3	8.457447	24.543	99.86226	176.39	307.814	30.186	90	62600	2561.414609	1.333333	262.682	302.054	319.7	333.435	339.909	0.404425	55.2
21.609375	1108.391271	0.598464	10400000	1280000	40000	200000	0	0	0	0	40000	0	0	0	0	0	0	0	48737881.6	176459390.9	8.446847	24.501	101.3303	176.459	307.773	30.166	90	29900	3542.334358	1.333333	262.692	302.234	319.681	333.442	339.831	0.322431	55.2
28.5625	1109.230313	0.595299	7480000	800000	80000	120000	80000	40000	0	0	0	0	0	0	0	0	0	0	23577028.08	200036418.9	8.456057	24.506	100.15482	176.669	307.774	30.145	90	21500	4015.032016	1.333333	262.571	302.228	319.654	333.444	339.805	0.383925	55.2
35.578125	1109.311751	0.594085	7200000	1360000	80000	240000	80000	40000	40000	0	0	0	0	0	0	0	0	0	33051250.19	233087669.1	8.456949	24.538	102.08206	176.824	307.771	30.176	90	22600	4677.177846	1.333333	262.559	301.977	319.662	333.427	339.873	0.369987	55.2
42.59375	1107.060422	0.590428	9120000	1080000	240000	80000	0	0	0	0	0	0	0	0	0	0	0	0	24359165.48	257446834.6	8.460439	24.537	102.2408	176.952	307.751	30.118	90	26300	5165.151392	1.333333	262.577	301.95	319.607	333.402	339.916	0.35195	55.2
49.5625	1110.520284	0.596824	46240000	7080000	280000	600000	160000	0	0	0	0	0	0	0	0	0	0	0	127331293.9	384778128.5	8.451045	24.508	100.63236	176.85	307.738	30.127	90	135900	7721.095272	1.333333	262.532	301.928	319.651	333.39	339.895	0.342931	55.2
56.5625	1107.722532	0.593446	101760000	16480000	1000000	840000	40000	0	0	0	0	0	0	0	0	0	0	0	276826825.4	661604954	8.48471	24.481	102.2736	176.701	307.692	30.145	90	300300	13260.57737	1.333333	262.565	302.122	319.631	333.387	339.82	0.33555	55.2
63.578125	1109.721337	0.593823	15080000	2720000	120000	360000	40000	0	0	0	40000	0	0	0	0	0	0	0	67129947.89	728734901.9	8.492031	24.521	100.32144	177.16	307.752	30.165	90	45900	14607.2834	1.333333	262.482	302.083	319.586	333.323	339.859	0.392125	55.2
70.578125	1106.379191	0.596037	21480000	3440000	120000	280000	40000	0	0	0	0	0	0	0	0	0	0	0	59344201.94	788079103.8	8.439342	24.559	101.70288	177.18	307.793	30.224	90	63400	15795.65385	1.333333	262.584	301.915	319.647	333.342	339.951	0.348669	55.2
77.59375	1110.127613	0.595036	8080000	920000	160000	40000	40000	0	0	0	0	0	0	0	0	0	0	0	21500332.91	809579436.7	8.495704	24.493	101.80521	177.103	307.721	30.226	90	23100	16227.49962	1.333333	262.501	302.021	319.657	333.356	339.792	0.341287	55.2
84.546875	1110.52554	0.596381	8600000	760000	80000	80000	40000	40000	0	0	0	0	0	0	0	0	0	0	24106025.31	833685462	8.451491	24.541	102.3182	176.867	307.753	30.243	90	24000	16710.04726	1.333333	262.591	302.096	319.62	333.34	339.779	0.385569	55.2
91.5625	1106.721382	0.595889	10760000	1520000	80000	40000	120000	0	0	0	0	0	0	0	0	0	0	0	30297171.95	863982634	8.500165	24.525	100.86194	176.916	307.778	30.204	90	31300	17316.3102	1.333333	262.469	302.062	319.582	333.29	339.845	0.328988	55.2
98.578125	1106.988715	0.596545	17040000	2680000	120000	120000	160000	0	0	0	0	0	0	0	0	0	0	0	48882709.22	912865343.2	8.454456	24.557	102.208	176.916	307.778	30.226	90	50300	18297.84218	1.333333	262.552	301.869	319.588	333.28	339.883	0.354406	55.6
105.578125	1114.721585	0.598562	12880000	1520000	80000	0	80000	0	0	0	0	0	0	0	0	0	0	0	3262630 7.23	945491650.4	8.510818	24.519	101.46411	177.011	307.728	30.22	90	36400	18952.79832	1.333333	262.447	301.983	319.623	333.221	339.823	0.369987	55.6
112.53125	1108.828758	0.595889	15480000	1600000	40000	200000	80000	0	0	0	0	0	0	0	0	0	0	0	39641220.38	985132870.8	8.474214	24.499	101.09415	177.041	307.731	30.205	90	43500	19743.05484	1.333333	262.479	302.037	319.571	333.226	339.772	0.37245	55.2
119.546875	1108.72668	0.595381	7520000	600000	120000	120000	80000	0	0	0	0	0	0	0	0	0	0	0	20626726.71	1005759598	8.50578	24.54	101.75142	177.088	307.726	30.187	90	21100	20156.43852	1.333333	262.436	301.985	319.541	333.184	339.796	0.384744	55.2
126.515625	1111.106021	0.595102	8560000	880000	40000	120000	80000	0	0	0	0	0	0	0	0	0	0	0	22914355.16	1028673953	8.454981	24.548	102.62782	177.085	307.812	30.171	90	24200	20615.71121	1.333333	262.537	301.882	319.665	333.26	339.925	0.390487	55.2
133.53125	1108.030513	0.599152	11120000	1400000	80000	0	0	0	0	0	0	0	0	0	0	0	0	0	27199159.21	1055873112	8.449523	24.535	102.24867	177.151	307.825	30.19	90	31500	21159.69689	1.333333	262.514	301.851	319.656	333.254	339.875	0.322431	55.2
140.5	1107.937291	0.59789	21840000	3520000	200000	160000	40000	0	0	0	0	0	0	0	0	0	0	0	59317751.36	1115190863	8.506253	24.477	102.04532	177.013	307.768	30.177	90	64400	22349.35028	1.333333	262.476	301.962	319.618	333.238	339.793	0.268312	54.8
147.5	1110.560213	0.595791	9680000	1800000	80000	80000	80000	40000	0	0	0	0	0	0	0	0	0	0	31627558.45	1146818422	8.456345	24.47	101.82489	176.967	307.825	30.174	90	29400	22983.71346	1.333333	262.53	302.129	319.606	333.2	339.777	0.278975	54.8
154.515625	1112.09432	0.595151	25880000	3320000	120000	280000	120000	0	0	0	0	0	0	0	0	0	0	0	68942555.95	1215760978	8.503917	24.558	102.08993	176.963	307.899	30.181	90	74300	24363.24857	1.333333	262.456	301.969	319.636	333.242	339.863	0.262575	54.8
161.484375	1109.463381	0.594856	7040000	1280000	80000	40000	40000	0	0	0	0	0	0	0	0	0	0	0	20449832.78	1236210810	8.390799	24.549	98.85996	176.87	307.719	30.212	90	21200	24771.88363	1.333333	262.573	301.924	319.669	333.268	339.886	0.131381	54.8
168.5	1110.668251	0.594856	14640000	1960000	160000	80000	0	0	0	0	0	0	0	0	0	0	0	0	37632233.41	1273843044	8.397122	24.534	97.79731	176.884	307.653	30.274	90	42100	25525.64609	1.333333	262.582	301.888	319.712	333.225	339.89	0.180581	54.8
175.5	1105.206924	0.597053	9440000	1720000	80000	240000	0	0	0	0	0	0	0	0	0	0	0	0	28148984.83	1301992029	8.437505	24.572	99.83078	176.751	307.641	30.247	90	28700	26088.85027	1.333333	262.657	302.051	319.687	333.216	339.803	0.137944	54.8
182.46875	1110.279076	0.596873	10680000	1360000	80000	200000	80000	0	0	0	0	0	0	0	0	0	0	0	29984214.79	1331976243	8.403787	24.566	98.92556	176.823	307.61	30.257	90	31000	26691.73817	1.333333	262.631	302.108	319.694	333.207	339.806	0.216656	54.8
189.484375	1106.904658	0.596709	10320000	1280000	120000	0	160000	0	0	0	0	0	0	0	0	0	0	0	29258935.22	1361235179	8.46894	24.546	98.50837	176.941	307.647	30.238	90	29700	27277.3554	1.333333	262.561	302.06	319.672	333.163	339.891	0.240437	54.8
196.5	1106.671101	0.593249	11360000	2040000	200000	160000	120000	0	0	0	0	0	0	0	0	0	0	0	35921046.98	1397156226	8.438083	24.584	100.58251	176.839	307.683	30.24	90	34700	27998.50648	1.333333	262.651	301.886	319.776	333.214	339.882	0.293731	54.8
203.5	1109.710693	0.597562	7880000	1520000	80000	80000	0	40000	0	0	0	0	0	0	0	0	0	0	25239464.55	1422395690	8.487045	24.562	99.65892	176.974	307.664	30.223	90	24000	28505.32101	1.333333	262.597	301.941	319.78	333.159	339.827	0.1814	54.8
210.46875	1106.863196	0.594626	13440000	2000000	120000	200000	120000	40000	0	0	0	0	0	0	0	0	0	0	41862418.11	1464258108	8.450861	24.521	101.67533	177.175	307.707	30.18	90	39800	29343.62595	1.333333	262.718	302.127	319.83	333.248	339.797	0.175662	54.4
217.484375	1106.546048	0.593987	20520000	2280000	160000	160000	40000	0	0	0	0	0	0	0	0	0	0	0	51521995.67	1515780104	8.49371	24.521	99.78224	177.615	307.735	30.224	90	57900	30378.02048	1.333333	262.648	302.045	319.774	333.164	339.873	0.110881	54
224.4375	1112.952223	0.594856	32560000	5200000	360000	680000	80000	40000	0	0	0	0	0	0	0	0	0	0	96516873.13	1612296977	8.478701	24.527	101.65041	177.674	307.808	30.231	90	97300	32316.32157	1.333333	262.718	301.891	319.83	333.233	339.883	-0.008831	54
231.453125	1105.971653	0.594331	11000000	1480000	80000	240000	120000	0	0	0	0	0	0	0	0	0	0	0	32897774.33	1645194751	8.453747	24.537	100.7911	177.657	307.795	30.237	90	32300	32973.18862	1.333333	262.769	301.894	319.862	333.174	339.867	-0.101481	54
238.46875	1106.978622	0.595331	26840000	3800000	240000	320000	80000	0	0	0	0	0	0	0	0	0	0	0	73030125.13	1718224877	8.488384	24.511	102.2303	177.447	307.845	30.25	90	78200	34440.57856	1.333333	262.76	302.055	319.893	333.205	339.745	-0.071144	54
245.421875	1110.531764	0.598513	7280000	1120000	40000	120000	40000	0	0	0	0	0	0	0	0	0	0	0	20615739.02	1738840616	8.474529	24.495	101.32505	177.261	307.83	30.276	90	21500	34854.43256	1.333333	262.715	302.118	319.843	333.124	339.826	-0.000631	54
252.4375	1110.333846	0.598021	6240000	920000	0	40000	0	40000	0	0	0	0	0	0	0	0	0	0	18630266.25	1757470882	8.511002	24.56	101.38409	177.364	307.95	30.337	90	18100	35227.23227	1.333333	262.722	302.055	319.868	333.185	339.903	0.008387	54
259.453125	1107.265459	0.596824	20160000	2760000	80000	40000	0	0	0	0	0	0	0	0	0	0	0	0	50141469.5	1807612351	8.491926	24.588	103.61306	177.204	308.017	30.382	90	57600	36230.76367	1.333333	262.812	301.94	319.87	333.208	339.957	0.127281	54
266.40625	1111.881626	0.598513	9160000	1000000	0	160000	40000	0	0	0	0	0	0	0	0	0	0	0	23626649.22	1831239001	8.511684	24.606	101.91151	177.126	308.027	30.356	90	25900	36704.93781	1.333333	262.8	301.983	319.987	333.218	339.911	0.1773	54
273.421875	1107.26305	0.595709	8440000	1200000	0	120000	80000	0	0	0	0	0	0	0	0	0	0	0	23967338.85	1855206339	8.485261	24.593	103.35724	177.149	308.002	30.346	90	24600	37183.95241	1.333333	262.832	302.138	319.918	333.215	339.87	0.1609	54

280.4375	1109.567797	0.594643	12320000	1640000	0	160000	40000	0	0	0	0	0	0	0	0	0	0	0	32399471.51	1887605811	8.529658	24.626	101.8262	177.353	308.046	30.32	90	35400	37834.19379	1.333333	262.72	302.059	319.868	333.149	339.989	0.1404	53.6
287.453125	1107.976291	0.598332	42360000	4080000	280000	120000	40000	0	0	0	0	0	0	0	0	0	0	0	100097928.9	1987703740	8.51381	24.6	103.49499	177.235	308.109	30.278	90	117200	39838.93692	1.333333	262.784	301.964	319.928	333.215	339.942	0.155981	53.6
294.40625	1109.359901	0.595348	7520000	880000	80000	80000	0	0	0	0	0	0	0	0	0	0	0	0	19003675.04	2006707415	8.52197	24.602	102.2959	177.287	308.072	30.277	90	21400	40220.08577	1.333333	262.752	301.939	319.985	333.225	339.915	0.1486	53.2
301.421875	1111.09168	0.597086	24680000	2560000	200000	320000	40000	0	0	0	0	0	0	0	0	0	0	0	62631452.45	2069338867	8.509559	24.585	104.046	177.393	308.035	30.271	90	69500	41474.69219	1.333333	262.805	302.096	319.944	333.21	339.925	0.124825	53.2
308.4375	1110.361447	0.596201	8720000	1240000	120000	80000	80000	0	0	0	0	0	0	0	0	0	0	0	25206378.45	2094545246	8.520159	24.543	101.88133	177.636	308.017	30.259	90	25600	41978.82858	1.333333	262.71	302.16	319.936	333.213	339.868	0.119081	53.2
315.390625	1109.077548	0.597037	8000000	1040000	80000	240000	0	0	0	0	0	0	0	0	0	0	0	0	22401152.97	2116946399	8.515961	24.626	103.50811	177.751	308.105	30.271	90	23400	42427.15412	1.333333	262.713	301.955	319.917	333.194	339.96	0.126462	53.2
322.40625	1109.227005	0.59502	21920000	3960000	80000	120000	40000	0	0	0	0	0	0	0	0	0	0	0	60361540.57	2177307939	8.538186	24.529	102.73146	177.718	308.096	30.291	90	65300	43636.59846	1.333333	262.662	302.019	319.936	333.157	339.953	0.180581	53.2
329.390625	1104.603854	0.592986	16680000	2280000	320000	240000	0	40000	0	0	0	0	0	0	0	0	0	0	48421220.98	2225729160	8.504836	24.574	102.57009	177.816	308.118	30.284	90	48900	44606.66783	1.333333	262.701	301.911	319.917	333.154	339.991	0.096125	53.2
336.40625	1110.967466	0.598382	47680000	5240000	560000	320000	0	0	0	0	0	0	0	0	0	0	0	0	118074083.6	2343803244	8.544247	24.558	103.2536	177.869	308.017	30.216	90	134500	46982.06106	1.333333	262.672	302.015	319.898	333.129	339.906	0.172381	53.2
343.40625	1110.223355	0.598906	10760000	960000	80000	80000	0	0	0	0	0	0	0	0	0	0	0	0	25467751.32	2369270995	8.517168	24.558	102.30771	177.987	308.008	30.206	90	29700	47491.48195	1.333333	262.665	302.123	319.87	333.069	339.894	0.143681	53.2
350.375	1109.090267	0.595479	21520000	2160000	240000	120000	80000	0	0	0	0	0	0	0	0	0	0	0	53789716.64	2423060712	8.507092	24.603	104.37266	177.967	308.061	30.219	90	60300	48568.1365	1.333333	262.739	301.949	319.917	333.135	340.028	0.124006	53.2
357.390625	1106.912734	0.594347	14640000	2480000	360000	320000	120000	0	0	0	0	0	0	0	0	0	0	0	47083037.25	2470143749	8.5496	24.6	102.58059	177.895	308.082	30.198	90	44800	49511.51302	1.333333	262.719	301.928	319.932	333.095	339.957	0.163362	53.2
364.359375	1112.534716	0.595627	15280000	3280000	160000	440000	200000	0	0	0	0	0	0	0	0	0	0	0	52794605.58	2522938355	8.544693	24.598	104.0906	177.856	308.046	30.281	90	48400	50571.41	1.333333	262.79	302.062	319.944	333.072	339.868	0.179762	53.2
371.359375	1104.158611	0.594429	12520000	2360000	160000	160000	80000	0	0	0	0	0	0	0	0	0	0	0	38271489.11	2561209844	8.538527	24.632	102.52024	178.12	308.072	30.306	90	38200	51335.86033	1.333333	262.73	302.116	319.919	333.075	339.934	0.1404	53.2
378.375	1109.417064	0.596611	12640000	1560000	120000	120000	0	0	0	0	0	0	0	0	0	0	0	0	32183235.37	2593393079	8.535824	24.643	104.38447	178.256	308.104	30.319	90	36100	51983.57797	1.333333	262.824	301.937	319.936	333.041	340.007	0.167462	53.2
385.34375	1104.94057	0.595331	27600000	3800000	200000	40000	40000	0	0	0	0	0	0	0	0	0	0	0	69746613.22	2663139692	8.519871	24.614	102.66455	178.23	308.143	30.34	90	79200	53380.64026	1.333333	262.857	301.95	320.028	333.101	339.986	0.183037	53.6
392.375	1112.961415	0.597201	13480000	2120000	40000	40000	40000	0	0	0	0	0	0	0	0	0	0	0	35595126.73	2698734819	8.50376	24.62	103.44252	178.233	308.137	30.339	90	39300	54096.51841	1.333333	262.898	301.96	319.975	333.125	340.047	0.1691	53.2
399.34375	1110.269951	0.598529	8960000	920000	120000	80000	40000	0	0	0	0	0	0	0	0	0	0	0	23203910.62	2721938730	8.472692	24.599	103.12766	178.13	308.154	30.306	90	25300	54559.82509	1.333333	262.927	302.001	319.997	333.108	340.076	0.128925	53.2
406.359375	1107.788862	0.597168	20560000	3560000	400000	480000	120000	0	0	0	0	0	0	0	0	0	0	0	64845761.6	2786784491	8.516407	24.582	102.77737	177.949	308.151	30.296	90	62800	55857.72289	1.333333	262.92	302.011	320.022	333.108	340.024	0.116625	53.6
413.3125	1109.178386	0.594544	7520000	920000	40000	160000	120000	0	0	0	0	0	0	0	0	0	0	0	22497803.34	2809282295	8.515279	24.599	105.03649	177.851	308.161	30.308	90	21900	56309.02837	1.333333	263.001	302.197	320.076	333.137	339.955	0.1732	53.6
420.3125	1110.6549	0.59666	11520000	1120000	80000	0	40000	0	0	0	0	0	0	0	0	0	0	0	27538688.47	2836820983	8.539839	24.615	104.34118	178.057	308.255	30.296	90	31900	56860.76185	1.333333	262.888	302.043	320.06	333.105	340.071	0.125644	54
427.328125	1110.959982	0.596004	9360000	1080000	120000	80000	80000	0	0	0	0	0	0	0	0	0	0	0	25675171.91	2862496155	8.49518	24.586	103.91087	177.825	308.261	30.315	90	26800	57374.47622	1.333333	262.972	302.011	320.038	333.049	340.102	0.098587	54
434.296875	1108.841464	0.596086	8040000	880000	0	40000	0	0	0	0	0	0	0	0	0	0	0	0	18920996.41	2881417151	8.49392	24.599	103.8256	177.644	308.246	30.296	90	22400	57752.94762	1.333333	262.975	302.017	320.073	333.096	340.105	0.045287	54
441.3125	1103.919102	0.59279	41000000	5880000	240000	480000	80000	0	0	0	0	0	0	0	0	0	0	0	110018163.5	2991435315	8.548446	24.608	103.17882	177.441	308.227	30.305	90	119200	59957.81474	1.333333	262.927	302.055	320.079	333.096	340.071	-0.079344	54
448.328125	1109.495256	0.593724	25360000	3400000	160000	80000	80000	0	0	0	0	0	0	0	0	0	0	0	65089186.3	3056524501	8.528425	24.604	105.18343	177.157	308.219	30.294	90	72700	61268.07956	1.333333	262.954	302.163	320.121	333.112	340.028	-0.099025	54
455.296875	1108.667423	0.594839	15280000	1800000	40000	120000	80000	80000	0	0	0	0	0	0	0	0	0	0	44543075.77	3101067577	8.532754	24.605	103.28902	177.073	308.245	30.277	90	43500	62160.23851	1.333333	262.887	302.221	320.093	333.087	340.018	-0.092463	53.6
462.296875	1110.081613	0.593429	9320000	1480000	0	120000	120000	0	0	0	0	0	0	0	0	0	0	0	27596774.52	3128664352	8.528084	24.674	104.93285	176.996	308.274	30.338	90	27600	62713.39056	1.333333	262.91	302.025	320.103	333.117	340.124	-0.023588	53.6
469.28125	1108.825716	0.595118	29360000	5160000	240000	240000	360000	0	0	0	0	0	0	0	0	0	0	0	89065150.62	3217729502	8.539104	24.671	103.48187	176.995	308.264	30.376	90	88400	64496.34557	1.333333	262.832	302.17	320.101	333.143	340.115	-0.103125	54
476.296875	1106.260352	0.596693	60240000	9320000	520000	800000	80000	0	0	0	0	0	0	0	0	0	0	0	166217649.8	3383947152	8.546766	24.661	103.0332	176.995	308.248	30.385	90	177400	67827.55037	1.333333	262.826	302.167	320.113	333.102	340.131	-0.149038	54
483.265625	1113.626174	0.601448	30000000	3680000	280000	280000	0	0	0	0	0	0	0	0	0	0	0	0	75827018.68	3459774171	8.526195	24.696	105.53371	176.956	308.283	30.364	90	85600	69350.74051	1.333333	262.874	301.98	320.136	333.169	340.172	-0.181838	54
490.28125	1110.052845	0.598775	8120000	960000	120000	120000	80000	0	0	0	0	0	0	0	0	0	0	0	23391329.13	3483165500	8.54304	24.67	103.62094	176.963	308.224	30.376	90	23500	69817.51053	1.333333	262.85	301.934	320.131	333.127	340.087	-0.079344	54
497.296875	1106.937779	0.593921	9280000	1600000	0	200000	0	40000	0	0	0	0	0	0	0	0	0	0	28967198.95	3512132699	8.568834	24.659	104.0027	177.079	308.156	30.326	90	27800	70397.40683	1.333333	262.755	302.019	320.121	333.123	340.142	0.122362	54.4
504.265625	1111.357877	0.596906	11080000	1240000	80000	120000	0	0	0	0	0	0	0	0	0	0	0	0	27498029.94	3539630729	8.537687	24.591	105.33299	177.125	308.106	30.278	90	31300	70949.44086	1.333333	262.832	302.089	320.128	333.11	340.057	0.200256	54.4
511.28125	1111.695904	0.596971	8680000	1440000	160000	200000	200000	0	0	0	0	0	0	0	0	0	0	0	30509032.28	3570139761	8.559729	24.662	103.33887	177.459	308.106	30.291	90	26700	71559.48603	1.333333	262.695	302.095	320.102	333.12	340.079	0.199437	54.4
518.234375	1105.388752	0.592904	11400000	1600000	120000	80000	40000	0	0	0	0	0	0	0	0	0	0	0	30505123.26	3600644884	8.550099	24.688	104.52878	177.617	308.115	30.3	90	33100	72169.26755	1.333333	262.637	301.927	320.099	333.132	340.129	0.119906	54.4
525.25	1110.831111	0.594741	20200000	2800000	120000	80000	200000	0	0	0	0	0	0	0	0	0	0	0	55595755.28	3656240639	8.50027	24.678	104.26246	177.603	308.099	30.336	90	58500	73286.93881	1.333333	262.733	301.864	320.093	333.088	340.189	0.151881	54.4
532.265625	1107.079941	0.595348	76560000	9520000	400000	280000	120000	0	0	0	0	0	0	0	0	0	0	0	191385153.4	3847625793	8.453774	24.623	99.13809	177.689	307.825	30.317	90	217200	77115.6067	1.333333	262.727	301.832	320.131	333.057	340.091	-0.103944	54.4
539.234375	1110.562577	0.596512	9160000	1120000	80000	0	80000	0	0	0	0	0	0	0	0	0	0	0	23997592.47	3871623385	8.43866	24.675	101.27782	177.541	307.816	30.313	90	26100	77597.30618	1.333333	262.707	301.858	320.118	333.076	340.104	-0.150681	54.4
546.265625	1112.800104	0.594544	106880000	13400000	440000	440000	80000	0	0	0	0	0	0	0	0	0	0	0	265690936.2	4137314322	8.466579	24.667	101.17943	177.461	307.852	30.322	90	303100	82913.74953	1.333333	262.712	301.868	320.094	333.026	340.105	-0.007188	54.4
553.234375	1110.328387	0.597873	69840000	7760000	480000	280000	0	0	0	0	0	0	0	0	0	0	0	0	168433213.6	4305747535	8.454377	24.712	101.80128	177.335	307.875	30.393	90	195900	86277.30089	1.333333	262.805	301.833	320.138	333.059	340.15	0.170737	54.4

560.234375	1111.213054	0.595413	7920000	1080000	0	40000	0	0	0	0	0	0	0	0	0	0	0	0	19643456.39	4325390992	8.491532	24.695	100.67172	177.135	307.888	30.408	90	22600	86670.44697	1.333333	262.854	301.89	320.144	333.02	340.03	0.067425	54.4
567.25	1106.313249	0.596709	7280000	920000	40000	40000	0	0	0	0	0	0	0	0	0	0	0	0	18170916.48	4343561908	8.501844	24.734	100.98527	176.912	307.888	30.395	90	20700	87033.83196	1.333333	262.825	301.839	320.147	332.998	340.011	0.062506	54
574.21875	1106.677519	0.594052	32520000	2360000	40000	240000	40000	0	0	0	0	0	0	0	0	0	0	0	73181528.72	4416743437	8.490089	24.723	101.21616	176.834	307.946	30.422	90	88000	88503.81001	1.333333	262.846	301.801	320.203	333.037	339.996	0.104325	53.6
581.234375	1108.283451	0.594741	8360000	680000	120000	80000	0	0	0	0	0	0	0	0	0	0	0	0	20160197.47	4436903634	8.503629	24.693	102.34182	177.068	307.947	30.367	90	23100	88908.62928	1.333333	262.834	301.923	320.176	332.98	339.99	0.190419	53.6
588.203125	1108.041216	0.596545	5600000	800000	120000	40000	0	0	0	0	0	0	0	0	0	0	0	0	15101070.86	4452004705	8.513468	24.66	103.25754	177.261	307.95	30.364	90	16400	89211.42127	1.333333	262.863	301.92	320.154	332.98	339.965	0.261756	53.6
595.21875	1111.332904	0.595413	7520000	840000	40000	160000	0	0	0	0	0	0	0	0	0	0	0	0	19565683.64	4471570389	8.490719	24.67	102.09518	177.402	307.966	30.377	90	21400	89603.8191	1.333333	262.818	302.005	320.133	332.987	339.974	0.183037	53.6
602.171875	1110.624859	0.593987	15480000	1960000	80000	280000	40000	0	0	0	0	0	0	0	0	0	0	0	41383883.61	4512954272	8.535116	24.715	102.02171	177.523	308.032	30.348	90	44600	90431.33159	1.333333	262.754	301.929	320.107	332.93	339.993	0.061687	54
609.203125	1111.667027	0.599349	7080000	720000	0	80000	0	0	0	0	0	0	0	0	0	0	0	0	17074252.87	4530028525	8.511684	24.664	102.65668	177.572	307.991	30.373	90	19700	90772.96616	1.333333	262.812	302.005	320.098	332.883	339.924	0.143681	54
616.171875	1109.632667	0.595331	16560000	2320000	120000	320000	0	0	0	0	0	0	0	0	0	0	0	0	44878713.5	4574907239	8.545979	24.715	103.02664	177.995	308.016	30.322	90	48300	91670.09157	1.333333	262.744	301.894	320.129	332.93	340.03	0.201081	54
623.1875	1112.10358	0.598119	7760000	1080000	160000	40000	80000	0	0	0	0	0	0	0	0	0	0	0	22604320.64	4597511559	8.515122	24.735	105.19655	177.963	308.114	30.299	90	22800	92122.78034	1.333333	262.882	301.809	320.145	332.965	340.018	-0.092463	54.4
630.203125	1108.615569	0.594511	25640000	3600000	400000	320000	120000	0	0	0	0	0	0	0	0	0	0	0	72653402.57	4670164962	8.524332	24.712	103.85577	177.776	308.148	30.312	90	75200	93574.55163	1.333333	262.837	301.774	320.117	332.927	340.005	-0.089181	54
637.171875	1109.979414	0.597627	17680000	2680000	280000	120000	160000	40000	0	0	0	0	0	0	0	0	0	0	53849355.33	4724014317	8.575892	24.673	104.9709	177.556	308.114	30.315	90	52400	94653.96308	1.333333	262.821	301.929	320.167	332.921	339.965	-0.045725	54
644.1875	1109.703495	0.595922	25960000	4800000	120000	120000	40000	0	0	0	0	0	0	0	0	0	0	0	71816382.14	4795830699	8.53934	24.699	105.35529	177.477	308.101	30.283	90	77600	96091.75516	1.333333	262.853	301.995	320.136	332.927	339.927	-0.187575	54
651.15625	1108.124403	0.593954	12280000	2120000	80000	200000	40000	0	0	0	0	0	0	0	0	0	0	0	35378158.53	4831208858	8.557997	24.634	103.68916	177.713	308.073	30.312	90	36800	96800.21584	1.333333	262.744	302.037	320.098	332.889	339.943	-0.1023	54
658.171875	1112.602155	0.594347	9560000	1440000	40000	120000	0	40000	0	0	0	0	0	0	0	0	0	0	28171285.82	4859380144	8.583213	24.713	105.16769	177.82	308.091	30.309	90	28000	97365.16015	1.333333	262.788	301.83	320.059	332.889	340.024	-0.1802	54
665.140625	1106.196554	0.595364	12560000	1960000	40000	200000	40000	0	0	0	0	0	0	0	0	0	0	0	34950928.97	4894331073	8.546976	24.755	104.37791	177.816	308.102	30.349	90	37000	98063.24195	1.333333	262.845	301.812	320.133	332.867	340.046	-0.132638	53.6
672.15625	1110.692474	0.597644	16960000	2880000	160000	120000	80000	0	0	0	0	0	0	0	0	0	0	0	48060378.6	4942391451	8.591242	24.74	104.1339	177.779	308.06	30.386	90	50500	99028.71993	1.333333	262.775	301.852	320.113	332.881	340.019	-0.138381	53.6
679.125	1109.053264	0.595577	13440000	1760000	80000	80000	0	40000	0	0	0	0	0	0	0	0	0	0	36395513.73	4978786965	8.598747	24.753	104.50517	177.836	308.052	30.356	90	38500	99756.90456	1.333333	262.769	301.868	320.128	332.882	340.026	-0.227756	53.6
686.140625	1109.31601	0.597053	16000000	1960000	120000	240000	40000	0	0	0	0	0	0	0	0	0	0	0	42511155.62	5021298121	8.539498	24.723	104.6521	177.994	307.961	30.346	90	45900	100608.7053	1.333333	262.82	301.978	320.09	332.835	339.957	-0.282694	53.6
693.15625	1106.975312	0.595299	11640000	1400000	40000	360000	80000	0	0	0	0	0	0	0	0	0	0	0	33700698.98	5054998820	8.456319	24.74	97.68842	178.302	307.75	30.362	90	33800	101283.8099	1.333333	262.746	301.956	320.068	332.863	339.935	-0.158056	53.2
700.125	1112.262949	0.596758	21400000	3680000	160000	120000	120000	0	0	0	0	0	0	0	0	0	0	0	60213494.6	5115212314	8.472745	24.714	97.68317	178.443	307.731	30.359	90	63700	102492.5791	1.333333	262.717	301.931	320.049	332.788	339.998	-0.3975	53.2
707.125	1104.195763	0.594692	19880000	2800000	120000	160000	0	0	0	0	0	0	0	0	0	0	0	0	51473225.5	5166685540	8.464191	24.73	98.57527	178.207	307.737	30.327	90	57400	103520.9775	1.333333	262.82	301.754	320.093	332.797	339.919	-0.413081	53.2
714.109375	1106.225076	0.593511	15840000	2280000	240000	120000	40000	0	0	0	0	0	0	0	0	0	0	0	42889866.47	5209575406	8.463745	24.746	100.67434	178.305	307.737	30.375	90	46300	104384.1471	1.333333	262.855	301.763	320.024	332.744	339.948	-0.363063	52.8
721.109375	1107.083949	0.594495	10240000	1160000	40000	160000	80000	0	0	0	0	0	0	0	0	0	0	0	27691065.64	5237266472	8.486442	24.736	99.26534	178.063	307.8	30.349	90	29200	104940.4145	1.333333	262.884	301.738	320.112	332.769	339.876	-0.381106	52.8
728.125	1107.045865	0.598464	30960000	4200000	40000	80000	120000	0	0	0	0	0	0	0	0	0	0	0	78907477.15	5316173949	8.511815	24.688	100.49986	178.066	307.744	30.382	90	88500	106524.3048	1.333333	262.903	301.845	320.09	332.675	339.841	-0.408981	52.8
735.109375	1110.336689	0.599743	7840000	1160000	40000	280000	80000	0	40000	0	0	0	0	0	0	0	0	0	30554201.01	5346728150	8.463823	24.753	98.53985	178.315	307.722	30.378	90	23600	107137.6328	1.333333	262.945	301.722	320.084	332.691	339.832	-0.495075	52.8
742.125	1107.900689	0.595528	16160000	1920000	120000	200000	80000	0	0	0	0	0	0	0	0	0	0	0	43160256.52	5389888407	8.495206	24.765	99.04363	178.4	307.747	30.359	90	46200	108001.44	1.333333	262.977	301.732	320.122	332.672	339.832	-0.368806	52.8
749.09375	1107.871262	0.594462	10480000	1560000	120000	120000	120000	0	0	0	0	0	0	0	0	0	0	0	30920378.83	5420808785	8.503996	24.723	99.92261	178.482	307.775	30.382	90	31000	108621.6396	1.333333	262.977	301.785	320.115	332.637	339.803	-0.399144	52.8
756.109375	1108.27663	0.594233	13400000	2160000	120000	160000	80000	0	0	0	0	0	0	0	0	0	0	0	38600383.71	5459409169	8.473348	24.691	101.65434	178.312	307.814	30.378	90	39800	109395.9049	1.333333	263.09	301.909	320.082	332.62	339.736	-0.312225	52.8
763.078125	1109.855137	0.594577	47760000	7680000	440000	440000	0	0	0	0	0	0	0	0	0	0	0	0	128680308.8	5588089478	8.481955	24.69	99.91868	178.329	307.814	30.388	90	140800	111976.0932	1.333333	263.072	301.98	320.109	332.585	339.776	-0.161338	52.8
770.09375	1109.450746	0.598431	40600000	6040000	280000	120000	40000	0	0	0	0	0	0	0	0	0	0	0	105418399.9	5693507878	8.4845	24.692	100.47887	178.239	307.86	30.407	90	117700	114086.8472	1.333333	263.11	302.014	320.146	332.57	339.78	-0.113781	53.2
777.0625	1110.184396	0.59197	20520000	2080000	80000	0	0	0	0	0	0	0	0	0	0	0	0	0	47037339.01	5740545217	8.508981	24.673	100.80291	178.311	307.917	30.381	90	56700	115029.0018	1.333333	263.11	301.986	320.203	332.664	339.789	-0.053106	53.2
784.078125	1107.375907	0.594298	11200000	1760000	40000	240000	40000	0	0	0	0	0	0	0	0	0	0	0	32196085.71	5772741302	8.518716	24.713	100.8685	178.216	308.022	30.37	90	33200	115673.4611	1.333333	263.11	301.923	320.232	332.655	339.881	0.250275	53.2
791.046875	1110.86992	0.59461	11920000	1720000	200000	200000	0	0	0	0	0	0	0	0	0	0	0	0	33011571.91	5805752874	8.499509	24.746	102.60551	177.898	308.141	30.407	90	35100	116335.9195	1.333333	263.286	301.84	320.258	332.7	339.941	0.267494	53.6
798.0625	1107.514171	0.593659	23600000	4040000	440000	320000	80000	0	0	0	0	0	0	0	0	0	0	0	70148908.24	5875901783	8.487491	24.818	101.6281	177.945	308.107	30.443	90	71200	117739.2023	1.333333	263.267	301.875	320.321	332.677	339.902	0.338831	53.6
805.078125	1106.848073	0.594889	18080000	2320000	200000	240000	0	0	0	0	0	0	0	0	0	0	0	0	47570097.42	5923471880	8.539026	24.761	101.27389	177.969	308.155	30.429	90	52100	118693.6941	1.333333	263.306	301.904	320.356	332.711	339.924	0.328169	53.6
812.046875	1108.805865	0.596299	20840000	3320000	160000	280000	0	0	0	0	0	0	0	0	0	0	0	0	56659249.25	5980131129	8.553221	24.803	101.34735	177.96	308.142	30.429	90	61500	119831.2436	1.333333	263.306	301.974	320.387	332.714	339.934	0.337187	53.6
819.0625	1104.059086	0.594971	12440000	2360000	120000	200000	0	0	0	0	0	0	0	0	0	0	0	0	36331330.4	6016462460	8.526772	24.751	103.33756	177.796	308.064	30.419	90	37800	120559.3809	1.333333	263.354	302.119	320.412	332.767	339.887	0.306031	54
826.03125	1104.496049	0.59479	7120000	960000	80000	80000	40000	40000	0	0	0	0	0	0	0	0	0	0	22204546.14	6038667006	8.532912	24.745	101.77373	177.802	308.108	30.442	90	20800	121006.3084	1.333333	263.277	302.116	320.375	332.717	339.884	0.366706	54

833.03125	1108.837712	0.596742	8560000	920000	40000	40000	120000	0	0	0	0	0	0	0	0	0	0	0	23129667.81	6061796674	8.483503	24.816	101.10334	177.822	308.089	30.442	90	24200	121471.6723	1.333333	263.338	301.917	320.431	332.758	339.987	0.297831	54
840.046875	1106.54842	0.594364	13640000	2200000	80000	240000	0	0	0	0	0	0	0	0	0	0	0	0	37949084.59	6099745758	8.510766	24.787	99.41884	177.848	307.988	30.493	90	40400	122232.2101	1.333333	263.322	301.958	320.453	332.752	339.946	0.373269	54
847.03125	1106.93662	0.594593	5880000	1520000	120000	0	0	0	0	0	0	0	0	0	0	0	0	0	18280106.96	6118025865	8.496072	24.8	99.90293	177.799	308.016	30.474	90	18800	122599.3197	1.333333	263.316	301.885	320.488	332.761	339.971	0.367525	54
854.046875	1108.485724	0.595741	9600000	1160000	0	240000	0	0	40000	0	0	0	0	0	0	0	0	0	31258841.17	6149284706	8.502107	24.741	100.55889	177.764	308.055	30.476	90	27600	123226.8542	1.333333	263.323	301.886	320.508	332.754	339.989	0.338831	54
861.015625	1110.670993	0.594905	39360000	7560000	520000	680000	160000	0	0	0	0	0	0	0	0	0	0	0	119963370	6269248076	8.53362	24.757	100.80553	177.79	308.056	30.497	90	120700	125631.8042	1.333333	263.327	301.966	320.543	332.777	339.927	0.333087	54.4
868.03125	1111.96398	0.598923	48320000	6080000	400000	200000	200000	0	0	0	0	0	0	0	0	0	0	0	125500364.2	6394748441	8.528058	24.752	102.48088	177.758	308.088	30.471	90	138000	128142.8061	1.333333	263.313	302.025	320.515	332.756	339.956	0.278156	54.4
875	1109.794036	0.59584	9240000	1040000	40000	400000	120000	40000	0	0	0	0	0	0	0	0	0	0	31698174.89	6426446616	8.490614	24.733	102.81804	177.585	308.057	30.467	90	27200	128776.2833	1.333333	263.365	302.13	320.506	332.731	339.948	0.282256	54.4
882.015625	1107.211836	0.595167	8800000	1080000	80000	40000	40000	0	0	0	0	0	0	0	0	0	0	0	22903847.15	6449350463	8.555268	24.752	102.01515	177.621	308.17	30.431	90	25100	129234.9039	1.333333	263.259	302.022	320.474	332.731	340.029	0.112525	54.4
888.984375	1109.899511	0.598628	11840000	2080000	240000	240000	80000	40000	0	0	0	0	0	0	0	0	0	0	39738375.22	6489088838	8.555294	24.742	102.99384	177.559	308.183	30.408	90	36300	130032.4704	1.333333	263.243	301.962	320.512	332.734	340.079	0.1527	54.4
896	1107.274624	0.595791	35240000	3920000	360000	400000	0	0	0	0	0	0	0	0	0	0	0	0	89281816.45	6578370654	8.516329	24.807	103.94498	177.414	308.174	30.402	90	99800	131820.0559	1.333333	263.323	301.858	320.531	332.775	340.07	0.032169	54.4
903.015625	1108.594656	0.596889	7280000	960000	40000	120000	40000	0	0	0	0	0	0	0	0	0	0	0	20112436.04	6598483090	8.560358	24.736	102.47039	177.277	308.107	30.399	90	21100	132223.6984	1.333333	263.291	301.902	320.578	332.763	339.985	0.1281	54.4
909.96875	1108.02551	0.594692	5320000	800000	40000	120000	40000	0	0	0	0	0	0	0	0	0	0	0	15708458.57	6614191549	8.553431	24.772	104.12078	177.234	308.082	30.37	90	15800	132538.5807	1.333333	263.262	302.016	320.566	332.775	339.929	0.154344	54.4
916.984375	1105.248873	0.596824	6680000	800000	40000	40000	40000	0	0	0	0	0	0	0	0	0	0	0	17429573.78	6631621123	8.53627	24.756	102.39167	177.521	308.103	30.375	90	19000	132888.1429	1.333333	263.194	302.091	320.517	332.711	339.952	0.219119	54.4
924	1113.116927	0.599267	10480000	1480000	120000	240000	0	0	0	0	0	0	0	0	0	0	0	0	29273211.75	6660894334	8.567522	24.809	102.92956	177.751	308.154	30.436	90	30800	133476.7125	1.333333	263.106	301.909	320.5	332.758	340.034	0.246175	54.4
930.96875	1106.071394	0.593905	6320000	960000	120000	240000	40000	0	0	0	0	0	0	0	0	0	0	0	20357282.26	6681251617	8.555793	24.806	103.62225	177.799	308.106	30.457	90	19200	133883.1244	1.333333	263.111	301.918	320.542	332.744	340.076	0.263394	54.4
937.984375	1110.201996	0.595791	6640000	800000	40000	80000	40000	0	0	0	0	0	0	0	0	0	0	0	17776356.52	6699027973	8.518979	24.872	103.18669	177.83	308.154	30.45	90	19000	134240.2715	1.333333	263.173	301.865	320.543	332.7	340.061	0.263394	54.4
944.953125	1110.059397	0.598316	15400000	1360000	40000	80000	40000	0	0	0	0	0	0	0	0	0	0	0	36112079.72	6735140053	8.56209	24.801	102.63437	177.571	308.109	30.424	90	42300	134963.1045	1.333333	263.189	301.884	320.568	332.707	339.986	0.270775	54.4
951.96875	1109.823165	0.598168	13400000	1680000	80000	80000	40000	0	0	0	0	0	0	0	0	0	0	0	34412067.92	6769552121	8.574764	24.798	102.90332	177.476	308.075	30.439	90	38200	135651.9979	1.333333	263.151	301.897	320.556	332.67	340.081	0.261756	54.4
958.9375	1108.741226	0.595807	5680000	1080000	40000	40000	0	0	0	0	0	0	0	0	0	0	0	0	15802375.67	6785354497	8.56537	24.806	104.39366	177.54	308.105	30.442	90	17100	135968.4122	1.333333	263.16	301.994	320.546	332.708	340.037	0.251912	54.4
965.9375	1110.076392	0.594479	34000000	4160000	200000	80000	40000	0	0	0	0	0	0	0	0	0	0	0	83731513.04	6869086010	8.574764	24.786	103.51861	177.944	308.128	30.404	90	96200	137646.6219	1.333333	263.046	301.916	320.517	332.664	340.118	0.273231	54.4
972.90625	1108.02955	0.593347	10000000	1040000	160000	200000	200000	0	0	0	0	0	0	0	0	0	0	0	30948021.58	6900034031	8.539026	24.831	103.42153	177.832	308.128	30.397	90	29000	138266.1593	1.333333	263.123	301.818	320.586	332.73	340.097	0.254375	54.8
979.90625	1109.503063	0.59743	8800000	1000000	80000	160000	0	0	0	0	0	0	0	0	0	0	0	0	22892648.52	6922926680	8.588041	24.783	102.98466	177.77	308.115	30.397	90	25100	138725.2856	1.333333	263.107	301.875	320.621	332.73	340.081	0.292094	54.8
986.921875	1105.046903	0.593577	10520000	1360000	120000	200000	120000	0	0	0	0	0	0	0	0	0	0	0	31281388.75	6954208068	8.52916	24.809	104.42777	177.642	308.046	30.41	90	30800	139351.8201	1.333333	263.132	301.992	320.567	332.689	340.006	-0.000631	54.4
993.9375	1109.737561	0.595741	8000000	1320000	80000	280000	40000	0	0	0	0	0	0	0	0	0	0	0	25085144.53	6979293213	8.584525	24.77	103.37298	177.728	308.084	30.381	90	24300	139856.2762	1.333333	263.023	301.945	320.52	332.714	340.09	-0.297469	54.4
1000.90625	1111.323881	0.595479	10080000	1280000	120000	120000	80000	0	0	40000	0	0	0	0	0	0	0	0	39164611.5	7018457824	8.538868	24.777	104.87513	177.511	308.081	30.426	90	29300	140640.538	1.333333	263.094	301.787	320.523	332.717	340.112	0.036269	54.4
1007.921875	1111.164429	0.596119	6640000	1000000	80000	160000	120000	0	0	0	0	0	0	0	0	0	0	0	21844423.5	7040302248	8.544641	24.809	103.76262	177.459	308.062	30.42	90	20000	141077.3428	1.333333	263.033	301.717	320.526	332.673	340.078	-0.041625	54.4
1014.9375	1107.813604	0.596266	11880000	1920000	200000	200000	80000	0	0	0	0	0	0	0	0	0	0	0	36011324	7076313572	8.5766	24.789	103.45039	177.334	308.049	30.394	90	35700	141797.5347	1.333333	263.011	301.761	320.536	332.667	340.062	0.03135	54.4
1021.90625	1111.662902	0.595873	5960000	960000	40000	0	40000	0	0	0	0	0	0	0	0	0	0	0	16241649.5	7092555221	8.578568	24.799	103.38217	177.21	307.996	30.41	90	17500	142123.3346	1.333333	262.943	301.742	320.564	332.667	340.012	-0.117063	54.4
1028.921875	1107.566717	0.594807	14480000	2280000	120000	160000	80000	0	0	0	0	0	0	0	0	0	0	0	41239792.81	7133795014	8.493946	24.789	99.87145	177.318	307.722	30.433	90	42800	142947.7211	1.333333	262.94	301.815	320.517	332.589	339.899	-0.124444	54.4
1035.875	1111.0319	0.595036	29960000	3680000	160000	240000	80000	0	0	0	0	0	0	0	0	0	0	0	76062541.53	7209857556	8.448657	24.786	99.66154	177.469	307.64	30.439	90	85300	144473.8401	1.333333	262.885	301.847	320.464	332.592	339.93	-0.050644	54.4
1042.890625	1107.080638	0.594167	13480000	2000000	160000	200000	80000	0	0	0	0	0	0	0	0	0	0	0	38953680.01	7248811236	8.503996	24.788	99.5802	177.423	307.687	30.466	90	39800	145252.9693	1.333333	262.888	301.793	320.472	332.549	339.891	-0.02605	54.4
1049.90625	1106.6965	0.597381	15040000	1360000	120000	0	0	0	0	0	0	0	0	0	0	0	0	0	34439694	7283250930	8.478675	24.869	102.00072	177.415	307.708	30.522	90	41300	145944.2708	1.333333	262.947	301.626	320.508	332.569	339.942	-0.017025	54.4
1056.859375	1107.768401	0.597627	6200000	1040000	120000	120000	0	0	0	0	0	0	0	0	0	0	0	0	18058726.6	7301309656	8.511894	24.857	100.68877	177.443	307.75	30.517	90	18700	146306.8861	1.333333	262.955	301.615	320.49	332.532	339.868	-0.00555	54.4
1063.875	1103.941463	0.591822	14840000	1800000	80000	240000	80000	40000	0	0	0	0	0	0	0	0	0	0	42947502.21	7344257159	8.537346	24.846	102.30246	177.466	307.698	30.497	90	42700	147168.428	1.333333	262.912	301.706	320.509	332.533	339.844	0.099406	54.4
1070.890625	1107.637672	0.59543	6480000	800000	80000	160000	120000	0	0	0	0	0	0	0	0	0	0	0	20542232.67	7364799391	8.532754	24.759	103.41497	177.497	307.692	30.473	90	19100	147581.9409	1.333333	262.935	301.678	320.494	332.5	339.823	0.219938	54.4
1077.859375	1108.454269	0.598119	24200000	3400000	120000	360000	40000	0	0	0	0	0	0	0	0	0	0	0	64639353.37	7429438745	8.547422	24.807	101.74749	177.756	307.727	30.483	90	70300	148878.782	1.333333	262.878	301.735	320.415	332.437	339.757	0.244537	54.4
1084.875	1109.234861	0.595413	6680000	640000	120000	0	40000	0	0	0	0	0	0	0	0	0	0	0	16968404.56	7446407149	8.567837	24.82	102.18963	177.929	307.774	30.473	90	18700	149218.9636	1.333333	262.785	301.618	320.418	332.393	339.835	0.30275	54.4
1091.84375	1112.456526	0.594003	8040000	840000	40000	0	80000	0	0	0	0	0	0	0	0	0	0	0	20458299.8	7466865449	8.5115	24.872	104.13127	177.89	307.808	30.448	90	22500	149628.8217	1.333333	262.903	301.441	320.443	332.412	339.879	0.238794	54.4
1098.84375	1106.983424	0.596151	8200000	1080000	80000	160000	40000	0	40000	0	0	0	0	0	0	0	0	0	29135499.23	7496000948	8.576758	24.833	103.20375	177.742	307.774	30.431	90	24000	150210.8269	1.333333	262.813	301.545	320.456	332.406	339.738	0.324887	54.4
1105.859375	1111.120184	0.599595	15200000	1520000	120000	0	40000	0	0	0	0	0	0	0	0	0	0	0	36353282.08	7532354230	8.533856	24.781	103.82822	177.559	307.774	30.405	90	42200	150940.6036	1.333333	262.794	301.69	320.415	332.315	339.707	0.384744	54
1112.828125	1111.020819	0.597414	5800000	1120000	40000	200000	0	0	0	0	0	0	0	0	0	0	0	0	18011510.15	7550365741	8.578542	24.811	104.83315	177.739	307.884	30.418	90	17900	151300.8309	1.333333	262.791	301.475	320.415	332.346	339.772	0.429844	54.4

1119.828125	1108.594894	0.595102	5920000	800000	0	40000	40000	0	0	0	0	0	0	0	0	0	0	0	15705765.74	7566071506	8.471564	24.827	100.58251	177.864	307.686	30.409	90	17000	151614.9717	1.333333	262.801	301.419	320.399	332.321	339.722	0.459362	54.4
1126.859375	1112.21331	0.596938	6680000	1160000	40000	0	0	0	0	0	0	0	0	0	0	0	0	0	17658649.01	7583730155	8.527113	24.811	100.52609	177.788	307.623	30.444	90	19700	151968.9463	1.333333	262.791	301.393	320.425	332.296	339.719	0.447881	54.4
1133.8125	1106.157241	0.593019	29840000	3240000	80000	200000	80000	40000	0	0	0	0	0	0	0	0	0	0	75838045.98	7659568201	8.536349	24.775	102.4061	177.513	307.575	30.431	90	83700	153484.2041	1.333333	262.752	301.513	320.443	332.321	339.591	0.5143	54
1140.828125	1108.10523	0.595659	11840000	1440000	120000	40000	0	0	0	0	0	0	0	0	0	0	0	0	29357204.52	7688925406	8.506567	24.788	101.97448	177.408	307.572	30.405	90	33600	154073.9777	1.333333	262.74	301.57	320.387	332.243	339.635	0.5307	54
1147.796875	1105.842277	0.594233	23720000	3040000	280000	200000	40000	0	0	0	0	0	0	0	0	0	0	0	61794557.87	7750719964	8.565396	24.812	101.54021	177.353	307.596	30.417	90	68200	155313.2214	1.333333	262.728	301.53	320.372	332.25	339.594	0.4651	53.6
1154.828125	1101.792942	0.589887	9680000	1240000	160000	40000	80000	0	0	0	0	0	0	0	0	0	0	0	26789631.86	7777509595	8.561854	24.828	103.72589	177.383	307.668	30.404	90	28000	155851.5668	1.333333	262.692	301.388	320.381	332.206	339.667	0.492162	53.6
1161.796875	1106.754876	0.596824	6880000	920000	80000	80000	160000	0	0	0	0	0	0	0	0	0	0	0	21630976.69	7799140572	8.549784	24.848	104.87775	177.686	307.704	30.426	90	20300	156287.8451	1.333333	262.807	301.283	320.431	332.266	339.733	0.502	53.6
1168.796875	1105.422433	0.594938	5360000	840000	40000	320000	80000	0	0	0	0	0	0	0	0	0	0	0	19211434.77	7818352007	8.579119	24.893	103.33625	177.744	307.69	30.478	90	16600	156673.5862	1.333333	262.799	301.376	320.439	332.216	339.661	0.5102	53.6
1175.765625	1109.37725	0.597873	5360000	1080000	120000	80000	0	0	0	0	0	0	0	0	0	0	0	0	16278523.26	7834630530	8.602604	24.846	104.88562	177.628	307.671	30.489	90	16600	157000.8321	1.333333	262.741	301.445	320.41	332.176	339.605	0.491337	53.6
1182.78125	1111.103154	0.596611	17000000	2360000	40000	240000	40000	0	40000	0	0	0	0	0	0	0	0	0	51385680.39	7886016211	8.563008	24.841	105.13489	177.416	307.64	30.543	90	49300	158030.1519	1.333333	262.78	301.499	320.398	332.16	339.57	0.472481	53.6
1189.796875	1110.583907	0.594397	6560000	840000	0	200000	80000	0	0	0	0	0	0	0	0	0	0	0	19835730.21	7905851941	8.604283	24.88	103.82166	177.748	307.728	30.517	90	19200	158426.8694	1.333333	262.658	301.398	320.357	332.132	339.661	0.503638	53.6
1196.765625	1109.07082	0.599333	38000000	3200000	160000	40000	40000	0	0	0	0	0	0	0	0	0	0	0	85853692.06	7991705633	8.562064	24.854	105.83939	177.843	307.757	30.514	90	103600	160144.7583	1.333333	262.757	301.237	320.376	332.154	339.696	0.4856	53.6
1203.78125	1108.991918	0.598792	4680000	640000	120000	160000	0	40000	0	0	0	0	0	0	0	0	0	0	16903152.26	8008608785	8.604178	24.848	104.24279	178.023	307.678	30.514	90	14100	160483.4433	1.333333	262.661	301.281	320.411	332.15	339.611	0.496262	54
1210.796875	1110.877354	0.597348	21800000	1920000	40000	40000	120000	40000	0	0	0	0	0	0	0	0	0	0	54608153.21	8063216938	8.5983	24.851	105.49173	177.961	307.684	30.485	90	59900	161577.6934	1.333333	262.645	301.31	320.398	332.141	339.536	0.539719	54
1217.75	1108.241894	0.593905	14440000	2280000	200000	200000	120000	0	0	0	0	0	0	0	0	0	0	0	42818154.17	8106035092	8.563586	24.845	105.31987	177.938	307.672	30.482	90	43100	162434.2366	1.333333	262.655	301.427	320.351	332.103	339.555	0.4815	54
1224.765625	1111.435447	0.596102	5440000	760000	40000	240000	40000	0	0	0	0	0	0	0	0	0	0	0	17245372.98	8123280465	8.606041	24.861	104.21786	177.908	307.712	30.469	90	16300	162780.0371	1.333333	262.591	301.363	320.307	332.041	339.614	0.474119	54
1231.75	1102.565853	0.595627	8280000	1240000	120000	0	0	0	0	0	0	0	0	0	0	0	0	0	21536593.69	8144817059	8.602787	24.883	104.36479	177.941	307.716	30.417	90	24100	163210.6432	1.333333	262.517	301.272	320.282	332.056	339.624	0.516756	54
1238.75	1111.596939	0.595692	6240000	960000	80000	120000	80000	0	0	0	0	0	0	0	0	0	0	0	19351889.07	8164168948	8.552539	24.874	105.18868	177.928	307.747	30.427	90	18700	163600.6807	1.333333	262.645	301.139	320.297	332.047	339.624	0.516756	54
1245.71875	1107.120032	0.593446	5480000	800000	120000	40000	40000	0	0	0	0	0	0	0	0	0	0	0	15854671.98	8180023620	8.610607	24.819	104.83708	177.938	307.703	30.404	90	16200	163917.6356	1.333333	262.578	301.243	320.351	332.05	339.561	0.547094	54
1252.734375	1108.814081	0.596775	11240000	1560000	40000	240000	120000	0	0	0	0	0	0	0	0	0	0	0	33172735.58	8213196356	8.580773	24.799	106.37727	177.761	307.7	30.404	90	33000	164583.482	1.333333	262.658	301.332	320.348	332.094	339.461	0.4938	53.6
1259.75	1108.401495	0.594167	9800000	1320000	40000	200000	40000	0	0	0	0	0	0	0	0	0	0	0	27226891.71	8240423248	8.58993	24.821	104.27952	177.938	307.696	30.389	90	28500	165129.1479	1.333333	262.619	301.345	320.298	332.006	339.527	0.479044	53.6
1266.71875	1106.629078	0.59315	6040000	760000	160000	0	40000	0	0	0	0	0	0	0	0	0	0	0	16544159.26	8256967407	8.609137	24.898	105.2136	178.173	307.791	30.479	90	17500	165460.8399	1.333333	262.642	301.202	320.335	332.02	339.684	0.487238	53.6
1273.734375	1106.980738	0.596201	69480000	12280000	560000	800000	0	0	0	0	0	0	0	0	0	0	0	0	194105308	8451072715	8.553064	24.91	105.06011	178.086	307.821	30.484	90	207800	169358.6693	1.333333	262.662	301.121	320.405	332.068	339.663	0.502819	53.6
1280.703125	1108.394253	0.597857	8960000	1200000	160000	120000	40000	0	0	0	0	0	0	0	0	0	0	0	25070201.49	8476142916	8.609715	24.892	104.69146	178.071	307.809	30.464	90	26200	169861.9441	1.333333	262.689	301.22	320.45	332.105	339.619	0.455262	53.6
1287.734375	1107.133825	0.597201	16400000	1960000	80000	160000	0	0	0	0	0	0	0	0	0	0	0	0	41136661.47	8517279578	8.623884	24.859	104.43564	178.28	307.784	30.496	90	46500	170686.694	1.333333	262.695	301.213	320.459	332.071	339.632	0.451981	53.6
1294.703125	1108.967057	0.597955	6000000	760000	80000	120000	40000	0	0	0	0	0	0	0	0	0	0	0	17123456.3	8534403034	8.598642	24.85	106.17917	178.353	307.758	30.5	90	17500	171030.3935	1.333333	262.772	301.308	320.484	332.086	339.597	0.441325	53.6
1301.703125	1110.474305	0.595889	10000000	1440000	40000	40000	0	0	0	0	0	0	0	0	0	0	0	0	25323328.09	8559726362	8.626744	24.882	104.36742	178.664	307.824	30.48	90	28800	171537.8392	1.333333	262.727	301.327	320.447	332.039	339.644	0.439681	53.6
1308.671875	1103.705334	0.59238	8880000	1160000	120000	440000	40000	0	0	0	0	0	0	0	0	0	0	0	28088322.08	8587814684	8.619974	24.863	105.24247	178.523	307.847	30.503	90	26600	172099.9278	1.333333	262.804	301.22	320.494	332.08	339.698	0.4692	54
1315.703125	1106.00168	0.595413	12400000	2160000	80000	120000	200000	0	0	0	0	0	0	0	0	0	0	0	38710525.99	8626525210	8.563927	24.885	105.39071	178.343	307.881	30.512	90	37400	172879.3332	1.333333	262.862	301.201	320.506	332.115	339.729	0.440506	53.6
1322.671875	1107.207717	0.593249	6280000	1240000	80000	120000	80000	0	0	0	0	0	0	0	0	0	0	0	20603475.51	8647128686	8.628477	24.885	104.30969	178.067	307.824	30.503	90	19500	173293.3064	1.333333	262.836	301.302	320.598	332.111	339.691	0.463462	53.6
1329.6875	1103.465575	0.591297	17240000	3080000	200000	160000	40000	40000	0	0	0	0	0	0	0	0	0	0	52055920.8	8699184607	8.620552	24.853	105.7856	177.894	307.859	30.512	90	51900	174338.0952	1.333333	262.865	301.333	320.594	332.108	339.691	0.490519	53.6
1336.65625	1106.41138	0.593216	9400000	1480000	120000	280000	160000	0	0	0	0	0	0	0	0	0	0	0	31203261.37	8730387868	8.618085	24.83	105.74362	177.73	307.869	30.5	90	28600	174966.4843	1.333333	262.958	301.387	320.654	332.152	339.669	0.506919	53.6
1343.671875	1106.390199	0.592642	42440000	5800000	160000	360000	120000	0	0	0	0	0	0	0	0	0	0	0	110963478.5	8841351346	8.587096	24.824	104.15882	177.782	307.85	30.493	90	122200	177195.1808	1.333333	262.904	301.485	320.598	332.068	339.666	0.501181	53.6
1350.640625	1105.405171	0.594364	13120000	1480000	80000	80000	80000	0	0	0	0	0	0	0	0	0	0	0	33622392.77	8874973739	8.596123	24.851	104.49861	177.875	307.879	30.508	90	37100	177870.4979	1.333333	262.93	301.464	320.645	332.109	339.629	0.455262	53.6
1357.6875	1109.335987	0.599562	10240000	1680000	120000	80000	120000	0	40000	0	0	0	0	0	0	0	0	0	36799640.26	8911773379	8.571746	24.85	105.72132	178.025	307.872	30.525	90	30700	178610.2898	1.333333	262.993	301.479	320.676	332.124	339.657	0.435581	54
1364.65625	1109.970692	0.598021	18640000	2400000	280000	360000	80000	0	0	0	0	0	0	0	0	0	0	0	52568146.33	8964341526	8.572218	24.844	104.8935	178.088	307.915	30.522	90	54400	179663.3351	1.333333	262.983	301.548	320.703	332.102	339.764	0.502819	54
1371.671875	1110.70189	0.596069	8280000	1480000	120000	120000	0	0	0	0	0	0	0	0	0	0	0	0	24004975.91	8988346502	8.612155	24.861	104.58782	178.149	307.986	30.539	90	25000	180143.9279	1.333333	262.981	301.446	320.724	332.139	339.838	0.551194	54
1378.640625	1110.086539	0.598365	25680000	3520000	280000	240000	0	0	0	0	0	0	0	0	0	0	0	0	67111699.64	9055458201	8.611368	24.897	105.49698	178.112	308.047	30.602	90	74300	181486.6564	1.333333	262.969	301.44	320.741	332.176	339.843	0.547919	54
1385.65625	1110.714627	0.595315	13760000	1800000	280000	120000	80000	0	0	0	0	0	0	0	0	0	0	0	38679267.35	9094137469	8.579907	24.926	106.51896	177.79	308.11	30.556	90	40100	182260.9557	1.333333	263.101	301.3	320.813	332.264	339.868	0.574156	54
1392.625	1108.35906	0.595053	15760000	3040000	200000	200000	160000	0	0	0	0	0	0	0	0	0	0	0	49527674.36	9143665143	8.564347	24.919	105.48255	177.731	308.113	30.553	90	48400	183251.8628	1.333333	263.085	301.342	320.854	332.245	339.881	0.532337	54
1399.640625	1110.531642	0.597217	13680000	1760000	120000	40000	0	0	0	0	0	0	0	0	0	0	0	0	34176482.69	9177841626	8.617744	24.893	105.0588	177.722	308.125	30.527	90	39000	183937.0897	1.333333	263.091	301.354	320.847	332.27	339.796	0.552019	53.6
1406.609375	1107.118342	0.598644	13160000	2240000	80000	40000	40000	0	0	0	0	0	0	0	0	0	0	0	35730082.37	9213571708	8.604834	24.939	105.06405	177.902	308.113	30.517	90	38900	184652.0642	1.333333	263.056	301.329	320.879	332.245	339.868	0.556119	53.6
1413.640625	1112.25226	0.600333	7360000	920000	120000	120000	0	0	0	0	0	0	0	0	0	0	0	0	19874505.31	9233446213	8.613756	24.88	104.18375	178.141	308.053	30.569	90	21300	185050.9878	1.333333	263.005	301.357	320.863	332.239	339.856	0.591375	53.6

1420.59375	1109.115692	0.594282	29600000	6040000	160000	480000	120000	0	0	0	0	0	0	0	0	0	0	0	89542583.91	9322988797	8.592843	24.893	105.84988	178.102	308.04	30.559	90	91000	186840.0021	1.333333	263.085	301.462	320.863	332.251	339.806	0.543819	53.2
1427.625	1107.234983	0.596545	57840000	8080000	640000	360000	40000	40000	0	0	0	0	0	0	0	0	0	0	154648036.2	9477636833	8.598143	24.861	106.6659	178.213	308.094	30.563	90	167500	189938.5274	1.333333	263.091	301.44	320.863	332.232	339.828	0.521675	53.2
1434.640625	1109.578389	0.595463	20040000	2400000	80000	120000	80000	0	0	0	0	0	0	0	0	0	0	0	50982422.18	9528619256	8.578778	24.845	105.94172	178.535	308.107	30.543	90	56800	190961.7454	1.333333	263.062	301.553	320.838	332.163	339.847	0.560213	53.2
1441.609375	1111.297947	0.595233	7600000	1280000	120000	80000	40000	0	0	0	0	0	0	0	0	0	0	0	22210283.69	9550829539	8.622178	24.9	104.8174	178.797	308.129	30.559	90	22800	191406.5647	1.333333	262.992	301.452	320.857	332.198	339.988	0.573338	53.2
1448.625	1113.160531	0.596184	10720000	1360000	80000	40000	40000	40000	0	0	0	0	0	0	0	0	0	0	30402610.32	9581232150	8.586125	24.942	106.41401	178.427	308.192	30.534	90	30700	192014.5146	1.333333	263.072	301.351	320.938	332.245	339.966	0.570056	53.2
1455.59375	1106.47121	0.592544	10120000	1400000	0	160000	0	0	0	0	0	0	0	0	0	0	0	0	26364704.98	9607596855	8.606461	24.89	105.12702	178.213	308.16	30.504	90	29200	192540.838	1.333333	263.062	301.3	320.923	332.245	339.903	0.524137	53.6
1462.5625	1107.316054	0.594462	20240000	2760000	240000	200000	40000	0	0	0	0	0	0	0	0	0	0	0	53838727.61	9661435582	8.642987	24.864	105.31593	178.135	308.164	30.465	90	58700	193622.1279	1.333333	263.076	301.336	320.911	332.243	339.914	0.542175	53.6
1469.578125	1107.614612	0.597955	54280000	8560000	320000	760000	80000	0	0	0	0	0	0	0	0	0	0	0	149638638.4	9811074221	8.614438	24.864	106.843	178.069	308.124	30.46	90	160000	196625.1576	1.333333	263.131	301.499	320.886	332.283	339.888	0.536438	54
1476.609375	1107.729278	0.596725	16760000	3000000	160000	280000	120000	0	0	0	0	0	0	0	0	0	0	0	51125720.92	9862199942	8.620105	24.906	106.986	178.118	308.164	30.49	90	50800	197650.8999	1.333333	263.165	301.541	320.895	332.268	339.86	0.561037	54
1483.5625	1107.427768	0.595922	9320000	1560000	80000	160000	280000	40000	0	0	0	0	0	0	0	0	0	0	35229651.59	9897429593	8.631521	24.911	105.27264	178.468	308.172	30.528	90	28600	198357.644	1.333333	263.113	301.535	320.9	332.196	339.957	0.528237	54
1490.578125	1110.162603	0.594216	7880000	1200000	80000	40000	40000	40000	0	40000	0	0	0	0	0	0	0	0	35511900.4	9932941494	8.645086	24.965	106.10177	178.83	308.224	30.556	90	23300	199070.2443	1.333333	263.051	301.418	320.88	332.225	339.999	0.576613	54
1497.5625	1109.606275	0.594626	8400000	1160000	0	280000	80000	0	0	0	0	0	0	0	0	0	0	0	25378622.98	9958320117	8.638868	24.931	105.50223	178.969	308.174	30.613	90	24800	199578.2504	1.333333	263.051	301.438	320.915	332.265	339.999	0.549556	54.4
1504.578125	1109.061045	0.59743	10600000	1040000	80000	160000	0	0	0	0	0	0	0	0	0	0	0	0	26451864.19	9984771981	8.628372	24.953	107.08964	178.799	308.253	30.632	90	29700	200108.0052	1.333333	263.109	301.34	320.94	332.272	340.008	0.5184	54.4
1511.546875	1110.466763	0.595823	16280000	2080000	200000	80000	80000	0	0	0	0	0	0	0	0	0	0	0	43059699.51	10027831680	8.590953	24.95	106.26445	178.707	308.256	30.594	90	46800	200970.7911	1.333333	263.141	301.277	320.987	332.25	340.024	0.5307	54.4
1518.578125	1106.964632	0.594397	34120000	8960000	1080000	800000	200000	0	0	0	0	0	0	0	0	0	0	0	124785448.2	10152617129	8.589353	24.963	106.80365	178.697	308.263	30.584	90	112900	203467.9482	1.333333	263.18	301.293	320.946	332.284	340.055	0.5348	54.4
1525.578125	1110.005191	0.596233	7320000	880000	80000	40000	0	0	0	0	0	0	0	0	0	0	0	0	18299154.47	10170916283	8.583108	24.953	106.13982	178.612	308.178	30.571	90	20800	203835.3022	1.333333	263.177	301.448	320.956	332.218	339.967	0.561856	54.4
1532.546875	1107.498507	0.598546	6200000	1160000	0	120000	0	0	0	0	0	0	0	0	0	0	0	0	17659292.78	10188575576	8.563166	24.911	101.63073	178.622	307.989	30.558	90	18700	204188.8399	1.333333	263.189	301.416	320.975	332.275	339.939	0.519219	54.4
1539.5625	1111.600407	0.595627	14000000	1880000	80000	160000	80000	0	0	0	0	0	0	0	0	0	0	0	38131751.67	10226707327	8.46915	24.895	100.61924	178.963	307.85	30.542	90	40500	204953.9626	1.333333	263.196	301.47	320.972	332.247	339.92	0.587275	54.4
1546.53125	1109.386444	0.598759	9360000	1360000	0	280000	120000	0	0	0	0	0	0	0	0	0	0	0	28899621.35	10255606949	8.482191	24.905	99.27453	178.845	307.878	30.509	90	27800	205531.7006	1.333333	263.18	301.523	320.965	332.221	339.93	0.547094	54.4
1553.53125	1108.892439	0.593724	6840000	1160000	40000	40000	40000	0	0	0	0	0	0	0	0	0	0	0	19266263.2	10274873212	8.52567	24.931	99.60644	178.992	307.973	30.542	90	20300	205917.6249	1.333333	263.17	301.41	320.953	332.19	339.961	0.570056	54.4
1560.546875	1109.404209	0.600054	7720000	1040000	40000	200000	80000	0	0	0	0	0	0	0	0	0	0	0	23131000.37	10298004212	8.525696	24.924	102.19882	179.159	307.985	30.519	90	22700	206381.1705	1.333333	263.334	301.312	320.994	332.209	339.936	0.512656	54.4
1567.515625	1109.385598	0.596791	6560000	520000	120000	80000	0	0	0	0	0	0	0	0	0	0	0	0	16105072.3	10314109285	8.530577	24.924	102.89545	179.563	308.036	30.548	90	18200	206703.7676	1.333333	263.366	301.321	321.019	332.234	339.996	0.490519	54.4
1574.53125	1108.48719	0.596922	8320000	720000	0	80000	0	0	0	0	0	0	0	0	0	0	0	0	19291254.77	10333400539	8.511894	24.928	103.24573	179.5	308.118	30.551	90	22800	207090.1928	1.333333	263.447	301.309	321.085	332.254	339.994	0.535619	54.4
1581.5	1108.293218	0.596479	11200000	1280000	120000	160000	80000	0	0	0	0	0	0	0	0	0	0	0	30562951.61	10363963491	8.515541	24.974	102.80361	179.512	308.186	30.6	90	32100	207702.8987	1.333333	263.467	301.346	321.115	332.228	339.98	0.565137	54.4
1588.515625	1107.272935	0.595151	6520000	720000	0	40000	120000	0	0	0	0	0	0	0	0	0	0	0	18315872.61	10382279364	8.542568	25.001	102.88364	179.549	308.271	30.634	90	18500	208070.1476	1.333333	263.535	301.424	321.194	332.239	340.01	0.539719	54.4
1595.484375	1107.66123	0.596824	26160000	5240000	440000	400000	80000	0	0	0	0	0	0	0	0	0	0	0	80176732.44	10462456096	8.585915	24.96	102.7249	179.478	308.327	30.625	90	80800	209679.2406	1.333333	263.582	301.474	321.249	332.273	340.016	0.5307	54.4
1602.5	1110.541559	0.595118	8280000	1040000	80000	40000	0	0	0	0	0	0	0	0	0	0	0	0	20803703.67	10483259800	8.601974	24.971	104.03157	179.417	308.362	30.641	90	23600	210096.6106	1.333333	263.573	301.573	321.269	332.267	339.972	0.516756	54.4
1609.46875	1108.144059	0.596725	12760000	1480000	80000	240000	0	0	0	0	0	0	0	0	0	0	0	0	33036717.31	10516296517	8.562064	24.916	105.01026	179.41	308.378	30.605	90	36400	210757.6838	1.333333	263.701	301.75	321.278	332.295	339.966	0.585631	54.4
1616.484375	1105.018635	0.595217	29200000	4320000	160000	360000	80000	0	0	40000	0	0	0	0	0	0	0	0	90643005.76	10606939523	8.560752	24.942	104.65604	179.387	308.403	30.608	90	85400	212575.3978	1.333333	263.669	301.734	321.291	332.286	339.988	0.544637	54.4
1623.453125	1105.699962	0.594725	11080000	1760000	120000	160000	40000	0	0	40000	0	0	0	0	0	0	0	0	42402108.47	10649341631	8.598458	24.933	103.58683	179.365	308.384	30.595	90	33000	213428.1156	1.333333	263.666	301.759	321.278	332.255	339.991	0.547094	54.4
1630.46875	1106.405839	0.594134	75600000	6360000	200000	80000	0	0	0	0	0	0	0	0	0	0	0	0	168324847.9	10817666479	8.625799	24.962	104.75312	179.453	308.438	30.621	90	205600	216811.0878	1.333333	263.631	301.62	321.278	332.276	340.044	0.545456	54
1637.5	1102.800766	0.592462	12600000	1400000	40000	80000	80000	0	0	0	0	0	0	0	0	0	0	0	32284239.25	10849950718	8.611525	24.981	104.84102	179.427	308.431	30.615	90	35500	217459.5185	1.333333	263.701	301.592	321.262	332.248	340.11	0.561856	54
1644.46875	1106.83204	0.594954	15120000	2200000	120000	80000	40000	0	0	0	0	0	0	0	0	0	0	0	39640418.73	10889591137	8.573294	24.952	104.70196	179.309	308.438	30.663	90	43900	218258.3012	1.333333	263.733	301.541	321.331	332.261	340.104	0.554475	53.6
1651.4375	1107.162061	0.595577	14280000	1880000	80000	160000	0	0	0	0	0	0	0	0	0	0	0	0	36516044.01	10926107181	8.589825	24.997	104.2887	179.174	308.479	30.621	90	41000	218991.4456	1.333333	263.759	301.544	321.35	332.292	340.038	0.607775	53.6
1658.453125	1107.46288	0.595922	10400000	1640000	40000	80000	40000	0	0	0	0	0	0	0	0	0	0	0	28319330.08	10954426511	8.637608	24.958	104.59176	179.122	308.475	30.637	90	30500	219559.8524	1.333333	263.756	301.655	321.407	332.289	340.057	0.596294	53.6
1665.421875	1109.547098	0.595856	7640000	1240000	80000	80000	120000	40000	0	0	0	0	0	0	0	0	0	0	26273535.55	10980700047	8.624382	24.955	104.72426	179.315	308.409	30.634	90	23000	220087.0541	1.333333	263.698	301.699	321.404	332.28	340.016	0.561856	54
1672.453125	1110.631324	0.59238	11720000	1800000	40000	280000	80000	0	0	0	0	0	0	0	0	0	0	0	34766562.08	11015466609	8.582793	24.92	105.43269	179.571	308.45	30.657	90	34800	220783.3655	1.333333	263.791	301.797	321.375	332.308	340.007	0.63155	54
1679.421875	1110.269575	0.595381	8560000	1240000	40000	120000	0	0	0	0	0	0	0	0	0	0	0	0	22656535.34	11038123144	8.579487	24.916	105.62555	179.824	308.463	30.631	90	24900	221236.6919	1.333333	263.765	301.784	321.382	332.245	340.066	0.589731	54
1686.4375	1107.520265	0.593396	26320000	3840000	200000	160000	120000	0	0	0	0	0	0	0	0	0	0	0	71316854.73	11109439999	8.63299	24.922	104.43826	179.945	308.517	30.6	90	76600	222664.1101	1.333333	263.702	301.735	321.385	332.275	340.084	0.578256	54
1693.46875	1110.775633	0.593446	11320000	1280000	40000	80000	0	0	0	0	0	0	0	0	0	0	0	0	27581542.17	11137021541	8.637713	24.986	104.48155	179.978	308.534	30.546	90	31800	223217.5295	1.333333	263.716	301.72	321.359	332.268	340.146	0.610231	53.6
1700.4375	1106.243129	0.593741	8960000	1080000	40000	80000	0	40000	0	0	0	0	0	0	0	0	0	0	24949779.09	11161971320	8.626692	24.951	106.1267	179.699	308.596	30.549	90	25500	223716.6758	1.333333	263.847	301.638	321.403	332.316	340.194	0.60695	53.2
1707.40625	1107.487655	0.591855	13040000	1880000	120000	120000	120000	0	0	0	0	0	0	0	0	0	0	0	36901946.03	11198873266	8.57765	24.994	105.12308	179.501	308.617	30.537	90	38200	224457.9624	1.333333	263.849	301.649	321.426	332.32	340.191	0.594656	53.2
1714.421875	1106.183499	0.595233	6800000	1160000	80000	40000	0	40000	0	0	0	0	0	0	0	0	0	0	21323887.3	11220197154	8.63711	24.992	104.71376	179.429	308.636	30.56	90	20300	224885.8355	1.333333	263.848	301.731	321.507	332.365	340.158	0.553656	53.6

1721.390625	1108.687102	0.594954	6240000	960000	80000	200000	120000	0	0	0	0	0	0	0	0	0	0	21147050.64	11241344204	8.6332	24.983	106.45074	179.55	308.676	30.629	90	19000	225310.6605	1.333333	263.883	301.802	321.496	332.378	340.102	0.612694	53.6
1728.40625	1107.02826	0.592937	20760000	2560000	280000	200000	40000	40000	0	0	0	0	0	0	0	0	0	57448050.91	11298792255	8.581376	24.973	105.26083	179.766	308.654	30.61	90	59700	226462.1336	1.333333	263.873	301.887	321.471	332.353	340.156	0.613512	53.6
1735.421875	1110.27028	0.598086	7120000	960000	120000	120000	80000	0	0	0	0	0	0	0	0	0	0	21422804.95	11320215060	8.645191	24.999	104.57339	179.907	308.707	30.587	90	21000	226892.1699	1.333333	263.87	301.846	321.462	332.378	340.231	0.593013	53.6
1742.40625	1108.66866	0.596742	8240000	920000	40000	80000	0	0	0	0	0	0	0	0	0	0	0	20279017.22	11340494077	8.631993	25.018	106.67246	179.878	308.798	30.584	90	23200	227298.0574	1.333333	263.857	301.726	321.478	332.416	340.221	0.578256	53.6
1749.421875	1104.398368	0.593839	7600000	1120000	80000	120000	40000	0	0	0	0	0	0	0	0	0	0	21758633.34	11362252711	8.582478	25.009	105.36316	179.819	308.789	30.581	90	22400	227734.1888	1.333333	263.963	301.691	321.49	332.363	340.278	0.600394	53.6
1756.390625	1104.821182	0.592921	19160000	2560000	160000	120000	40000	0	0	0	0	0	0	0	0	0	0	49354159.11	11411606870	8.646162	24.976	105.61636	179.806	308.795	30.581	90	55100	228727.2716	1.333333	263.915	301.811	321.503	332.378	340.24	0.588094	53.6
1763.40625	1104.761395	0.595725	22280000	3240000	0	200000	120000	0	0	0	0	0	0	0	0	0	0	59750425.58	11471357295	8.589038	24.976	105.37891	179.927	308.811	30.597	90	64600	229929.0835	1.333333	263.927	301.947	321.5	332.382	340.228	0.544637	53.6
1770.375	1107.314727	0.592806	6440000	920000	80000	40000	40000	0	0	0	0	0	0	0	0	0	0	17678660.88	11489035956	8.661014	25.028	105.455	180.284	308.868	30.603	90	18800	230284.689	1.333333	263.918	301.77	321.474	332.416	340.403	0.628269	53.6
1777.390625	1107.163581	0.598956	14800000	1920000	40000	40000	40000	0	0	0	0	0	0	0	0	0	0	37140730.81	11526176687	8.627716	25.006	106.92303	180.088	308.877	30.607	90	42100	231030.0503	1.333333	264.04	301.736	321.569	332.469	340.397	0.603675	53.6
1784.359375	1108.38325	0.595282	7160000	640000	80000	80000	0	0	0	0	0	0	0	0	0	0	0	17343751.71	11543520439	8.598484	25.028	105.92991	179.97	308.887	30.626	90	19900	231378.1621	1.333333	264.04	301.71	321.562	332.432	340.397	0.60695	53.6
1791.375	1106.502655	0.593593	24280000	1880000	80000	80000	120000	0	0	0	0	0	0	0	0	0	0	57024816.69	11600545255	8.660751	24.96	106.22509	179.727	308.865	30.626	90	66100	232521.4653	1.333333	264.053	301.894	321.6	332.469	340.316	0.572512	53.6
1798.359375	1101.610608	0.594315	19520000	3040000	240000	200000	120000	0	0	0	0	0	0	0	0	0	0	55709060.05	11656254315	8.606645	24.908	106.25527	179.648	308.883	30.626	90	57800	233640.2869	1.333333	264.133	301.992	321.534	332.51	340.312	0.540537	53.6

Table E-3 Aerosol counts at simulated cruise speed conditions (Test 1: 50.8 PSI, 249.7°C)

Time (sec)	Flow (CFM)	Filter dP ("H2O)	0.3 µm	0.4 µm	0.5 µm	0.55 µm	0.7 µm	1.0 µm	1.3 µm	1.6 µm	2.0 µm	2.2 µm	3.0 µm	4.0 µm	5.0 µm	5.5 µm	7.0 µm	10.0 µm	dm (pg)	Total Mass (pg)	Aerosol Generator (PSIA)	Aerosol Generator Temp (°C)	Compressor (PSIA)	Compressor Temp (°C)	Reactor Tube Temp (°C)	Duct Temp (°C)	Aero. Gen.Flow (CFH)	Sum of Particles	Total Sample Mass (pg)	Sample Filter Flow Rate (SCFH)	Temp S1 (°C)	Temp S2 (°C)	Temp S3 (°C)	Temp S4 (°C)	Temp S5 (°C)	CO (PPM)	RH (%)
0.65625	1116.630497	0.584738	243560000	20560000	2160000	2880000	960000	0	0	0	0	0	0	0	0	0	0	0	815268387.6	0	6.595152	21.08	51.158284	136.672	249.418	26.46	90	675300	0	1.333333	208.203	244.056	255.038	275.07	278.27	-1.50115	47.6
16.640625	1118.687051	0.58605	274320000	22720000	2240000	2840000	1040000	0	0	0	0	0	0	0	0	0	0	0	1552906399	1552906399	6.581612	21.136	50.811268	136.498	249.292	26.457	90	757900	30904.61095	1.333333	208.196	243.94	254.941	274.948	278.11	-0.708263	47.6
23.625	1115.684111	0.583147	252120000	22280000	1720000	3040000	960000	0	0	0	0	0	0	0	0	0	0	0	632968613.4	2185875013	6.626561	21.073	50.201329	136.398	249.205	26.441	90	700300	43478.25179	1.333333	208.255	244.066	255.044	274.878	278.132	-1.170713	47.6
30.609375	1121.281358	0.58523	239720000	20080000	1880000	2960000	760000	40000	0	0	0	0	0	0	0	0	0	0	597438262.8	2783313276	6.639155	21.09	50.329771	136.579	249.147	26.408	90	663600	55378.04108	1.333333	208.219	243.705	254.986	274.907	278.161	-1.105119	47.2
37.578125	1118.139561	0.584869	279880000	22920000	2360000	3080000	1800000	0	0	0	0	0	0	0	0	0	0	0	712475224.1	3495788500	6.620394	21.064	50.54848	136.678	249.082	26.425	90	775100	69498.2997	1.333333	208.131	243.93	254.938	274.741	277.922	-1.069863	47.2
44.625	1112.9173	0.581491	264480000	22800000	1760000	2640000	1200000	80000	0	0	0	0	0	0	0	0	0	0	670484380	4166272880	6.634091	21.103	50.271651	136.749	249.04	26.431	90	732400	82823.69612	1.333333	208.259	243.682	254.935	274.798	278.101	-1.105119	47.2
51.609375	1118.475547	0.582524	288640000	25640000	2000000	3280000	1120000	40000	0	0	0	0	0	0	0	0	0	0	722694902.1	4888967782	6.621732	21.126	51.631648	136.876	248.992	26.454	90	801800	97254.13647	1.333333	208.131	243.827	254.803	274.696	277.915	-1.159238	47.2
58.59375	1115.553678	0.582114	253480000	22840000	1680000	3640000	680000	0	0	0	0	0	0	0	0	0	0	0	637712620.8	5526680403	6.611499	21.03	50.990876	136.798	248.976	26.426	90	705800	109924.4104	1.333333	208.341	243.934	254.904	274.708	277.978	-1.092	47.2
65.5625	1112.787744	0.581999	272040000	22080000	2160000	3280000	1080000	0	0	0	0	0	0	0	0	0	0	0	674635407.4	6201315810	6.645217	21.151	50.330165	136.967	248.977	26.45	90	751600	123363.3854	1.333333	208.343	243.675	254.931	274.729	278.006	-1.236313	47.2
72.609375	1116.958	0.582179	297640000	22440000	2000000	3040000	1400000	0	0	0	0	0	0	0	0	0	0	0	732793604.6	6934109415	6.645243	21.035	50.373591	136.942	248.991	26.432	90	816300	137997.1755	1.333333	208.353	243.988	255	274.635	277.851	-1.064938	47.2
79.59375	1111.869732	0.582835	352200000	28040000	2600000	4040000	1320000	80000	0	0	0	0	0	0	0	0	0	0	873714553	7807823968	6.649756	21.1	50.66354	136.988	248.995	26.434	90	970700	155379.9947	1.333333	208.409	243.735	255.004	274.736	277.974	-1.211713	47.2
86.578125	1115.99665	0.583557	325080000	25880000	2400000	2840000	1360000	0	0	0	0	0	0	0	0	0	0	0	791027186	8598851154	6.651147	21.017	50.244099	136.947	248.961	26.452	90	893900	171189.7442	1.333333	208.427	244.045	255.005	274.596	277.822	-1.20925	47.2
93.5625	1117.155389	0.582507	284040000	22320000	2040000	3480000	1200000	80000	40000	0	0	0	0	0	0	0	0	0	714961871	9313813025	6.641255	21.102	50.199361	136.947	249.012	26.465	90	783000	185426.3833	1.333333	208.499	243.794	255.034	274.676	277.953	-1.304363	47.2
100.546875	1114.782531	0.58459	303720000	22400000	1760000	3320000	1240000	40000	40000	0	0	0	0	0	0	0	0	0	746248391.6	10060061416	6.569778	21.096	49.182713	136.6	249.227	26.528	90	831300	200270.6008	1.333333	208.429	244.025	254.965	274.619	277.784	-1.132994	47.2
107.578125	1116.984219	0.584967	311920000	24000000	2040000	3320000	840000	0	80000	0	0	0	0	0	0	0	0	0	768094112.4	10828155529	6.596464	21.095	49.996924	136.2	249.487	26.565	90	855500	215581.8903	1.333333	208.584	243.942	255.071	274.708	277.955	-1.164975	47.6
114.5625	1117.210888	0.584984	325840000	22320000	1920000	3320000	800000	40000	0	0	0	0	0	0	0	0	0	0	771549818.9	11599705347	6.618085	21.144	50.997305	136.155	249.458	26.543	90	885600	230931.7504	1.333333	208.502	244.081	255.01	274.666	277.796	-0.89275	47.6
121.546875	1114.050277	0.582934	248560000	21880000	1560000	2640000	880000	0	0	0	0	0	0	0	0	0	0	0	616082897.5	12215788245	6.598484	21.072	51.297878	135.961	249.451	26.552	90	688800	243186.1343	1.333333	208.712	244.103	255.103	274.739	277.978	-0.866513	47.6
128.53125	1111.170416	0.583377	284720000	23920000	1880000	3000000	640000	0	0	0	0	0	0	0	0	0	0	0	690692228.7	12906480474	6.603129	21.186	50.570652	136.09	249.474	26.53	90	785400	256963.5342	1.333333	208.591	244.071	255.1	274.749	277.863	-0.777138	47.6
135.53125	1115.776963	0.584656	294720000	23120000	2120000	3240000	400000	0	0	0	0	0	0	0	0	0	0	0	704458544.7	13610939018	6.602761	21.124	51.26088	135.955	249.451	26.497	90	809000	271051.9531	1.333333	208.698	244.135	255.212	274.81	278.051	-0.803375	47.6
142.5625	1114.913675	0.585066	332800000	26840000	2360000	3320000	800000	80000	0	0	0	0	0	0	0	0	0	0	815063157.3	14426002176	6.601764	21.127	51.275181	136.171	249.439	26.491	90	915500	287285.0492	1.333333	208.584	244.168	255.161	274.746	277.927	-0.990325	47.6
149.546875	1118.944214	0.581786	277800000	21720000	1920000	3600000	1240000	40000	0	0	0	0	0	0	0	0	0	0	692789447.8	15118791624	6.611237	21.088	51.512647	136.197	249.477	26.471	90	765800	301093.5811	1.333333	208.702	244.151	255.27	274.845	278.064	-0.597569	47.6
156.515625	1113.844413	0.581261	267440000	23080000	1840000	2600000	1080000	0	40000	0	0	0	0	0	0	0	0	0	668148977.2	15786940601	6.595047	21.065	50.870044	136.187	249.477	26.462	90	740200	314363.0139	1.333333	208.78	244.229	255.254	274.838	278.064	-0.88045	48
163.515625	1115.59488	0.586328	232680000	19200000	1400000	2720000	680000	80000	0	0	0	0	0	0	0	0	0	0	575077463.6	16362018064	6.632097	21.078	50.085613	136.264	249.43	26.444	90	641900	325836.3391	1.333333	208.653	244.29	255.325	274.826	277.911	-0.499994	48
170.546875	1114.349398	0.582507	314120000	27640000	2280000	4120000	960000	0	0	0	0	0	0	0	0	0	0	0	790617349.8	17152635414	6.595257	21.048	51.303913	136.188	249.483	26.441	90	872800	341585.1335	1.333333	208.737	244.238	255.303	274.929	278.05	-0.367987	48
177.53125	1116.258285	0.583016	220720000	18120000	1800000	2440000	1000000	0	0	0	0	0	0	0	0	0	0	0	549679916.1	17702315330	6.607826	21.108	51.208401	136.437	249.477	26.416	90	610200	352546.7846	1.333333	208.633	244.223	255.246	274.916	278.021	-0.305669	48
184.515625	1115.947252	0.585066	239400000	20960000	1560000	2640000	640000	0	40000	0	0	0	0	0	0	0	0	0	595103204.4	18297418535	6.60061	21.069	51.07235	136.35	249.49	26.439	90	663100	364393.9671	1.333333	208.78	244.33	255.326	274.926	278.107	-0.144119	48
191.5	1120.240153	0.583705	214960000	18680000	2280000	2880000	880000	80000	0	0	0	0	0	0	0	0	0	0	554029816.1	18851448351	6.609557	21.131	50.713001	136.537	249.47	26.429	90	599400	375426.5438	1.333333	208.731	244.123	255.269	274.993	278.043	-0.231031	48
198.484375	1117.853858	0.584311	216880000	17520000	1960000	2800000	720000	120000	40000	0	0	0	0	0	0	0	0	0	555976059.4	19407424410	6.625563	21.033	50.356011	136.488	249.409	26.419	90	600100	386455.45	1.333333	208.705	244.401	255.4	274.875	278.027	-0.440963	48
205.484375	1119.9788	0.585131	266320000	21880000	1640000	3040000	1480000	0	0	0	0	0	0	0	0	0	0	0	669841423.4	20077265834	6.63026	21.112	50.481307	136.595	249.454	26.422	90	735900	399771.4706	1.333333	208.771	244.159	255.403	274.983	278.072	-0.377006	48
212.515625	1116.150135	0.583573	315120000	28920000	2160000	3440000	1360000	120000	0	0	0	0	0	0	0	0	0	0	810078791.7	20887344625	6.642645	21.065	50.407965	136.506	249.385	26.437	90	877800	415844.7667	1.333333	208.736	244.424	255.472	274.904	277.996	-0.394225	48
219.5	1115.539623	0.582934	332200000	25920000	1840000	3720000	1200000	40000	0	0	0	0	0	0	0	0	0	0	811510442.7	21698855068	6.648024	21.137	50.805233	136.63	249.426	26.442	90	912300	432001.7019	1.333333	208.734	244.126	255.403	274.981	278.118	-0.27285	48
226.5	1116.990392	0.584295	304600000	24520000	2200000	3320000	1240000	0	0	0	0	0	0	0	0	0	0	0	752734704.2	22451589772	6.634196	21.149	50.362702	136.53	249.421	26.502	90	839700	446996.6313	1.333333	208.736	244.434	255.461	274.907	278.056	-0.365525	48
233.46875	1113.840641	0.583049	292840000	23720000	2160000	2880000	1000000	40000	0	0	0	0	0	0	0	0	0	0	717115195.1	23168704967	6.642304	21.142	50.726645	136.569	249.437	26.541	90	806600	461263.4445	1.333333	208.762	244.166	255.39	274.984	278.132	-0.343388	48
240.453125	1115.107597	0.582179	337560000	24040000	2040000	3960000	1160000	0	0	0	0	0	0	0	0	0	0	0	812248816.1	23980953783	6.632018	21.188	51.602916	136.585	249.443	26.522	90	921900	477468.6116	1.333333	208.622	244.237	255.297	274.894	278.008	-0.554113	48
247.484375	1115.171027	0.582983	325520000	23480000	2280000	2920000	1160000	40000	0	0	0	0	0	0	0	0	0	0	786885802.6	24767839586	6.604283	21.129	51.191608	136.543	249.418	26.538	90	888500	493149.9245	1.333333	208.785	244.295	255.374	274.984	278.085	-0.598388	48
254.484375	1114.317091	0.584098	343720000	26160000	2040000	3360000	1360000	0	0	0	0	0	0	0	0	0	0	0	833483972.2	25601323558	6.630155	21.152	50.251446	136.608	249.385	26.547	90	941600	509758.9159	1.333333	208.703	244.398	255.39	274.856	277.916	-0.558213	47.6
261.484375	1116.425594	0.586	410520000	27840000	2200000	3920000	1600000	80000	0	0	0	0	0	0	0	0	0	0	981687748.9	26583011307	6.596306	21.162	49.375966	136.305	249.556	26.551	90	1115400	529336.183	1.333333	208.772	244.14	255.426	274.958	278.059	-0.764019	47.2
268.46875	1112.760669	0.581868	396760000	27560000	1720000	3440000	1400000	0	0	0	0	0	0	0	0	0	0	0	935221271.5	27518232579	6.594365	21.129	50.040613	135.934	249.637	26.564	90	1077200	547951.5704	1.333333	208.854	244.427	255.439	274.92	278.008	-0.671363	47.2
275.453125	1116.182824	0.581146	406240000	27840000	2160000	3920000	1840000	0	0	0	0	0	0	0	0	0	0	0	970108984.7	28488341563	6.646634	21.185	50.29566	136.082	249.66	26.531	90	1105000	567324.9883	1.333333	208.808	244.208	255.445	274.99	278.046	-0.761563	47.2

282.4375	1115.650113	0.585082	350760000	25240000	2160000	3880000	1080000	40000	0	0	0	0	0	0	0	0	0	0	844397521.6	29332739085	6.634905	21.138	50.153705	135.98	249.674	26.503	90	957900	584136.2032	1.333333	208.849	244.493	255.511	274.935	278.043	-0.780419	47.6
289.4375	1115.56452	0.583951	303240000	23560000	1600000	2960000	760000	80000	0	0	0	0	0	0	0	0	0	0	731157968.1	30063897053	6.614622	21.183	50.352075	136.219	249.714	26.489	90	830500	598699.8685	1.333333	208.831	244.192	255.402	275.054	278.072	-0.664806	47.6
296.421875	1116.582088	0.579408	312040000	25560000	1560000	3320000	800000	0	40000	0	0	0	0	0	0	0	0	0	759529689.7	30823426743	6.61289	21.107	50.302351	136.155	249.698	26.476	90	858300	613829.8205	1.333333	208.864	244.509	255.553	275.017	278.054	-0.408163	47.6
303.46875	1116.909213	0.58459	311120000	24720000	2160000	2640000	1360000	40000	0	0	0	0	0	0	0	0	0	0	768911264.7	31592338007	6.616852	21.162	51.294729	136.406	249.695	26.443	90	855100	629132.6962	1.333333	208.678	244.328	255.392	275.017	278.102	-0.485238	47.6
310.453125	1114.634214	0.582967	305600000	23200000	2120000	2960000	800000	80000	40000	0	0	0	0	0	0	0	0	0	744460000.5	32336798008	6.634852	21.123	50.850102	136.329	249.698	26.427	90	837000	643944.6034	1.333333	208.802	244.257	255.492	275.09	278.214	-0.427019	47.6
317.4375	1116.966164	0.584508	375760000	29600000	2000000	3920000	1200000	0	40000	0	0	0	0	0	0	0	0	0	913183247.4	33249981255	6.604546	21.149	51.083633	136.425	249.698	26.427	90	1031300	662150.5411	1.333333	208.7	244.335	255.408	275.039	278.044	-0.1433	47.6
324.421875	1116.497734	0.586066	330520000	25320000	2120000	4040000	1040000	120000	0	0	0	0	0	0	0	0	0	0	814118892.9	34064100148	6.599586	21.135	50.371492	136.214	249.696	26.42	90	907900	678347.5679	1.333333	208.859	244.458	255.522	275.097	278.179	-0.173638	47.6
331.4375	1118.601839	0.583475	275160000	22600000	1280000	2520000	840000	0	0	0	0	0	0	0	0	0	0	0	665991932	34730092080	6.629473	21.106	50.724546	136.375	249.69	26.429	90	756000	691603.1441	1.333333	208.82	244.274	255.512	275.132	278.243	-0.280231	47.6
338.4375	1118.894033	0.583951	276720000	21680000	1880000	2800000	1160000	0	0	0	0	0	0	0	0	0	0	0	680423873.7	35410515954	6.640126	21.142	50.088368	136.387	249.659	26.467	90	760600	705120.4923	1.333333	208.775	244.531	255.549	275.034	278.119	-0.203975	47.6
345.421875	1115.657391	0.586	293520000	22040000	2200000	2680000	880000	40000	0	0	0	0	0	0	0	0	0	0	709132298.3	36119648252	6.602919	21.24	50.846691	136.656	249.673	26.488	90	803400	719204.4851	1.333333	208.842	244.263	255.475	275.118	278.153	-0.177738	47.2
352.421875	1116.270689	0.585918	298120000	22400000	2360000	3080000	1000000	40000	0	0	0	0	0	0	0	0	0	0	727401108.8	36847049361	6.605674	21.173	51.885515	136.729	249.648	26.513	90	817500	733693.2244	1.333333	208.806	244.374	255.501	275.129	278.294	-0.1679	47.2
359.421875	1112.98641	0.581048	447720000	32680000	2400000	3680000	1240000	40000	0	0	0	0	0	0	0	0	0	0	1060854590	37907903951	6.583895	21.19	49.172086	136.458	249.774	26.517	90	1219400	754812.2474	1.333333	208.797	244.564	255.575	275.008	278.153	-0.131	47.2
366.40625	1114.140451	0.583409	336280000	24640000	2120000	3200000	1000000	80000	40000	0	0	0	0	0	0	0	0	0	811652679	38719556630	6.608403	21.222	50.191489	136.242	249.913	26.497	90	918400	771017.9495	1.333333	208.846	244.29	255.485	275.161	278.185	-0.165438	47.2
373.40625	1117.42727	0.584902	329400000	24920000	1680000	2960000	1040000	40000	0	0	0	0	0	0	0	0	0	0	788658465.1	39508215095	6.620735	21.196	51.553324	136.203	249.868	26.468	90	900100	786748.2317	1.333333	208.78	244.355	255.533	275.148	278.243	-0.207256	47.2
380.40625	1113.213883	0.581458	316600000	24800000	2480000	3360000	760000	0	0	0	0	0	0	0	0	0	0	0	768952883	40277167978	6.631599	21.167	50.177714	136.074	249.803	26.471	90	870000	802040.3606	1.333333	208.8	244.558	255.62	275.078	278.188	-0.201519	47.2
387.390625	1118.282669	0.585131	348400000	23840000	2520000	4040000	800000	80000	0	0	0	0	0	0	0	0	0	0	832805766	41109973744	6.619004	21.212	51.269014	136.181	249.801	26.466	90	949200	818665.0138	1.333333	208.719	244.339	255.448	275.118	278.2	-0.306488	47.6
394.375	1118.258257	0.58523	312200000	23800000	1880000	3320000	1080000	120000	0	0	0	0	0	0	0	0	0	0	765459001.3	41875432745	6.620893	21.148	51.601079	136.147	249.764	26.462	90	856000	833876.0159	1.333333	208.787	244.374	255.561	275.216	278.387	-0.340925	47.6
401.375	1115.642003	0.579474	298760000	23480000	1480000	3120000	920000	0	0	0	0	0	0	0	0	0	0	0	723332473.4	42598765219	6.655266	21.157	49.965568	136.263	249.793	26.451	90	819400	848250.2044	1.333333	208.735	244.52	255.58	275.117	278.171	-0.431938	47.6
408.375	1117.689522	0.580572	326560000	25840000	1640000	3680000	1080000	80000	0	0	0	0	0	0	0	0	0	0	799992348.5	43398757567	6.659543	21.19	50.531293	136.285	249.793	26.461	90	897200	864185.0721	1.333333	208.784	244.227	255.589	275.213	278.346	-0.712363	47.2
415.375	1116.70107	0.582458	267600000	22440000	1560000	2480000	1440000	40000	40000	0	0	0	0	0	0	0	0	0	675299914.9	44074057482	6.616143	21.128	51.596619	136.279	249.703	26.461	90	739000	877611.5779	1.333333	208.797	244.427	255.512	275.175	278.413	-0.768119	47.2
422.359375	1116.505562	0.582409	343600000	25440000	2280000	3440000	1240000	0	0	0	0	0	0	0	0	0	0	0	829553988.1	44903611470	6.616721	21.21	51.421859	136.392	249.745	26.448	90	940000	894119.6064	1.333333	208.643	244.385	255.474	275.146	278.238	-0.736963	47.2
429.34375	1116.306851	0.586197	335120000	26800000	1840000	4000000	1480000	0	0	0	0	0	0	0	0	0	0	0	827950416	45731561886	6.636768	21.166	52.096873	136.351	249.659	26.476	90	923100	910598.609	1.333333	208.694	244.398	255.578	275.182	278.455	-0.781238	47.2
436.328125	1116.034696	0.583426	337240000	27440000	2360000	3680000	1160000	40000	0	0	0	0	0	0	0	0	0	0	830538232.1	46562100118	6.631677	21.163	51.806009	136.528	249.591	26.492	90	929800	927132.0605	1.333333	208.625	244.318	255.43	275.131	278.241	-0.764838	47.2
443.328125	1115.96631	0.582425	299440000	23160000	1920000	3520000	1280000	160000	0	0	0	0	0	0	0	0	0	0	749362449.1	47311462567	6.656132	21.184	50.454408	136.704	249.582	26.459	90	823700	942053.1906	1.333333	208.737	244.247	255.556	275.182	278.398	-0.794356	47.2
450.328125	1117.792766	0.584131	282440000	23360000	2080000	3040000	1440000	40000	40000	0	0	0	0	0	0	0	0	0	716369726.8	48027832294	6.639024	21.181	50.633233	136.696	249.52	26.48	90	781100	956318.2514	1.333333	208.683	244.511	255.583	275.068	278.249	-0.743519	47.2
457.359375	1115.768369	0.583737	324640000	25800000	2200000	3680000	720000	0	0	0	0	0	0	0	0	0	0	0	792226765.7	48820059060	6.604414	21.253	49.556102	136.692	249.625	26.497	90	892600	972068.0753	1.333333	208.727	244.267	255.453	275.152	278.301	-0.754181	47.2
464.359375	1117.980812	0.584311	315920000	23160000	1880000	2280000	880000	0	0	0	0	0	0	0	0	0	0	0	744852497	49564911557	6.605202	21.214	49.90115	136.305	249.776	26.541	90	860300	986902.9444	1.333333	208.73	244.53	255.564	275.063	278.305	-0.745163	46.8
471.34375	1117.609289	0.581228	357440000	26920000	1920000	3600000	880000	0	0	0	0	0	0	0	0	0	0	0	852755460.5	50417667017	6.608429	21.27	50.335937	136.43	249.789	26.502	90	976900	1003853.254	1.333333	208.759	244.208	255.467	275.156	278.321	-0.745981	46.4
478.328125	1114.801192	0.58254	345520000	26680000	2440000	4000000	1440000	40000	40000	0	0	0	0	0	0	0	0	0	860258699.3	51277925717	6.609584	21.195	50.473694	136.337	249.727	26.505	90	950400	1020958.391	1.333333	208.792	244.414	255.516	275.121	278.41	-0.731219	46.4
485.328125	1117.102193	0.584902	292640000	22600000	1840000	2120000	1000000	0	0	0	0	0	0	0	0	0	0	0	699611312.6	51977537029	6.610869	21.25	50.973165	136.534	249.753	26.502	90	800500	1034904.302	1.333333	208.651	244.331	255.429	275.114	278.209	-0.757463	46.4
492.3125	1115.659203	0.584213	322440000	24840000	2000000	3880000	920000	80000	40000	0	0	0	0	0	0	0	0	0	794896149.9	52772433179	6.606514	21.172	50.281097	136.414	249.724	26.489	90	885500	1050716.964	1.333333	208.792	244.489	255.564	275.099	278.35	-0.609869	46.4
499.296875	1114.774577	0.583934	330480000	28040000	2520000	3040000	1240000	0	0	0	0	0	0	0	0	0	0	0	813521591.2	53585954770	6.601423	21.226	50.640055	136.557	249.738	26.476	90	913300	1066921.068	1.333333	208.735	244.265	255.441	275.17	278.312	-0.7058	46.8
506.296875	1117.359955	0.580786	301400000	23600000	2480000	3720000	880000	160000	0	0	0	0	0	0	0	0	0	0	751727488.3	54337682258	6.610764	21.156	51.562639	136.506	249.708	26.483	90	830600	1081906.21	1.333333	208.714	244.34	255.533	275.169	278.455	-0.690225	46.8
513.328125	1116.516821	0.581983	341120000	26480000	2560000	3440000	1240000	120000	0	0	0	0	0	0	0	0	0	0	846213639.9	55183895898	6.599035	21.254	51.085601	136.577	249.724	26.44	90	937400	1098735.833	1.333333	208.697	244.28	255.447	275.18	278.303	-0.745981	47.2
520.3125	1114.990444	0.581769	286040000	22520000	1840000	3160000	720000	0	0	40000	0	0	0	0	0	0	0	0	703037611.4	55886933510	6.599691	21.202	51.034565	136.471	249.679	26.443	90	785800	1112728.509	1.333333	208.772	244.444	255.54	275.167	278.437	-0.770581	47.2
527.296875	1114.200233	0.583393	310880000	24480000	2240000	4000000	1200000	40000	0	0	0	0	0	0	0	0	0	0	771848156.9	56658781667	6.6491	21.211	50.667476	136.69	249.659	26.43	90	857100	1128111.763	1.333333	208.74	244.283	255.549	275.196	278.383	-0.772219	46.8
534.28125	1113.30607	0.579178	278080000	20360000	1960000	3600000	1000000	80000	40000	0	0	0	0	0	0	0	0	0	690382149.2	57349163816	6.618872	21.169	51.066052	136.696	249.575	26.417	90	762800	1141881.125	1.333333	208.782	244.519	255.533	275.151	278.36	-0.7796	46.8
541.28125	1117.223132	0.585016	352320000	26560000	2480000	3960000	1520000	0	40000	0	0	0	0	0	0	0	0	0	869860717	58219024533	6.626849	21.269	50.794212	136.918	249.577	26.436	90	967200	1159244.039	1.333333	208.748	244.258	255.48	275.18	278.361	-0.827975	46.4
548.265625	1113.877171	0.582983	340080000	24200000	1880000	3120000	920000	40000	0	0	0	0	0	0	0	0	0	0	806285625.7	59025310159	6.620421	21.174	50.664064	136.944	249.512	26.442	90	925600	1175281.532	1.333333	208.774	244.429	255.48	275.11	278.371	-0.789438	46.4
555.296875	1116.499676	0.581327	313360000	23720000	2160000	2920000	1200000	0	40000	0	0	0	0	0	0	0	0	0	767812728.4	59793122887	6.644797	21.244	50.75564	137.091	249.504	26.459	90	858500	1190599.653	1.333333	208.75	244.225	255.495	275.141	278.354	-0.86405	46.8
562.296875	1108.368473	0.579096	344280000	25600000	2120000	3080000	1200000	0	0	0	0	0	0	0	0	0	0	0	826825647.5	60619948534	6.623595	21.201	49.234667	137.059	249.527	26.483	90	940700	1207056.356	1.333333	208.71	244.512	255.536	275.018	278.253	-0.902588	46.8
569.28125	1112.066633	0.582475	302560000	23040000	2040000	2680000	600000	0	0	0	0	0	0	0	0	0	0	0	712732512.4	61332681047	6.590534	21.284	49.197669	136.742	249.878	26.567	90	827300	1221346.279	1.333333	208.808	244.22	255.574	275.131	278.373	-0.833713	47.2
576.265625	1114.704602	0.582491	296400000	20360000	1680000	3240000	1080000	40000	40000	0	0	0	0	0	0	0	0	0	715303776.2	62047984823	6.564032	21.209	48.998118	136.39	250.039	26.604	90	807100	1235640.062	1.333333	208.878	244.555	255.556	275.119	278.345	-0.828794	47.2

583.25	1116.159293	0.584656	347360000	25520000	1960000	3440000	1120000	120000	0	0	0	0	0	0	0	0	0	0	837955009.8	62885939833	6.562877	21.269	49.60189	136.302	250.238	26.575	90	948800	1252345.136	1.333333	208.838	244.386	255.504	275.198	278.328	-0.938669	47.2
590.234375	1114.710907	0.584524	373440000	26680000	2000000	3600000	1200000	0	0	0	0	0	0	0	0	0	0	0	887857416.1	63773797249	6.603417	21.229	50.669837	136.329	250.087	26.617	90	1017300	1270021.972	1.333333	208.931	244.584	255.594	275.183	278.482	-0.850113	47.2
597.21875	1119.068809	0.583787	286520000	23920000	2200000	3160000	920000	0	0	0	0	0	0	0	0	0	0	0	705455197.2	64479252446	6.6348	21.304	50.309567	136.616	250.055	26.601	90	791800	1284085.513	1.333333	208.901	244.374	255.658	275.279	278.457	-0.894394	47.2
604.265625	1115.985757	0.581622	340000000	25920000	2200000	3280000	1360000	80000	0	0	0	0	0	0	0	0	0	0	839994780.4	65319247227	6.612837	21.209	50.437746	136.59	250.006	26.598	90	932100	1300765.944	1.333333	208.976	244.606	255.697	275.257	278.527	-0.873894	47.6
611.25	1116.201842	0.582147	303480000	22920000	1920000	2680000	920000	0	40000	0	0	0	0	0	0	0	0	0	731221080.7	66050468307	6.612654	21.3	50.521847	136.729	250.004	26.589	90	829900	1315326.486	1.333333	208.935	244.388	255.628	275.31	278.532	-0.919813	47.6
618.25	1113.78125	0.578752	315880000	23360000	1600000	3360000	720000	40000	0	0	0	0	0	0	0	0	0	0	754791737.1	66805260044	6.612391	21.241	51.580481	136.761	249.97	26.532	90	862400	1330353.472	1.333333	208.903	244.454	255.739	275.338	278.653	-0.955888	47.6
625.234375	1117.137068	0.585525	331320000	25560000	2200000	3800000	1400000	80000	80000	0	0	0	0	0	0	0	0	0	829873297.2	67635133342	6.614333	21.266	51.557653	136.973	249.98	26.526	90	911100	1346911.148	1.333333	208.797	244.51	255.683	275.311	278.511	-0.88865	47.6
632.21875	1116.243494	0.58336	316360000	25440000	1960000	3920000	1240000	120000	0	0	0	0	0	0	0	0	0	0	790684084.7	68425817426	6.618426	21.242	51.881185	137.012	249.903	26.555	90	872600	1362639.529	1.333333	208.882	244.511	255.734	275.382	278.688	-0.864875	47.6
639.203125	1112.767296	0.582704	317120000	25600000	2160000	3960000	1200000	80000	40000	0	0	0	0	0	0	0	0	0	796622135.5	69222439562	6.597251	21.291	51.2883	137.262	249.883	26.539	90	875400	1378498.716	1.333333	208.918	244.478	255.66	275.331	278.522	-0.832894	47.6
646.234375	1121.0134	0.584016	281600000	21760000	1680000	3480000	600000	120000	0	0	0	40000	0	0	0	0	0	0	719419974.4	69941859536	6.59279	21.213	50.844198	137.077	249.848	26.529	90	773200	1392865.7	1.333333	208.987	244.607	255.724	275.36	278.633	-0.821419	47.6
653.21875	1111.91387	0.583524	311040000	22120000	1880000	3360000	960000	80000	0	0	0	0	0	0	0	0	0	0	752751171.8	70694610708	6.599272	21.269	50.848528	137.142	249.832	26.535	90	848600	1407787.738	1.333333	208.944	244.423	255.686	275.389	278.515	-0.867331	47.6
660.21875	1117.728055	0.584246	384560000	27840000	2280000	4320000	1440000	40000	0	0	0	0	0	0	0	0	0	0	930716982.4	71625327690	6.609505	21.203	50.533523	136.882	249.745	26.558	90	1051200	1426388.638	1.333333	208.964	244.688	255.814	275.309	278.566	-0.918169	47.6
667.203125	1113.10223	0.582589	410480000	29520000	2280000	3480000	1520000	40000	80000	0	40000	0	0	0	0	0	0	0	1014619777	72639947468	6.595099	21.275	50.939841	136.876	249.793	26.519	90	1118600	1446560.903	1.333333	208.964	244.433	255.65	275.366	278.49	-0.943588	47.6
674.1875	1114.247794	0.582868	396760000	29440000	2120000	4200000	1240000	80000	0	0	0	0	0	0	0	0	0	0	954275206.1	73594222674	6.597618	21.197	50.998355	136.691	249.751	26.523	90	1084600	1465612.267	1.333333	208.954	244.601	255.683	275.35	278.579	-0.985406	47.2
681.1875	1117.752706	0.583245	445240000	30000000	2840000	3640000	1400000	0	0	40000	0	0	0	0	0	0	0	0	1058155151	74652377825	6.608088	21.275	50.810874	136.695	249.738	26.51	90	1207900	1486715.795	1.333333	208.924	244.414	255.631	275.376	278.528	-1.078881	47.2
688.21875	1117.560612	0.583327	430520000	29680000	2680000	4000000	1320000	40000	40000	0	0	0	0	0	0	0	0	0	1035947498	75688325323	6.612916	21.174	50.191489	136.414	249.748	26.532	90	1170700	1507311.634	1.333333	208.996	244.572	255.692	275.325	278.509	-1.092819	47.2
695.203125	1115.724408	0.584754	406560000	29160000	2000000	3880000	1200000	0	0	0	0	0	0	0	0	0	0	0	963868173.6	76652193497	6.622992	21.274	50.503086	136.448	249.765	26.525	90	1107000	1526477.747	1.333333	208.939	244.411	255.617	275.351	278.5	-1.187931	47.6
702.203125	1113.165887	0.580261	367400000	27360000	1920000	3440000	1160000	40000	40000	0	0	0	0	0	0	0	0	0	886633064.4	77538826562	6.622284	21.232	51.464105	136.311	249.742	26.559	90	1003400	1544137.087	1.333333	208.927	244.526	255.663	275.336	278.504	-1.045263	47.6
709.1875	1116.016069	0.584738	345840000	25680000	2080000	3280000	1280000	80000	0	0	0	0	0	0	0	0	0	0	834929789.7	78373756351	6.623359	21.358	50.994288	136.34	249.743	26.648	90	945600	1560804.859	1.333333	208.877	244.476	255.618	275.328	278.417	-1.179731	47.2
716.1875	1114.669801	0.584688	329600000	23480000	1920000	3120000	1000000	0	0	0	0	0	0	0	0	0	0	0	784269111.5	79158025463	6.623307	21.319	51.858094	136.372	249.731	26.661	90	897800	1576421.303	1.333333	208.896	244.421	255.692	275.319	278.567	-1.27075	47.6
723.171875	1114.024509	0.582343	361480000	24600000	2120000	3120000	1240000	120000	40000	0	0	0	0	0	0	0	0	0	866338352.3	80024363815	6.645584	21.293	50.207364	136.44	249.698	26.657	90	981800	1593692.753	1.333333	208.847	244.611	255.67	275.207	278.391	-1.387181	47.6
730.171875	1116.658873	0.582819	372280000	26800000	2480000	3960000	1040000	80000	0	0	0	0	0	0	0	0	0	0	896401542.8	80920765358	6.653141	21.357	50.518304	136.479	249.686	26.675	90	1016600	1611573.899	1.333333	208.904	244.318	255.693	275.297	278.494	-1.432275	47.6
737.15625	1117.812202	0.581851	311200000	23600000	2160000	3080000	1000000	40000	40000	0	40000	0	0	0	0	0	0	0	781751283.2	81702516641	6.646712	21.252	50.022245	136.47	249.642	26.647	90	852900	1627131.247	1.333333	208.787	244.565	255.656	275.199	278.373	-1.422438	47.6
744.140625	1114.332019	0.583459	344600000	25400000	2640000	4520000	1000000	0	0	0	0	0	0	0	0	0	0	0	841743970.7	82544260612	6.642357	21.3	50.697913	136.451	249.688	26.622	90	945400	1643865.204	1.333333	208.874	244.286	255.681	275.316	278.548	-1.455238	47.6
751.140625	1115.045587	0.581638	306040000	23680000	2400000	3480000	1280000	80000	0	0	0	0	0	0	0	0	0	0	760800346.4	83305060958	6.644718	21.28	50.578918	136.548	249.572	26.621	90	842400	1659037.23	1.333333	208.789	244.602	255.655	275.199	278.418	-1.50115	47.6
758.171875	1118.497527	0.583131	314000000	22240000	2800000	3280000	1200000	80000	0	40000	0	0	0	0	0	0	0	0	783561727.6	84088622686	6.644456	21.313	50.710377	136.819	249.556	26.608	90	859100	1674653.168	1.333333	208.825	244.264	255.607	275.266	278.504	-1.50525	47.6
765.15625	1115.203899	0.58031	333840000	26200000	2440000	3800000	1040000	120000	0	0	0	0	0	0	0	0	0	0	825190298.8	84913812985	6.632491	21.251	50.293167	136.796	249.521	26.599	90	918600	1691047.985	1.333333	208.763	244.457	255.591	275.148	278.31	-1.474094	48
772.140625	1114.904692	0.583163	411320000	28840000	1800000	3680000	1520000	160000	0	0	0	0	0	0	0	0	0	0	983554278.3	85897367263	6.625905	21.303	50.276505	136.799	249.537	26.586	90	1118300	1710646.878	1.333333	208.812	244.238	255.562	275.231	278.45	-1.467538	48
779.140625	1112.813845	0.582245	312280000	22360000	2080000	3840000	1320000	80000	0	0	0	0	0	0	0	0	0	0	769201579.7	86666568843	6.533725	21.254	49.439336	136.309	249.769	26.56	90	854900	1725978.564	1.333333	208.828	244.454	255.543	275.189	278.402	-1.464256	48
786.125	1115.720313	0.581901	328040000	23240000	1720000	3400000	960000	40000	0	0	0	0	0	0	0	0	0	0	779621054.4	87446189897	6.539577	21.306	50.1335	136.181	249.953	26.556	90	893500	1741547.126	1.333333	208.655	244.341	255.437	275.145	278.383	-1.440475	48
793.125	1113.616131	0.580605	333680000	25720000	1800000	3240000	1200000	120000	0	0	0	0	0	0	0	0	0	0	814532562.9	88260722460	6.587962	21.283	50.497969	135.871	250.104	26.579	90	914400	1757770.479	1.333333	208.789	244.267	255.549	275.272	278.488	-1.417519	47.6
800.109375	1115.488753	0.579884	353880000	26240000	2280000	3880000	1320000	40000	0	0	0	0	0	0	0	0	0	0	859123214.6	89119845674	6.617009	21.267	50.497969	135.887	249.94	26.547	90	969100	1774914.292	1.333333	208.714	244.525	255.607	275.189	278.348	-1.430638	47.6
807.09375	1114.851295	0.58195	313000000	25360000	1680000	3560000	1160000	40000	0	0	0	0	0	0	0	0	0	0	769244756.4	89889090431	6.623044	21.28	50.127465	135.942	249.969	26.566	90	862000	1790238.81	1.333333	208.822	244.27	255.639	275.291	278.53	-1.470813	47.6
814.09375	1113.334655	0.580917	329840000	25200000	2040000	3480000	1280000	120000	0	0	0	0	0	0	0	0	0	0	811201961.8	90700292393	6.629893	21.244	50.264041	135.936	249.891	26.576	90	904900	1806408.42	1.333333	208.763	244.577	255.668	275.212	278.469	-1.480656	47.6
821.125	1114.12297	0.582491	309920000	25320000	1920000	2880000	1120000	80000	0	0	0	0	0	0	0	0	0	0	763172252.6	91463464645	6.626482	21.341	50.605419	136.047	249.922	26.597	90	853100	1821641.381	1.333333	208.784	244.242	255.647	275.321	278.581	-1.469175	47.6
828.109375	1114.484746	0.583819	307040000	25600000	1600000	3320000	1040000	80000	0	0	0	0	0	0	0	0	0	0	754949196.1	92218413841	6.629316	21.244	50.371885	136.084	249.888	26.573	90	846700	1836699.547	1.333333	208.746	244.551	255.697	275.218	278.44	-1.506894	47.2
835.109375	1111.931358	0.584065	328640000	23360000	2120000	2960000	1040000	80000	0	0	0	0	0	0	0	0	0	0	787175669.9	93005589511	6.643065	21.323	50.687942	136.383	249.858	26.583	90	895500	1852395.404	1.333333	208.742	244.256	255.689	275.337	278.562	-1.530669	47.2
842.09375	1112.159475	0.579031	325240000	25400000	2320000	3320000	880000	120000	0	0	0	0	0	0	0	0	0	0	790991057.8	93796580569	6.65768	21.327	50.423708	136.571	249.717	26.628	90	893200	1868203.555	1.333333	208.739	244.52	255.66	275.221	278.501	-1.496231	47.2
849.078125	1114.557837	0.581687	333040000	25360000	2320000	3760000	960000	0	40000	0	0	0	0	0	0	0	0	0	809900653.1	94606481222	6.65999	21.393	50.647271	136.705	249.697	26.642	90	913700	1884386.299	1.333333	208.757	244.239	255.678	275.319	278.576	-1.501975	47.2
856.078125	1111.611512	0.580671	341560000	26840000	2440000	3920000	680000	200000	0	0	0	0	0	0	0	0	0	0	839502546.5	95445983769	6.645191	21.352	51.232279	136.758	249.615	26.626	90	939100	1901124.427	1.333333	208.629	244.425	255.598	275.239	278.388	-1.50525	47.2
863.0625	1113.146413	0.579982	300800000	24480000	1560000	3360000	840000	40000	0	0	0	0	0	0	0	0	0	0	729730014.2	96175713783	6.655949	21.37	50.87398	136.701	249.606	26.639	90	827700	1915712.458	1.333333	208.751	244.22	255.654	275.322	278.573	-1.531494	47.2
870.0625	1114.914409	0.578686	349720000	27840000	2600000	3080000	1240000	80000	40000	40000	0	0	0	0	0	0	0	0	871647402.2	97047361185	6.643065	21.337	50.749736	136.653	249.493	26.639	90	961600	1933113.531	1.333333	208.719	244.53	255.654	275.204	278.525	-1.578225	47.2
877.0625	1110.973554	0.582261	284280000	23800000	2160000	2920000	680000	80000	80000	0	0	0	0	0	0	0	0	0	711272684.9	97758633870	6.63459	21.324	51.906637	136.83	249.477	26.675	90	785000	1947290.458	1.333333	208.594	244.378	255.487	275.197	278.394	-1.519194	47.2

884.0625	1111.434033	0.581737	269840000	22280000	1720000	3280000	1280000	80000	0	0	0	0	0	0	0	0	0	0	678068088.4	98436701958	6.604283	21.331	49.505984	136.627	249.577	26.681	90	746200	1960853.499	1.333333	208.699	244.195	255.545	275.287	278.509	-1.498694	47.2
891.046875	1109.346362	0.581146	307600000	23840000	2120000	2480000	880000	40000	0	0	0	0	0	0	0	0	0	0	735029486.4	99171731445	6.590717	21.363	49.317583	136.114	249.748	26.675	90	842400	1975549.817	1.333333	208.712	244.469	255.574	275.172	278.394	-1.493775	47.2
898.046875	1115.024879	0.582196	300040000	22880000	1840000	3560000	880000	0	40000	0	0	0	0	0	0	0	0	0	730343522.8	99902074968	6.62824	21.416	50.447717	136.095	249.764	26.681	90	823100	1990179.924	1.333333	208.768	244.175	255.567	275.268	278.477	-1.53805	47.2
905.078125	1115.277978	0.583672	331920000	25560000	1720000	3080000	1120000	40000	0	0	0	0	0	0	0	0	0	0	803850967.2	1.00706E+11	6.630155	21.311	50.325048	135.931	249.68	26.678	90	908600	2006200.513	1.333333	208.705	244.495	255.641	275.14	278.413	-1.543788	47.6
912.0625	1112.802463	0.583163	287360000	23920000	1880000	3000000	1160000	0	0	0	0	0	0	0	0	0	0	0	708423006.4	1.01414E+11	6.64582	21.347	50.312322	136.063	249.7	26.678	90	793300	2020316.037	1.333333	208.738	244.159	255.593	275.236	278.499	-1.527394	47.6
919.046875	1115.349217	0.583196	345920000	26120000	2080000	3400000	1320000	0	0	0	0	0	0	0	0	0	0	0	833572334.9	1.02248E+11	6.628319	21.324	50.411507	135.979	249.671	26.665	90	947100	2036962.145	1.333333	208.696	244.495	255.615	275.165	278.365	-1.556088	47.6
926.03125	1112.871506	0.581491	344160000	28200000	2040000	3920000	1160000	0	40000	0	0	0	0	0	0	0	0	0	849084006.4	1.03097E+11	6.638211	21.367	50.316651	136.137	249.696	26.678	90	948800	2053879.298	1.333333	208.689	244.091	255.57	275.255	278.509	-1.561831	47.6
933.03125	1119.032425	0.584147	324360000	26440000	2440000	3240000	1360000	0	0	0	0	0	0	0	0	0	0	0	799490085.8	1.03896E+11	6.632963	21.311	50.242919	136.221	249.638	26.633	90	894600	2069843.806	1.333333	208.66	244.433	255.57	275.124	278.356	-1.526569	47.2
940.015625	1113.335504	0.580622	253480000	22320000	1960000	3080000	1080000	40000	0	0	0	0	0	0	0	0	0	0	643878729	1.0454E+11	6.639418	21.377	50.600696	136.321	249.671	26.629	90	704900	2082630.224	1.333333	208.676	244.127	255.554	275.213	278.445	-1.53805	47.2
947.046875	1112.363932	0.580408	282560000	23560000	2360000	3240000	1120000	0	0	0	0	0	0	0	0	0	0	0	707397326	1.05248E+11	6.632386	21.324	51.044536	136.469	249.564	26.636	90	782100	2096749.904	1.333333	208.558	244.288	255.493	275.127	278.318	-1.572488	47.2
954.046875	1116.173272	0.580671	283760000	24160000	1960000	4080000	1280000	120000	0	0	0	0	0	0	0	0	0	0	726431716.5	1.05974E+11	6.641045	21.344	50.941153	136.556	249.541	26.616	90	788400	2111262.175	1.333333	208.617	244.13	255.513	275.226	278.48	-1.555269	47.6
961.03125	1116.418384	0.58072	332160000	26560000	2600000	3880000	1360000	0	0	0	0	0	0	0	0	0	0	0	823526563.6	1.06798E+11	6.637712	21.357	50.371492	136.714	249.474	26.623	90	916400	2127658.008	1.333333	208.545	244.346	255.455	275.073	278.289	-1.52165	47.6
968.03125	1114.480871	0.581687	260320000	20960000	2000000	3160000	1240000	0	0	0	0	0	0	0	0	0	0	0	652734078.8	1.0745E+11	6.6348	21.41	50.786734	136.816	249.484	26.69	90	719200	2140650.629	1.333333	208.625	244.082	255.484	275.187	278.415	-1.54215	47.6
975.015625	1118.39494	0.583196	284920000	21520000	2120000	2960000	1120000	40000	80000	0	0	0	0	0	0	0	0	0	708317799.2	1.08159E+11	6.635823	21.399	50.752754	136.825	249.422	26.684	90	781900	2154774.152	1.333333	208.61	244.38	255.499	275.079	278.34	-1.532313	47.6
982.015625	1116.112027	0.581032	315000000	24040000	2160000	3720000	960000	40000	0	0	0	0	0	0	0	0	0	0	772123008.4	1.08931E+11	6.632281	21.476	50.764168	136.931	249.464	26.682	90	864800	2170116.039	1.333333	208.663	244.072	255.494	275.194	278.371	-1.497875	47.6
989	1115.012327	0.587394	365720000	25080000	1880000	3680000	1120000	80000	40000	0	0	0	0	0	0	0	0	0	876113014.2	1.09807E+11	6.644666	21.367	50.736485	136.947	249.409	26.655	90	994000	2187559.788	1.333333	208.588	244.388	255.513	275.051	278.286	-1.523294	47.6
995.984375	1118.707941	0.584688	339440000	25360000	1800000	2920000	1480000	80000	0	0	0	0	0	0	0	0	0	0	821392352.7	1.10628E+11	6.651934	21.437	50.730188	137.017	249.456	26.634	90	927700	2203930.157	1.333333	208.619	244.025	255.469	275.17	278.354	-1.49705	47.6
1002.96875	1114.751951	0.583131	339200000	26440000	1800000	3720000	1120000	40000	0	0	0	0	0	0	0	0	0	0	826314449.9	1.11455E+11	6.658258	21.395	50.330034	137.105	249.404	26.654	90	930800	2220344.221	1.333333	208.567	244.345	255.431	275.033	278.182	-1.522469	47.6
1010.015625	1111.327036	0.581556	322360000	23040000	2080000	3160000	840000	40000	0	0	0	0	0	0	0	0	0	0	774102780.6	1.12229E+11	6.655266	21.391	51.345371	137.101	249.395	26.66	90	878800	2235775.711	1.333333	208.632	244.112	255.444	275.103	278.313	-1.515913	47.6
1017	1115.937598	0.584492	312240000	23640000	2720000	3920000	1400000	40000	0	0	0	0	0	0	0	0	0	0	775967195.7	1.13005E+11	6.641255	21.404	51.73818	137.283	249.359	26.657	90	859900	2251292.04	1.333333	208.537	244.222	255.373	275.014	278.179	-1.536413	47.6
1024	1111.937768	0.580261	430080000	29760000	2480000	3880000	1440000	80000	40000	0	0	0	0	0	0	0	0	0	1031675046	1.14036E+11	6.642593	21.424	51.462005	137.212	249.379	26.644	90	1169400	2271836.3	1.333333	208.648	244.087	255.45	275.055	278.297	-1.55855	47.6
1031	1114.088554	0.581277	338880000	26800000	2080000	3760000	920000	40000	0	0	0	0	0	0	0	0	0	0	822299057.2	1.14859E+11	6.656946	21.372	50.628379	137.176	249.359	26.702	90	931200	2288270.054	1.333333	208.665	244.367	255.463	274.953	278.195	-1.526569	47.2
1037.984375	1116.351699	0.585672	383480000	27960000	2200000	3760000	1360000	40000	0	0	0	0	0	0	0	0	0	0	920128223	1.15779E+11	6.655844	21.395	51.29158	137.374	249.375	26.686	90	1047000	2306623.437	1.333333	208.655	244.138	255.402	275.027	278.322	-1.543788	47.2
1044.984375	1116.661564	0.584147	287120000	23360000	1880000	3320000	960000	0	0	0	0	0	0	0	0	0	0	0	706757964.7	1.16486E+11	6.621024	21.385	51.508974	137.377	249.35	26.667	90	791600	2320692.241	1.333333	208.684	244.167	255.437	275.036	278.284	-1.480656	47.2
1051.984375	1114.91549	0.58336	313200000	23600000	2680000	3320000	720000	40000	0	0	0	0	0	0	0	0	0	0	759969261.8	1.17246E+11	6.608875	21.365	49.531437	137.101	249.517	26.692	90	858900	2335816.076	1.333333	208.665	244.328	255.399	274.915	278.042	-1.4167	47.6
1058.984375	1114.735343	0.582179	354280000	25920000	1800000	3560000	1320000	80000	0	0	0	0	0	0	0	0	0	0	856402476.1	1.18102E+11	6.648287	21.411	50.134025	136.8	249.669	26.702	90	967400	2352885.68	1.333333	208.766	244.093	255.463	275.043	278.227	-1.465894	47.6
1065.96875	1111.261881	0.582491	367760000	26120000	2120000	3640000	1360000	120000	0	0	0	0	0	0	0	0	0	0	887223089.1	1.18989E+11	6.623333	21.365	50.291462	136.571	249.637	26.715	90	1002800	2370572.451	1.333333	208.822	244.441	255.489	275.004	278.195	-1.481475	47.6
1072.96875	1115.504677	0.583213	379640000	26640000	2400000	3640000	1120000	40000	0	0	0	0	0	0	0	0	0	0	901827660.7	1.19891E+11	6.634957	21.434	50.455458	136.67	249.662	26.689	90	1033700	2388606.557	1.333333	208.809	244.164	255.482	275.065	278.224	-1.457694	48
1079.90625	1117.508741	0.582786	338640000	25040000	2160000	3360000	1080000	80000	0	0	0	0	0	0	0	0	0	0	812115283.4	1.20703E+11	6.593473	21.362	51.23451	136.593	249.646	26.712	90	925900	2404784.891	1.333333	208.848	244.383	255.479	275.049	278.252	-1.403581	48
1086.953125	1116.854066	0.582278	288080000	23520000	1840000	2720000	1280000	0	40000	0	0	0	0	0	0	0	0	0	721091544.2	1.21424E+11	6.616432	21.43	50.760757	136.723	249.706	26.664	90	793700	2419124.158	1.333333	208.859	244.162	255.481	275.116	278.265	-1.459338	48
1093.9375	1115.953904	0.583754	317040000	23720000	1520000	3600000	760000	0	0	0	0	0	0	0	0	0	0	0	757495875.2	1.22182E+11	6.610948	21.305	51.021314	136.711	249.681	26.685	90	866600	2434196.173	1.333333	208.864	244.409	255.502	275.108	278.302	-1.291244	48
1100.9375	1112.14306	0.582704	329120000	24600000	1560000	3200000	960000	40000	0	0	0	0	0	0	0	0	0	0	787859554.9	1.2297E+11	6.621208	21.4	51.704987	136.806	249.663	26.662	90	898700	2449884.984	1.333333	208.778	244.282	255.424	275.109	278.206	-1.333063	48
1107.921875	1116.585908	0.582671	304000000	22400000	1360000	3320000	960000	80000	0	0	0	0	0	0	0	0	0	0	730267737.1	1.237E+11	6.618531	21.423	51.143328	136.831	249.662	26.725	90	830300	2464476.787	1.333333	208.94	244.49	255.547	275.139	278.304	-1.381438	48.4
1114.90625	1116.873516	0.582163	315080000	26000000	2440000	3080000	1040000	0	0	0	0	0	0	0	0	0	0	0	772117903.1	1.24472E+11	6.629211	21.467	51.996901	137.186	249.654	26.727	90	869100	2479843.429	1.333333	208.764	244.426	255.567	275.079	278.251	-1.384719	48.4
1121.90625	1114.488809	0.583377	295960000	22800000	2240000	2600000	1000000	120000	0	0	0	0	0	0	0	0	0	0	724947824.4	1.25197E+11	6.625563	21.426	51.655001	137.392	249.654	26.723	90	811800	2494267.579	1.333333	208.817	244.356	255.58	275.178	278.356	-1.394563	48.4
1128.890625	1115.856713	0.58436	280600000	21920000	1680000	3120000	1000000	80000	0	0	0	40000	0	0	0	0	0	0	717124990.7	1.25914E+11	6.632858	21.429	50.766923	137.434	249.609	26.736	90	771100	2508566.611	1.333333	208.8	244.466	255.548	275.054	278.184	-1.281406	48.4
1135.90625	1119.763519	0.584754	350400000	26320000	1680000	3160000	1520000	0	0	0	0	0	0	0	0	0	0	0	847280826.6	1.26761E+11	6.609452	21.488	51.758385	137.418	249.658	26.733	90	957700	2525440.16	1.333333	208.813	244.327	255.503	275.105	278.232	-1.368319	48.4
1142.90625	1114.362465	0.580359	309920000	23240000	2200000	2520000	1280000	0	0	0	0	0	0	0	0	0	0	0	751640784	1.27513E+11	6.630733	21.471	50.716412	137.375	249.622	26.739	90	847900	2540356.817	1.333333	208.885	244.237	255.603	275.15	278.331	-1.296169	48.4
1149.890625	1114.980169	0.582343	383200000	28400000	2640000	3880000	1240000	40000	0	0	0	0	0	0	0	0	0	0	924049665.4	1.28437E+11	6.6311	21.452	50.443519	137.408	249.613	26.723	90	1048500	2558783.889	1.333333	208.856	244.524	255.612	275.032	278.203	-1.405219	48
1156.875	1114.089641	0.582294	365480000	26280000	2160000	3560000	1000000	80000	0	0	0	0	0	0	0	0	0	0	872255786.1	1.29309E+11	6.633409	21.452	51.68885	137.528	249.632	26.736	90	996400	2576168.469	1.333333	208.885	244.35	255.58	275.127	278.337	-1.442938	48
1163.875	1112.111656	0.581966	316120000	23080000	2000000	2960000	1120000	0	0	0	0	0	0	0	0	0	0	0	758073582.4	1.30067E+11	6.618767	21.452	51.88394	137.512	249.622	26.726	90	863200	2591289.406	1.333333	208.784	244.391	255.465	275.051	278.219	-1.3593	48
1170.90625	1113.41817	0.579113	309080000	23480000	2320000	2920000	920000	40000	0	0	0	0	0	0	0	0	0	0	749205879.4	1.30817E+11	6.635797	21.429	52.021304	137.476	249.654	26.713	90	846900	2606260.043	1.333333	208.918	244.337	255.583	275.137	278.334	-1.434738	47.6
1177.859375	1112.336318	0.579933	367840000	27960000	2000000	3080000	1480000	40000	0	0	0	0	0	0	0	0	0	0	880379572.8	1.31697E+11	6.650517	21.383	50.692797	137.408	249.622	26.726	90	1006000	2623831.15	1.333333	208.908	244.537	255.628	275	278.193	-1.384719	47.6

1184.859375	1116.236521	0.580392	309280000	22040000	2120000	2880000	1240000	0	0	0	0	0	0	0	0	0	0	0	742720705.9	1.3244E+11	6.655975	21.462	50.694371	137.414	249.635	26.765	90	843900	2638669.203	1.333333	208.957	244.291	255.615	275.121	278.327	-1.415881	47.6
1191.890625	1117.905825	0.582425	313600000	22160000	1760000	3320000	1080000	40000	0	0	0	0	0	0	0	0	0	0	758079763.7	1.33198E+11	6.655057	21.435	50.871225	137.401	249.554	26.765	90	854900	2653761.181	1.333333	208.876	244.472	255.548	274.974	278.142	-1.429	48
1198.875	1112.656466	0.582606	352600000	25920000	1840000	3280000	1280000	80000	0	0	0	0	0	0	0	0	0	0	849923742.8	1.34048E+11	6.648995	21.449	50.975133	137.242	249.651	26.755	90	962500	2670656.338	1.333333	208.954	244.295	255.548	275.095	278.369	-1.471638	48
1205.890625	1116.431368	0.584164	334400000	24440000	2080000	3480000	760000	40000	0	0	0	0	0	0	0	0	0	0	799226776.2	1.34847E+11	6.611237	21.416	51.128765	137.067	249.687	26.768	90	913000	2686618.672	1.333333	209.001	244.399	255.552	275.065	278.322	-1.443756	47.6
1212.875	1118.201725	0.583934	304200000	22880000	1480000	2880000	800000	80000	0	0	0	0	0	0	0	0	0	0	727846360.4	1.35575E+11	6.640362	21.468	50.66026	137.042	249.71	26.767	90	830800	2701106.23	1.333333	209.005	244.312	255.623	275.107	278.301	-1.441294	47.6
1219.859375	1117.126288	0.581097	421720000	29720000	2800000	4480000	1240000	40000	0	0	0	0	0	0	0	0	0	0	1012041067	1.36587E+11	6.618689	21.389	50.484062	136.857	249.698	26.762	90	1150000	2721218.702	1.333333	209.067	244.581	255.676	275.077	278.242	-1.451956	47.6
1226.859375	1117.850989	0.583737	321120000	23920000	1920000	3600000	1120000	80000	0	0	0	0	0	0	0	0	0	0	785064320.1	1.37372E+11	6.64094	21.491	50.597941	136.944	249.716	26.749	90	879400	2736835.445	1.333333	209.025	244.358	255.64	275.173	278.345	-1.506075	47.6
1233.84375	1116.915216	0.581556	273840000	19760000	1960000	2480000	800000	40000	0	0	0	0	0	0	0	0	0	0	656145275.7	1.38028E+11	6.630103	21.464	50.375297	136.814	249.757	26.788	90	747200	2749879.228	1.333333	209.046	244.692	255.706	275.055	278.319	-1.432275	47.6
1240.84375	1116.588572	0.58441	334560000	23600000	1840000	3840000	1360000	0	0	0	0	0	0	0	0	0	0	0	810477784.1	1.38839E+11	6.602893	21.501	51.309554	136.853	249.794	26.774	90	913000	2766004.55	1.333333	209.047	244.46	255.559	275.129	278.31	-1.4044	47.2
1247.828125	1119.703122	0.581425	324240000	24120000	2120000	3720000	1080000	80000	0	0	0	0	0	0	0	0	0	0	791665504.2	1.3963E+11	6.601948	21.418	51.730046	136.829	249.814	26.799	90	888400	2781760.19	1.333333	209.064	244.493	255.627	275.135	278.351	-1.471638	47.2
1254.828125	1114.7009	0.580441	330720000	25200000	2280000	2800000	1440000	0	0	0	0	0	0	0	0	0	0	0	806217003.5	1.40436E+11	6.629237	21.522	51.474207	136.936	249.772	26.764	90	906100	2797760.8	1.333333	208.979	244.6	255.64	275.078	278.291	-1.434738	47.2
1261.8125	1120.484114	0.582327	316920000	24160000	2040000	3480000	1400000	40000	0	0	0	0	0	0	0	0	0	0	778420440.6	1.41215E+11	6.640914	21.486	50.359815	136.887	249.821	26.799	90	870100	2813279.072	1.333333	209.06	244.39	255.717	275.174	278.412	-1.474913	47.2
1268.828125	1114.174575	0.582753	307720000	22760000	2320000	3040000	960000	80000	0	0	0	0	0	0	0	0	0	0	752543507.1	1.41967E+11	6.609557	21.457	51.654214	136.832	249.763	26.783	90	842200	2828204.04	1.333333	209.06	244.532	255.63	275.164	278.406	-1.478194	47.2
1275.828125	1115.814817	0.585328	288280000	21120000	1840000	3600000	1040000	40000	0	0	0	0	0	0	0	0	0	0	705174432.2	1.42673E+11	6.643957	21.493	50.402717	136.816	249.785	26.789	90	789800	2842268.75	1.333333	208.992	244.661	255.697	275.065	278.307	-1.479831	47.2
1282.8125	1112.868666	0.582835	361480000	27280000	2680000	4840000	960000	40000	40000	40000	0	0	0	0	0	0	0	0	902285948.1	1.43575E+11	6.634616	21.516	50.72061	136.871	249.808	26.796	90	993400	2860238.398	1.333333	209.047	244.377	255.656	275.17	278.361	-1.419975	47.2
1289.796875	1113.196027	0.583557	363040000	26800000	2040000	3480000	1480000	40000	40000	0	0	0	0	0	0	0	0	0	880887579.9	1.44456E+11	6.620394	21.45	50.802871	136.965	249.717	26.786	90	992300	2877828.326	1.333333	209.038	244.612	255.697	275.11	278.358	-1.409319	47.6
1296.796875	1115.4992	0.584934	326120000	24400000	1840000	3040000	1040000	80000	0	0	0	0	0	0	0	0	0	0	784689840.5	1.4524E+11	6.587175	21.535	51.058574	137.231	249.734	26.786	90	891300	2893492.729	1.333333	209.021	244.354	255.575	275.158	278.345	-1.438838	47.6
1303.78125	1115.442958	0.582967	347920000	27800000	2240000	3120000	920000	0	0	0	0	0	0	0	0	0	0	0	835438395.4	1.46076E+11	6.590455	21.447	52.005298	137.293	249.701	26.793	90	955000	2910135.769	1.333333	208.998	244.467	255.624	275.135	278.412	-1.444575	47.6
1310.78125	1113.41755	0.581573	377640000	24600000	2320000	3120000	1280000	80000	0	0	0	0	0	0	0	0	0	0	892533695.8	1.46968E+11	6.62412	21.486	50.875948	137.452	249.692	26.77	90	1022600	2927917.12	1.333333	208.946	244.596	255.659	275.059	278.294	-1.469175	47.6
1317.765625	1112.301621	0.58213	348800000	22560000	1960000	3520000	1000000	40000	0	0	0	0	0	0	0	0	0	0	819451020.8	1.47788E+11	6.602919	21.483	49.456654	137.458	249.788	26.793	90	944700	2944272.19	1.333333	209.024	244.361	255.636	275.148	278.482	-1.423256	47.6
1324.8125	1113.031446	0.580195	397720000	27040000	2400000	3880000	880000	0	40000	0	0	0	0	0	0	0	0	0	944233671.7	1.48732E+11	6.590166	21.467	49.970422	136.997	249.885	26.757	90	1079900	2963136.651	1.333333	209.06	244.59	255.652	275.097	278.425	-1.406038	47.6
1331.8125	1114.82128	0.582803	382000000	27280000	1640000	3800000	960000	40000	0	0	0	0	0	0	0	0	0	0	902000447.2	1.49634E+11	6.606933	21.486	50.827142	137.102	249.947	26.74	90	1039300	2981145.535	1.333333	209.029	244.385	255.593	275.173	278.404	-1.417519	47.6
1338.796875	1117.732464	0.582885	375480000	26920000	2080000	3600000	1040000	80000	0	0	0	0	0	0	0	0	0	0	893965732.5	1.50528E+11	6.631467	21.462	51.861637	137.028	249.897	26.75	90	1023000	2998965.347	1.333333	209.011	244.535	255.691	275.169	278.532	-1.392919	47.6
1345.75	1114.25037	0.58213	396760000	27920000	2640000	3360000	840000	80000	40000	0	0	0	0	0	0	0	0	0	938944755.5	1.51467E+11	6.65482	21.429	50.10608	137.074	249.913	26.739	90	1079100	3017632.997	1.333333	208.989	244.639	255.692	275.123	278.361	-1.311744	47.6
1352.796875	1115.416374	0.582032	384560000	26160000	2440000	3680000	1800000	0	0	0	0	0	0	0	0	0	0	0	931345310.3	1.52398E+11	6.643118	21.5	50.478945	137.136	249.975	26.764	90	1046600	3036207.425	1.333333	209.087	244.435	255.724	275.243	278.535	-1.244506	47.6
1359.78125	1114.026946	0.582917	347720000	23840000	1640000	3440000	1320000	40000	0	0	0	0	0	0	0	0	0	0	828346733.7	1.53227E+11	6.645663	21.419	50.413606	137.127	249.876	26.792	90	945000	3052710.415	1.333333	209.101	244.685	255.754	275.18	278.524	-1.111675	47.6
1366.765625	1115.676166	0.584951	329040000	22240000	2400000	3200000	520000	40000	0	0	0	0	0	0	0	0	0	0	771223276.5	1.53998E+11	6.617928	21.513	50.653962	137.322	249.986	26.86	90	893600	3068094.509	1.333333	209.127	244.423	255.682	275.268	278.583	-1.277306	47.6
1373.734375	1116.78012	0.584623	398360000	26880000	2320000	3840000	1600000	40000	0	0	0	0	0	0	0	0	0	0	949453264.8	1.54947E+11	6.60738	21.55	50.748818	137.317	249.929	26.856	90	1082600	3087005.876	1.333333	209.137	244.443	255.683	275.239	278.513	-1.295344	47.6
1380.734375	1115.190166	0.582327	363640000	26360000	2160000	3560000	920000	40000	0	0	0	0	0	0	0	0	0	0	867977739.9	1.55815E+11	6.631336	21.481	51.182818	137.398	249.926	26.882	90	991700	3104277.31	1.333333	209.088	244.488	255.744	275.271	278.634	-1.244506	47.6
1387.71875	1119.067923	0.583491	314360000	22560000	1800000	3960000	1040000	80000	80000	0	0	0	0	0	0	0	0	0	776765116.9	1.56592E+11	6.635692	21.498	50.085745	137.291	249.887	26.856	90	859700	3119755.788	1.333333	209.134	244.721	255.798	275.166	278.484	-1.405219	47.6
1394.71875	1113.310019	0.583098	331000000	23240000	2000000	3040000	880000	80000	0	0	0	0	0	0	0	0	0	0	790376598.8	1.57382E+11	6.618348	21.55	50.629297	137.32	249.961	26.83	90	900600	3135450.925	1.333333	209.154	244.44	255.712	275.306	278.525	-1.4208	47.6
1401.765625	1117.78292	0.584049	355720000	25880000	2320000	3840000	1120000	40000	0	0	0	0	0	0	0	0	0	0	863586805.9	1.58246E+11	6.61268	21.458	52.039278	137.301	249.919	26.849	90	972300	3152688.548	1.333333	209.141	244.582	255.709	275.277	278.599	-1.4126	47.6
1408.71875	1117.669726	0.584065	354360000	24280000	2360000	2800000	1240000	40000	0	0	0	0	0	0	0	0	0	0	837480717.8	1.59084E+11	6.640415	21.462	50.512138	137.324	249.867	26.872	90	962700	3169338.187	1.333333	209.095	244.701	255.786	275.172	278.452	-1.306006	47.6
1415.71875	1117.787899	0.585443	339560000	25800000	2080000	3720000	960000	80000	0	0	0	40000	0	0	0	0	0	0	855714739.7	1.59939E+11	6.631074	21.537	51.098589	137.45	249.797	26.866	90	930600	3186352.053	1.333333	209.049	244.595	255.721	275.198	278.442	-1.462613	47.6
1422.71875	1111.992396	0.580376	371600000	27120000	1840000	2960000	1000000	40000	0	40000	0	0	0	0	0	0	0	0	890270784.4	1.6083E+11	6.636925	21.501	50.88054	137.353	249.8	26.866	90	1011500	3204051.113	1.333333	209.134	244.382	255.734	275.268	278.615	-1.4044	47.6
1429.71875	1117.049259	0.584541	439480000	29840000	2640000	4480000	1480000	40000	40000	0	0	0	0	0	0	0	0	0	1051969894	1.61881E+11	6.61966	21.501	50.749605	137.071	249.7	26.862	90	1195000	3225073.837	1.333333	209.183	244.692	255.76	275.214	278.522	-1.491313	47.6
1436.703125	1112.779179	0.582032	370160000	25960000	2040000	3680000	1160000	80000	0	40000	0	0	0	0	0	0	0	0	896312664.3	1.62778E+11	6.545245	21.557	49.564105	137.071	249.874	26.823	90	1007800	3242904.796	1.333333	209.15	244.424	255.712	275.293	278.506	-1.430638	47.6
1443.703125	1114.933848	0.584098	424160000	25320000	2280000	4200000	1120000	0	0	0	0	0	0	0	0	0	0	0	981620686.2	1.63759E+11	6.555032	21.475	49.673261	136.762	250.09	26.869	90	1142700	3262507.78	1.333333	209.105	244.466	255.744	275.271	278.592	-1.3511	47.6
1450.6875	1115.54426	0.583409	439920000	30880000	1920000	3960000	1160000	40000	0	0	0	0	0	0	0	0	0	0	1032302782	1.64792E+11	6.555268	21.475	49.753029	136.382	250.196	26.849	90	1194700	3283083.047	1.333333	209.203	244.653	255.728	275.268	278.548	-1.287144	47.6
1457.6875	1118.804815	0.582015	337280000	23760000	1560000	3200000	1160000	40000	0	0	0	0	0	0	0	0	0	0	803595260.5	1.65595E+11	6.608009	21.527	51.519863	136.65	250.151	26.872	90	917500	3299091.083	1.333333	209.023	244.569	255.689	275.246	278.436	-1.201869	47.6
1464.6875	1113.76573	0.580064	342320000	23840000	2080000	3760000	1360000	80000	0	40000	0	0	0	0	0	0	0	0	845023763.1	1.6644E+11	6.627558	21.56	50.579311	136.608	250.122	26.872	90	933700	3315875.339	1.333333	209.18	244.466	255.818	275.325	278.608	-1.198594	47.6
1471.671875	1114.546874	0.581048	329720000	23280000	2000000	4320000	1080000	40000	0	0	0	0	0	0	0	0	0	0	799101700.3	1.67239E+11	6.619187	21.481	50.352599	136.607	250.065	26.884	90	901100	3331819.28	1.333333	209.193	244.779	255.882	275.304	278.622	-1.166613	47.2
1478.671875	1116.842251	0.581491	340520000	23960000	2200000	3120000	1360000	40000	0	0	0	0	0	0	0	0	0	0	818915281	1.68058E+11	6.625012	21.526	51.691343	136.915	250.072	26.819	90	928000	3348147.097	1.333333	209.051	244.613	255.733	275.345	278.548	-1.18465	47.2

1485.6875	1113.353622	0.578457	308840000	22320000	2080000	3800000	1280000	40000	40000	0	0	0	0	0	0	0	0	0	767613160	1.68826E+11	6.61449	21.565	51.558703	137.06	250.067	26.902	90	846000	3363420.579	1.333333	209.059	244.576	255.754	275.355	278.596	-1.175631	47.2
1492.6875	1115.610121	0.579785	324160000	24640000	1720000	2920000	1080000	40000	0	0	0	0	0	0	0	0	0	0	778081111.5	1.69604E+11	6.646896	21.56	50.429612	137.084	250.075	26.914	90	886400	3378950.857	1.333333	209.181	244.47	255.896	275.429	278.795	-1.220731	47.2
1499.65625	1113.931521	0.581261	314400000	24160000	2040000	3200000	1040000	0	0	0	0	0	0	0	0	0	0	0	758444619.5	1.70362E+11	6.622598	21.555	51.689113	137.095	250.027	26.916	90	862100	3394058.577	1.333333	209.021	244.606	255.742	275.346	278.588	-1.23385	47.2
1506.65625	1114.354499	0.583754	316760000	24440000	2040000	3400000	1520000	0	0	0	0	0	0	0	0	0	0	0	779722063.8	1.71142E+11	6.639759	21.542	51.133619	136.985	249.985	26.916	90	870400	3409613.534	1.333333	209.123	244.522	255.835	275.432	278.792	-1.193675	47.2
1513.6875	1111.447484	0.583918	344920000	22720000	1600000	2960000	1200000	80000	0	0	0	0	0	0	0	0	0	0	817160124.2	1.71959E+11	6.644456	21.568	50.831603	137.017	249.95	26.938	90	933700	3425909.169	1.333333	209.083	244.658	255.835	275.333	278.623	-1.070681	47.2
1520.6875	1110.375178	0.582803	348600000	26200000	1880000	3760000	1080000	120000	40000	0	0	0	0	0	0	0	0	0	850574367.5	1.7281E+11	6.646109	21.614	51.000979	137.173	249.905	26.929	90	954200	3442915.508	1.333333	209.11	244.435	255.794	275.423	278.741	-1.095281	47.6
1527.671875	1114.700107	0.580048	387880000	29080000	2120000	4000000	1120000	80000	0	0	0	0	0	0	0	0	0	0	929114033.2	1.73739E+11	6.620211	21.522	50.923048	137.134	249.827	26.964	90	1060700	3461510.104	1.333333	209.165	244.584	255.816	275.336	278.731	-0.983763	47.2
1534.671875	1116.100333	0.584115	405280000	30600000	2840000	3920000	1000000	40000	0	0	0	0	0	0	0	0	0	0	973129487.9	1.74712E+11	6.61024	21.601	51.306406	137.4	249.83	26.942	90	1109200	3480910.03	1.333333	209.041	244.416	255.685	275.346	278.655	-0.514756	47.2
1541.65625	1119.005124	0.58441	351160000	25280000	2040000	3520000	1080000	80000	0	0	0	0	0	0	0	0	0	0	842870166.4	1.75555E+11	6.597067	21.525	51.872133	137.355	249.763	26.954	90	957900	3497692.077	1.333333	209.123	244.564	255.733	275.333	278.68	-0.342569	47.6
1548.65625	1115.133916	0.579949	321720000	24080000	1600000	3680000	1040000	0	0	0	0	0	0	0	0	0	0	0	779023406.4	1.76334E+11	6.602525	21.578	51.27951	137.416	249.763	26.932	90	880300	3513162.633	1.333333	208.959	244.474	255.669	275.273	278.604	-0.331088	47.6
1555.65625	1119.592474	0.585213	319320000	22480000	1840000	3440000	1000000	0	0	0	0	0	0	0	0	0	0	0	763327732	1.77097E+11	6.573688	21.578	49.196095	137.014	250.024	26.932	90	870200	3528374.114	1.333333	209.11	244.342	255.749	275.321	278.683	-0.375363	47.6
1562.640625	1114.652484	0.581507	291440000	21160000	2040000	2800000	1120000	40000	40000	0	0	0	0	0	0	0	0	0	713511343.4	1.77811E+11	6.576758	21.467	50.034971	136.558	250.105	26.909	90	796600	3542536.238	1.333333	209.123	244.664	255.826	275.295	278.623	-0.314688	47.6
1569.625	1113.317652	0.579359	421920000	28280000	2840000	3560000	1560000	0	40000	0	0	0	0	0	0	0	0	0	1003584973	1.78815E+11	6.611473	21.601	50.550973	136.642	250.124	26.906	90	1145500	3562544.168	1.333333	209.116	244.419	255.678	275.356	278.674	-0.354044	47.6
1576.625	1112.68153	0.580408	379800000	25320000	2360000	3000000	1000000	0	40000	0	0	0	0	0	0	0	0	0	890919820.8	1.79705E+11	6.633698	21.571	50.411638	136.767	250.098	26.903	90	1028800	3580327.249	1.333333	209.106	244.358	255.784	275.359	278.75	-0.350763	47.6
1583.625	1112.482767	0.579687	317080000	21960000	2160000	3400000	1280000	0	0	0	40000	0	0	0	0	0	0	0	785820809.9	1.80491E+11	6.615776	21.506	50.540214	136.732	250.017	26.903	90	864800	3596021.483	1.333333	209.133	244.671	255.79	275.308	278.737	-0.339288	47.6
1590.609375	1116.631834	0.58436	250080000	19520000	1560000	3000000	640000	0	0	0	0	0	0	0	0	0	0	0	604496376.8	1.81096E+11	6.605149	21.568	50.992188	136.852	250.024	26.912	90	687000	3608096.504	1.333333	209.093	244.442	255.701	275.378	278.709	-0.30485	47.6
1597.609375	1115.938653	0.580113	359800000	26520000	1520000	3480000	1160000	40000	40000	0	0	0	0	0	0	0	0	0	866733595.6	1.81962E+11	6.630838	21.519	51.063953	137.001	250.021	26.886	90	981400	3625345.472	1.333333	209.022	244.494	255.801	275.383	278.812	-0.349125	47.6
1604.609375	1115.811024	0.584164	236720000	19120000	1880000	2680000	440000	40000	0	0	0	0	0	0	0	0	0	0	578543604.6	1.82541E+11	6.603968	21.53	50.60765	136.892	250.039	26.925	90	652200	3636866.289	1.333333	209.132	244.657	255.841	275.375	278.763	-0.326169	47.6
1611.59375	1118.644965	0.585246	343880000	23760000	2040000	4080000	1320000	80000	0	40000	0	0	0	0	0	0	0	0	845745406	1.83387E+11	6.607143	21.585	51.686357	137.163	250.056	26.964	90	938000	3653709.95	1.333333	208.953	244.548	255.755	275.369	278.728	-0.387663	47.6
1618.59375	1120.522502	0.58277	294920000	21640000	2200000	3120000	720000	40000	0	0	0	0	0	0	0	0	0	0	712646416.1	1.84099E+11	6.634564	21.655	50.781223	137.054	250.061	26.976	90	806600	3667866.887	1.333333	209.085	244.424	255.84	275.466	278.86	-0.372906	47.6
1625.609375	1112.414405	0.578555	339480000	25560000	1800000	3800000	1200000	80000	0	0	0	0	0	0	0	0	0	0	833552463.7	1.84933E+11	6.631808	21.55	52.146859	137.165	249.98	26.937	90	929800	3684397.915	1.333333	209.046	244.524	255.827	275.424	278.88	-0.346669	47.6
1632.59375	1115.852189	0.582442	272640000	20840000	1960000	3560000	1280000	0	0	0	0	0	0	0	0	0	0	0	676077643.6	1.85609E+11	6.650307	21.576	51.293155	137.327	249.848	26.943	90	750700	3697903.626	1.333333	208.984	244.569	255.757	275.345	278.675	-0.312225	47.6
1639.578125	1114.3547	0.581983	303280000	22280000	2120000	2680000	1200000	80000	0	0	0	0	0	0	0	0	0	0	735676724.3	1.86345E+11	6.651724	21.609	51.500053	137.415	249.881	26.94	90	829100	3712554.645	1.333333	209.052	244.405	255.811	275.415	278.876	-0.26875	47.2
1646.578125	1113.231891	0.578752	345680000	24280000	1880000	2760000	1440000	80000	0	0	0	0	0	0	0	0	0	0	827442716.8	1.87172E+11	6.653089	21.557	51.144115	137.479	249.803	26.959	90	940300	3729055.33	1.333333	209.01	244.592	255.75	275.293	278.691	-0.351588	46.8
1653.578125	1112.515336	0.580031	340120000	24720000	1920000	3720000	800000	160000	0	0	0	0	0	0	0	0	0	0	820028980.9	1.87992E+11	6.638027	21.609	50.933937	137.421	249.819	26.969	90	928600	3745424.665	1.333333	209.082	244.353	255.693	275.38	278.736	-0.374544	46.8
1660.5625	1114.64953	0.582081	386920000	28920000	1680000	4040000	1400000	0	0	0	0	0	0	0	0	0	0	0	926262350.7	1.88918E+11	6.641517	21.534	50.907042	137.304	249.787	26.979	90	1057400	3763926.53	1.333333	209.085	244.666	255.808	275.332	278.672	-0.416363	46.8
1667.5625	1113.421036	0.581015	328040000	22800000	1760000	2800000	840000	0	0	0	0	0	0	0	0	0	0	0	768753857.6	1.89687E+11	6.579802	21.609	49.931719	137.187	249.906	26.992	90	890600	3779252.799	1.333333	209.039	244.376	255.657	275.316	278.663	-0.433581	47.2
1674.5625	1115.250875	0.583983	368480000	24280000	2240000	3160000	1440000	0	0	0	0	0	0	0	0	0	0	0	870765362.9	1.90558E+11	6.587438	21.599	49.131152	136.811	250.155	27.011	90	999000	3796631.976	1.333333	209.062	244.363	255.734	275.332	278.774	-0.449981	47.2
1681.5625	1117.961474	0.584902	268960000	20200000	1560000	2600000	800000	0	40000	0	0	0	0	0	0	0	0	0	650241344.4	1.91208E+11	6.538317	21.57	49.745026	136.308	250.251	26.995	90	735400	3809588.53	1.333333	209.128	244.576	255.68	275.29	278.749	-1.151038	47.2
1688.5625	1113.677718	0.582639	347880000	23000000	2640000	3040000	1080000	80000	0	0	0	0	0	0	0	0	0	0	829819346.7	1.92038E+11	6.599823	21.54	49.455736	136.166	250.435	27.005	90	944300	3826083.221	1.333333	209.046	244.672	255.779	275.255	278.675	-1.0879	47.6
1695.546875	1114.482943	0.58154	325480000	23520000	2160000	3240000	920000	80000	0	0	0	0	0	0	0	0	0	0	780461131.8	1.92818E+11	6.643826	21.629	50.713395	136.224	250.342	27.011	90	888500	3841656.471	1.333333	209.098	244.369	255.821	275.392	278.854	-1.132994	47.6
1702.546875	1112.344258	0.581835	294080000	23360000	1800000	2840000	600000	40000	0	0	0	0	0	0	0	0	0	0	706567467.7	1.93525E+11	6.628738	21.543	50.354699	136.218	250.238	27.018	90	806800	3855745.066	1.333333	209.072	244.73	255.863	275.348	278.755	-1.224831	47.6
1709.546875	1114.242076	0.582229	302960000	23720000	1880000	3160000	960000	80000	0	0	0	0	0	0	0	0	0	0	738474083.5	1.94264E+11	6.627217	21.578	50.817565	136.477	250.182	26.978	90	831900	3870498.174	1.333333	209.011	244.66	255.806	275.355	278.679	-1.228113	48
1716.53125	1118.114098	0.582622	333000000	24480000	2240000	3360000	1000000	80000	0	0	0	0	0	0	0	0	0	0	802716886.5	1.95066E+11	6.63926	21.621	50.382381	136.489	250.197	27.008	90	910400	3886507.4	1.333333	209.068	244.44	255.872	275.499	278.878	-1.128894	48
1723.546875	1115.700024	0.579851	321560000	21960000	2120000	3560000	1080000	80000	0	0	0	0	0	0	0	0	0	0	780055377.8	1.95846E+11	6.603863	21.612	51.308242	136.406	250.117	27.04	90	875900	3902010.795	1.333333	209.085	244.604	255.82	275.469	278.918	-0.877175	47.6
1730.53125	1114.595941	0.581113	340840000	24160000	2200000	3840000	1640000	40000	40000	0	0	0	0	0	0	0	0	0	840043617.8	1.96686E+11	6.633015	21.658	52.157486	136.699	250.065	27.021	90	931900	3918742.564	1.333333	208.909	244.488	255.73	275.425	278.781	-0.700881	47.6
1737.53125	1115.01661	0.583442	346000000	27160000	2040000	3840000	1040000	40000	0	0	0	0	0	0	0	0	0	0	842290804.4	1.97529E+11	6.636951	21.575	51.914247	136.83	249.95	27.058	90	950300	3935535.711	1.333333	208.946	244.47	255.838	275.49	278.955	-0.62545	47.2
1744.515625	1116.300377	0.581589	284600000	23760000	2120000	3480000	840000	80000	0	0	0	0	0	0	0	0	0	0	707940290.2	1.98237E+11	6.649126	21.628	51.16222	137.053	249.901	27.024	90	787200	3949644.924	1.333333	208.903	244.615	255.806	275.402	278.7	-0.93785	47.2
1751.515625	1113.66352	0.581901	418760000	31000000	2560000	4080000	1040000	120000	0	40000	0	0	0	0	0	0	0	0	1018082780	1.99255E+11	6.645742	21.63	50.807594	137.118	249.914	27.045	90	1144000	3969911.926	1.333333	208.982	244.316	255.797	275.474	278.923	-0.945225	47.2
1758.515625	1113.590723	0.579506	394640000	28720000	2200000	3280000	1280000	40000	0	0	0	0	0	0	0	0	0	0	938342972.7	2.00193E+11	6.614044	21.607	51.048078	137.069	249.831	27.019	90	1075400	3988635.774	1.333333	209.002	244.568	255.771	275.4	278.785	-0.591013	47.2
1765.5	1114.883545	0.581212	334160000	23480000	1440000	2600000	1120000	0	0	0	0	0	0	0	0	0	0	0	782023701.1	2.00975E+11	6.61777	21.65	51.159202	137.254	249.821	27.013	90	907000	4004241.421	1.333333	208.93	244.293	255.659	275.445	278.795	-0.445063	46.8
1772.5	1115.270932	0.581146	356600000	25840000	1760000	3960000	880000	40000	40000	0	0	0	0	0	0	0	0	0	857469650.8	2.01832E+11	6.613178	21.594	50.884607	137.205	249.76	27.003	90	972800	4021332.786	1.333333	208.946	244.587	255.723	275.343	278.747	-0.339288	46.8
1779.484375	1115.07569	0.582967	291480000	20280000	2000000	3280000	1000000	0	0	0	0	0	0	0	0	0	0	0	700600276.8	2.02533E+11	6.61798	21.673	50.999667	137.426	249.769	27	90	795100	4035292.528	1.333333	208.917	244.271	255.588	275.378	278.734	-0.235131	46.8

1786.484375	1115.803189	0.582983	361240000	24200000	2160000	3120000	1320000	40000	0	0	0	0	0	0	0	0	0	0	857181829	2.0339E+11	6.601974	21.584	51.576021	137.452	249.702	27.016	90	980200	4052375.212	1.333333	208.894	244.4	255.617	275.337	278.757	-0.246613	46.8
1793.484375	1111.353674	0.581409	391600000	26480000	2200000	3600000	1000000	0	0	0	0	0	0	0	0	0	0	0	919135996.3	2.04309E+11	6.654532	21.62	50.861647	137.536	249.718	27.006	90	1062200	4070680.63	1.333333	208.802	244.439	255.649	275.206	278.549	-0.232675	46.8
1800.46875	1112.154665	0.580294	384360000	25680000	2640000	3840000	1120000	80000	0	0	0	0	0	0	0	0	0	0	911355192.8	2.05221E+11	6.659963	21.63	50.766529	137.549	249.744	26.98	90	1044300	4088903.756	1.333333	208.887	244.203	255.643	275.298	278.706	-0.249894	47.2

Table E-4 Aerosol counts at simulated initial descent from cruise conditions (Test 1: 29.7 PSI, 185.1°C)

Time (sec)	Flow (CFM)	Filter dP ("H2O)	0.3 µm	0.4 µm	0.5 µm	0.55 µm	0.7 µm	1.0 µm	1.3 µm	1.6 µm	2.0 µm	2.2 µm	3.0 µm	4.0 µm	5.0 µm	5.5 µm	7.0 µm	10.0 µm	dm (pg)	Total Mass (pg)	Aerosol Generator (PSIA)	Aerosol Generator Temp (°C)	Compressor (PSIA)	Compressor Temp (°C)	Reactor Tube Temp (°C)	Duct Temp (°C)	Aero. Gen.Flow (CFH)	Sum of Particles	Total Sample Mass (pg)	Sample Filter Flow Rate (SCFH)	Temp S1 (°C)	Temp S2 (°C)	Temp S3 (°C)	Temp S4 (°C)	Temp S5 (°C)	CO (PPM)	RH (%)
0.65625	1101.036646	0.585197	103560000	24600000	2280000	2920000	1160000	80000	0	0	0	0	0	0	0	0	0	0	4819169139	0	5.705502	23.111	30.016339	117.513	185.15	28.292	90	336500	0	1.333333	161.484	186.464	188.38	199.213	200.759	0.112525	45.2
16.640625	1104.477546	0.585312	126080000	33120000	2760000	4040000	1080000	120000	0	0	0	0	0	0	0	0	0	0	1079913008	1079913008	5.700517	23.14	29.775461	117.48	185.217	28.36	90	418000	21795.88384	1.333333	161.527	186.586	188.389	199.247	200.761	0.105962	44.8
23.625	1099.925823	0.589018	123720000	31440000	2560000	3840000	1160000	40000	0	0	0	0	0	0	0	0	0	0	4543540526	1534267060	5.702878	23.09	29.595196	117.513	185.219	28.309	90	406900	30937.5425	1.333333	161.546	186.555	188.392	199.247	200.767	0.093662	45.2
30.625	1103.23401	0.58541	108960000	27000000	2240000	3720000	840000	80000	0	0	0	0	0	0	0	0	0	0	398907836	1933174896	5.69435	23.153	29.886848	117.594	185.239	28.335	90	357100	38996.83013	1.333333	161.513	186.571	188.454	199.28	200.827	0.123181	45.2
37.59375	1103.960275	0.584885	113240000	27040000	2480000	4040000	1200000	0	0	0	0	0	0	0	0	0	0	0	414748188.2	2347923084	5.701015	23.105	29.394461	117.553	185.229	28.325	90	370000	47351.02001	1.333333	161.559	186.636	188.437	199.287	200.807	0.099406	45.2
44.625	1099.354504	0.586492	106000000	29000000	1880000	3640000	960000	40000	0	0	0	0	0	0	0	0	0	0	401543988.1	2749467072	5.724683	23.147	29.280451	117.568	185.316	28.398	90	353800	55433.91931	1.333333	161.557	186.734	188.547	199.282	200.747	0.131381	45.2
51.625	1099.17339	0.585033	127560000	32120000	2680000	4480000	1040000	40000	0	0	0	0	0	0	0	0	0	0	468537575.3	3218004648	5.698129	23.163	29.438412	117.449	185.277	28.395	90	419800	64904.88257	1.333333	161.609	186.625	188.449	199.334	200.835	0.127281	45.6
58.59375	1098.362619	0.58277	126480000	30960000	2720000	3280000	1080000	40000	0	0	0	0	0	0	0	0	0	0	447363026	3665367674	5.724132	23.163	29.279139	117.561	185.362	28.389	90	411400	73949.31603	1.333333	161.56	186.766	188.619	199.295	200.747	0.175662	45.6
65.625	1102.158008	0.587443	114560000	29560000	2440000	4240000	1680000	80000	0	0	0	0	0	0	0	0	0	0	448284517.2	4113652191	5.724211	23.167	29.290028	117.757	185.359	28.395	90	381400	83019.06948	1.333333	161.544	186.75	188.577	199.301	200.806	0.137125	45.6
72.609375	1102.121016	0.584705	115800000	28160000	2520000	4000000	1200000	40000	0	0	0	0	0	0	0	0	0	0	427307072.5	4540959263	5.708415	23.222	30.15449	117.878	185.329	28.389	90	379300	91634.63336	1.333333	161.446	186.638	188.452	199.337	200.881	0.217475	46
79.59375	1101.680233	0.584934	122680000	30360000	3400000	3680000	1120000	40000	0	0	0	0	0	0	0	0	0	0	451198778.7	4992158042	5.695531	23.267	29.767327	117.805	185.303	28.363	90	403200	100732.2183	1.333333	161.472	186.625	188.367	199.354	200.946	0.204356	46
86.578125	1103.393985	0.58436	108240000	28680000	2920000	3760000	1520000	160000	0	0	0	0	0	0	0	0	0	0	431754351.7	5423912394	5.704426	23.18	30.070261	117.913	185.369	28.356	90	363200	109441.2255	1.333333	161.446	186.691	188.442	199.331	200.887	0.176481	46
93.5625	1103.084073	0.584738	132920000	33320000	2600000	4000000	1800000	0	40000	0	0	0	0	0	0	0	0	0	498815187.3	5922727581	5.715972	23.183	29.038129	117.664	185.405	28.359	90	436700	119487.3035	1.333333	161.567	186.793	188.613	199.341	200.812	0.190419	46
100.609375	1102.25518	0.585607	118040000	29880000	3000000	4000000	1240000	80000	0	0	0	0	0	0	0	0	0	0	450777175.1	6373504756	5.691306	23.15	29.672603	117.536	185.333	28.356	90	390600	128568.4522	1.333333	161.622	186.681	188.54	199.416	200.937	0.198619	46
107.59375	1103.950023	0.585886	112360000	28840000	2560000	4000000	1200000	0	0	0	0	0	0	0	0	0	0	0	421677218.7	6795181975	5.711747	23.121	29.556493	117.46	185.357	28.334	90	372400	137069.7548	1.333333	161.634	186.702	188.507	199.448	200.946	0.2101	46
114.578125	1099.22637	0.58687	122800000	28640000	2400000	4520000	1320000	0	0	0	0	0	0	0	0	0	0	0	447675910.2	7242857885	5.715001	23.137	29.387114	117.441	185.415	28.296	90	399200	146081.3526	1.333333	161.637	186.761	188.562	199.437	200.889	0.212556	46
121.5625	1105.337078	0.585705	97880000	28080000	1440000	3560000	1280000	40000	40000	0	0	0	0	0	0	0	0	0	387188004.3	7630045889	5.699729	23.124	29.618025	117.521	185.331	28.337	90	330800	153908.8376	1.333333	161.608	186.722	188.579	199.465	201.031	0.206	46
128.546875	1102.81231	0.585541	103760000	27560000	2520000	3520000	920000	120000	0	0	0	0	0	0	0	0	0	0	397590946.6	8027636836	5.711957	23.156	30.238981	117.671	185.328	28.349	90	346000	161902.195	1.333333	161.583	186.658	188.593	199.493	201.086	0.161719	46
135.53125	1101.596085	0.583869	107320000	26960000	2280000	3480000	1120000	80000	0	0	0	0	0	0	0	0	0	0	400021097.4	8427657933	5.720852	23.159	30.250001	117.645	185.276	28.365	90	353100	169962.8211	1.333333	161.57	186.668	188.622	199.49	201.142	0.131381	46
142.5625	1101.232723	0.581851	103200000	26240000	2520000	3200000	800000	0	0	0	0	0	0	0	0	0	0	0	377680442	8805338375	5.711012	23.152	30.39786	117.597	185.295	28.353	90	339900	177581.6742	1.333333	161.585	186.687	188.592	199.489	201.14	0.106781	46
149.546875	1101.961982	0.58523	110320000	27160000	2840000	4320000	960000	0	0	0	0	0	0	0	0	0	0	0	4107696656.9	9216108032	5.705633	23.165	30.280701	117.562	185.328	28.339	90	364000	185870.7619	1.333333	161.56	186.668	188.596	199.513	201.119	0.124825	45.6
156.53125	1102.463115	0.584147	121960000	30280000	2640000	4880000	1320000	0	0	0	0	0	0	0	0	0	0	0	4584338105	9674541843	5.701776	23.152	30.403108	117.579	185.306	28.33	90	402700	195115.5618	1.333333	161.609	186.711	188.637	199.527	201.117	0.101862	45.2
163.515625	1104.615855	0.583852	147360000	39960000	3880000	5360000	1680000	80000	0	0	0	0	0	0	0	0	0	0	575808071.6	10250349914	5.72017	23.161	29.373338	117.665	185.322	28.31	90	495800	206722.0588	1.333333	161.617	186.633	188.673	199.552	201.171	0.105962	44.8
170.5	1104.948448	0.586378	137920000	37440000	2960000	4360000	1360000	40000	0	0	0	0	0	0	0	0	0	0	519887003.7	10770236918	5.704006	23.194	29.565152	117.649	185.303	28.32	90	460200	217180.9387	1.333333	161.623	186.643	188.641	199.581	201.184	0.1445	44.8
177.53125	1103.223641	0.582835	113200000	30880000	2400000	3800000	1120000	0	0	0	0	0	0	0	0	0	0	0	430461621.8	11200698540	5.710776	23.226	29.492859	117.617	185.335	28.339	90	378500	225838.1877	1.333333	161.617	186.649	188.555	199.588	201.141	0.082187	44.8
184.53125	1101.239408	0.583623	122960000	29400000	2800000	4120000	1240000	0	0	0	0	0	0	0	0	0	0	0	448986706.7	11649685247	5.694377	23.21	29.577222	117.566	185.372	28.337	90	401300	234882.1222	1.333333	161.593	186.662	188.522	199.567	201.143	0.1732	45.2
191.515625	1107.644068	0.588214	137240000	35520000	3520000	4920000	1360000	0	40000	0	0	0	0	0	0	0	0	0	522983578.6	12172668825	5.68737	23.187	29.684673	117.518	185.381	28.304	90	456500	245435.5561	1.333333	161.551	186.712	188.509	199.549	201.131	0.142044	45.2
198.484375	1103.34181	0.587575	135280000	33320000	2280000	4800000	1400000	0	0	0	0	0	0	0	0	0	0	0	495018323.6	12667687149	5.691227	23.171	29.614745	117.508	185.401	28.307	90	442700	255366.9118	1.333333	161.535	186.741	188.487	199.565	201.125	0.169919	45.6
205.53125	1101.823033	0.583737	158440000	43440000	3120000	5320000	1760000	80000	0	0	0	0	0	0	0	0	0	0	611798120.6	13279485269	5.705764	23.171	30.108571	117.508	185.421	28.32	90	530400	267689.0351	1.333333	161.503	186.813	188.624	199.519	201.079	0.1445	45.6
212.515625	1105.706419	0.588149	141560000	37280000	3200000	5880000	1320000	40000	0	0	0	0	0	0	0	0	0	0	542561465.5	13822046735	5.689653	23.187	30.073935	117.476	185.398	28.304	90	473200	278631.7374	1.333333	161.496	186.745	188.578	199.549	201.122	0.161719	45.6
219.5	1104.75117	0.588706	145600000	38840000	3040000	5280000	1840000	0	0	0	0	0	0	0	0	0	0	0	559802602.3	14381849337	5.700622	23.19	29.738595	117.371	185.457	28.278	90	486500	289882.5157	1.333333	161.499	186.84	188.654	199.539	201.046	0.1896	45.6
226.484375	1103.162267	0.587066	152320000	37160000	2520000	4720000	1760000	40000	0	0	0	0	0	0	0	0	0	0	554491744.4	14936341082	5.700149	23.145	29.240304	117.201	185.493	28.275	90	496300	301036.1937	1.333333	161.555	186.892	188.716	199.542	200.968	0.164181	45.6
233.515625	1099.489537	0.585	139240000	37000000	3560000	4680000	1080000	80000	0	0	0	0	0	0	0	0	0	0	528080930.8	15464422012	5.705764	23.145	29.221149	117.105	185.45	28.271	90	464100	311673.9141	1.333333	161.548	186.885	188.732	199.539	200.997	0.124006	46
240.515625	1102.347517	0.586279	132920000	34680000	2480000	5080000	1680000	80000	0	0	0	0	0	0	0	0	0	0	511775193.1	15976197205	5.710881	23.113	29.282681	116.993	185.447	28.265	90	442300	322017.607	1.333333	161.545	186.935	188.69	199.575	201.036	0.131381	46
247.5	1106.520358	0.584803	126440000	33600000	2520000	4680000	1280000	120000	0	0	0	0	0	0	0	0	0	0	484894711	16461091916	5.691962	23.158	29.454024	116.945	185.384	28.305	90	421600	331792.5988	1.333333	161.573	186.798	188.593	199.621	201.119	0.133025	46
254.484375	1096.657861	0.582639	152600000	39680000	3040000	4880000	1760000	0	40000	0	0	0	0	0	0	0	0	0	576174979.8	17037266896	5.682411	23.163	30.256036	117.106	185.323	28.321	90	505000	343363.9073	1.333333	161.522	186.728	188.643	199.635	201.195	0.174837	46
261.484375	1103.947056	0.587542	138520000	33600000	2600000	4600000	1440000	0	40000	40000	0	0	0	0	0	0	0	0	517599725.8	17554866622	5.690335	23.195	30.387365	117.155	185.36	28.352	90	452100	353852.3345	1.333333	161.506	186.786	188.666	199.633	201.147	0.161719	46
268.46875	1099.225372	0.580966	141200000	35240000	2840000	5760000	1360000	40000	0	0	0	0	0	0	0	0	0	0	530720475.3	18085587097	5.705869	23.197	30.424362	117.141	185.347	28.345	90	466100	364535.6262	1.333333	161.503	186.768	188.65	199.657	201.201	0.1896	46
275.453125	1099.590832	0.584082	153640000	38200000	3520000	5920000	1800000	0	80000	0	0	0	0	0	0	0	0	0	590331202.7	18675918300	5.713715	23.217	30.349449	117.17	185.367	28.338	90	507900	376469.9132	1.333333	161.467	186.722	188.647	199.628	201.217	0.198619	45.6

282.5	1098.203426	0.584705	146560000	39080000	3320000	4480000	1640000	120000	0	0	0	0	0	0	0	0	0	0	561321584.5	19237239885	5.717389	23.259	29.786482	117.138	185.305	28.319	90	488000	387813.9629	1.333333	161.5	186.657	188.709	199.644	201.256	0.118262	45.2
289.484375	1102.691277	0.584295	151160000	38200000	3200000	5680000	1400000	40000	40000	0	0	0	0	0	0	0	0	0	567561734.2	19804801619	5.736281	23.301	29.678507	117.061	185.285	28.345	90	499300	399298.6138	1.333333	161.474	186.637	188.736	199.647	201.253	0.190419	45.2
296.46875	1098.673692	0.583934	117400000	29960000	2040000	4840000	1600000	0	0	0	0	0	0	0	0	0	0	0	450052769.5	20254854388	5.733526	23.285	29.289766	116.974	185.295	28.371	90	389600	408368.3987	1.333333	161.454	186.67	188.719	199.667	201.253	0.167462	45.2
303.453125	1104.029724	0.584246	124160000	31960000	2800000	4440000	1640000	40000	80000	0	0	0	0	0	0	0	0	0	486478914.9	20741333303	5.728829	23.288	29.318891	116.958	185.256	28.364	90	412800	418208.1196	1.333333	161.438	186.634	188.683	199.637	201.243	0.183862	45.2
310.4375	1098.914945	0.585918	116000000	29720000	2040000	4160000	1040000	40000	0	0	0	0	0	0	0	0	0	0	429175335.4	21170508639	5.722663	23.285	29.234138	116.917	185.252	28.393	90	382500	426846.682	1.333333	161.415	186.614	188.696	199.641	201.22	0.170737	45.2
317.4375	1107.455553	0.584672	108200000	28360000	1960000	3800000	1000000	40000	40000	0	0	0	0	0	0	0	0	0	408448776.6	21578957415	5.716969	23.256	29.3757	116.92	185.229	28.384	90	358500	435106.3199	1.333333	161.392	186.65	188.677	199.628	201.204	0.151062	45.2
324.421875	1102.751892	0.586361	109280000	25840000	2080000	3720000	1000000	0	80000	0	0	0	0	0	0	0	0	0	405132287.3	21984089702	5.716549	23.295	29.515166	116.879	185.243	28.384	90	355000	443235.7114	1.333333	161.343	186.568	188.529	199.608	201.201	0.114981	45.2
331.453125	1103.76773	0.586558	118960000	30360000	2920000	4200000	1120000	0	0	0	0	0	0	0	0	0	0	0	446778344.9	22430868047	5.708625	23.304	29.519233	116.939	185.22	28.384	90	393900	452239.0128	1.333333	161.327	186.565	188.516	199.631	201.155	0.115806	45.2
338.4375	1105.897762	0.58623	123880000	32040000	2680000	3760000	960000	80000	0	0	0	0	0	0	0	0	0	0	455125667.4	22885993715	5.715499	23.252	29.253817	116.91	185.17	28.377	90	408500	461402.0852	1.333333	161.314	186.562	188.654	199.601	201.21	0.169919	44.8
345.421875	1102.982251	0.585508	131480000	34480000	3000000	4120000	1160000	80000	0	0	0	0	0	0	0	0	0	0	491718655	23377712370	5.725234	23.278	29.229152	116.939	185.157	28.351	90	435800	471282.8189	1.333333	161.278	186.548	188.568	199.555	201.174	0.119081	44.8
352.421875	1103.362506	0.586722	138320000	35120000	2680000	5360000	1160000	0	0	0	0	0	0	0	0	0	0	0	512537492.4	23890249862	5.708231	23.246	29.483019	116.962	185.167	28.358	90	456600	481609.1157	1.333333	161.281	186.565	188.477	199.592	201.119	0.196981	44.8
359.40625	1102.924371	0.586771	137640000	33760000	2680000	4000000	1640000	80000	0	0	0	0	0	0	0	0	0	0	505716960.2	24395966822	5.71033	23.265	29.52002	117.026	185.147	28.348	90	449500	491794.485	1.333333	161.239	186.486	188.447	199.575	201.142	0.146144	44.8
366.40625	1097.5826	0.584164	105320000	26480000	2080000	3200000	1200000	40000	0	0	0	0	0	0	0	0	0	0	389579658.3	24785546481	5.704452	23.262	29.52658	117.256	185.269	28.351	90	345800	499643.9133	1.333333	161.193	186.739	188.536	199.447	200.893	0.158444	44.4
373.390625	1098.131549	0.582967	123440000	31920000	2160000	3680000	1160000	80000	40000	0	40000	0	0	0	0	0	0	0	477903495.1	25263449976	5.71033	23.262	29.482494	117.298	185.282	28.338	90	406300	509319.7934	1.333333	161.187	186.67	188.568	199.431	200.896	0.172381	44
380.375	1105.551997	0.58541	131760000	33720000	2600000	4840000	1360000	0	0	0	0	0	0	0	0	0	0	0	489424121.3	25752874097	5.712744	23.217	28.905489	117.326	185.288	28.335	90	435700	519223.9726	1.333333	161.19	186.739	188.562	199.434	200.883	0.190419	44
387.421875	1102.743751	0.585049	122240000	29680000	2280000	4240000	1120000	40000	0	0	0	0	0	0	0	0	0	0	449703267.8	26202577365	5.692907	23.21	29.325582	117.129	185.266	28.34	90	399000	528263.2633	1.333333	161.28	186.667	188.475	199.459	200.901	0.1732	43.6
394.40625	1103.203912	0.585361	108920000	28240000	2400000	3440000	760000	0	0	0	0	0	0	0	0	0	0	0	395290351.6	26597867716	5.675326	23.223	29.952315	117.279	185.218	28.323	90	359400	536229.0578	1.333333	161.169	186.583	188.466	199.48	201.036	0.163362	43.6
401.40625	1102.965014	0.585426	120560000	29560000	2680000	3960000	1240000	40000	40000	0	0	0	0	0	0	0	0	0	451114968.6	27048982685	5.690939	23.276	29.227447	117.421	185.153	28.297	90	395200	545316.0244	1.333333	161.181	186.456	188.507	199.502	201.157	0.172381	43.6
408.390625	1101.305563	0.585197	143040000	36040000	2640000	4120000	1400000	80000	0	0	0	0	0	0	0	0	0	0	520617913.2	27569600598	5.71012	23.254	29.258934	117.378	185.153	28.315	90	468300	555805.2845	1.333333	161.196	186.44	188.519	199.485	201.075	0.164181	44
415.375	1098.692336	0.583737	125400000	29080000	2200000	4680000	1400000	0	40000	0	0	0	0	0	0	0	0	0	461055485.2	28030656083	5.690545	23.26	29.545342	117.328	185.133	28.317	90	407000	565108.495	1.333333	161.213	186.45	188.402	199.509	201.111	0.187956	44
422.359375	1103.81172	0.587165	127480000	33160000	2800000	4320000	1520000	0	0	0	0	0	0	0	0	0	0	0	479091167.2	28509747250	5.721324	23.254	29.530779	117.302	185.16	28.276	90	423200	574798.6239	1.333333	161.201	186.461	188.413	199.527	201.12	0.143681	44.4
429.390625	1103.544157	0.582852	118480000	28720000	2680000	4200000	1200000	80000	40000	0	0	0	0	0	0	0	0	0	450418088.9	28960165339	5.708231	23.276	29.697924	117.286	185.141	28.283	90	388500	583866.557	1.333333	161.181	186.438	188.41	199.524	201.179	0.155981	44.4
436.390625	1103.359452	0.584967	142680000	36640000	2840000	4280000	1120000	160000	40000	0	0	0	0	0	0	0	0	0	532312596	29492477935	5.695584	23.257	30.283457	117.414	185.177	28.312	90	469400	594585.8098	1.333333	161.051	186.599	188.439	199.436	200.953	0.1773	44.8
443.375	1100.624503	0.584656	113000000	26560000	2160000	3160000	1320000	0	40000	0	0	0	0	0	0	0	0	0	409365553.6	29901843489	5.712482	23.195	29.571581	117.209	185.268	28.302	90	365600	602830.6409	1.333333	161.097	186.704	188.492	199.39	200.874	0.187956	44.8
450.375	1101.05648	0.58605	151360000	35880000	2960000	4920000	1360000	40000	0	0	0	0	0	0	0	0	0	0	543116513.8	30444960003	5.723397	23.192	28.946554	117.113	185.232	28.318	90	491300	613796.4661	1.333333	161.119	186.723	188.551	199.403	200.887	0.125644	44.8
457.359375	1100.246294	0.583524	145160000	34320000	3120000	5440000	1280000	40000	0	0	0	0	0	0	0	0	0	0	529489214.8	30974449218	5.725287	23.161	28.90116	117.045	185.234	28.356	90	473400	624482.9542	1.333333	161.136	186.727	188.535	199.4	200.878	0.1527	44.8
464.34375	1104.743332	0.582442	141960000	37160000	3640000	4760000	1360000	80000	0	0	0	0	0	0	0	0	0	0	536789060.6	31511238278	5.726048	23.182	29.366122	116.957	185.213	28.357	90	472400	635324.7501	1.333333	161.132	186.671	188.528	199.416	200.855	0.133844	44.8
471.328125	1103.287308	0.585476	127080000	31160000	2920000	4400000	1520000	120000	0	0	0	0	0	0	0	0	0	0	482370088.2	31993608366	5.702878	23.179	29.341588	116.89	185.19	28.36	90	418000	645027.7598	1.333333	161.201	186.645	188.393	199.432	200.874	0.155981	44.8
478.328125	1101.50875	0.58336	125640000	32200000	2520000	4080000	1440000	80000	0	40000	0	0	0	0	0	0	0	0	484216574.4	32477824941	5.710173	23.195	29.365729	116.806	185.137	28.38	90	415000	654780.7664	1.333333	161.172	186.582	188.423	199.429	200.897	0.1527	44.4
485.3125	1099.783328	0.583065	136880000	34760000	3240000	4920000	1680000	40000	0	0	0	0	0	0	0	0	0	0	520998013.2	32998822954	5.684877	23.169	29.391968	116.867	185.192	28.397	90	453800	665291.5622	1.333333	161.161	186.581	188.368	199.43	200.882	0.139581	44.4
492.34375	1102.925165	0.584049	113960000	29720000	2440000	3200000	1080000	40000	0	0	0	0	0	0	0	0	0	0	420198744.7	33419021699	5.702747	23.218	29.588505	116.955	185.157	28.442	90	376100	673782.0982	1.333333	161.164	186.551	188.372	199.415	200.942	0.166637	44.4
499.34375	1101.559454	0.583475	112720000	27640000	2440000	3720000	1120000	0	0	0	0	0	0	0	0	0	0	0	412360052.9	33831381752	5.681886	23.261	29.794747	117.015	185.169	28.453	90	369100	682090.5102	1.333333	161.169	186.517	188.406	199.42	200.963	0.151881	44.4
506.328125	1101.110118	0.584459	113960000	28440000	2040000	2880000	1320000	0	0	0	0	0	0	0	0	0	0	0	408481195.9	34239862947	5.689784	23.287	30.236882	117.091	185.107	28.447	90	371600	690330.9732	1.333333	161.117	186.501	188.426	199.436	201.016	0.1691	44
513.3125	1103.050817	0.583705	109680000	27320000	2480000	3600000	1280000	0	40000	0	0	0	0	0	0	0	0	0	412456106.8	34652319054	5.692618	23.267	30.30904	117.05	185.084	28.424	90	361000	698655.0192	1.333333	161.123	186.452	188.423	199.426	201.022	0.116625	44
520.3125	1103.43454	0.58459	130480000	31720000	2480000	4240000	1240000	120000	0	0	0	0	0	0	0	0	0	0	479338125.8	35131657180	5.710199	23.332	29.216558	117.111	185.074	28.428	90	425700	708311.8348	1.333333	161.12	186.426	188.501	199.416	201.078	0.194519	44
527.3125	1105.05538	0.585361	133720000	34760000	2760000	4400000	1240000	40000	0	0	0	0	0	0	0	0	0	0	497276872.5	35628934053	5.714738	23.274	29.432114	117.088	185.1	28.434	90	442300	718326.5632	1.333333	161.12	186.439	188.406	199.423	201.062	0.163362	44
534.296875	1103.46494	0.581523	132240000	33760000	3240000	4040000	1160000	40000	0	0	0	0	0	0	0	0	0	0	488052548.1	36116986601	5.702196	23.322	29.510574	117.123	185.133	28.45	90	436200	728141.1049	1.333333	161.11	186.396	188.338	199.416	201.012	0.175662	44
541.296875	1099.010039	0.582622	99800000	24160000	1920000	3080000	1000000	40000	40000	0	0	0	0	0	0	0	0	0	368321407.5	36485308008	5.690204	23.342	29.795797	117.274	185.146	28.402	90	325100	735558.5768	1.333333	161.016	186.501	188.318	199.367	200.947	0.241256	44
548.28125	1106.518219	0.583803	99040000	25320000	2040000	3120000	720000	0	0	0	0	0	0	0	0	0	0	0	356065331.7	36841373340	5.69519	23.28	30.223106	117.267	185.176	28.431	90	325600	742758.2953	1.333333	161.003	186.554	188.387	199.318	200.878	0.201081	44
555.265625	1100.63748	0.584164	156280000	35880000	3240000	5000000	1520000	0	0	0	0	0	0	0	0	0	0	0	558026782.2	37399400122	5.701409	23.296	29.766802	117.223	185.189	28.428	90	504800	753965.1557	1.333333	161.016	186.599	188.413	199.311	200.832	0.1937	44
562.265625	1101.650435	0.58482	145320000	39240000	3200000	4560000	1480000	80000	40000	0	0	0	0	0	0	0	0	0	555971693.5	37955371816	5.708939	23.261	29.0031	117.031	185.205	28.44	90	484800	765190.4017	1.333333	161.078	186.622	188.488	199.305	200.803	0.202719	44
569.296875	1107.963192	0.584295	137160000	33680000	2640000	4200000	840000	0	0	0	0	0	0	0	0	0	0	0	485054026.8	38440425842	5.690886	23.177	29.269036	116.935	185.195	28.424	90	446300	774974.7925	1.333333	161.123	186.609	188.419	199.364	200.842	0.200256	44.4
576.296875	1103.889825	0.584623	121240000	30280000	3040000	4480000	1400000	0	0	0	0	0	0	0	0	0	0	0	461382896.3	38901808739	5.685901	23.228	29.798552	116.986	185.087	28.428	90	401100	784228.6679	1.333333	161.104	186.517	188.413	199.37	200.917	0.230594	44.8

583.28125	1101.965599	0.588067	111360000	27960000	2280000	3160000	960000	0	40000	0	0	0	0	0	0	0	0	0	405312783.2	39307121522	5.701435	23.238	30.32767	117.101	185.061	28.415	90	364400	792387.952	1.333333	161.065	186.449	188.393	199.364	200.966	0.228137	44.8
590.265625	1102.424402	0.583262	129600000	31720000	2200000	4120000	1040000	80000	40000	0	0	0	0	0	0	0	0	0	471118416.3	39778239938	5.694219	23.222	29.932898	117.031	185.09	28.392	90	422000	801888.5191	1.333333	161.071	186.524	188.397	199.357	200.881	0.246994	44.8
597.25	1101.547584	0.583934	134720000	31320000	3080000	4720000	1240000	80000	0	0	0	0	0	0	0	0	0	0	491686462.1	40269926400	5.695033	23.212	29.689265	116.976	185.103	28.392	90	437900	811799.7346	1.333333	161.097	186.521	188.338	199.321	200.885	0.246994	44.8
604.234375	1104.67111	0.586492	131320000	32640000	3480000	4240000	1560000	0	0	0	0	0	0	0	0	0	0	0	490797222.2	40760723622	5.698916	23.215	30.354959	117.005	185.051	28.395	90	433100	821700.9001	1.333333	161.058	186.478	188.374	199.357	200.94	0.239619	44.8
611.21875	1102.573719	0.58705	112040000	29520000	2640000	3360000	760000	0	0	0	0	0	0	0	0	0	0	0	408292504.7	41169016127	5.704689	23.263	30.508066	117.066	185.039	28.407	90	370800	829914.3554	1.333333	161.059	186.406	188.361	199.338	200.967	0.231419	44.8
618.265625	1101.026671	0.585656	130600000	32280000	2760000	4560000	1360000	0	0	0	0	0	0	0	0	0	0	0	485626374.5	41654642502	5.711091	23.263	30.185846	117.168	184.999	28.4	90	428900	839702.0884	1.333333	161.072	186.373	188.401	199.342	200.984	0.192056	44.8
625.25	1100.749863	0.585722	132920000	32920000	3120000	4360000	1280000	120000	0	0	0	0	0	0	0	0	0	0	494594613.4	42149237115	5.726835	23.285	29.309839	117.23	184.993	28.427	90	436800	849684.5818	1.333333	161.099	186.362	188.464	199.391	201.019	0.246994	45.2
632.25	1097.41242	0.585869	131120000	33160000	2960000	4040000	1760000	80000	40000	0	0	0	0	0	0	0	0	0	502706699.5	42651943814	5.69889	23.298	29.56712	117.185	185.04	28.414	90	432900	859833.3543	1.333333	161.09	186.356	188.317	199.402	200.981	0.211737	45.2
639.234375	1103.699768	0.586492	127840000	34400000	3040000	3920000	1520000	80000	0	0	0	0	0	0	0	0	0	0	487397649.1	43139341464	5.680286	23.268	30.005187	117.336	185.09	28.395	90	427000	869702.9883	1.333333	160.954	186.498	188.329	199.325	200.901	0.28635	45.2
646.21875	1103.614466	0.585689	124640000	30760000	2600000	3880000	1480000	40000	0	0	0	0	0	0	0	0	0	0	460945148.3	43600286612	5.696108	23.226	29.958088	117.227	185.136	28.411	90	408500	878983.7962	1.333333	161.033	186.581	188.434	199.313	200.86	0.206	45.2
653.21875	1104.081527	0.582491	133320000	31840000	2560000	4680000	920000	0	0	0	0	0	0	0	0	0	0	0	475390126.9	44075676739	5.705922	23.197	28.957968	117.077	185.182	28.398	90	433300	888556.1834	1.333333	161.065	186.616	188.47	199.311	200.796	0.224856	45.2
660.203125	1097.63394	0.585705	145640000	35840000	3240000	4880000	1320000	80000	0	0	0	0	0	0	0	0	0	0	536717084.3	44612393823	5.704479	23.2	29.22338	116.965	185.149	28.375	90	477500	899358.8697	1.333333	161.115	186.624	188.48	199.349	200.778	0.216656	45.2
667.1875	1100.599138	0.584524	131160000	32200000	2360000	4040000	840000	40000	0	40000	0	0	0	0	0	0	0	0	472403508.3	45084797331	5.70852	23.22	29.34067	116.904	185.192	28.352	90	426700	908922.9469	1.333333	161.177	186.594	188.366	199.356	200.797	0.196981	45.2
674.171875	1099.928905	0.582639	144520000	36080000	2960000	5600000	1360000	40000	0	0	0	0	0	0	0	0	0	0	537950997.1	45622748329	5.696449	23.207	29.290159	116.898	185.152	28.385	90	476400	919784.7277	1.333333	161.177	186.574	188.418	199.385	200.837	0.267494	45.2
681.1875	1102.511766	0.58641	137600000	35240000	3640000	4440000	1440000	0	0	0	0	0	0	0	0	0	0	0	515708402.9	46138456731	5.73531	23.294	29.90141	117.099	185.051	28.382	90	455900	930203.7526	1.333333	161.102	186.384	188.336	199.441	201.004	0.228956	45.2
688.171875	1099.665035	0.583409	128160000	31160000	2920000	4400000	1080000	0	0	0	0	0	0	0	0	0	0	0	465149851.3	46603606583	5.701802	23.284	29.6011	117.147	185.024	28.365	90	419300	939579.311	1.333333	161.111	186.374	188.356	199.418	201.027	0.245356	44.8
695.203125	1101.671349	0.584344	113560000	28760000	1840000	3520000	1320000	40000	0	0	0	0	0	0	0	0	0	0	419365444.4	47022972027	5.705686	23.302	29.447071	117.139	185.072	28.358	90	372600	948053.9208	1.333333	161.106	186.378	188.343	199.424	200.988	0.210919	44.8
702.203125	1102.404568	0.58459	127280000	32560000	2440000	3720000	1520000	40000	0	0	0	0	0	0	0	0	0	0	471462824	47494434851	5.702327	23.289	29.422143	117.174	185.085	28.371	90	418900	957563.9726	1.333333	161.115	186.382	188.32	199.411	201.05	0.186319	44.8
709.1875	1102.744267	0.584541	125120000	32160000	3280000	4200000	1240000	80000	0	0	0	0	0	0	0	0	0	0	473740443.4	47968175295	5.688577	23.323	29.618025	117.31	185.125	28.36	90	415200	967113.6114	1.333333	161.003	186.438	188.275	199.36	200.929	0.2142	45.2
716.171875	1102.935193	0.58541	135280000	33360000	2480000	4920000	1320000	0	0	0	0	0	0	0	0	0	0	0	495283507.4	48463458802	5.681099	23.301	29.785039	117.287	185.143	28.359	90	443400	977094.4388	1.333333	161.05	186.44	188.293	199.344	200.943	0.228137	45.2
723.15625	1096.312952	0.585246	127720000	34600000	2920000	4040000	1040000	0	0	0	0	0	0	0	0	0	0	0	474381227.1	48937840029	5.680286	23.351	29.831482	117.182	185.142	28.39	90	425800	986652.3939	1.333333	161.006	186.471	188.268	199.351	200.931	0.266675	45.2
730.15625	1104.646168	0.58559	126320000	31760000	2600000	4120000	1560000	80000	0	0	0	0	0	0	0	0	0	0	473398838	49411238867	5.677819	23.33	29.966484	117.066	185.137	28.381	90	416100	996248.1705	1.333333	161.007	186.466	188.267	199.347	200.953	0.187137	45.2
737.1875	1100.129514	0.584738	113880000	30000000	2640000	3440000	960000	80000	40000	0	0	0	0	0	0	0	0	0	433403799.7	49844642667	5.682962	23.361	29.981178	117.044	185.16	28.404	90	377600	1004966.976	1.333333	161.033	186.508	188.266	199.352	200.948	0.230594	45.2
744.171875	1101.702373	0.583754	138040000	35200000	2600000	5160000	1640000	0	0	0	0	0	0	0	0	0	0	0	518045062.7	50362687729	5.693406	23.369	30.057535	117.045	185.118	28.41	90	456600	1015431.301	1.333333	160.998	186.487	188.31	199.343	200.909	0.255194	44.8
751.15625	1097.908918	0.582852	123200000	31160000	2760000	3960000	1400000	120000	80000	0	0	0	0	0	0	0	0	0	476787404.7	50839475134	5.691201	23.389	29.944312	117.004	185.092	28.416	90	406700	1025048.486	1.333333	161.004	186.45	188.264	199.343	200.945	0.217475	44.4
758.15625	1101.640078	0.587378	133040000	34760000	2800000	4320000	1600000	80000	40000	0	0	0	0	0	0	0	0	0	509856063.3	51349331198	5.694901	23.35	30.203426	117.055	185.145	28.449	90	441600	1035368.226	1.333333	160.939	186.539	188.28	199.333	200.899	0.212556	44.4
765.140625	1102.071701	0.585295	137600000	34040000	1960000	4360000	1440000	80000	40000	0	0	0	0	0	0	0	0	0	505331377.9	51854662575	5.711327	23.359	29.474753	117.084	185.171	28.455	90	448800	1045561.743	1.333333	161.004	186.572	188.395	199.3	200.837	0.203538	44
772.125	1100.336207	0.584016	126200000	35440000	2760000	4560000	960000	0	0	0	0	0	0	0	0	0	0	0	477488977.7	52332151553	5.713925	23.292	29.377143	117	185.167	28.471	90	424800	1055189.852	1.333333	161.027	186.634	188.454	199.307	200.788	0.246175	44
779.140625	1098.110168	0.58523	110240000	27160000	2080000	3520000	960000	40000	0	0	0	0	0	0	0	0	0	0	399454640.2	52731606193	5.693379	23.285	29.834369	116.844	185.069	28.475	90	360000	1063257.177	1.333333	161.086	186.509	188.333	199.372	200.877	0.224856	43.6
786.109375	1097.552109	0.582147	117320000	30200000	2360000	3680000	1160000	80000	0	40000	0	0	0	0	0	0	0	0	444050062.2	53175656256	5.704006	23.279	29.39433	116.991	185.089	28.478	90	387100	1072243.323	1.333333	161.076	186.565	188.366	199.336	200.781	0.217475	43.6
793.125	1097.495802	0.582458	98200000	24440000	2160000	3360000	880000	80000	0	0	0	0	0	0	0	0	0	0	364629912.1	53540286168	5.698654	23.324	29.639672	117.164	184.984	28.481	90	322800	1079626.013	1.333333	161.014	186.352	188.441	199.34	201.011	0.2101	43.2
800.109375	1101.296965	0.582442	106120000	27360000	2200000	3360000	880000	0	0	0	0	0	0	0	0	0	0	0	384775345.6	53925061513	5.702511	23.324	29.4535	117.154	184.981	28.488	90	349800	1087416.989	1.333333	161.031	186.326	188.425	199.356	201.04	0.215837	43.2
807.09375	1104.15051	0.586263	112400000	28800000	2600000	3440000	960000	0	0	0	0	0	0	0	0	0	0	0	409767290.2	54334828803	5.711406	23.334	29.280319	117.154	184.984	28.481	90	370500	1095685.367	1.333333	161.014	186.303	188.411	199.353	201.021	0.239619	43.6
814.09375	1102.358118	0.585476	130440000	32640000	2240000	3840000	1520000	0	0	0	0	0	0	0	0	0	0	0	475586295.8	54810415099	5.688892	23.327	30.022112	117.196	185.046	28.478	90	426700	1105257.055	1.333333	160.907	186.414	188.251	199.303	200.88	0.244537	43.6
821.09375	1102.927305	0.583672	121480000	30440000	2720000	4280000	1360000	80000	40000	0	0	0	0	0	0	0	0	0	465621451.8	55276036551	5.692828	23.314	29.81036	117.189	185.099	28.458	90	401000	1114643.427	1.333333	160.926	186.454	188.323	199.271	200.837	0.259294	44
828.125	1103.315235	0.584672	124480000	33000000	2560000	4200000	1560000	40000	0	40000	0	0	0	0	0	0	0	0	489332927.8	55765369479	5.696423	23.275	29.414272	117.077	185.095	28.42	90	414700	1124502.704	1.333333	160.913	186.516	188.343	199.261	200.775	0.232237	44
835.109375	1102.122202	0.584065	97880000	24520000	1920000	3480000	800000	0	0	0	0	0	0	0	0	0	0	0	356775247.6	56122144726	5.697105	23.295	29.311282	117.01	185.099	28.439	90	321500	1131688.627	1.333333	160.965	186.546	188.405	199.258	200.722	0.271594	44
842.09375	1100.89401	0.584295	133640000	33760000	2600000	4840000	1440000	40000	0	0	0	0	0	0	0	0	0	0	499314704.6	56621459431	5.692881	23.337	29.354577	117.077	185.115	28.439	90	440800	1141756.369	1.333333	160.907	186.526	188.379	199.238	200.772	0.196981	44
849.09375	1098.961114	0.584393	131600000	31680000	2520000	4400000	1280000	80000	40000	0	0	0	0	0	0	0	0	0	486531370.2	57107990801	5.689181	23.262	29.385408	116.943	185.122	28.429	90	429000	1151577.304	1.333333	160.998	186.536	188.382	199.287	200.762	0.1855	43.6
856.078125	1101.031	0.583951	130240000	32760000	2600000	4440000	960000	0	0	0	0	0	0	0	0	0	0	0	469281991.6	57577272793	5.672597	23.246	29.734659	116.872	185.049	28.442	90	427500	1161066.711	1.333333	160.965	186.47	188.316	199.281	200.827	0.201081	43.6
863.078125	1101.659738	0.585705	111120000	26200000	2680000	3400000	1480000	0	40000	0	0	0	0	0	0	0	0	0	415200405.4	57992473198	5.681807	23.308	30.394056	116.952	185.004	28.465	90	362300	1169446.743	1.333333	160.929	186.391	188.303	199.317	200.88	0.145319	43.6
870.0625	1100.195578	0.586246	129680000	32800000	2680000	4120000	1240000	0	40000	0	0	0	0	0	0	0	0	0	479037157.2	58471510355	5.692067	23.294	30.13481	116.921	184.965	28.466	90	426400	1179109.682	1.333333	160.944	186.343	188.347	199.289	200.94	0.139581	43.6
877.046875	1101.367172	0.586099	148440000	37920000	3280000	5560000	1880000	40000	0	0	0	0	0	0	0	0	0	0	566944039.2	59038454395	5.691385	23.315	29.677851	116.858	184.986	28.404	90	492800	1190561.061	1.333333	160.943	186.306	188.382	199.345	200.958	0.187956	44

884.046875	1097.748751	0.579195	139520000	33720000	2440000	4200000	1200000	80000	0	0	0	0	0	0	0	0	0	0	499241197.9	59537695593	5.677845	23.354	30.175875	116.941	185.043	28.42	90	452900	1200634.222	1.333333	160.825	186.385	188.17	199.287	200.87	0.198619	44.4
891.03125	1098.72031	0.585098	147760000	39040000	3160000	5320000	1600000	80000	0	0	0	0	0	0	0	0	0	0	561825915	60099521507	5.684274	23.338	30.036019	116.861	185.045	28.437	90	492400	1212007.517	1.333333	160.838	186.421	188.209	199.257	200.876	0.1978	44.4
898.078125	1100.912935	0.582409	113160000	28120000	2000000	4360000	1160000	40000	0	0	0	0	0	0	0	0	0	0	423525081	60523046588	5.701697	23.254	29.009135	116.666	185.075	28.42	90	372100	1220573.544	1.333333	160.93	186.559	188.367	199.254	200.722	0.126462	44.8
905.0625	1099.890722	0.582294	116080000	29080000	2640000	3960000	1080000	40000	40000	0	0	0	0	0	0	0	0	0	434977443.5	60958024032	5.71277	23.244	29.43605	116.644	185.065	28.413	90	382300	1229353.68	1.333333	160.953	186.556	188.347	199.297	200.736	0.133025	44.4
912.0625	1098.645979	0.584033	126360000	33880000	2720000	5040000	1600000	80000	0	0	0	0	0	0	0	0	0	0	496346315.4	61454370347	5.685087	23.251	29.772575	116.583	185.049	28.4	90	424200	1239381.875	1.333333	160.953	186.389	188.262	199.321	200.803	0.065787	44.4
919.046875	1102.127076	0.586345	150120000	37760000	3040000	4720000	1280000	160000	40000	0	0	0	0	0	0	0	0	0	557269276.5	62011639624	5.670839	23.276	29.856541	116.66	184.951	28.422	90	492800	1250653.715	1.333333	160.882	186.379	188.253	199.315	200.891	0.105144	44.8
926.03125	1099.161857	0.581573	133800000	33520000	2800000	4440000	1080000	120000	40000	0	0	0	0	0	0	0	0	0	498766751	62510406375	5.685665	23.267	30.172857	116.656	184.902	28.448	90	439500	1260710.364	1.333333	160.901	186.366	188.272	199.292	200.868	0.108425	44.8
933.03125	1098.766294	0.584934	116720000	29000000	2240000	3640000	920000	0	0	0	0	0	0	0	0	0	0	0	416870431.5	62927276806	5.694954	23.293	30.055567	116.72	184.879	28.458	90	381300	1269138.411	1.333333	160.875	186.284	188.295	199.289	200.924	0.1322	44.8
940.015625	1103.304958	0.585705	128560000	32520000	2760000	4320000	1440000	40000	0	0	0	0	0	0	0	0	0	0	478839464.1	63406116270	5.709595	23.322	29.216295	116.74	184.859	28.493	90	424100	1278822.797	1.333333	160.862	186.258	188.315	199.318	200.947	0.090387	44.8
947	1103.25019	0.58623	132920000	34040000	2840000	4240000	1280000	80000	0	0	0	0	0	0	0	0	0	0	494052210.4	63900168481	5.692618	23.341	29.603593	116.723	184.924	28.477	90	438500	1288773.752	1.333333	160.839	186.261	188.141	199.305	200.862	0.123181	44.4
954.015625	1098.542985	0.585754	144560000	35280000	3040000	4800000	1840000	0	0	0	0	0	0	0	0	0	0	0	538378221	64438546702	5.700359	23.265	29.444447	116.607	185.005	28.466	90	473800	1299618.038	1.333333	160.892	186.472	188.283	199.256	200.711	0.075625	44.8
961	1101.158324	0.583114	118640000	31760000	2440000	3480000	1160000	40000	0	0	0	0	0	0	0	0	0	0	439085555.8	64877632257	5.671049	23.252	29.558199	116.536	184.998	28.489	90	393800	1308500.218	1.333333	160.886	186.347	188.194	199.289	200.753	0.069887	44.8
968.03125	1102.191247	0.58723	134520000	34440000	2560000	4840000	1640000	40000	0	0	0	0	0	0	0	0	0	0	511069263.8	65388701521	5.668819	23.295	30.278209	116.643	184.897	28.468	90	445100	1318813.989	1.333333	160.809	186.322	188.192	199.27	200.843	0.046925	44.8
975.015625	1102.314729	0.585476	139720000	35040000	2480000	4240000	1720000	80000	0	0	0	0	0	0	0	0	0	0	517302527.9	65906004049	5.690676	23.339	29.66355	116.69	184.844	28.424	90	458200	1329243.768	1.333333	160.82	186.226	188.293	199.256	200.901	0.108425	44.8
982.015625	1104.925053	0.585115	145880000	37120000	3240000	5080000	1400000	0	0	0	0	0	0	0	0	0	0	0	541710961.8	66447715011	5.6753	23.393	29.78189	116.904	184.951	28.513	90	481800	1340164.444	1.333333	160.832	186.25	188.107	199.235	200.795	0.073169	44.8
989.015625	1103.350686	0.588444	136480000	35240000	2600000	4640000	1320000	40000	0	0	0	0	0	0	0	0	0	0	508249160.6	66955964172	5.693642	23.294	28.848681	116.946	185.037	28.499	90	450800	1350386.337	1.333333	160.823	186.493	188.291	199.196	200.638	0.03545	44.4
996	1101.812068	0.587493	132000000	32680000	2880000	4720000	1160000	40000	0	0	0	0	0	0	0	0	0	0	486797645.7	67442761817	5.688184	23.351	29.335684	116.916	185.002	28.531	90	433700	1360190.768	1.333333	160.895	186.413	188.171	199.25	200.711	0.028887	44
1002.984375	1105.331602	0.586181	130400000	31480000	2400000	4120000	1320000	40000	40000	0	0	0	0	0	0	0	0	0	476914121.5	67919675939	5.676796	23.377	30.390513	117.156	184.927	28.535	90	424500	1369809.551	1.333333	160.82	186.278	188.23	199.236	200.842	0.065787	43.6
1009.984375	1101.275592	0.585295	137720000	34920000	2840000	4960000	1160000	80000	0	0	0	0	0	0	0	0	0	0	513929664.7	68433605604	5.679525	23.371	30.124052	117.191	184.897	28.56	90	454200	1380141.889	1.333333	160.83	186.272	188.272	199.246	200.868	0.05185	43.6
1016.96875	1101.750612	0.586656	125120000	31960000	2560000	3880000	1320000	40000	0	0	0	0	0	0	0	0	0	0	461938357.6	68895543961	5.705135	23.381	29.411385	117.204	184.91	28.531	90	412200	1389463.168	1.333333	160.866	186.213	188.289	199.266	200.891	0.033806	43.6
1023.96875	1103.335565	0.586345	128480000	32200000	3120000	4840000	1200000	40000	0	0	0	0	0	0	0	0	0	0	483001368.5	69378545330	5.689522	23.374	29.18507	117.213	185.022	28.525	90	424700	1399205.267	1.333333	160.83	186.433	188.279	199.158	200.613	0.028887	43.6
1030.96875	1102.195636	0.583737	119480000	32280000	2240000	4000000	1160000	40000	0	0	0	0	0	0	0	0	0	0	449905410.5	69828450740	5.678764	23.293	29.40968	116.964	184.989	28.505	90	398000	1408266.787	1.333333	160.915	186.377	188.207	199.207	200.688	-0.01785	43.6
1037.96875	1100.362816	0.586115	120800000	32280000	2240000	4480000	1760000	0	40000	0	0	0	0	0	0	0	0	0	474297214.4	70302747955	5.686583	23.429	29.441561	117.181	184.92	28.486	90	404000	1417829.462	1.333333	160.889	186.259	188.138	199.23	200.839	0.028069	43.6
1044.953125	1102.251474	0.58559	137080000	34520000	2440000	4120000	1640000	80000	0	0	0	0	0	0	0	0	0	0	505917153.2	70808665108	5.668714	23.419	29.662632	117.169	184.992	28.492	90	449700	1428046.64	1.333333	160.856	186.249	188.102	199.207	200.796	0.057587	43.6
1051.953125	1100.835097	0.582163	143200000	34720000	2720000	4920000	1800000	160000	0	0	0	0	0	0	0	0	0	0	540307635.8	71348972744	5.70314	23.339	28.900504	117.098	185.064	28.48	90	468800	1438939.65	1.333333	160.873	186.469	188.308	199.161	200.606	0.021512	43.6
1058.953125	1100.57031	0.584574	125440000	34440000	2680000	4400000	1040000	80000	0	0	0	0	0	0	0	0	0	0	477098937.5	71826071681	5.694455	23.348	30.351548	117.14	184.956	28.499	90	420200	1448570.701	1.333333	160.889	186.265	188.315	199.217	200.885	0.00675	43.6
1065.9375	1100.071494	0.584262	125080000	30920000	1840000	4240000	1400000	120000	0	0	0	0	0	0	0	0	0	0	462292861.8	72288364543	5.685481	23.381	30.103585	117.175	184.904	28.505	90	409000	1457905.111	1.333333	160.895	186.252	188.269	199.24	200.849	0.05185	43.6
1072.9375	1104.534258	0.584885	132880000	31880000	3320000	4320000	1440000	0	0	0	0	0	0	0	0	0	0	0	487582416.6	72775946960	5.702747	23.384	29.45573	117.2	184.923	28.554	90	434600	1467754.621	1.333333	160.908	186.242	188.308	199.25	200.865	-0.007188	43.6
1079.921875	1100.455057	0.584197	145360000	32160000	2240000	5560000	1400000	120000	0	0	0	0	0	0	0	0	0	0	524314038.7	73300260998	5.713216	23.397	29.419913	117.137	184.907	28.538	90	467100	1478303.341	1.333333	160.905	186.219	188.217	199.246	200.888	0.00675	44
1086.90625	1105.291261	0.58728	116680000	29120000	2440000	4080000	1440000	80000	0	0	0	0	0	0	0	0	0	0	440787822.2	73741048820	5.683487	23.41	29.828071	117.2	184.973	28.586	90	384600	1487204.464	1.333333	160.873	186.269	188.121	199.184	200.806	-0.007188	44
1093.90625	1097.905258	0.581933	118360000	29120000	2120000	4200000	1240000	40000	0	0	0	0	0	0	0	0	0	0	438092807.5	74179141628	5.704636	23.329	29.296063	116.909	185.045	28.593	90	387700	1496012.455	1.333333	160.934	186.478	188.312	199.187	200.619	-0.039988	44
1100.90625	1103.2392	0.586296	128840000	32840000	2800000	4240000	880000	80000	0	0	0	0	0	0	0	0	0	0	470658270.6	74649799899	5.688131	23.312	29.390394	116.702	185.006	28.594	90	424200	1505538.844	1.333333	160.969	186.45	188.208	199.192	200.696	-0.023588	44
1107.9375	1103.00401	0.586443	134440000	33320000	2800000	4040000	1840000	80000	0	40000	0	0	0	0	0	0	0	0	518499807.9	75168299706	5.702406	23.28	29.313512	116.664	185.02	28.58	90	441400	1515982.833	1.333333	160.986	186.46	188.274	199.203	200.688	0.020687	44
1114.921875	1101.100471	0.580753	118320000	30240000	2640000	3880000	920000	80000	0	0	0	0	0	0	0	0	0	0	437057447.5	75605357154	5.688787	23.318	29.373732	116.692	185.055	28.585	90	390200	1524788.229	1.333333	160.965	186.495	188.293	199.195	200.643	0.048569	44
1121.90625	1103.699919	0.585476	125600000	31320000	2560000	3960000	1320000	80000	0	0	0	0	0	0	0	0	0	0	463563513.3	76068920667	5.681545	23.315	29.510837	116.773	185.01	28.587	90	412100	1534143.789	1.333333	160.946	186.375	188.209	199.207	200.747	0.086287	44
1128.90625	1101.588287	0.58277	138640000	35840000	3040000	5600000	1840000	40000	0	0	0	0	0	0	0	0	0	0	540708516.4	76609629184	5.679708	23.333	30.27283	116.93	184.939	28.573	90	462500	1545030.575	1.333333	160.938	186.302	188.227	199.243	200.868	0.110881	44
1135.890625	1105.284414	0.584049	138360000	35160000	3040000	5160000	1400000	80000	0	40000	0	0	0	0	0	0	0	0	533677798.7	77143306982	5.688262	23.399	29.988788	116.945	184.939	28.592	90	458100	1555796.4	1.333333	160.944	186.304	188.298	199.225	200.883	0.063325	44
1142.875	1094.615841	0.581277	137400000	34600000	2920000	4680000	1440000	0	0	0	0	0	0	0	0	0	0	0	509414813.2	77652721796	5.703508	23.392	29.556624	116.859	184.922	28.598	90	452600	1566038.406	1.333333	160.928	186.268	188.321	199.251	200.926	0.069069	44
1149.875	1099.260528	0.581081	110520000	27440000	2520000	3360000	1200000	0	0	40000	0	0	0	0	0	0	0	0	413879518.2	78066601314	5.705896	23.417	29.163554	116.853	184.956	28.593	90	362700	1574440.735	1.333333	160.958	186.259	188.339	199.24	200.911	0.015769	43.6
1156.90625	1100.153951	0.582999	128200000	28880000	2600000	3720000	1320000	40000	0	0	0	0	0	0	0	0	0	0	455042867.5	78521644181	5.703245	23.398	29.200945	116.818	184.949	28.611	90	411900	1583639.704	1.333333	160.949	186.266	188.307	199.267	200.945	0.059225	43.6
1163.859375	1098.389186	0.583967	133000000	34080000	2560000	3840000	1600000	0	0	40000	0	0	0	0	0	0	0	0	496896837.9	79018541019	5.678895	23.382	29.85208	116.853	184.982	28.563	90	437800	1593676.619	1.333333	160.854	186.309	188.13	199.212	200.84	0.057587	43.6
1170.890625	1102.975083	0.583639	113120000	27840000	2440000	4200000	1080000	0	0	0	0	0	0	0	0	0	0	0	418545615	79437086634	5.689601	23.391	30.173382	116.872	185.015	28.544	90	371700	1602144.487	1.333333	160.854	186.421	188.248	199.176	200.736	0.075625	43.6

1177.890625	1103.904905	0.588772	136200000	33480000	3360000	4600000	1400000	80000	40000	0	0	0	0	0	0	0	0	0	515670893.8	79952757528	5.696712	23.353	29.509	116.84	185.057	28.525	90	447900	1612533.981	1.333333	160.84	186.446	188.28	199.161	200.721	0.100225	43.6
1184.875	1102.790752	0.587575	135440000	32400000	2760000	5160000	1160000	120000	0	0	0	0	0	0	0	0	0	0	501384588.2	80454142116	5.698968	23.346	29.11934	116.767	185.041	28.534	90	442600	1622627.132	1.333333	160.909	186.444	188.317	199.172	200.703	0.061687	44
1191.859375	1102.339934	0.58459	141840000	36000000	2680000	4480000	1520000	40000	0	0	0	0	0	0	0	0	0	0	522625718	80976767834	5.698365	23.365	28.901422	116.764	185.061	28.527	90	466400	1633158.509	1.333333	160.919	186.522	188.294	199.199	200.673	0.073169	44
1198.859375	1100.511297	0.582425	148960000	37880000	2360000	4800000	1280000	0	0	0	0	0	0	0	0	0	0	0	537282736.8	81514050571	5.676927	23.291	30.307334	116.677	184.953	28.54	90	488200	1643989.666	1.333333	160.893	186.299	188.189	199.212	200.876	0.102687	43.6
1205.84375	1103.389818	0.586886	115880000	30640000	2800000	4000000	1360000	40000	0	0	0	0	0	0	0	0	0	0	443488707.7	81957539279	5.689128	23.398	30.354303	116.709	184.894	28.521	90	386800	1652944.871	1.333333	160.89	186.25	188.254	199.235	200.876	0.065787	43.6
1212.84375	1101.858702	0.583524	138120000	37720000	2520000	5160000	1640000	40000	0	0	0	0	0	0	0	0	0	0	533780985.4	82491320264	5.707234	23.382	29.587325	116.751	184.903	28.498	90	463000	1663695.197	1.333333	160.896	186.217	188.304	199.294	200.893	0.038731	43.6
1219.828125	1103.608516	0.586296	142240000	35760000	2720000	5360000	1720000	0	0	0	0	0	0	0	0	0	0	0	533966962.6	83025287227	5.711458	23.443	29.450613	116.744	184.871	28.511	90	469500	1674464.211	1.333333	160.913	186.211	188.284	199.251	200.945	0.070706	43.6
1226.828125	1102.588627	0.584442	142440000	34560000	3040000	5080000	960000	0	40000	0	0	0	0	0	0	0	0	0	519104563.5	83544391790	5.68409	23.446	29.774149	116.856	184.923	28.514	90	465300	1684916.882	1.333333	160.812	186.247	188.081	199.192	200.834	0.06415	43.6
1233.828125	1098.651016	0.585689	157200000	36680000	3080000	4640000	1680000	0	0	40000	0	0	0	0	0	0	0	0	571760871.9	84116152662	5.718333	23.395	29.05899	116.744	185.012	28.527	90	508300	1696440.489	1.333333	160.851	186.43	188.261	199.159	200.693	0.074806	43.6
1240.8125	1102.76634	0.584787	138000000	35720000	3560000	4360000	1600000	40000	40000	0	0	0	0	0	0	0	0	0	526272330.8	84642424993	5.719068	23.333	28.880037	116.604	184.975	28.54	90	458300	1707085.307	1.333333	160.88	186.453	188.317	199.172	200.706	0.143681	44
1247.796875	1100.802726	0.583852	126800000	31040000	2880000	4440000	1640000	0	0	0	0	0	0	0	0	0	0	0	475294628.4	85117719621	5.696659	23.34	29.404825	116.536	184.946	28.531	90	417000	1716663.132	1.333333	160.949	186.381	188.156	199.212	200.758	0.137944	44
1254.796875	1100.350077	0.586394	158840000	40640000	3600000	5320000	1880000	0	80000	0	0	0	0	0	0	0	0	0	608247769.1	85725967390	5.70049	23.42	29.865462	116.751	184.851	28.563	90	525900	1728942.005	1.333333	160.887	186.191	188.241	199.222	200.913	0.234694	44
1261.828125	1103.487061	0.58377	126960000	32040000	3320000	3680000	1360000	40000	40000	0	0	0	0	0	0	0	0	0	479374861.3	86205342252	5.685743	23.372	30.432759	116.773	184.834	28.556	90	418600	1738623.265	1.333333	160.841	186.214	188.218	199.202	200.89	0.129744	44
1268.78125	1102.622062	0.586033	135080000	35080000	2320000	4200000	1240000	0	0	0	0	0	0	0	0	0	0	0	489211450.1	86694553702	5.686609	23.466	29.726	116.92	184.91	28.592	90	444800	1748475.093	1.333333	160.756	186.253	188.028	199.172	200.827	0.158444	44.4
1275.78125	1102.002573	0.584475	122840000	31000000	2320000	3760000	1240000	0	0	0	0	0	0	0	0	0	0	0	447345264.7	87141898966	5.692251	23.356	29.033275	116.872	184.992	28.579	90	402900	1757490.881	1.333333	160.815	186.414	188.235	199.136	200.673	0.169919	44
1282.78125	1107.399917	0.587034	133280000	34240000	3000000	5000000	1000000	0	40000	0	0	0	0	0	0	0	0	0	500012560.1	87641911527	5.692015	23.353	29.236368	116.645	184.949	28.563	90	441400	1767573.788	1.333333	160.913	186.362	188.182	199.212	200.722	0.147781	44
1289.828125	1102.037437	0.58541	129000000	32920000	2760000	3880000	1800000	40000	0	0	0	0	0	0	0	0	0	0	492896693.9	88134808220	5.673043	23.369	29.976718	116.76	184.871	28.569	90	426000	1777464.759	1.333333	160.815	186.306	188.163	199.195	200.834	0.164181	44.4
1296.8125	1103.744523	0.585213	111120000	28760000	3360000	3880000	1160000	40000	0	0	0	0	0	0	0	0	0	0	426142292.9	88560950513	5.689469	23.395	30.281095	116.863	184.834	28.553	90	370800	1786057.778	1.333333	160.841	186.257	188.153	199.199	200.863	0.103506	44.4
1303.8125	1100.741074	0.584902	119960000	31840000	2400000	4560000	1240000	0	0	0	0	0	0	0	0	0	0	0	455830847.3	89016781361	5.699677	23.456	29.583389	116.888	184.848	28.521	90	400000	1795235.241	1.333333	160.844	186.181	188.186	199.202	200.863	0.145319	44.4
1310.796875	1099.156005	0.584344	141000000	33480000	3320000	4560000	1920000	40000	0	0	0	0	0	0	0	0	0	0	524777407.2	89541558768	5.691543	23.505	29.383309	116.892	184.838	28.534	90	460800	1805829.667	1.333333	160.825	186.168	188.087	199.185	200.87	0.198619	44
1317.78125	1104.477448	0.58951	116320000	28160000	2520000	4040000	1320000	0	0	0	0	0	0	0	0	0	0	0	427607343	89969166111	5.673148	23.443	29.619861	116.911	184.884	28.527	90	380900	1814474.832	1.333333	160.753	186.221	187.989	199.166	200.795	0.155163	44.4
1324.78125	1102.268985	0.580097	155760000	42040000	2920000	4840000	1480000	40000	40000	0	0	0	0	0	0	0	0	0	587102740.1	90556268851	5.674959	23.408	30.210905	117.023	184.946	28.492	90	517800	1826287.412	1.333333	160.714	186.303	188.153	199.09	200.686	0.192881	44.4
1331.78125	1099.076598	0.585705	118840000	32120000	2200000	3720000	1360000	120000	0	0	0	0	0	0	0	0	0	0	454149853.7	91010418705	5.682988	23.372	29.293177	116.786	184.949	28.514	90	395900	1835443.27	1.333333	160.818	186.384	188.179	199.117	200.601	0.212556	44.4
1338.765625	1103.209254	0.58723	142480000	36120000	2960000	5080000	1240000	0	0	0	0	0	0	0	0	0	0	0	522456187.6	91532874892	5.684169	23.375	28.932778	116.856	184.943	28.518	90	469700	1846006.809	1.333333	160.772	186.371	188.159	199.058	200.552	0.192881	44
1345.75	1105.454939	0.586509	154040000	38440000	3560000	4760000	1440000	120000	0	0	0	0	0	0	0	0	0	0	569536565	92102411457	5.678108	23.356	29.324664	116.716	184.903	28.511	90	505900	1857479.127	1.333333	160.844	186.365	188.107	199.087	200.585	0.165819	44.4
1352.75	1103.281009	0.583836	138800000	33520000	2720000	3480000	1040000	40000	0	0	0	0	0	0	0	0	0	0	486784207.9	92589195665	5.697289	23.45	29.315349	116.904	184.792	28.514	90	449000	1867264.625	1.333333	160.776	186.119	188.153	199.117	200.821	0.163362	44.4
1359.75	1103.800859	0.584574	125560000	29640000	2840000	3400000	1200000	0	40000	0	0	0	0	0	0	0	0	0	452038138.6	93041233804	5.686216	23.427	29.629964	116.911	184.821	28.501	90	406700	1876369.551	1.333333	160.756	186.139	187.995	199.117	200.775	0.107606	44.8
1366.75	1099.406726	0.587362	131720000	31440000	3320000	4280000	1320000	40000	0	0	0	0	0	0	0	0	0	0	484697851.1	93525931655	5.705371	23.388	29.430146	116.92	184.903	28.482	90	430300	1886127.709	1.333333	160.74	186.352	188.146	199.022	200.588	0.133025	44.8
1373.734375	1100.144881	0.584754	120800000	29800000	2160000	3560000	880000	40000	0	0	0	0	0	0	0	0	0	0	427044172.7	93952975828	5.69624	23.34	29.382391	116.661	184.903	28.482	90	393100	1894759.52	1.333333	160.851	186.319	188.1	199.071	200.627	0.071525	44.8
1380.734375	1101.905991	0.583606	138040000	34760000	2800000	4280000	1600000	160000	40000	0	0	0	0	0	0	0	0	0	524896041.1	94477871869	5.693012	23.34	29.480526	116.732	184.946	28.495	90	454200	1905362.084	1.333333	160.844	186.303	188.048	199.077	200.641	0.094487	44.8
1387.71875	1101.174412	0.583196	148920000	36280000	3480000	4760000	1200000	40000	0	0	0	0	0	0	0	0	0	0	538721732.7	95016593601	5.68165	23.397	30.443255	116.902	184.799	28.503	90	486700	1916226.526	1.333333	160.776	186.193	188.177	199.109	200.797	0.113344	44.8
1394.71875	1105.045518	0.586788	131000000	32720000	2720000	4400000	1160000	0	40000	0	0	0	0	0	0	0	0	0	483574467.1	95500168068	5.698024	23.419	29.554001	116.976	184.82	28.507	90	430100	1925985.288	1.333333	160.818	186.158	188.215	199.145	200.859	0.079725	44.8
1401.71875	1102.65257	0.585066	139360000	34080000	2760000	4640000	1160000	0	0	40000	0	0	0	0	0	0	0	0	514547285.8	96014715354	5.6806	23.441	29.901279	117.069	184.903	28.476	90	455100	1936332.721	1.333333	160.747	186.225	188.01	199.121	200.779	0.069887	44.8
1408.703125	1100.97802	0.585508	140040000	34560000	3120000	4760000	1480000	80000	0	0	0	0	0	0	0	0	0	0	521693599.6	96536408954	5.685192	23.376	30.164198	117.047	184.912	28.516	90	460100	1946846.632	1.333333	160.762	186.342	188.173	199.073	200.725	0.005931	44.4
1415.6875	1097.809395	0.585738	154560000	37240000	2880000	4720000	1960000	120000	0	0	0	0	0	0	0	0	0	0	569991505.1	97106400459	5.69393	23.344	29.41414	116.931	184.932	28.499	90	503700	1958351.383	1.333333	160.789	186.445	188.219	199.098	200.671	0.075625	44.8
1422.6875	1102.129507	0.585574	125360000	32360000	2720000	4480000	1640000	80000	0	0	0	0	0	0	0	0	0	0	481744666.7	97588145126	5.697263	23.385	29.408892	116.801	185.015	28.527	90	416600	1968103.018	1.333333	160.913	186.49	188.292	199.146	200.676	0.059225	44.8
1429.671875	1100.900615	0.581556	135840000	35880000	2640000	3960000	1280000	120000	40000	0	0	0	0	0	0	0	0	0	510514068.3	98098659194	5.686819	23.358	29.283468	116.728	184.977	28.507	90	449400	1978396.507	1.333333	160.944	186.423	188.198	199.184	200.712	0.069069	44.8
1436.671875	1100.056051	0.582212	138760000	33160000	3160000	5200000	1160000	80000	40000	0	0	0	0	0	0	0	0	0	517468032.6	98616127227	5.664437	23.381	29.816526	116.82	184.943	28.531	90	453900	1988841.854	1.333333	160.93	186.326	188.223	199.175	200.791	-0.029325	44.8
1443.703125	1102.460671	0.587345	134400000	36120000	2440000	4920000	1600000	0	40000	0	0	0	0	0	0	0	0	0	519788109.9	99135915336	5.68884	23.386	30.044022	116.819	184.859	28.516	90	448800	1999342.089	1.333333	160.922	186.286	188.274	199.227	200.872	0.05185	44.8
1450.6875	1105.270689	0.586345	121400000	32880000	2720000	4000000	1840000	40000	0	0	0	0	0	0	0	0	0	0	474313201.3	99610228538	5.68165	23.426	29.919778	116.807	184.899	28.545	90	407200	2008902.787	1.333333	160.954	186.288	188.31	199.258	200.919	-0.016206	44.8
1457.6875	1100.466243	0.58515	116080000	30560000	2360000	4160000	1120000	0	0	0	0	0	0	0	0	0	0	0	436247174.5	1.00046E+11	5.693616	23.488	29.505982	116.886	184.931	28.579	90	385700	2017673.834	1.333333	160.963	186.287	188.252	199.272	200.956	0.016587	44.8
1464.671875	1102.702178	0.587443	119480000	30240000	2320000	3880000	1520000	80000	0	0	0	0	0	0	0	0	0	0	4492734246	1.00496E+11	5.660055	23.48	29.602412	116.919	184.99	28.568	90	393800	2026746.22	1.333333	160.96	186.37	188.194	199.269	200.921	0.073169	44.8

1471.671875	1102.124734	0.585656	105080000	24960000	2200000	2880000	1040000	40000	40000	0	0	0	0	0	0	0	0	0	382158908	1.00878E+11	5.693878	23.383	29.364417	116.772	185.079	28.549	90	340600	2034447.683	1.333333	161.012	186.501	188.384	199.243	200.737	0.054306	44.8
1478.671875	1102.28581	0.584984	148600000	37920000	3280000	4440000	1680000	0	0	0	0	0	0	0	0	0	0	0	549642729.2	1.01428E+11	5.650031	23.396	30.184534	116.724	185.017	28.536	90	489800	2045530.17	1.333333	161.035	186.403	188.309	199.259	200.898	0.034631	44.8
1485.671875	1105.460823	0.58377	138920000	35320000	3240000	4480000	1080000	40000	0	0	0	0	0	0	0	0	0	0	509867249.7	1.01937E+11	5.698339	23.513	29.562004	116.836	184.974	28.529	90	457700	2055809.158	1.333333	161.012	186.36	188.266	199.312	200.98	0.065787	44.8
1492.65625	1100.467795	0.58518	121000000	32080000	3120000	3800000	1000000	120000	0	0	0	0	0	0	0	0	0	0	458530706.3	1.02396E+11	5.667769	23.493	29.76431	116.906	185.069	28.565	90	402800	2065026.646	1.333333	160.934	186.429	188.207	199.269	200.921	0.078087	44.8
1499.625	1099.323686	0.582917	131960000	34080000	3200000	4280000	1440000	40000	0	0	0	0	0	0	0	0	0	0	494568757.1	1.02891E+11	5.689889	23.471	29.663157	116.778	184.987	28.584	90	437500	2075013.687	1.333333	161.038	186.363	188.437	199.345	201.022	0.025612	44.8
1506.671875	1101.539686	0.584852	126320000	29920000	2160000	4280000	1280000	40000	0	0	0	0	0	0	0	0	0	0	458801319.3	1.03349E+11	5.689942	23.503	29.450876	116.807	184.997	28.6	90	410000	2084288.102	1.333333	161.009	186.386	188.25	199.345	201.003	0.063325	44.8
1513.65625	1101.01621	0.583163	153000000	36560000	3000000	5280000	1200000	40000	0	0	0	0	0	0	0	0	0	0	548922004.9	1.03898E+11	5.670157	23.474	29.980785	116.849	185.099	28.587	90	497700	2095361.936	1.333333	160.901	186.511	188.286	199.299	200.904	0.04365	44.8
1520.65625	1098.938259	0.584672	145080000	36440000	2680000	4040000	1560000	80000	0	0	0	0	0	0	0	0	0	0	529419166.2	1.04428E+11	5.689391	23.461	29.947329	116.753	185.095	28.565	90	474700	2106047.401	1.333333	160.947	186.567	188.4	199.282	200.839	0.066606	44.8
1527.640625	1101.15669	0.585426	131320000	32840000	3040000	4160000	1360000	120000	0	0	0	0	0	0	0	0	0	0	489359341.3	1.04917E+11	5.700674	23.451	29.151615	116.625	185.115	28.587	90	432100	2115942.999	1.333333	160.983	186.596	188.456	199.292	200.8	0.092025	44.4
1534.625	1106.01716	0.588509	139360000	35200000	2440000	4640000	1520000	40000	0	0	0	0	0	0	0	0	0	0	513694075.7	1.05431E+11	5.739981	23.471	29.425948	116.669	185.125	28.591	90	458000	2126309.757	1.333333	160.99	186.619	188.482	199.289	200.78	0.110062	44.4
1541.609375	1098.913898	0.587362	140720000	36600000	3680000	4800000	1840000	40000	0	0	0	0	0	0	0	0	0	0	544119469.5	1.05975E+11	5.740427	23.429	29.914137	116.721	185.007	28.591	90	469200	2137242.267	1.333333	161.048	186.58	188.427	199.328	200.79	0.064969	44
1548.59375	1101.501344	0.584902	151720000	36280000	3240000	4960000	1240000	120000	40000	0	0	0	0	0	0	0	0	0	554705251.1	1.0653E+11	5.723607	23.419	30.023949	116.676	184.961	28.613	90	494000	2148459.509	1.333333	161.038	186.501	188.318	199.367	200.872	0.106781	44.4
1555.640625	1103.466036	0.588181	133040000	33320000	2680000	4880000	1520000	80000	0	0	0	0	0	0	0	0	0	0	506190597.7	1.07036E+11	5.716995	23.429	30.625095	116.865	184.882	28.623	90	438800	2158671.643	1.333333	160.96	186.376	188.345	199.341	200.967	0.098587	44
1562.625	1097.623578	0.583065	125280000	30200000	2400000	3960000	1160000	40000	0	40000	0	0	0	0	0	0	0	0	462450254.4	1.07498E+11	5.748351	23.503	29.844602	116.964	184.823	28.613	90	407700	2167984.728	1.333333	160.993	186.357	188.309	199.381	201.013	0.087925	44
1569.578125	1096.654295	0.580589	144080000	37440000	2840000	4560000	2120000	0	0	0	0	40000	0	0	0	0	0	0	569643128.7	1.08068E+11	5.683644	23.522	29.950872	117.108	184.905	28.623	90	477700	2179517.585	1.333333	160.885	186.37	188.21	199.309	200.914	0.04365	44
1576.625	1104.619872	0.587427	138120000	33000000	2480000	4200000	1160000	40000	0	0	0	0	0	0	0	0	0	0	491491250.4	1.08559E+11	5.727858	23.442	29.420175	116.919	185.007	28.607	90	447500	2189476.993	1.333333	160.99	186.563	188.459	199.256	200.77	0.088744	44
1583.609375	1105.506654	0.586443	124320000	32680000	2400000	4480000	1280000	80000	0	0	0	0	0	0	0	0	0	0	472133007.4	1.09031E+11	5.721954	23.442	29.894195	116.868	184.905	28.594	90	413100	2198975.143	1.333333	161.045	186.475	188.299	199.328	200.839	0.032169	44
1590.609375	1102.681638	0.587214	156520000	38760000	3160000	5080000	1560000	40000	40000	0	0	0	0	0	0	0	0	0	581434901.4	1.09613E+11	5.711353	23.429	30.626669	117.095	184.833	28.591	90	512900	2210662.793	1.333333	160.99	186.393	188.296	199.315	200.921	0.059225	44
1597.609375	1103.861259	0.58705	126920000	31000000	2520000	5000000	1480000	40000	0	0	0	0	0	0	0	0	0	0	478609523.8	1.10091E+11	5.686688	23.513	29.509656	117.232	184.885	28.594	90	417400	2220308.159	1.333333	161.003	186.308	188.25	199.338	200.957	0.062506	44
1604.59375	1101.180812	0.583475	134320000	33440000	3280000	4720000	1600000	0	0	0	0	0	0	0	0	0	0	0	505336670.6	1.10597E+11	5.670944	23.5	30.260891	117.328	185.01	28.561	90	443400	2230481.27	1.333333	160.937	186.504	188.338	199.266	200.842	0.076444	44
1611.578125	1105.588896	0.587411	132800000	32720000	2520000	4080000	1360000	0	0	0	0	0	0	0	0	0	0	0	479214492.6	1.11076E+11	5.689076	23.442	29.126687	117.248	185.069	28.542	90	433700	2240151.99	1.333333	161.003	186.524	188.466	199.243	200.75	0.058406	44
1618.578125	1104.118356	0.586017	126080000	32120000	2840000	3520000	1440000	80000	0	0	0	0	0	0	0	0	0	0	471027141.1	1.11547E+11	5.667376	23.429	29.525006	117.057	185.066	28.581	90	415200	2249619.587	1.333333	161.11	186.481	188.315	199.325	200.839	0.045287	44.4
1625.5625	1098.725459	0.583623	142960000	34040000	2680000	5280000	1800000	0	0	0	0	0	0	0	0	0	0	0	529576690.4	1.12077E+11	5.687816	23.458	29.874515	117.268	184.984	28.574	90	466900	2260278.2	1.333333	161.078	186.386	188.446	199.361	200.983	0.056769	44.4
1632.5625	1101.14724	0.584557	128280000	32240000	3200000	4040000	1280000	40000	0	40000	0	0	0	0	0	0	0	0	486060603.8	1.12563E+11	5.685061	23.487	29.539175	117.312	185.049	28.552	90	422800	2270108.997	1.333333	161.11	186.419	188.286	199.39	200.996	0.03955	44.4
1639.5625	1102.614694	0.585951	118200000	30320000	2760000	4000000	1080000	40000	0	0	0	0	0	0	0	0	0	0	440777122.3	1.13003E+11	5.683513	23.442	29.392624	117.351	185.171	28.578	90	391000	2279004.308	1.333333	161.061	186.678	188.469	199.295	200.832	0.066606	44.4
1646.546875	1101.029844	0.585361	125320000	31080000	3400000	4520000	1440000	0	40000	0	0	0	0	0	0	0	0	0	479274310.6	1.13483E+11	5.657851	23.374	29.393936	117.015	185.217	28.565	90	414500	2288663.657	1.333333	161.231	186.596	188.404	199.358	200.859	0.127281	44.4
1653.546875	1102.993596	0.58482	115240000	28200000	1960000	3400000	1400000	0	0	0	0	0	0	0	0	0	0	0	417481364	1.139E+11	5.663702	23.421	30.396286	117.176	185.175	28.515	90	375500	2297089.736	1.333333	161.183	186.568	188.448	199.432	201.057	0.070706	44.8
1660.53125	1101.206476	0.583983	130320000	32160000	2480000	4640000	1240000	0	0	0	0	0	0	0	0	0	0	0	476252753.7	1.14376E+11	5.693799	23.466	29.594278	117.108	185.162	28.526	90	427100	2306684.891	1.333333	161.229	186.509	188.612	199.465	201.147	0.070706	44.4
1667.53125	1101.866228	0.585312	146080000	34920000	2920000	4240000	1440000	0	0	40000	0	0	0	0	0	0	0	0	531910471.7	1.14908E+11	5.662102	23.502	29.688084	117.195	185.277	28.522	90	474100	2317418.784	1.333333	161.171	186.608	188.416	199.479	201.088	0.070706	44.4
1674.53125	1104.177372	0.584508	123320000	28640000	2680000	3920000	960000	0	0	0	0	0	0	0	0	0	0	0	436100873.7	1.15345E+11	5.696161	23.443	29.082868	117.1	185.397	28.501	90	398800	2326213.981	1.333333	161.251	186.807	188.68	199.45	200.984	0.070706	44.4
1681.53125	1104.364412	0.585722	123320000	31560000	2840000	3640000	1120000	160000	0	0	0	0	0	0	0	0	0	0	462321274.9	1.15807E+11	5.671863	23.393	30.182304	116.959	185.295	28.493	90	406600	2335518.47	1.333333	161.281	186.692	188.628	199.566	201.168	0.110062	44.8
1688.515625	1099.215359	0.583163	139720000	33200000	3520000	5000000	1480000	40000	0	0	0	0	0	0	0	0	0	0	519424029.2	1.16326E+11	5.692015	23.423	29.975143	116.895	185.269	28.503	90	457400	2345970.415	1.333333	161.327	186.643	188.71	199.579	201.25	0.057587	44.4
1695.515625	1097.351505	0.580162	136640000	32120000	2280000	5040000	1600000	80000	0	0	0	0	0	0	0	0	0	0	503422370.4	1.1683E+11	5.707995	23.448	29.730723	116.876	185.262	28.499	90	444400	2356147.823	1.333333	161.333	186.633	188.74	199.654	201.266	0.085462	44.4
1702.5	1099.474323	0.587968	105680000	27680000	2280000	3240000	1280000	40000	0	0	0	0	0	0	0	0	0	0	396485261.8	1.17226E+11	5.695242	23.474	29.681787	116.998	185.344	28.535	90	350500	2364176.959	1.333333	161.32	186.722	188.579	199.651	201.257	0.113344	44.8
1709.5	1101.990954	0.58441	126320000	32480000	1920000	4520000	1360000	0	0	0	0	0	0	0	0	0	0	0	466639233.5	1.17693E+11	5.675694	23.468	30.010173	117.151	185.36	28.528	90	416500	2373608.521	1.333333	161.284	186.751	188.602	199.641	201.253	0.151881	44.8
1716.5	1101.754283	0.586164	145280000	38120000	3040000	4280000	1280000	80000	40000	0	0	0	0	0	0	0	0	0	542657190.9	1.18235E+11	5.701277	23.419	29.323352	117.167	185.465	28.538	90	480300	2384551.486	1.333333	161.317	186.938	188.815	199.628	201.142	0.089562	44.8
1723.484375	1102.523994	0.586066	149760000	36440000	3400000	5280000	1400000	40000	40000	0	0	0	0	0	0	0	0	0	556504316.2	1.18792E+11	5.697368	23.387	29.389082	116.959	185.472	28.522	90	490900	2395776.097	1.333333	161.438	186.951	188.756	199.713	201.178	0.137944	44.8
1730.53125	1100.880831	0.583803	155840000	37960000	3640000	4400000	1520000	40000	0	0	0	0	0	0	0	0	0	0	568541939.9	1.1936E+11	5.671495	23.381	29.7096	116.889	185.452	28.58	90	508500	2407235.498	1.333333	161.444	186.922	188.747	199.743	201.286	0.1363	44.8
1737.515625	1103.327975	0.588657	148840000	38720000	3600000	5360000	1480000	80000	0	0	0	0	0	0	0	0	0	0	565386517.9	1.19926E+11	5.665801	23.384	29.746204	116.889	185.462	28.57	90	495200	2418648.309	1.333333	161.441	186.915	188.766	199.762	201.302	0.154344	44.8
1744.5	1103.767268	0.585131	133840000	33960000	3120000	4480000	1280000	40000	80000	0	0	0	0	0	0	0	0	0	509557135	1.20435E+11	5.674014	23.416	30.024342	116.889	185.449	28.551	90	442000	2428911.343	1.333333	161.424	186.882	188.796	199.795	201.342	0.133025	44.8
1751.5	1107.297916	0.585968	146000000	35320000	2960000	4400000	1400000	0	0	0	0	0	0	0	0	0	0	0	524887799	1.2096E+11	5.69023	23.445	29.790024	116.956	185.42	28.545	90	475200	2439478.945	1.333333	161.415	186.823	188.897	199.841	201.479	0.150244	44.8
1758.5	1104.128481	0.586312	141560000	34640000	3000000	4840000	1520000	40000	0	0	0	0	0	0	0	0	0	0	526293839.4	1.21487E+11	5.693091	23.48	29.69858	116.832	185.431	28.567	90	464000	2450041.069	1.333333	161.415	186.799	188.869	199.861	201.497	0.097762	44.8
1765.484375	1100.466022	0.585016	137720000	32960000	1920000	4160000	1680000	0	80000	0	0	0	0	0	0	0	0	0	505533701.8	1.21992E+11	5.688656	23.48	29.587587	116.8	185.45	28.564	90	446300	2460215.685	1.333333	161.422	186.805	188.813	199.884	201.506	0.143681	44.8

1772.46875	1101.405643	0.581605	140240000	35520000	3000000	4480000	1520000	0	0	0	0	0	0	0	0	0	0	0	516565920.6	1.22509E+11	5.684379	23.513	29.488267	116.741	185.497	28.569	90	461900	2470646.94	1.333333	161.426	186.826	188.797	199.907	201.483	0.146962	44.8
1779.46875	1102.009139	0.583459	136440000	37560000	3200000	5000000	1480000	0	0	0	0	0	0	0	0	0	0	0	526624527.8	1.23035E+11	5.670236	23.509	29.707108	116.829	185.567	28.558	90	459200	2481272.242	1.333333	161.339	186.958	188.743	199.852	201.461	0.097762	44.8
1786.453125	1100.273065	0.584393	136480000	33720000	2880000	4920000	1280000	0	0	0	0	0	0	0	0	0	0	0	501113950.5	1.23536E+11	5.678318	23.506	30.258398	116.867	185.587	28.584	90	448200	2491377.3	1.333333	161.3	186.997	188.782	199.839	201.415	0.150244	44.8
1793.4375	1101.923716	0.587821	156080000	38320000	3160000	5880000	1880000	40000	40000	0	0	0	0	0	0	0	0	0	590992104.1	1.24127E+11	5.687921	23.483	29.634556	116.809	185.617	28.584	90	513500	2503313.571	1.333333	161.349	187.089	188.963	199.855	201.366	0.135481	44.8
1800.4375	1107.168206	0.588214	132640000	31840000	2280000	4600000	1400000	80000	0	0	40000	0	0	0	0	0	0	0	508181523.7	1.24636E+11	5.708782	23.44	29.370583	116.663	185.662	28.624	90	432200	2513561.942	1.333333	161.439	187.167	189.001	199.896	201.355	0.123181	44.4

Table E-5 Aerosol counts at simulated end of descent conditions (Test 1: 66.1 PSI, 230.9°C)

Time (sec)	Flow (CFM)	Filter dP ("H2O)	0.3 µm	0.4 µm	0.5 µm	0.55 µm	0.7 µm	1.0 µm	1.3 µm	1.6 µm	2.0 µm	2.2 µm	3.0 µm	4.0 µm	5.0 µm	5.5 µm	7.0 µm	10.0 µm	dm (pg)	Total Mass (pg)	Aerosol Generator (PSIA)	Aerosol Generator Temp (°C)	Compressor (PSIA)	Compressor Temp (°C)	Reactor Tube Temp (°C)	Duct Temp (°C)	Aero. Gen.Flow (CFH)	Sum of Particles	Total Sample Mass (pg)	Sample Filter Flow Rate (SCFH)	Temp S1 (°C)	Temp S2 (°C)	Temp S3 (°C)	Temp S4 (°C)	Temp S5 (°C)	CO (PPM)	RH (%)
0.046875	1113.604546	0.589739	556840000	64000000	4680000	8360000	2360000	80000	40000	0	0	0	0	0	0	0	0	0	10009515.37	10009515.37	7.123247	19.118	68.334141	142.327	231.107	24.836	90	1590900	200.748634	1.333333	195.541	223.055	232.878	247.621	250.13	0.29045	62.4
17.046875	1111.119549	0.59192	455840000	54520000	3720000	6080000	1600000	80000	0	0	0	0	0	0	0	0	0	0	2957580707	2967590222	7.161138	19.102	68.031596	142.29	231.039	24.872	90	1304600	59219.91838	1.333333	195.465	223.1	232.787	247.381	249.922	0.255194	62.8
24.078125	1111.052075	0.59156	527040000	60000000	4560000	6280000	2160000	40000	80000	40000	0	0	0	0	0	0	0	0	1418458605	4386048827	7.134058	19.122	68.2402	142.144	230.886	24.849	90	1500500	87588.87504	1.333333	195.465	223.009	232.661	247.345	249.874	0.314231	62.4
31.046875	1107.883297	0.587099	594800000	64000000	4360000	6520000	2120000	80000	40000	0	0	0	0	0	0	0	0	0	1532454107	5918502934	7.102308	19.122	69.257637	142.368	230.743	24.863	90	1679800	118239.5857	1.333333	195.438	222.806	232.52	247.299	249.831	0.301112	62.4
38.0625	1108.546893	0.591478	469400000	56160000	4640000	6040000	1280000	40000	0	0	0	0	0	0	0	0	0	0	1243418279	7161921213	7.129466	19.21	69.160158	142.637	230.672	24.882	90	1343900	143180.4052	1.333333	195.265	222.771	232.424	247.207	249.709	0.348669	62.4
45.046875	1113.580542	0.591871	553920000	59600000	4680000	7080000	2320000	80000	0	40000	0	0	0	0	0	0	0	0	1457588739	8619509952	7.155837	19.14	67.886099	142.551	230.69	24.903	90	1569300	172399.6119	1.333333	195.332	222.795	232.487	247.098	249.633	0.333087	62.4
52.046875	1111.950661	0.592314	597440000	65040000	5360000	6920000	1920000	40000	0	0	0	0	0	0	0	0	0	0	1551870377	10171380329	7.152741	19.179	67.183141	142.606	230.44	24.899	90	1691800	203368.1922	1.333333	195.29	222.499	232.438	247.101	249.591	0.354406	62.8
59.03125	1110.300732	0.590904	649920000	71840000	5200000	7400000	2760000	120000	0	0	0	0	0	0	0	0	0	0	1700673327	11872053656	7.14807	19.195	67.510219	142.347	230.489	24.89	90	1843100	237355.9777	1.333333	195.237	222.44	232.312	247.027	249.533	0.395406	62.4
66	1108.338174	0.594019	595360000	67520000	5160000	8080000	2240000	80000	40000	0	0	0	0	0	0	0	0	0	1574706244	13446759899	7.122749	19.192	67.722627	142.442	230.565	24.9	90	1696200	268873.0893	1.333333	195.225	222.455	232.173	246.946	249.452	0.310131	62.4
73.015625	1109.178873	0.591478	565200000	62200000	4560000	7080000	1720000	40000	40000	0	0	0	0	0	0	0	0	0	1472940953	14919700853	7.091262	19.187	68.00129	142.118	230.662	24.917	90	1602100	298405.611	1.333333	195.311	222.536	232.193	246.922	249.47	0.384744	62.8
80.046875	1107.944989	0.590395	679920000	66840000	4760000	7600000	1600000	120000	0	0	0	0	0	0	0	0	0	0	1712610446	16632311298	7.158539	19.206	67.742307	142.309	230.493	24.94	90	1902100	332717.4888	1.333333	195.212	222.363	232.235	246.858	249.419	0.373269	62.4
87.03125	1110.465654	0.593593	512960000	55320000	5000000	7000000	1840000	40000	0	0	0	0	40000	0	0	0	0	0	1413468406	18045779704	7.132248	19.2	67.675265	142.306	230.402	24.962	90	1455500	361067.6409	1.333333	195.166	222.315	232.067	246.793	249.286	0.29045	62.4
94.015625	1110.515458	0.590477	487600000	55840000	3440000	6440000	1960000	40000	0	0	0	0	0	0	0	0	0	0	1282776590	19328556294	7.128784	19.178	68.239806	142.421	230.375	24.961	90	1388300	386738.085	1.333333	195.062	222.42	232.035	246.671	249.213	0.324069	62
101	1110.04799	0.589985	555840000	62920000	5800000	5880000	2200000	80000	40000	0	0	0	0	0	0	0	0	0	1466103054	20794659348	7.132641	19.19	67.389517	142.345	230.396	24.969	90	1581900	416075.8737	1.333333	195.169	222.47	232.111	246.651	249.144	0.256012	62
107.984375	1113.846093	0.592396	605960000	66720000	5040000	7480000	2720000	0	0	0	0	0	0	0	0	0	0	0	1585789258	22380448607	7.08457	19.162	68.661478	142.314	230.313	24.983	90	1719800	447822.0339	1.333333	195.246	222.339	231.971	246.649	249.204	0.307669	62
115.03125	1108.22025	0.58969	584160000	64640000	4440000	7880000	1840000	0	40000	0	0	0	0	0	0	0	0	0	1540784491	23921233098	7.126291	19.191	67.668836	142.58	230.17	24.973	90	1657500	478562.0577	1.333333	195.115	222.146	231.964	246.604	249.178	0.280612	62.4
122	1110.960981	0.589313	593440000	63800000	5920000	8080000	1720000	200000	0	0	0	0	0	0	0	0	0	0	1548763046	25469996144	7.126344	19.254	67.836375	142.619	230.125	24.96	90	1682900	509618.1194	1.333333	195.106	222.052	231.831	246.54	249.039	0.313412	62.4
129.015625	1112.41396	0.591133	521320000	59480000	4200000	7360000	1960000	40000	0	0	0	0	0	0	0	0	0	0	1383733031	26853729174	7.096588	19.208	69.245042	142.643	230.133	25.017	90	1485900	537296.5199	1.333333	195.129	222.177	231.828	246.456	249.016	0.319969	62.4
136.015625	1109.060675	0.589641	573240000	64400000	5280000	7240000	1800000	40000	40000	40000	0	0	0	0	0	0	0	0	1520307050	28374036225	7.118	19.239	69.203715	142.75	230.133	25.004	90	1630200	567667.0495	1.333333	195.021	222.167	231.774	246.389	248.905	0.30275	62.4
143	1108.182843	0.590658	622520000	68720000	5280000	8200000	1920000	80000	0	0	0	0	0	0	0	0	0	0	1620239919	29994276144	7.134452	19.206	67.634987	142.529	230.172	25	90	1766800	600131.758	1.333333	195.074	222.216	231.855	246.312	248.779	0.299475	62.4
149.984375	1109.404483	0.592462	629640000	70640000	5200000	8360000	2520000	40000	0	0	0	0	0	0	0	0	0	0	1652563291	31646839435	7.101023	19.265	69.24478	142.5	229.964	24.975	90	1791000	633270.3587	1.333333	195.077	222.04	231.697	246.332	248.896	0.270775	62.4
156.984375	1112.729869	0.595233	619000000	67560000	4640000	7240000	2360000	120000	40000	0	0	0	0	0	0	0	0	0	1615544404	33262383839	7.11779	19.222	67.340581	142.559	229.929	24.945	90	1752400	665630.9515	1.333333	195.074	221.898	231.625	246.301	248.729	0.324887	62.4
163.96875	1109.383596	0.595233	589360000	64920000	5080000	8280000	2240000	80000	0	0	0	0	0	0	0	0	0	0	1555035851	34817419690	7.110548	19.254	68.461402	142.807	230.044	24.973	90	1674900	696686.4243	1.333333	194.987	222.107	231.682	246.188	248.691	0.365069	62.4
171	1112.555421	0.592117	495840000	55160000	4080000	6320000	1960000	0	0	0	0	0	0	0	0	0	0	0	1303673253	36121092942	7.099711	19.23	67.690221	142.647	230.011	25.005	90	1408400	722800.4906	1.333333	195.177	222.133	231.679	246.22	248.723	0.326531	62.4
178	1109.161883	0.592478	573680000	62360000	4600000	7720000	2440000	80000	0	0	0	0	0	0	0	0	0	0	1512615414	37633708356	7.048859	19.276	65.449632	142.66	230.001	24.979	90	1627200	753013.5256	1.333333	195.092	221.928	231.552	246.165	248.671	0.282256	62
184.984375	1107.398225	0.589887	527760000	53720000	3920000	6600000	1720000	0	0	0	0	0	0	0	0	0	0	0	1342988549	38976696905	7.078168	19.194	65.046853	142.333	230.325	25.005	90	1484300	779920.4996	1.333333	195.069	222.126	231.685	246.094	248.507	0.29865	62
191.96875	1110.54311	0.590953	631440000	66520000	4480000	7120000	2400000	80000	0	0	0	0	0	0	0	0	0	0	1616798446	40593495352	7.03713	19.248	66.459064	141.967	230.382	25	90	1780100	812364.8846	1.333333	195.165	221.991	231.596	246.141	248.598	0.338831	61.6
198.953125	1109.63591	0.591789	566480000	58840000	4200000	6680000	2200000	160000	40000	0	0	0	0	0	0	0	0	0	1468796982	42062292334	7.077932	19.295	65.200882	141.943	230.439	25.041	90	1596500	841755.849	1.333333	195.176	221.93	231.733	246.181	248.658	0.338831	61.6
205.984375	1111.305251	0.594249	542320000	58400000	4560000	6520000	2000000	40000	0	0	0	0	0	0	0	0	0	0	1413542232	43475834566	7.052348	19.29	66.443977	141.76	230.589	25.055	90	1534600	870064.2781	1.333333	195.1	222.066	231.583	246.144	248.54	0.363425	61.6
212.984375	1109.635376	0.589969	697240000	74000000	6160000	9040000	2400000	80000	0	0	0	0	0	0	0	0	0	0	1815178044	45291012610	7.075072	19.225	65.625961	141.309	230.732	25.074	90	1972300	906361.497	1.333333	195.257	222.177	231.738	246.154	248.637	0.326531	62
219.953125	1108.965678	0.588378	568080000	60480000	4480000	7720000	1800000	40000	0	0	0	0	0	0	0	0	0	0	1465062922	46756075532	7.081474	19.294	66.722902	141.409	230.645	25.042	90	1606500	935701.724	1.333333	195.133	222.043	231.706	246.225	248.766	0.278975	61.6
226.953125	1105.860034	0.590313	700800000	71720000	4960000	9080000	2400000	40000	0	0	0	0	0	0	0	0	0	0	1795562735	48551638267	7.078037	19.274	65.68723	141.395	230.787	25.014	90	1972500	971682.4535	1.333333	195.063	222.17	231.732	246.214	248.656	0.325713	61.6
233.9375	1110.61331	0.589953	645280000	70760000	5320000	8200000	2600000	80000	0	0	0	0	0	0	0	0	0	0	1681842150	50233480417	7.115638	19.252	66.140647	141.11	230.851	25.11	90	1830600	1005479.018	1.333333	195.197	222.307	231.867	246.229	248.722	0.355231	61.2
240.921875	1110.922684	0.59297	493160000	49320000	3200000	5360000	2280000	120000	0	0	0	0	0	0	0	0	0	0	1263513780	51496994198	7.041879	19.328	64.100262	140.983	230.779	25.105	90	1383600	1030760.62	1.333333	195.154	222.058	231.863	246.32	248.755	0.341287	61.2
247.921875	1110.303499	0.590231	529920000	56200000	3840000	6920000	2040000	40000	0	40000	0	0	0	0	0	0	0	0	1387074646	52884068844	6.986855	19.243	63.276607	140.295	231.191	25.053	90	1497500	1058506.819	1.333333	195.137	222.247	231.912	246.307	248.797	0.285531	61.2
254.953125	1110.371892	0.59074	592720000	58160000	5240000	7360000	2080000	120000	0	0	0	0	0	0	0	0	0	0	1528685519	54412754363	7.017922	19.281	64.926414	139.964	231.191	25.029	90	1664200	1089102.768	1.333333	195.072	222.111	231.899	246.399	248.85	0.314231	61.2
261.9375	1110.654991	0.588723	535800000	55480000	4720000	6640000	2000000	40000	0	40000	0	0	0	0	0	0	0	0	1394281436	55807035800	6.94558	19.308	63.453985	139.634	231.401	25.057	90	1511800	1117006.961	1.333333	195.054	222.152	231.798	246.438	248.847	0.36835	61.2
268.921875	1109.43256	0.589641	537800000	56280000	5640000	6360000	2360000	280000	40000	0	0	0	0	0	0	0	0	0	1425853274	57232889073	6.957231	19.313	62.961074	139.167	231.607	25.1	90	1521900	1145535.738	1.333333	195.106	222.359	231.897	246.469	249.011	0.319969	61.2
275.921875	1111.6086	0.59115	605080000	65800000	5040000	8840000	2600000	120000	0	0	0	0	0	0	0	0	0	0	1603532827	58836421900	7.005695	19.319	63.613652	139.128	231.604	25.08	90	1718700	1177654.917	1.333333	194.981	222.131	232.013	246.55	249.053	0.297012	61.6

282.90625	1109.123088	0.590756	544600000	59440000	5520000	6280000	2600000	160000	0	0	0	0	0	0	0	0	0	0	1442794114	60279216014	6.985727	19.293	63.013946	138.865	231.824	25.048	90	1546500	1206497.885	1.333333	194.854	222.395	232.072	246.524	249.024	0.313412	61.6
289.90625	1107.414072	0.590018	545920000	56640000	4280000	7520000	2160000	160000	0	40000	0	0	0	0	0	0	0	0	1437413453	61716629467	6.980767	19.304	63.688172	138.741	231.797	25.052	90	1541800	1235297.683	1.333333	194.803	222.191	232.06	246.672	249.201	0.301112	61.6
296.890625	1111.74787	0.590477	460160000	45600000	3640000	5600000	2560000	80000	40000	0	0	0	0	0	0	0	0	0	1199786174	62916415641	6.95828	19.348	64.298635	138.555	231.927	25.062	90	1294200	1259373.515	1.333333	194.76	222.26	231.944	246.702	249.208	0.324887	62
303.921875	1112.347367	0.590559	495400000	53400000	3800000	6360000	1880000	80000	40000	0	0	0	0	0	0	0	0	0	1305604005	64222019647	6.985149	19.311	63.641072	138.169	232.02	25.075	90	1402400	1285470.639	1.333333	194.717	222.468	232.154	246.709	249.315	0.30275	62
310.921875	1108.774698	0.590969	526880000	58160000	4400000	8040000	2600000	200000	0	0	0	0	0	0	0	0	0	0	1422008722	65644028368	7.01989	19.35	64.771995	138.111	231.832	25.046	90	1500700	1313879.205	1.333333	194.622	222.155	232.148	246.813	249.415	0.30275	62
317.875	1111.744608	0.590117	485680000	53680000	4680000	6320000	2600000	0	0	0	0	0	0	0	0	0	0	0	1283466879	66927495248	6.989479	19.314	64.413826	137.841	231.891	25.027	90	1382400	1339602.633	1.333333	194.527	222.363	232.093	246.806	249.461	0.265856	61.6
324.90625	1111.021785	0.58928	516560000	57720000	4040000	7320000	1840000	40000	0	0	0	0	0	0	0	0	0	0	1366716070	68294211317	6.989951	19.357	63.482586	137.915	231.829	25.022	90	1468800	1366921.379	1.333333	194.406	222.073	232.105	246.888	249.542	0.262575	61.6
331.890625	1106.652413	0.590215	501000000	57000000	4360000	6600000	2640000	40000	0	40000	0	0	0	0	0	0	0	0	1349425452	69643636769	6.971688	19.356	64.054606	137.791	232.022	25.027	90	1429200	1393912.058	1.333333	194.175	222.238	232.01	246.855	249.467	0.313412	61.2
338.875	1111.498067	0.592429	447200000	47880000	4440000	7040000	2640000	40000	0	0	0	0	0	0	0	0	0	0	1201331200	70844967969	7.002756	19.329	64.704953	137.603	231.941	25.057	90	1273100	1418035.485	1.333333	194.198	222.254	232.068	246.908	249.594	0.31505	61.2
345.875	1107.042727	0.589133	518320000	58240000	5000000	7640000	2280000	160000	40000	0	0	0	0	0	0	0	0	0	1401950376	72246918345	7.028313	19.384	64.251404	137.739	231.727	25.028	90	1479200	1446064.731	1.333333	194.034	221.938	232.02	246.95	249.694	0.278975	60.8
352.875	1112.537996	0.589428	444080000	53680000	4360000	7840000	2160000	40000	0	0	0	0	0	0	0	0	0	0	1221040020	73467958364	6.968514	19.302	64.457909	137.593	231.827	25.038	90	1280400	1470575.278	1.333333	193.988	222.062	231.893	246.888	249.672	0.33145	60.8
359.859375	1109.524414	0.589838	444800000	49600000	4240000	6080000	2480000	80000	0	0	0	0	0	0	0	0	0	0	1197255975	74665214339	7.003333	19.373	64.285647	137.758	231.651	25.046	90	1268200	1494489.687	1.333333	193.833	221.787	231.96	246.984	249.819	0.32735	60.8
366.84375	1105.702908	0.58951	461240000	52520000	3480000	6800000	2000000	80000	40000	0	0	0	0	0	0	0	0	0	1233153994	75898368333	7.014354	19.334	64.584514	137.649	231.76	25.085	90	1315400	1519188.037	1.333333	193.67	222.03	231.913	246.886	249.663	0.311769	60.8
373.890625	1112.594535	0.592347	433360000	50200000	3800000	6080000	2320000	80000	0	0	0	0	0	0	0	0	0	0	1174685384	77073053717	6.993388	19.379	65.027829	137.517	231.592	25.107	90	1239600	1542796.657	1.333333	193.58	221.803	231.826	246.977	249.844	0.340469	61.2
380.875	1114.185122	0.591133	425400000	49000000	3920000	5800000	2040000	80000	40000	0	0	0	0	0	0	0	0	0	1149045955	78222099672	6.988062	19.389	65.859492	137.555	231.602	25.094	90	1215700	1565746.935	1.333333	193.39	221.672	231.677	246.893	249.689	0.35605	62
387.859375	1108.249424	0.590035	406760000	50200000	4840000	6600000	2360000	120000	0	0	0	0	0	0	0	0	0	0	1142777166	79364876838	6.973394	19.379	65.445696	137.432	231.475	25.075	90	1177200	1588539.421	1.333333	193.334	221.591	231.736	246.928	249.773	0.332269	62.4
394.84375	1109.604058	0.589871	416520000	50200000	3600000	6440000	1960000	80000	0	0	0	0	0	0	0	0	0	0	1130251822	80495128660	6.957965	19.373	64.953309	137.534	231.47	25.09	90	1197000	1611202.827	1.333333	193.224	221.505	231.562	246.922	249.747	0.420825	62.4
401.84375	1111.709667	0.590838	432960000	52000000	3880000	6520000	2400000	120000	0	0	0	0	0	0	0	0	0	0	1188275902	81683404562	6.942457	19.357	63.642253	137.343	231.548	25.131	90	1244700	1635000.623	1.333333	193.263	221.628	231.633	246.949	249.81	0.405244	62.8
408.828125	1111.549383	0.592626	467800000	54200000	4800000	7480000	1480000	0	0	0	0	0	0	0	0	0	0	0	1250254913	82933659474	6.980872	19.449	64.8372	137.385	231.441	25.128	90	1339400	1659992.258	1.333333	193.113	221.39	231.504	246.933	249.768	0.401963	62.8
415.828125	1113.968172	0.592445	457520000	55240000	4480000	7920000	2760000	80000	0	0	0	0	0	0	0	0	0	0	1276042011	84209701486	7.066229	19.38	65.560625	137.667	231.097	25.121	90	1320000	1685503.036	1.333333	192.978	221.547	231.604	246.83	249.716	0.403606	62.4
422.8125	1106.194153	0.588099	466640000	56200000	4680000	7240000	2200000	40000	40000	0	0	0	0	0	0	0	0	0	1281079904	85490781389	7.102125	19.412	66.882306	138.194	230.667	25.089	90	1342600	1711058.921	1.333333	192.852	221.197	231.483	246.866	249.785	0.324887	62.4
429.796875	1109.110351	0.590346	432760000	53120000	3640000	6000000	2280000	40000	0	0	0	0	0	0	0	0	0	0	1170424063	86661205452	7.078614	19.468	67.970458	138.561	230.622	25.141	90	1244600	1734571.451	1.333333	192.698	221.226	231.285	246.769	249.671	0.35605	62.4
436.84375	1110.636862	0.590084	365800000	44400000	4080000	5920000	1760000	0	0	0	0	0	0	0	0	0	0	0	1010586991	87671792444	7.068013	19.421	65.828135	138.61	230.573	25.161	90	1054900	1754819.652	1.333333	192.76	221.177	231.301	246.731	249.64	0.342113	62.4
443.828125	1110.751042	0.590838	416080000	47040000	3720000	6240000	1760000	80000	0	0	0	0	0	0	0	0	0	0	1112311252	88784103696	7.063631	19.454	65.627929	138.976	230.363	25.148	90	1187300	1777075.376	1.333333	192.593	220.87	231.223	246.673	249.582	0.338831	62.4
450.8125	1104.5016	0.588657	426480000	50240000	4200000	6080000	1680000	40000	0	0	0	0	0	0	0	0	0	0	1142995073	89927098769	7.041643	19.46	66.234324	139.109	230.265	25.148	90	1221800	1799942.688	1.333333	192.472	220.782	230.947	246.573	249.482	0.362606	62.4
457.8125	1107.024089	0.586738	373120000	43040000	3520000	4640000	1960000	40000	0	0	0	0	0	0	0	0	0	0	995391367.8	90922490137	7.053897	19.397	66.462082	138.996	230.218	25.142	90	1065800	1819969.647	1.333333	192.506	220.836	230.926	246.498	249.43	0.411806	62.4
464.796875	1108.192913	0.588493	324240000	40360000	2960000	4280000	1400000	120000	120000	0	0	0	0	0	0	0	0	0	896277954.8	91818768091	7.136577	19.483	68.615559	139.509	229.793	25.206	90	933700	1837961.385	1.333333	192.404	220.602	230.906	246.466	249.475	0.388025	62
471.828125	1111.38971	0.590182	383000000	47960000	4480000	5440000	2000000	120000	40000	0	0	0	0	0	0	0	0	0	1072285542	92891053633	7.107819	19.517	67.958782	139.941	229.524	25.244	90	1107600	1859463.569	1.333333	192.378	220.539	230.751	246.362	249.209	0.391306	62
478.828125	1107.385099	0.58805	347200000	45280000	3560000	5360000	1680000	0	0	0	0	0	0	0	0	0	0	0	963055303.8	93854108937	7.113381	19.498	69.35105	140.34	229.317	25.208	90	1007700	1878719.847	1.333333	192.208	220.549	230.689	246.197	249.103	0.329812	62
485.8125	1109.063654	0.590822	428320000	54080000	4640000	6280000	1880000	40000	0	0	0	0	0	0	0	0	0	0	1170060560	95024169497	7.129125	19.386	67.668443	140.402	229.206	25.201	90	1238100	1902199.796	1.333333	192.234	220.51	230.624	246.042	248.968	0.320794	62
492.78125	1108.746806	0.589313	354400000	42920000	2440000	5480000	1920000	120000	0	0	0	0	0	0	0	0	0	0	965223646.4	95989393143	7.124848	19.414	68.370482	140.617	228.978	25.145	90	1018200	1921539.907	1.333333	192.132	220.393	230.443	245.971	248.871	0.36835	62
499.765625	1111.994096	0.590231	479400000	57200000	4040000	7080000	1640000	120000	0	0	0	0	0	0	0	0	0	0	1281964188	97271357331	7.111702	19.457	67.92021	140.565	228.916	25.193	90	1373700	1947233.864	1.333333	192.272	220.369	230.419	245.871	248.777	0.36835	62
506.765625	1112.233601	0.589936	467440000	54920000	4760000	6200000	2800000	0	0	0	0	0	0	0	0	0	0	0	1271791812	98543149143	7.128338	19.486	68.904586	140.844	228.679	25.235	90	1340300	1972649.503	1.333333	192.193	220.085	230.282	245.812	248.717	0.367525	62
513.796875	1106.524541	0.589346	412240000	51200000	4400000	5120000	1240000	120000	0	0	0	0	0	0	0	0	0	0	1116121827	99659270970	7.128758	19.499	68.059541	140.958	228.559	25.229	90	1185800	1994949.411	1.333333	192.216	219.954	230.172	245.673	248.492	0.309313	62
520.78125	1106.753853	0.588263	431120000	52200000	4160000	5320000	2120000	40000	0	0	0	0	0	0	0	0	0	0	1156868604	1.00816E+11	7.108737	19.492	69.142184	141.175	228.481	25.222	90	1237400	2018182.688	1.333333	192.143	219.938	229.942	245.521	248.292	0.375725	62
527.78125	1109.703415	0.590477	418600000	48880000	4920000	6080000	1960000	0	0	0	0	0	0	0	0	0	0	0	1131034316	1.01947E+11	7.14046	19.403	67.75805	141.128	228.451	25.183	90	1201100	2040892.432	1.333333	192.214	220.104	230.074	245.355	248.132	0.35195	62
534.765625	1109.680568	0.589198	490320000	58480000	4680000	5320000	1760000	40000	40000	40000	0	0	0	0	0	0	0	0	1308557074	1.03256E+11	7.11779	19.471	69.345802	141.152	228.323	25.218	90	1401700	2067096.772	1.333333	192.298	219.907	229.962	245.373	248.198	0.345388	62
541.765625	1111.599465	0.592134	476240000	55040000	4280000	6440000	2600000	40000	0	40000	0	0	0	0	0	0	0	0	1293579475	1.04549E+11	7.115927	19.563	68.001552	141.365	228.226	25.298	90	1361700	2093001.714	1.333333	192.378	219.793	229.823	245.274	248.025	0.365069	61.6
548.765625	1109.56514	0.58764	407120000	48080000	3080000	5720000	1720000	40000	0	0	0	0	0	0	0	0	0	0	1088903472	1.05638E+11	7.093203	19.514	66.927832	141.29	228.249	25.259	90	1164400	2114770.216	1.333333	192.342	219.813	229.868	245.187	247.945	0.378188	61.6
555.765625	1109.166213	0.58969	365240000	40760000	3680000	5400000	2200000	40000	0	0	0	0	0	0	0	0	0	0	991149125.9	1.06629E+11	7.099238	19.543	68.038681	140.992	228.408	25.272	90	1043300	2134620.818	1.333333	192.325	219.822	229.677	245.045	247.755	0.418363	61.2
562.765625	1106.390573	0.590428	477040000	53440000	4040000	6720000	2280000	40000	0	0	0	0	0	0	0	0	0	0	1270091188	1.07899E+11	7.127052	19.472	67.961537	140.87	228.271	25.241	90	1358900	2160067.183	1.333333	192.456	219.8	229.862	245.081	247.793	0.418363	61.2
569.75	1108.231627	0.588739	474920000	52040000	4120000	6600000	2080000	40000	0	0	0	0	0	0	0	0	0	0	1248884792	1.09148E+11	7.103725	19.539	67.466924	140.97	228.323	25.28	90	1349500	2185151.449	1.333333	192.609	219.766	229.766	245.003	247.69	0.373269	61.2
576.734375	1109.081024	0.589543	506040000	59480000	4480000	7160000	2200000	0	0	0	0	0	0	0	0	0	0	0	1349293016	1.10498E+11	7.072212	19.518	65.098675	140.718	228.653	25.306	90	1448400	2212207.426	1.333333	192.644	220.078	229.896	244.889	247.569	0.341287	61.2

583.734375	1108.875604	0.590051	455800000	52640000	3640000	7760000	1960000	120000	40000	0	0	0	0	0	0	0	0	0	1239944524	1.11738E+11	7.053451	19.541	66.73038	140.62	228.718	25.283	90	1304900	2237051.709	1.333333	192.739	219.974	229.879	244.953	247.679	0.350306	61.2
590.71875	1111.303211	0.588936	451760000	49960000	4480000	7280000	1880000	40000	0	40000	0	0	0	0	0	0	0	0	1217554474	1.12955E+11	7.038022	19.544	66.355288	140.438	228.964	25.277	90	1288600	2261451.89	1.333333	192.759	219.974	229.795	244.892	247.524	0.383106	60.8
597.71875	1112.026772	0.592134	371840000	41960000	2800000	4760000	1520000	40000	0	0	0	0	0	0	0	0	0	0	979483011.2	1.13935E+11	7.050879	19.447	65.721866	140.028	229.135	25.23	90	1057300	2281038.164	1.333333	192.991	220.3	230	244.956	247.646	0.369987	60.8
604.703125	1109.882992	0.59033	502920000	57840000	3760000	7600000	1920000	40000	80000	0	0	0	0	0	0	0	0	0	1348066112	1.15283E+11	7.07843	19.542	65.741021	140.068	229.151	25.287	90	1435400	2307977.286	1.333333	193.044	220.14	230.08	245.044	247.702	0.333912	61.2
611.703125	1106.660087	0.590576	459720000	53880000	3680000	6320000	2440000	0	0	0	0	0	0	0	0	0	0	0	1234561584	1.16517E+11	7.079769	19.497	65.586339	139.947	229.374	25.285	90	1315100	2332695.84	1.333333	193.124	220.464	230.247	245.026	247.635	0.314231	60.8
618.734375	1110.700123	0.59215	496840000	57080000	4360000	6320000	1760000	40000	0	0	0	0	0	0	0	0	0	0	1311084776	1.17828E+11	7.06825	19.556	67.224862	140.015	229.28	25.272	90	1416000	2359023	1.333333	193.183	220.353	230.208	245.103	247.867	0.212556	61.2
625.71875	1108.545687	0.592183	471360000	52720000	4000000	6520000	2560000	80000	80000	40000	0	0	0	0	0	0	0	0	1285115596	1.19113E+11	7.027893	19.561	66.26135	140.1	229.372	25.258	90	1343400	2384734.822	1.333333	193.252	220.419	230.176	245.143	247.726	0.276513	61.2
632.71875	1111.054525	0.590608	423680000	51080000	4080000	6640000	1800000	80000	0	0	0	0	0	0	0	0	0	0	1152588095	1.20266E+11	7.111702	19.475	67.029903	140.13	229.471	25.211	90	1218400	2407839.931	1.333333	193.314	220.715	230.459	245.168	247.838	0.310131	61.6
639.703125	1109.153125	0.59133	512920000	59800000	5000000	7520000	2320000	80000	0	40000	0	0	0	0	0	0	0	0	1394453971	1.2166E+11	7.033299	19.506	67.074904	140.269	229.431	25.26	90	1469200	2435730.431	1.333333	193.447	220.606	230.428	245.271	248.002	0.34375	61.6
646.6875	1108.467685	0.589067	551680000	65400000	4280000	8080000	2000000	120000	0	0	0	0	0	0	0	0	0	0	1471466709	1.23132E+11	7.096667	19.577	67.087892	140.477	229.427	25.296	90	1578900	2465211.716	1.333333	193.46	220.566	230.554	245.353	248.007	0.316694	61.6
653.71875	1104.372143	0.589428	433160000	50920000	4600000	5080000	1680000	120000	0	0	0	0	0	0	0	0	0	0	1161053871	1.24293E+11	7.062057	19.567	65.886387	140.555	229.586	25.254	90	1238900	2488488.171	1.333333	193.421	220.81	230.586	245.269	247.926	0.285531	61.6
660.671875	1107.257901	0.591855	427640000	48640000	4320000	6520000	1520000	80000	0	40000	0	0	0	0	0	0	0	0	1142475737	1.25435E+11	7.109813	19.528	66.842422	140.558	229.544	25.238	90	1221900	2511477.115	1.333333	193.522	220.693	230.622	245.398	248.11	0.277331	61.6
667.703125	1110.135022	0.590494	476400000	56080000	4120000	6480000	2680000	120000	0	0	0	0	0	0	0	0	0	0	1296594731	1.26732E+11	7.072789	19.613	66.571238	140.704	229.515	25.212	90	1364700	2537499.251	1.333333	193.591	220.772	230.587	245.443	248.094	0.293731	61.6
674.703125	1106.745947	0.589772	519040000	60840000	5320000	7640000	1960000	120000	40000	0	0	0	0	0	0	0	0	0	1405390456	1.28137E+11	7.078903	19.487	65.680408	140.608	229.734	25.232	90	1487400	2565631.774	1.333333	193.645	221.044	230.812	245.443	248.094	0.313412	61.6
681.6875	1110.038967	0.592068	601680000	70600000	5560000	9080000	2480000	80000	0	0	0	0	0	0	0	0	0	0	1612212586	1.2975E+11	7.064025	19.552	68.159513	140.534	229.695	25.297	90	1723700	2598003.202	1.333333	193.789	221.004	230.727	245.554	248.228	0.257656	62
688.671875	1108.399655	0.591297	577240000	70840000	5280000	9120000	2400000	240000	0	0	0	0	0	0	0	0	0	0	1580454125	1.3133E+11	7.075702	19.594	66.048678	140.647	229.685	25.287	90	1662800	2629642.815	1.333333	193.753	220.896	230.811	245.615	248.199	0.237975	62
695.671875	1109.476989	0.588837	479320000	55960000	3960000	6640000	1840000	0	0	0	0	0	0	0	0	0	0	0	1269796381	1.326E+11	7.115848	19.505	66.831795	140.619	229.799	25.277	90	1369300	2655100.868	1.333333	193.756	221.236	230.957	245.578	248.194	0.260113	62
702.65625	1106.348508	0.585295	495920000	57520000	4640000	6600000	2480000	160000	0	0	0	0	0	0	0	0	0	0	1336215590	1.33936E+11	7.07725	19.537	68.016246	140.772	229.662	25.256	90	1418300	2681864.541	1.333333	193.785	221.067	230.945	245.726	248.373	0.283075	62
709.640625	1107.190704	0.589625	459920000	52120000	3840000	5920000	2240000	40000	0	0	0	0	0	0	0	0	0	0	1215584167	1.35152E+11	7.058935	19.598	67.020719	140.859	229.829	25.263	90	1310200	2706280.881	1.333333	193.798	221.059	230.827	245.741	248.337	0.235519	62
716.640625	1108.991286	0.590756	550680000	62720000	5040000	7000000	2480000	80000	0	0	0	0	0	0	0	0	0	0	1461424841	1.36613E+11	7.050774	19.576	66.333902	140.674	229.913	25.347	90	1570000	2735612.872	1.333333	194	221.273	230.991	245.794	248.413	0.275694	62
723.671875	1110.138808	0.590543	495200000	54280000	3960000	6920000	1720000	80000	0	0	0	0	0	0	0	0	0	0	1303818193	1.37917E+11	7.081343	19.642	65.286685	140.441	229.998	25.376	90	1405400	2761739.081	1.333333	193.935	221.084	231.033	245.872	248.439	0.301931	62
730.625	1107.086054	0.588788	569600000	62320000	4600000	6880000	2320000	40000	0	0	0	0	0	0	0	0	0	0	1476748910	1.39394E+11	7.043453	19.559	64.623873	139.906	230.219	25.363	90	1614400	2791299.927	1.333333	193.981	221.443	231.169	245.844	248.444	0.29865	62
737.609375	1108.82783	0.589493	530160000	60000000	5240000	7280000	2200000	40000	40000	0	0	0	0	0	0	0	0	0	1410474145	1.40804E+11	7.103542	19.577	67.421661	139.842	230.14	25.29	90	1512400	2819611.971	1.333333	193.993	221.189	231.229	246.008	248.633	0.280612	62
744.65625	1110.875416	0.587771	466720000	55280000	3960000	5600000	1720000	40000	0	0	0	0	0	0	0	0	0	0	1240750513	1.42045E+11	7.062818	19.618	67.183273	139.989	230.148	25.307	90	1333300	2844478.08	1.333333	193.919	221.321	231.097	245.98	248.554	0.308494	62
751.640625	1107.863552	0.588854	541480000	62080000	3880000	6880000	2840000	40000	0	0	0	0	0	0	0	0	0	0	1437906282	1.43483E+11	7.106717	19.621	67.000384	139.965	230.206	25.363	90	1543000	2873242.308	1.333333	194.076	221.58	231.351	246.009	248.631	0.274056	62.4
758.625	1108.119008	0.593331	512960000	59480000	4400000	7120000	2240000	160000	0	0	0	0	0	0	0	0	0	0	1372066882	1.44855E+11	7.109209	19.646	67.35908	140.235	230.068	25.361	90	1465900	2900764.086	1.333333	194.038	221.379	231.385	246.126	248.719	0.267494	62.4
765.609375	1109.163046	0.591855	475320000	53760000	4000000	5960000	1960000	40000	40000	40000	0	0	0	0	0	0	0	0	1265016543	1.4612E+11	7.079218	19.636	66.868793	140.252	230.113	25.38	90	1352800	2926132.732	1.333333	194.08	221.346	231.271	246.155	248.684	0.31505	62.4
772.59375	1109.545492	0.589083	535600000	58480000	5120000	7120000	2360000	120000	0	0	0	0	0	0	0	0	0	0	1416837171	1.47537E+11	7.124691	19.576	68.167516	140.414	230.134	25.353	90	1522000	2954519.244	1.333333	193.952	221.561	231.362	246.125	248.653	0.280612	62.4
779.578125	1105.788976	0.589018	430960000	50200000	3600000	5360000	1280000	40000	0	0	0	0	0	0	0	0	0	0	1127310079	1.48664E+11	7.053083	19.588	65.758995	140.167	230.211	25.363	90	1228600	2977097.26	1.333333	194.116	221.652	231.456	246.166	248.743	0.292913	62.4
786.625	1110.68926	0.589526	549360000	60560000	5160000	5760000	2240000	80000	40000	40000	0	0	0	0	0	0	0	0	1456034979	1.5012E+11	7.082104	19.634	66.143271	140.26	230.164	25.404	90	1558100	3006358.116	1.333333	194.103	221.417	231.472	246.245	248.831	0.299475	62.4
793.578125	1107.39734	0.590658	542480000	61280000	4800000	6680000	2560000	40000	0	40000	0	0	0	0	0	0	0	0	1439678946	1.5156E+11	7.025243	19.661	66.591311	140.184	230.266	25.411	90	1544700	3035162.631	1.333333	194.111	221.517	231.428	246.242	248.845	0.34375	62.4
800.625	1108.572876	0.591904	511560000	54400000	3760000	6800000	2320000	80000	0	0	0	0	0	0	0	0	0	0	1346394467	1.52906E+11	7.040383	19.69	66.925208	140.255	230.321	25.402	90	1447300	3062180.826	1.333333	194.095	221.442	231.308	246.249	248.816	0.322431	62.4
807.578125	1111.288164	0.590543	514920000	55760000	3800000	6600000	2200000	40000	0	0	0	0	0	0	0	0	0	0	1334488477	1.54241E+11	7.087903	19.597	66.701386	140.094	230.303	25.359	90	1458300	3088931.706	1.333333	194.175	221.695	231.456	246.272	248.881	0.349487	62.4
814.609375	1109.554758	0.588591	572080000	62280000	4960000	7600000	2200000	40000	0	0	0	0	0	0	0	0	0	0	1507709041	1.55748E+11	7.095302	19.609	67.093271	140.241	230.217	25.32	90	1622900	3119081.082	1.333333	194.082	221.54	231.459	246.353	248.998	0.371625	62
821.609375	1109.584127	0.58951	498080000	52800000	4280000	6560000	2400000	0	40000	0	0	0	0	0	0	0	0	0	1312527810	1.57061E+11	7.081632	19.697	66.342299	140.305	230.184	25.341	90	1410400	3145368.46	1.333333	194.101	221.481	231.451	246.351	248.925	0.398687	62.4
828.59375	1109.834054	0.590346	523600000	59800000	4160000	5480000	2120000	120000	0	0	0	0	0	0	0	0	0	0	1369040704	1.5843E+11	7.11144	19.688	68.473341	140.533	230.294	25.422	90	1488200	3172786.955	1.333333	194.034	221.71	231.514	246.289	248.898	0.392125	62.4
835.578125	1107.027213	0.590215	518360000	60840000	4640000	7880000	2240000	120000	0	0	0	0	0	0	0	0	0	0	1398134545	1.59828E+11	7.106743	19.665	69.507963	140.744	230.022	25.431	90	1485200	3200781.821	1.333333	194.126	221.613	231.498	246.361	249.054	0.37655	62
842.578125	1110.572237	0.592609	490600000	56160000	4680000	7240000	2040000	80000	0	0	0	0	0	0	0	0	0	0	1312571191	1.61141E+11	7.134819	19.729	68.109003	141.108	229.909	25.406	90	1402000	3227130.089	1.333333	194.131	221.445	231.445	246.39	248.963	0.375725	62.4
849.5625	1106.977805	0.592084	540400000	63360000	4840000	7520000	2480000	80000	0	0	0	0	0	0	0	0	0	0	1450764760	1.62591E+11	7.145945	19.676	69.070419	141.468	229.884	25.418	90	1546700	3256159.463	1.333333	194.001	221.603	231.443	246.314	248.901	0.427381	62.4
856.546875	1110.082799	0.59033	580760000	69160000	4680000	7560000	2640000	160000	0	0	0	0	0	0	0	0	0	0	1552838282	1.64144E+11	7.119574	19.64	68.26211	141.458	229.845	25.407	90	1662400	3287332.19	1.333333	194.177	221.7	231.504	246.343	248.933	0.397044	62.4
863.59375	1112.322358	0.594101	524040000	55640000	4240000	7280000	1680000	40000	0	0	0	0	0	0	0	0	0	0	1369911050	1.65514E+11	7.151429	19.732	68.350278	141.822	229.702	25.488	90	1482300	3314755.791	1.333333	194.15	221.474	231.535	246.374	248.974	0.432306	62.4
870.578125	1106.280628	0.587607	536720000	63600000	4520000	6640000	2400000	80000	80000	0	0	0	0	0	0	0	0	0	1444773740	1.66959E+11	7.112909	19.742	68.242299	141.855	229.66	25.511	90	1535100	3343619.801	1.333333	194.157	221.461	231.399	246.335	248.851	0.303569	62.4
877.5625	1108.812961	0.593839	602960000	72000000	5320000	8560000	2440000	0	0	0	0	0	0	0	0	0	0	0	1605730885	1.68565E+11	7.140251	19.722	69.557162	142.014	229.677	25.468	90	1728200	3375874.644	1.333333	194.085	221.641	231.383	246.254	248.776	0.391306	62

884.546875	1107.699077	0.592199	595920000	66200000	5040000	8240000	2360000	80000	0	0	0	0	0	0	0	0	0	0	1569062532	1.70134E+11	7.139122	19.662	68.210549	141.862	229.675	25.425	90	1694600	3407320.936	1.333333	194.251	221.696	231.487	246.268	248.829	0.328169	62
891.546875	1108.3119	0.590838	492400000	54160000	3920000	6120000	2000000	120000	0	0	0	0	0	0	0	0	0	0	1290736402	1.71424E+11	7.129099	19.697	68.198085	142.068	229.526	25.42	90	1396800	3433215.181	1.333333	194.246	221.419	231.345	246.269	248.723	0.292094	62
898.546875	1111.781454	0.590772	473480000	56040000	4280000	6040000	1920000	80000	0	0	0	0	0	0	0	0	0	0	1262590765	1.72687E+11	7.154341	19.684	67.922178	142.114	229.657	25.484	90	1354600	3458530.774	1.333333	194.226	221.68	231.465	246.171	248.683	0.329812	62
905.53125	1109.232212	0.590969	624000000	73000000	4520000	9040000	2840000	200000	0	0	0	0	0	0	0	0	0	0	1678031987	1.74365E+11	7.11981	19.708	69.025943	142.09	229.596	25.509	90	1784000	3492071.178	1.333333	194.391	221.602	231.339	246.221	248.794	0.34785	61.6
912.515625	1109.872216	0.591888	511320000	56520000	4520000	7280000	2080000	40000	0	0	0	0	0	0	0	0	0	0	1348951197	1.75714E+11	7.049567	19.792	65.908035	141.876	229.798	25.486	90	1454400	3519095.901	1.333333	194.345	221.447	231.436	246.216	248.677	0.317512	61.6
919.5625	1110.542931	0.589083	626880000	67360000	5440000	7120000	2000000	120000	0	0	0	0	0	0	0	0	0	0	1631732960	1.77346E+11	7.059774	19.722	65.35412	141.436	230.133	25.466	90	1772300	3551766.989	1.333333	194.413	221.726	231.504	246.151	248.632	0.332269	61.6
926.546875	1107.200238	0.590199	620880000	66160000	4760000	7280000	2280000	80000	0	0	0	0	0	0	0	0	0	0	1601915934	1.78948E+11	7.066255	19.753	65.625698	141.21	230.129	25.479	90	1753600	3583821.699	1.333333	194.467	221.582	231.545	246.287	248.738	0.359331	61.2
933.546875	1110.527528	0.589067	510840000	55000000	3640000	6520000	1960000	240000	0	0	0	0	0	0	0	0	0	0	1336787448	1.80284E+11	7.048281	19.753	66.749666	141.044	230.407	25.467	90	1445500	3610651.885	1.333333	194.427	221.766	231.456	246.252	248.671	0.280612	61.2
940.53125	1108.972663	0.59069	458520000	51040000	3760000	6040000	1240000	0	0	0	0	0	0	0	0	0	0	0	1187689166	1.81472E+11	7.056363	19.738	65.405287	140.664	230.548	25.566	90	1301500	3634418.15	1.333333	194.622	221.93	231.651	246.3	248.722	0.209275	61.2
947.515625	1106.604698	0.589215	545040000	57880000	3960000	5560000	2200000	120000	40000	0	0	0	0	0	0	0	0	0	1406112811	1.82878E+11	7.059564	19.803	66.53634	140.59	230.545	25.542	90	1537000	3662594.635	1.333333	194.573	221.803	231.635	246.414	248.81	0.225675	60.8
954.546875	1111.901043	0.591412	503800000	51480000	4360000	6240000	1720000	80000	0	0	0	0	0	0	0	0	0	0	1300324161	1.84179E+11	7.024955	19.825	66.765147	140.561	230.637	25.493	90	1419200	3688707.024	1.333333	194.572	221.858	231.609	246.406	248.834	0.201081	60.8
961.53125	1106.998086	0.58969	554000000	61240000	4400000	7240000	1560000	120000	0	0	0	0	0	0	0	0	0	0	1442631522	1.85621E+11	7.0148	19.758	66.288508	140.273	230.761	25.458	90	1571400	3717539.157	1.333333	194.757	221.989	231.731	246.507	248.955	0.188781	60.8
968.53125	1110.076527	0.590543	564640000	60880000	4760000	6800000	2000000	160000	0	0	0	0	0	0	0	0	0	0	1468355168	1.8709E+11	7.057649	19.768	65.699694	140.322	230.784	25.475	90	1598100	3747015.373	1.333333	194.698	221.921	231.721	246.552	248.971	0.163362	60.8
975.53125	1111.689963	0.5911	470560000	51680000	4120000	6200000	1600000	80000	0	0	0	0	0	0	0	0	0	0	1233338934	1.88323E+11	7.039859	19.764	66.369194	140.079	230.911	25.462	90	1335600	3771705.141	1.333333	194.763	222.054	231.804	246.58	249.018	0.192881	60.8
982.515625	1113.191756	0.590199	602400000	68000000	5640000	7960000	2440000	40000	0	0	0	0	0	0	0	0	0	0	1593868599	1.89917E+11	7.067699	19.854	65.78589	140.24	230.874	25.531	90	1716200	3803565.915	1.333333	194.695	221.941	231.977	246.669	249.113	0.201081	60.8
989.5	1107.642235	0.591002	494600000	54360000	4520000	5760000	1760000	120000	40000	0	0	0	0	0	0	0	0	0	1300542122	1.91217E+11	7.074232	19.814	66.745861	140.283	230.975	25.518	90	1402900	3829528.141	1.333333	194.591	222.14	231.925	246.641	249.092	0.276513	60.8
996.5	1107.392579	0.588575	495080000	54040000	3880000	6040000	1520000	80000	0	0	0	0	0	0	0	0	0	0	1279961301	1.92497E+11	7.04962	19.787	66.658615	140.177	231.009	25.485	90	1401600	3855207.537	1.333333	194.734	222.192	231.964	246.759	249.22	0.301112	60.8
1003.484375	1108.576793	0.590445	634200000	68120000	4720000	7320000	2640000	40000	0	0	0	0	0	0	0	0	0	0	1635858769	1.94133E+11	7.070244	19.829	65.84073	140.223	230.938	25.495	90	1792600	3888034.574	1.333333	194.643	222.023	232.063	246.809	249.231	0.275694	60.4
1010.46875	1109.572787	0.589346	561120000	61640000	4240000	7400000	1800000	120000	0	0	0	0	0	0	0	0	0	0	1459046980	1.95592E+11	7.043453	19.845	66.881782	140.225	231.05	25.516	90	1590800	3917282.225	1.333333	194.518	222.172	231.951	246.816	249.242	0.194519	60.4
1017.453125	1107.750866	0.589395	533400000	57280000	4000000	6880000	2640000	80000	40000	0	0	0	0	0	0	0	0	0	1405714242	1.96998E+11	7.065573	19.834	65.923122	140.027	231.153	25.583	90	1510800	3945435.487	1.333333	194.623	222.339	232.126	246.802	249.263	0.2142	60.4
1024.5	1110.308068	0.59192	606280000	63680000	4680000	7360000	2600000	160000	40000	0	0	0	0	0	0	0	0	0	1593660182	1.98592E+11	7.085095	19.845	66.344267	140.077	231.054	25.584	90	1712000	3977405.375	1.333333	194.641	222.07	232.157	246.923	249.41	0.183862	60.4
1031.4375	1107.951323	0.591182	558800000	60040000	4920000	7520000	2400000	0	0	0	0	0	0	0	0	0	0	0	1453247250	2.00045E+11	7.065652	19.857	66.037133	140.055	231.172	25.56	90	1584200	4006491.342	1.333333	194.51	222.265	232.125	246.899	249.395	0.142044	60.8
1038.484375	1109.876356	0.590854	561320000	62760000	4440000	7760000	2160000	40000	0	0	0	0	0	0	0	0	0	0	1485271249	2.0153E+11	7.035477	19.804	66.086594	139.819	231.202	25.536	90	1596200	4036281.484	1.333333	194.648	222.243	232.081	246.997	249.516	0.215837	60.8
1045.484375	1106.494008	0.591937	580760000	60960000	4560000	7120000	2120000	0	0	40000	0	0	0	0	0	0	0	0	1506994294	2.03037E+11	7.049357	19.863	66.2767	140.026	231.238	25.519	90	1638900	4066454.901	1.333333	194.445	222.276	232.103	246.92	249.397	0.1978	60.8
1052.46875	1108.583738	0.591806	472880000	52760000	3440000	6960000	1880000	160000	0	0	0	0	0	0	0	0	0	0	1250167942	2.04287E+11	7.038888	19.814	65.815803	139.79	231.303	25.561	90	1345200	4091562.592	1.333333	194.593	222.328	232.161	247.019	249.515	0.171562	60.8
1059.453125	1108.0234	0.587788	528840000	58000000	4040000	6640000	2360000	120000	0	0	0	0	0	0	0	0	0	0	1387171149	2.05674E+11	7.052296	19.916	65.651282	139.961	231.181	25.576	90	1500000	4119369.265	1.333333	194.535	222.13	232.226	247.062	249.587	0.169919	60.8
1066.453125	1109.37695	0.5901	487280000	54440000	4240000	6360000	2160000	80000	0	0	0	0	0	0	0	0	0	0	1289387665	2.06964E+11	7.047179	19.898	66.547754	139.978	231.297	25.527	90	1386400	4145228.881	1.333333	194.412	222.315	232.171	247.044	249.557	0.157619	61.2
1073.4375	1102.575108	0.587575	560920000	59480000	4600000	7240000	2080000	120000	40000	0	0	0	0	0	0	0	0	0	1464066499	2.08428E+11	7.033167	19.828	65.960513	139.723	231.356	25.518	90	1586200	4174555.983	1.333333	194.554	222.391	232.235	247.105	249.656	0.1363	60.8
1080.421875	1107.876946	0.590313	550800000	56080000	4960000	7480000	2320000	80000	0	0	0	0	0	0	0	0	0	0	1424750225	2.09853E+11	7.074783	19.881	66.163475	139.982	231.171	25.514	90	1554300	4203271.592	1.333333	194.446	222.124	232.244	247.16	249.74	0.123181	60.8
1087.46875	1108.905262	0.590182	454360000	49160000	3880000	5400000	1240000	40000	40000	0	0	0	0	0	0	0	0	0	1182087398	2.11035E+11	7.03734	19.902	66.173971	139.934	231.25	25.543	90	1285300	4226982.356	1.333333	194.404	222.177	232.08	247.128	249.654	0.113344	61.2
1094.453125	1110.024077	0.587607	482920000	52640000	4240000	5680000	1440000	80000	0	0	0	0	0	0	0	0	0	0	1247452808	2.12282E+11	7.056888	19.875	65.738397	139.866	231.391	25.57	90	1367500	4251981.041	1.333333	194.426	222.361	232.287	247.114	249.691	0.117444	60.8
1101.4375	1105.497425	0.588936	521880000	58520000	4800000	6920000	2040000	160000	40000	0	0	0	0	0	0	0	0	0	1389316124	2.13672E+11	7.052086	19.946	67.27039	139.891	231.274	25.576	90	1485900	4279794.575	1.333333	194.363	222.181	232.209	247.211	249.804	0.092844	60.8
1108.421875	1109.073101	0.591281	492480000	54920000	4040000	6160000	1680000	0	0	0	0	0	0	0	0	0	0	0	1274696314	2.14946E+11	7.070952	19.938	65.890979	139.834	231.27	25.569	90	1398200	4305417.959	1.333333	194.404	222.09	232.164	247.251	249.779	0.118262	60.8
1115.421875	1111.432339	0.589805	523520000	57440000	4320000	7960000	2760000	40000	0	0	0	0	0	0	0	0	0	0	1399853769	2.16346E+11	7.058567	19.859	65.784053	139.734	231.399	25.548	90	1490100	4333466.481	1.333333	194.369	222.386	232.294	247.165	249.758	0.122362	60.8
1122.40625	1110.033809	0.590494	567920000	64320000	5440000	8160000	2200000	80000	40000	0	0	0	0	0	0	0	0	0	1518126449	2.17864E+11	7.032328	19.898	67.301615	139.705	231.273	25.542	90	1620400	4363820.234	1.333333	194.346	222.217	232.174	247.223	249.835	0.138762	60.8
1129.390625	1106.969041	0.589461	651280000	67760000	5360000	8280000	3320000	40000	80000	0	0	0	0	0	0	0	0	0	1713292500	2.19577E+11	7.079139	19.945	65.911446	139.903	231.277	25.557	90	1840300	4398119.34	1.333333	194.304	222.064	232.262	247.273	249.847	0.188781	61.2
1136.390625	1105.76371	0.590854	529880000	58160000	4080000	6400000	2200000	80000	40000	0	0	0	0	0	0	0	0	0	1388005337	2.20965E+11	7.03999	19.937	67.013241	139.96	231.32	25.57	90	1502100	4425983.32	1.333333	194.163	222.224	232.167	247.195	249.807	0.210919	61.2
1143.375	1109.856548	0.589198	510560000	54000000	4240000	7240000	2240000	120000	0	0	0	0	0	0	0	0	0	0	1338763463	2.22304E+11	7.011782	19.91	66.910776	139.735	231.342	25.568	90	1446000	4452888.072	1.333333	194.337	222.185	232.181	247.268	249.916	0.205175	61.2
1150.421875	1111.321664	0.592773	499800000	51440000	4200000	6680000	1920000	160000	0	0	0	40000	0	0	0	0	0	0	1342340544	2.23647E+11	7.026818	19.949	65.927452	139.755	231.268	25.563	90	1410600	4479765.23	1.333333	194.269	222.065	232.13	247.295	249.894	0.195337	61.2
1157.40625	1108.082846	0.590592	524120000	55680000	4360000	7000000	1800000	120000	0	0	0	0	0	0	0	0	0	0	1365663435	2.25012E+11	7.045526	19.928	66.144452	139.908	231.321	25.585	90	1482700	4507073.324	1.333333	194.112	222.233	232.183	247.228	249.824	0.231419	61.2
1164.390625	1111.809846	0.591166	419680000	43960000	3360000	6120000	1720000	40000	0	0	0	0	0	0	0	0	0	0	1094989277	2.26107E+11	7.011704	19.926	66.411965	139.786	231.319	25.59	90	1187200	4529032.959	1.333333	194.232	222.149	232.09	247.28	249.889	0.178119	61.2
1171.375	1109.062943	0.590166	459000000	48200000	3320000	5920000	1920000	80000	0	0	0	0	0	0	0	0	0	0	1193768555	2.27301E+11	7.049829	20.02	66.164131	139.977	231.253	25.659	90	1296100	4552893.326	1.333333	194.18	222.009	232.187	247.318	249.937	0.228137	61.2
1178.375	1108.736183	0.591018	478880000	52160000	3760000	6200000	2120000	120000	40000	0	0	0	0	0	0	0	0	0	1267211832	2.28568E+11	7.058357	19.981	65.55249	139.949	231.372	25.655	90	1358200	4578284.367	1.333333	194.118	222.269	232.203	247.234	249.836	0.265856	61.2

1185.359375	1111.791075	0.591133	441680000	46800000	3840000	4760000	2200000	80000	0	0	0	0	0	0	0	0	0	0	1150651893	2.29719E+11	7.03099	19.986	67.511531	139.892	231.198	25.651	90	1248400	4601346.699	1.333333	194.149	222.053	232.148	247.338	250.044	0.254375	61.6
1192.359375	1110.080364	0.590527	426880000	49320000	3720000	5120000	1480000	40000	0	0	0	0	0	0	0	0	0	0	1123777969	2.30843E+11	7.023669	19.96	66.901855	139.948	231.318	25.625	90	1216400	4623808.513	1.333333	194.021	222.099	232.093	247.255	249.867	0.216656	61.6
1199.34375	1115.272153	0.593314	624040000	62520000	5440000	7960000	2280000	120000	0	0	0	0	0	0	0	0	0	0	1607371554	2.3245E+11	6.999345	19.927	66.319471	139.636	231.315	25.612	90	1755900	4655985.794	1.333333	194.179	222.174	232.051	247.3	249.954	0.234694	61.2
1206.359375	1110.765679	0.591576	514120000	55440000	3920000	5760000	1520000	160000	0	0	0	0	0	0	0	0	0	0	1335497320	2.33786E+11	7.01501	19.943	65.551572	139.529	231.335	25.632	90	1452300	4682596.086	1.333333	194.178	222.193	232.17	247.298	249.959	0.206819	61.6
1213.375	1107.361579	0.589198	427640000	48520000	3560000	5960000	1520000	80000	0	0	0	0	0	0	0	0	0	0	1134958307	2.3492E+11	7.038652	19.965	65.341132	139.687	231.44	25.674	90	1218200	4705302.311	1.333333	194.019	222.24	232.152	247.251	249.863	0.248637	61.2
1220.359375	1110.381083	0.589395	490640000	54640000	3600000	6480000	1840000	80000	0	0	0	0	0	0	0	0	0	0	1281267980	2.36202E+11	7.022226	19.965	66.638542	139.479	231.368	25.653	90	1393200	4731014.439	1.333333	194.18	222.127	232.101	247.362	250.049	0.252738	61.2
1227.359375	1101.258903	0.590477	528720000	58840000	4280000	6320000	2120000	40000	80000	0	0	0	0	0	0	0	0	0	1395290499	2.37597E+11	7.041931	19.971	65.464195	139.715	231.436	25.627	90	1501000	4758938.595	1.333333	194.016	222.188	232.143	247.317	249.917	0.258475	61.2
1234.34375	1102.332671	0.590838	519640000	56520000	4200000	6040000	1680000	40000	0	0	0	0	0	0	0	0	0	0	1328591432	2.38926E+11	7.011887	19.945	66.049071	139.569	231.394	25.62	90	1470300	4785748.144	1.333333	194.147	222.11	232.104	247.356	249.991	0.207637	61.6
1241.328125	1113.396508	0.592822	521440000	56680000	4160000	7080000	2280000	160000	0	0	0	0	0	0	0	0	0	0	1367019298	2.40293E+11	7.037628	20.04	65.767785	139.753	231.315	25.606	90	1479500	4813306.255	1.333333	194.032	221.936	232.187	247.348	249.992	0.251094	61.6
1248.375	1105.14848	0.588362	580560000	58800000	5400000	7240000	2320000	40000	40000	0	0	0	0	0	0	0	0	0	1522853624	2.41815E+11	7.026214	20.082	66.382839	139.906	231.382	25.695	90	1636000	4843700.811	1.333333	193.934	222.107	232.08	247.308	249.923	0.292913	61.6
1255.359375	1107.590029	0.587476	522080000	57440000	4560000	6800000	2360000	120000	0	0	0	0	0	0	0	0	0	0	1374335531	2.4319E+11	6.986068	19.998	66.018503	139.654	231.429	25.676	90	1483400	4871335.821	1.333333	194.107	222.155	232.095	247.374	250.026	0.238794	61.6
1262.34375	1109.375922	0.591445	697960000	76280000	6560000	9040000	2760000	160000	0	0	0	0	0	0	0	0	0	0	1833346471	2.45023E+11	7.030963	20.042	65.529924	139.694	231.357	25.665	90	1981900	4908119.316	1.333333	194.033	221.913	232.202	247.395	250.034	0.211737	61.6
1269.34375	1107.496306	0.591428	567920000	57720000	3920000	7040000	1720000	120000	80000	0	0	0	0	0	0	0	0	0	1462087425	2.46485E+11	6.92737	19.989	62.472102	139.234	231.697	25.648	90	1596300	4937406.802	1.333333	193.982	222.271	232.222	247.312	249.96	0.216656	61.2
1276.34375	1109.180411	0.588067	507040000	52480000	3720000	6120000	1720000	0	0	0	0	0	0	0	0	0	0	0	1293660878	2.47779E+11	6.937367	20.029	63.009092	138.792	231.788	25.638	90	1427700	4963364.468	1.333333	194.051	221.978	232.177	247.415	250.096	0.2224	61.6
1283.328125	1108.357211	0.588952	608240000	63240000	4880000	6880000	2360000	80000	0	0	0	0	0	0	0	0	0	0	1562614485	2.49342E+11	6.93023	20.029	63.056585	138.219	232.142	25.67	90	1714200	4994671.158	1.333333	194.025	222.246	232.258	247.398	250.033	0.215837	61.6
1290.328125	1102.67936	0.589165	501320000	49920000	4720000	6240000	1840000	160000	0	0	0	0	0	0	0	0	0	0	1296551762	2.50638E+11	6.940227	20.088	63.081123	137.897	232.121	25.697	90	1410500	5020666.623	1.333333	194.042	222.048	232.242	247.514	250.175	0.208456	61.6
1297.3125	1102.350848	0.587525	387280000	41560000	3480000	4800000	1920000	0	0	0	0	0	0	0	0	0	0	0	1008702721	2.51647E+11	7.008896	20.07	66.959188	138.147	231.983	25.664	90	1097600	5040994.94	1.333333	193.95	222.148	232.138	247.522	250.192	0.172381	61.6
1304.296875	1105.426783	0.591182	392160000	44200000	3960000	5320000	1640000	0	0	0	0	0	0	0	0	0	0	0	1031998463	2.52679E+11	7.013173	20.037	66.807918	138.369	231.832	25.633	90	1118200	5061798.933	1.333333	194.045	222.27	232.269	247.594	250.326	0.029706	61.6
1311.296875	1108.125461	0.59174	450800000	51680000	4320000	6160000	2160000	40000	0	0	0	0	0	0	0	0	0	0	1203654285	2.53882E+11	7.012806	20.079	66.263843	138.836	231.705	25.623	90	1287900	5085995.807	1.333333	193.924	222.087	232.201	247.62	250.236	0.061687	61.6
1318.296875	1108.13865	0.589592	481840000	56520000	4080000	6840000	2600000	120000	0	0	0	0	0	0	0	0	0	0	1305550678	2.55188E+11	7.044896	20.004	65.872611	139.036	231.73	25.683	90	1380000	5112177.173	1.333333	193.864	222.285	232.3	247.57	250.276	0.077269	61.6
1325.28125	1106.961483	0.588132	486840000	56240000	4440000	7280000	2280000	160000	0	0	0	0	0	0	0	0	0	0	1313831770	2.56502E+11	7.053844	20.088	66.17161	139.419	231.567	25.74	90	1393100	5138524.292	1.333333	193.822	222.022	232.323	247.63	250.41	0.045287	61.6
1332.265625	1112.89579	0.591084	516480000	60360000	4200000	6960000	2080000	40000	0	40000	40000	0	0	0	0	0	0	0	1398524468	2.579E+11	7.016322	20.102	66.068751	139.602	231.572	25.7	90	1475500	5166599.634	1.333333	193.806	222.008	232.17	247.646	250.313	0.088744	61.6
1339.3125	1107.738532	0.589903	498880000	57440000	3800000	7400000	2200000	80000	0	0	0	0	0	0	0	0	0	0	1347321539	2.59248E+11	7.062293	20.041	65.79468	139.574	231.613	25.696	90	1424500	5193502.852	1.333333	193.782	222.222	232.261	247.589	250.357	0.075625	61.2
1346.25	1110.192234	0.593659	473400000	50560000	3880000	5360000	2560000	200000	0	0	0	0	0	0	0	0	0	0	1238833872	2.60487E+11	7.053529	20.074	65.842567	139.652	231.428	25.706	90	1339900	5218354.964	1.333333	193.729	221.913	232.242	247.66	250.37	0.062506	61.2
1353.25	1109.507994	0.591461	494440000	53560000	3560000	6360000	2160000	80000	0	0	0	0	0	0	0	0	0	0	1295438024	2.61782E+11	7.058856	20.038	65.864215	139.619	231.499	25.719	90	1400400	5244285.168	1.333333	193.605	222.056	232.173	247.567	250.295	0.083006	61.2
1360.296875	1106.583564	0.592347	464960000	51160000	4000000	5320000	2040000	120000	0	0	0	0	0	0	0	0	0	0	1230388429	2.63012E+11	7.066701	20.119	65.858311	139.568	231.347	25.732	90	1319000	5268928.492	1.333333	193.66	221.889	232.179	247.639	250.374	0.064969	61.2
1367.296875	1109.642276	0.589756	488840000	58000000	4720000	6080000	1800000	80000	0	0	0	0	0	0	0	0	0	0	1298520630	2.64311E+11	7.053372	20.117	64.940714	139.593	231.517	25.779	90	1398800	5295005.162	1.333333	193.596	222.099	232.193	247.503	250.228	0.094487	61.2
1374.28125	1109.284462	0.587919	567000000	63920000	5160000	7080000	2400000	160000	0	0	0	0	0	0	0	0	0	0	1501856868	2.65813E+11	7.023984	20.132	64.061559	139.399	231.502	25.753	90	1614300	5325082.059	1.333333	193.653	221.857	232.172	247.597	250.335	0.061687	60.8
1381.28125	1107.621111	0.589083	584520000	58560000	4920000	7560000	2320000	160000	0	0	0	0	0	0	0	0	0	0	1515059691	2.67328E+11	6.986199	20.049	63.840492	138.923	231.734	25.746	90	1645100	5355433.15	1.333333	193.619	222.103	232.149	247.533	250.236	0.049387	60.8
1388.28125	1107.161904	0.592117	449920000	47720000	3680000	5400000	1240000	40000	0	0	0	0	0	0	0	0	0	0	1151968811	2.6848E+11	7.006298	20.115	65.421293	138.66	231.672	25.736	90	1270000	5378545.121	1.333333	193.596	221.849	232.113	247.597	250.313	0.101044	60.4
1395.28125	1108.220757	0.591297	480560000	55480000	4400000	6840000	2520000	120000	0	0	0	0	0	0	0	0	0	0	1298425903	2.69778E+11	6.909317	20.075	64.551321	138.268	231.821	25.671	90	1374800	5404606.268	1.333333	193.55	221.917	232.087	247.575	250.39	0.085462	60.4
1402.28125	1106.300418	0.589001	459320000	51480000	3920000	5600000	2240000	80000	40000	0	0	0	0	0	0	0	0	0	1222225626	2.71E+11	6.91097	20.112	64.033221	137.974	232.076	25.719	90	1306700	5429114.534	1.333333	193.505	222.065	232.117	247.552	250.309	0.06415	60.4
1409.265625	1109.900831	0.593544	402880000	44680000	3840000	5320000	2040000	40000	0	0	0	0	0	0	0	0	0	0	1068221118	2.72069E+11	6.944504	20.18	65.056692	137.632	232.107	25.731	90	1147000	5450571.859	1.333333	193.661	222.024	232.209	247.663	250.508	0.072344	60.4
1416.25	1105.989833	0.590035	401480000	45520000	3440000	5280000	1880000	80000	0	40000	0	0	0	0	0	0	0	0	1079021584	2.73148E+11	6.926268	20.195	64.547648	137.61	232.261	25.71	90	1144300	5472175.822	1.333333	193.551	222.147	232.234	247.685	250.446	0.101044	60.4
1423.25	1112.607651	0.592166	324240000	37240000	3240000	4520000	1480000	80000	0	0	0	0	0	0	0	0	0	0	870355202.3	2.74018E+11	7.013016	20.146	67.186553	137.448	232.18	25.731	90	927000	5489663.53	1.333333	193.693	222.147	232.3	247.792	250.676	0.068244	60.4
1430.234375	1111.349027	0.591609	442960000	48880000	3720000	6160000	1560000	40000	40000	0	0	0	0	0	0	0	0	0	1169179465	2.75187E+11	7.01173	20.182	66.114145	137.919	231.927	25.721	90	1258400	5513015.667	1.333333	193.69	222.059	232.283	247.86	250.676	0.050206	60.8
1437.21875	1112.699159	0.594298	442240000	54440000	4880000	6760000	1960000	40000	0	0	0	0	0	0	0	0	0	0	1210568015	2.76398E+11	6.918553	20.099	63.258239	137.806	232.178	25.715	90	1275800	5537221.844	1.333333	193.648	222.331	232.459	247.79	250.663	0.071525	60.8
1444.234375	1104.709364	0.589772	466160000	52440000	2840000	6000000	2720000	40000	0	0	0	0	0	0	0	0	0	0	1244511475	2.77642E+11	6.916428	20.158	63.423679	137.528	232.395	25.769	90	1325500	5562076.55	1.333333	193.634	222.33	232.48	247.855	250.715	0.033806	60.8
1451.234375	1106.638312	0.589903	418400000	47000000	4240000	6920000	1840000	40000	0	0	0	0	0	0	0	0	0	0	1124077773	2.78766E+11	6.903203	20.207	63.356112	137.384	232.433	25.748	90	1196100	5584688.385	1.333333	193.631	222.16	232.409	248.014	250.832	0.051025	60.8
1458.21875	1108.434011	0.591543	464000000	50920000	3640000	6440000	2360000	80000	0	0	40000	0	0	0	0	0	0	0	1249360043	2.80016E+11	6.920154	20.19	63.317934	137.087	232.609	25.703	90	1318700	5609776.579	1.333333	193.675	222.403	232.548	248.045	250.909	0.037087	61.2
1465.21875	1106.700115	0.589231	416720000	47160000	3240000	5280000	1680000	120000	0	0	0	0	0	0	0	0	0	0	1100251705	2.81116E+11	6.895804	20.18	63.599745	137.129	232.577	25.691	90	1185500	5631834.76	1.333333	193.616	222.243	232.476	248.1	250.938	0.062506	61.2
1472.21875	1107.979488	0.593232	392040000	43720000	3720000	4960000	1840000	0	0	0	0	0	0	0	0	0	0	0	1034652504	2.82151E+11	6.91013	20.114	64.16101	136.83	232.694	25.681	90	1115700	5652610.287	1.333333	193.586	222.328	232.561	248.165	251.084	0.062506	61.2
1479.203125	1105.617193	0.588067	422000000	49560000	4600000	5880000	2000000	0	0	0	0	0	0	0	0	0	0	0	1134875941	2.83285E+11	6.917451	20.218	63.868962	136.855	232.748	25.734	90	1210100	5675371.958	1.333333	193.506	222.286	232.486	248.189	251.021	0.032169	61.2

1486.203125	1107.327411	0.592216	519280000	58440000	3960000	8600000	1720000	40000	0	0	0	0	0	0	0	0	0	0	1372142434	2.84658E+11	6.942746	20.209	63.551858	136.714	232.758	25.775	90	1480100	5702951.173	1.333333	193.552	222.258	232.746	248.328	251.276	0.087106	61.2
1493.1875	1107.246624	0.591117	454680000	55080000	3960000	7080000	2200000	120000	0	0	0	0	0	0	0	0	0	0	1238407941	2.85896E+11	6.930623	20.159	63.188574	136.47	232.951	25.735	90	1307800	5727803.964	1.333333	193.498	222.554	232.785	248.32	251.226	0.02315	61.2
1500.171875	1112.621682	0.590854	407400000	47600000	4040000	6240000	2040000	80000	0	0	0	0	0	0	0	0	0	0	1104699324	2.87001E+11	6.924483	20.198	63.45451	136.512	232.831	25.734	90	1168500	5749975.062	1.333333	193.447	222.287	232.779	248.46	251.375	0.022331	61.2
1507.171875	1111.558963	0.588378	443760000	54200000	4560000	6600000	2440000	40000	0	0	0	0	0	0	0	0	0	0	1223073015	2.88224E+11	6.918789	20.149	63.254041	136.267	232.984	25.737	90	1279000	5774403.312	1.333333	193.407	222.557	232.825	248.431	251.379	0.012487	61.2
1514.15625	1111.993345	0.591724	497360000	61720000	4280000	6000000	2680000	80000	0	0	0	0	0	0	0	0	0	0	1348984080	2.89573E+11	6.902573	20.214	64.072317	136.437	232.937	25.758	90	1430300	5801372.123	1.333333	193.301	222.338	232.667	248.5	251.441	0.080544	61.2
1521.15625	1105.152313	0.59338	492880000	59520000	4840000	7200000	2240000	40000	40000	0	0	0	0	0	0	0	0	0	1346066954	2.90919E+11	6.912754	20.2	63.834851	136.405	232.933	25.808	90	1416900	5828272.104	1.333333	193.286	222.329	232.836	248.615	251.588	0.057587	61.2
1528.171875	1107.820774	0.589756	480040000	52960000	4320000	8160000	2040000	160000	0	40000	0	0	0	0	0	0	0	0	1303934880	2.92223E+11	6.921702	20.196	63.888904	136.188	232.981	25.78	90	1369300	5854491.413	1.333333	193.215	222.389	232.805	248.673	251.669	0.02315	61.2
1535.171875	1107.862183	0.593577	413440000	48600000	3760000	6560000	1560000	120000	0	0	0	0	0	0	0	0	0	0	1115911566	2.93339E+11	6.923198	20.15	63.308357	135.995	233.128	25.755	90	1185100	5876875.932	1.333333	193.173	222.595	232.911	248.639	251.622	0.01085	61.6
1542.15625	1110.897979	0.590559	394960000	48560000	4080000	7160000	2480000	120000	0	0	0	0	0	0	0	0	0	0	1110347072	2.94449E+11	6.919524	20.202	63.358343	136.03	232.969	25.729	90	1143400	5899147.998	1.333333	193.088	222.249	232.829	248.755	251.657	0.079725	61.6
1549.140625	1112.698685	0.5911	473800000	53640000	4000000	5800000	2320000	160000	0	0	0	0	0	0	0	0	0	0	1262529832	2.95712E+11	6.920469	20.127	63.307176	135.969	233.099	25.748	90	1349300	5924403.439	1.333333	193.026	222.513	232.875	248.684	251.664	0.022331	61.6
1556.140625	1105.259832	0.589592	442480000	51240000	4320000	6400000	3040000	40000	40000	0	0	0	0	0	0	0	0	0	1223593016	2.96935E+11	6.905748	20.218	63.374611	136.127	232.992	25.781	90	1268900	5948840.383	1.333333	192.969	222.203	232.78	248.772	251.762	0.080544	61.6
1563.140625	1107.790164	0.589198	403200000	48560000	3800000	5880000	2560000	40000	80000	0	0	0	0	0	0	0	0	0	1116814758	2.98052E+11	6.918842	20.275	64.233562	136.14	232.972	25.811	90	1160300	5971294.927	1.333333	192.896	222.293	232.81	248.821	251.875	-0.012931	61.6
1570.140625	1109.954459	0.588854	404320000	45360000	4480000	6400000	2200000	40000	0	0	0	0	0	0	0	0	0	0	1098915600	2.99151E+11	6.898795	20.228	63.601976	135.989	233.048	25.775	90	1157000	5993339.126	1.333333	192.924	222.393	232.764	248.841	251.882	0.055125	61.6
1577.125	1102.602816	0.588214	372920000	46600000	4040000	6760000	1760000	80000	0	0	0	0	0	0	0	0	0	0	1039445597	3.0019E+11	6.871926	20.256	63.825273	136.083	232.954	25.756	90	1080400	6014149.702	1.333333	192.785	222.179	232.708	248.876	251.894	0.093662	61.2
1584.109375	1108.633312	0.593659	316080000	36800000	2440000	4800000	1040000	0	0	0	0	0	0	0	0	0	0	0	829945784.4	3.0102E+11	6.881897	20.194	63.845215	135.858	232.98	25.756	90	902900	6030876.704	1.333333	192.785	222.326	232.73	248.876	251.994	0.066606	61.2
1591.15625	1107.711178	0.59074	401680000	48440000	3640000	5920000	1960000	0	40000	0	0	0	0	0	0	0	0	0	1100744670	3.02121E+11	6.918265	20.2	63.308619	135.955	233.038	25.724	90	1154200	6052940.801	1.333333	192.601	222.349	232.815	248.837	251.885	0.078906	61.2
1598.15625	1111.641528	0.589789	443880000	50800000	4360000	7040000	2480000	80000	40000	0	0	0	0	0	0	0	0	0	1216013495	3.03337E+11	6.909212	20.247	63.873291	135.902	232.872	25.735	90	1271700	6077335.717	1.333333	192.58	222.1	232.823	248.954	252.073	0.06005	61.2
1605.140625	1107.833413	0.590133	405160000	48320000	3880000	5560000	2000000	240000	0	0	0	0	0	0	0	0	0	0	1108999085	3.04446E+11	6.909212	20.265	63.291301	135.94	232.994	25.811	90	1162900	6099505.116	1.333333	192.503	222.297	232.785	248.867	251.911	0.054306	60.8
1612.125	1108.571127	0.591363	380720000	47040000	4040000	4880000	1800000	120000	40000	0	0	0	0	0	0	0	0	0	1042022130	3.05488E+11	6.914198	20.281	64.028498	135.946	232.884	25.779	90	1096600	6120407.218	1.333333	192.52	222.125	232.825	248.986	252.131	0.073987	60.8
1619.125	1105.812414	0.589051	382640000	43560000	3840000	4720000	1440000	40000	0	40000	0	0	0	0	0	0	0	0	1021345799	3.06509E+11	6.913305	20.267	63.856498	136.011	232.975	25.751	90	1090700	6140880.937	1.333333	192.331	222.21	232.732	248.929	252.002	0.078087	60.8
1626.125	1109.414409	0.593003	489480000	58200000	4600000	6640000	2560000	40000	0	0	0	0	0	0	0	0	0	0	1319835023	3.07829E+11	6.929836	20.251	63.892053	135.946	232.81	25.758	90	1403800	6167404.122	1.333333	192.383	222.028	232.761	248.987	252.183	0.078906	60.8
1633.109375	1106.172139	0.59192	392680000	48480000	4000000	5640000	1800000	80000	0	0	0	0	0	0	0	0	0	0	1071141372	3.089E+11	6.997928	20.27	66.192339	136.304	232.648	25.768	90	1131700	6188859.713	1.333333	192.255	222.196	232.715	248.917	252.017	0.073169	60.8
1640.109375	1109.152575	0.591281	428000000	53040000	4200000	7320000	2160000	80000	40000	0	0	0	0	0	0	0	0	0	1189418555	3.1009E+11	6.967307	20.282	67.057717	136.552	232.384	25.857	90	1237100	6212754.297	1.333333	192.299	221.976	232.677	248.958	252.173	0.118262	61.2
1647.09375	1105.722586	0.590035	383320000	45760000	3560000	6600000	2960000	80000	40000	0	0	0	0	0	0	0	0	0	1081953836	3.11172E+11	6.955971	20.326	66.275257	136.876	232.23	25.807	90	1105800	6234431.584	1.333333	192.252	221.855	232.527	248.953	252.072	0.084644	61.2
1654.09375	1109.714099	0.590182	363320000	46520000	3320000	5800000	2120000	40000	40000	0	0	0	0	0	0	0	0	0	1014652831	3.12186E+11	6.973368	20.253	65.597491	136.883	232.159	25.814	90	1052900	6254823.535	1.333333	192.253	222.029	232.588	248.882	252.052	0.04365	61.6
1661.078125	1104.597999	0.588378	384160000	48760000	4240000	6400000	1960000	80000	0	0	0	0	0	0	0	0	0	0	1071376952	3.13258E+11	6.986146	20.318	65.743645	137.276	231.952	25.847	90	1114000	6276278.049	1.333333	192.116	221.687	232.455	248.866	252.049	0.093662	61.6
1668.078125	1105.648519	0.588263	392920000	47200000	3560000	5520000	2000000	80000	40000	0	0	0	0	0	0	0	0	0	1069286924	3.14327E+11	6.993808	20.22	65.748761	137.334	231.936	25.814	90	1128300	6297789.885	1.333333	192.135	221.847	232.468	248.762	251.936	0.072344	61.6
1675.078125	1105.490241	0.590182	344680000	42920000	3120000	5760000	1520000	40000	40000	0	0	0	0	0	0	0	0	0	948994188.2	3.15276E+11	6.980374	20.295	65.759126	137.651	231.734	25.832	90	995200	6316863.542	1.333333	192.033	221.555	232.375	248.764	251.957	0.074806	61.6
1682.0625	1110.241849	0.591888	454960000	52440000	3840000	6720000	2200000	80000	0	0	0	0	0	0	0	0	0	0	1217736588	3.16494E+11	6.947784	20.35	66.547754	137.758	231.778	25.872	90	1300600	6341342.105	1.333333	191.942	221.576	232.174	248.64	251.752	0.097762	61.6
1689.078125	1106.759259	0.589641	424440000	51440000	4520000	6200000	2200000	200000	0	0	0	0	0	0	0	0	0	0	1176134208	3.1767E+11	6.99491	20.331	65.557476	137.747	231.638	25.844	90	1222500	6364883.206	1.333333	192.027	221.511	232.269	248.658	251.812	0.104325	61.6
1696.078125	1107.912039	0.590527	442240000	52560000	4720000	6720000	2360000	40000	0	0	0	0	0	0	0	0	0	0	1207604634	3.18878E+11	6.977829	20.277	65.141708	137.79	231.723	25.845	90	1271600	6389130.267	1.333333	191.97	221.669	232.258	248.503	251.641	0.112525	61.2
1703.078125	1110.19393	0.59151	406240000	47200000	3720000	6840000	2080000	80000	40000	0	0	0	0	0	0	0	0	0	1114908797	3.19992E+11	6.97077	20.333	65.334441	137.819	231.568	25.812	90	1165500	6411492.828	1.333333	192.042	221.385	232.07	248.541	251.621	0.130562	61.2
1710.078125	1110.219784	0.593495	454400000	51800000	3760000	7440000	2720000	0	0	40000	0	0	0	0	0	0	0	0	1247078050	3.2124E+11	6.932723	20.267	66.522301	137.767	231.587	25.812	90	1300400	6436454.995	1.333333	192.058	221.516	232.005	248.461	251.589	0.041187	61.2
1717.078125	1105.338965	0.590428	362480000	43320000	3040000	5560000	1400000	40000	0	0	0	0	0	0	0	0	0	0	975561674.6	3.22215E+11	6.977199	20.306	65.473772	137.965	231.496	25.825	90	1039600	6455981.892	1.333333	191.989	221.314	231.924	248.429	251.483	0.099406	61.2
1724.0625	1110.367517	0.592478	415960000	45320000	3640000	5920000	1720000	40000	0	0	0	0	0	0	0	0	0	0	1091491267	3.23307E+11	6.979036	20.321	65.543175	138.091	231.632	25.846	90	1181500	6477925.714	1.333333	191.942	221.504	232.013	248.284	251.425	0.085462	61.2
1731.046875	1105.813839	0.589346	394080000	46600000	4440000	5920000	1640000	80000	0	0	0	0	0	0	0	0	0	0	1069637745	3.24376E+11	6.95235	20.341	65.990033	137.878	231.581	25.877	90	1131900	6499332.796	1.333333	192.131	221.504	231.963	248.329	251.441	0.05185	61.2
1738.046875	1105.350696	0.588198	411960000	49600000	4360000	6160000	1560000	160000	40000	0	0	0	0	0	0	0	0	0	1124723018	3.25501E+11	6.981161	20.373	65.791925	138.048	231.404	25.846	90	1184600	6521935.013	1.333333	192.076	221.286	231.884	248.307	251.417	0.069069	61.2
1745.03125	1108.329954	0.58869	374720000	45120000	3360000	5600000	1440000	0	40000	40000	0	0	0	0	0	0	0	0	1017472558	3.26518E+11	7.002021	20.341	65.633439	138.07	231.482	25.837	90	1075800	6542390.513	1.333333	192.03	221.498	231.958	248.169	251.236	0.096944	60.8
1752.03125	1107.750524	0.588821	328120000	36880000	2840000	4680000	920000	120000	0	0	0	0	0	0	0	0	0	0	865850178.4	3.27384E+11	6.991106	20.386	65.399252	138.119	231.306	25.837	90	933900	6559750.971	1.333333	192.102	221.159	231.9	248.217	251.32	0.117444	60.8
1759.03125	1109.039612	0.590527	350760000	41200000	2560000	5280000	1360000	80000	0	0	0	0	0	0	0	0	0	0	937363440.8	3.28322E+11	6.96093	20.393	66.604168	138.164	231.349	25.804	90	1003100	6578555.113	1.333333	192.004	221.341	231.676	248.085	251.142	0.089562	60.8
1766.03125	1108.935036	0.593462	485160000	56720000	4000000	7520000	2480000	80000	40000	0	0	0	0	0	0	0	0	0	1321010124	3.29643E+11	6.9624	20.335	66.337314	138.049	231.337	25.837	90	1390000	6605024.664	1.333333	192.192	221.394	231.784	248.096	251.172	0.128925	61.2
1773.015625	1104.639716	0.590822	408960000	45080000	3560000	5640000	1800000	160000	80000	0	0	0	0	0	0	0	0	0	1099250088	3.30742E+11	7.012989	20.447	67.107572	138.217	231.327	25.904	90	1163200	6627052.807	1.333333	192.198	221.271	231.774	248.112	251.127	0.076444	61.2

1780.015625	1106.821274	0.588755	426400000	46440000	4240000	5280000	1920000	120000	0	0	0	0	0	0	0	0	0	0	1125001876	3.31867E+11	7.03894	20.375	67.257796	138.267	231.421	25.864	90	1211000	6649684.659	1.333333	192.183	221.493	231.885	247.98	251.041	0.084644	61.2
1787	1105.656507	0.588624	411120000	48800000	3920000	5360000	1440000	40000	0	0	0	0	0	0	0	0	0	0	1088760959	3.32956E+11	7.004278	20.411	68.237707	138.335	231.227	25.857	90	1176700	6671544.274	1.333333	192.176	221.32	231.791	248.035	251.147	0.057587	61.2
1794	1104.66391	0.589559	468560000	53400000	4000000	6720000	1960000	80000	0	0	0	0	0	0	0	0	0	0	1245385901	3.34201E+11	6.990974	20.408	67.975706	138.458	231.318	25.874	90	1336800	6696574.871	1.333333	192.163	221.199	231.665	247.948	250.97	0.03135	61.2
1801.015625	1107.873827	0.591133	461840000	50160000	3240000	4920000	1560000	0	40000	0	0	0	0	0	0	0	0	0	1185325805	3.35386E+11	6.995619	20.408	67.032789	138.383	231.305	25.867	90	1304400	6720419.747	1.333333	192.215	221.193	231.678	247.954	250.918	0.069887	61.6

Table E-6 Aerosol counts at simulated high pressure to low pressure conditions (Test 1: 70.9 PSI, 279.5°C)

Time (sec)	Flow (CFM)	Filter dP ("H2O)	0.3 µm	0.4 µm	0.5 µm	0.55 µm	0.7 µm	1.0 µm	1.3 µm	1.6 µm	2.0 µm	2.2 µm	3.0 µm	4.0 µm	5.0 µm	5.5 µm	7.0 µm	10.0 µm	dm (pg)	Total Mass (pg)	Aerosol Generator (PSIA)	Aerosol Generator Temp (°C)	Compressor (PSIA)	Compressor Temp (°C)	Reactor Tube Temp (°C)	Duct Temp (°C)	Aero. Gen.Flow (CFH)	Sum of Particles	Total Sample Mass (pg)	Sample Filter Flow Rate (SCFH)	Temp S1 (°C)	Temp S2 (°C)	Temp S3 (°C)	Temp S4 (°C)	Temp S5 (°C)	CO (PPM)	RH (%)
0.65625	1108.511628	0.583508	118040000	16760000	1200000	1400000	520000	0	0	0	0	0	0	0	0	0	0	0	440951085.8	0	7.201835	23.982	70.496144	149.699	279.515	29.049	90	344800	0	1.333333	229.056	268.596	282.627	304.726	309.881	-0.199875	40.8
17.640625	1110.765901	0.583983	86920000	12320000	1000000	1080000	280000	0	0	0	0	0	0	0	0	0	0	0	580971701.6	580971701.6	7.2355	24.008	70.510051	149.771	279.531	29.036	90	254000	11646.68185	1.333333	229.02	268.389	282.63	304.834	310.13	-0.158881	41.2
24.625	1112.590126	0.584524	111840000	15400000	1480000	1760000	320000	0	0	0	0	0	0	0	0	0	0	0	310942916.7	891914618.3	7.144213	24.027	70.666307	149.829	279.64	29.043	90	327000	17867.47291	1.333333	229.033	268.434	282.519	304.802	310.142	-0.25235	40.8
31.609375	1110.355509	0.580736	104920000	14840000	1120000	2280000	600000	0	0	0	0	0	0	0	0	0	0	0	305681038.3	1197595657	7.159012	24.029	72.394308	149.887	279.556	29.021	90	309400	23972.96657	1.333333	228.899	268.503	282.616	304.79	310.01	-0.212175	40.8
38.65625	1110.443101	0.585492	105520000	15800000	1280000	1640000	520000	0	0	0	0	0	0	0	0	0	0	0	305319720.6	1502915377	7.169508	23.993	70.802227	149.688	279.483	29.031	90	311900	30083.51641	1.333333	228.951	268.589	282.648	304.688	309.878	-0.244156	40.8
45.640625	1107.168237	0.583672	118680000	18160000	1240000	1960000	360000	0	0	0	0	0	0	0	0	0	0	0	336457554.2	1839372931	7.169902	23.971	71.284508	149.484	279.492	29.021	90	351000	36816.71556	1.333333	229.013	268.522	282.508	304.723	309.975	-0.206438	40.8
52.609375	1110.632479	0.584606	102240000	14000000	840000	1520000	360000	40000	0	0	0	0	0	0	0	0	0	0	281299343.3	2120672275	7.167698	23.951	71.667214	149.536	279.502	29.054	90	297500	42462.73782	1.333333	229.036	268.519	282.537	304.774	309.979	-0.211356	41.2
59.59375	1111.283712	0.584721	86040000	11640000	760000	1320000	200000	40000	0	0	0	0	0	0	0	0	0	0	236334357.2	2357006632	7.199474	23.949	71.761282	149.833	279.484	29.038	90	250000	47191.46195	1.333333	228.843	268.375	282.634	304.795	310.063	-0.172819	41.2
66.578125	1110.610329	0.584508	91680000	11640000	720000	1040000	80000	0	0	0	0	0	0	0	0	0	0	0	237796097.5	2594802729	7.215217	24.003	70.838437	149.913	279.502	29.066	90	262900	51946.64523	1.333333	228.899	268.325	282.597	304.85	310.086	-0.217913	41.6
73.59375	1110.603651	0.585098	118120000	15640000	960000	1640000	520000	0	0	0	0	0	0	0	0	0	0	0	323751271.9	2918554001	7.211308	23.964	70.761818	149.806	279.423	29.033	90	342200	58424.5903	1.333333	228.868	268.537	282.608	304.729	309.88	-0.221194	41.6
80.578125	1110.370648	0.582376	106400000	16600000	1040000	1800000	280000	80000	0	0	0	0	40000	0	0	0	0	0	380474524.7	3299028526	7.17578	23.948	71.820058	149.533	279.369	29.049	90	315600	66037.55775	1.333333	228.939	268.4	282.471	304.751	309.99	-0.253994	41.6
87.609375	1114.211295	0.585246	100720000	14480000	1040000	1840000	520000	80000	0	0	0	0	0	0	0	0	0	0	295734950.7	3594763477	7.177616	23.937	72.535872	149.421	279.336	28.982	90	296700	71956.20105	1.333333	228.855	268.326	282.488	304.733	309.973	-0.237594	41.6
94.59375	1108.617344	0.583918	103640000	14240000	1280000	1560000	360000	40000	0	0	0	0	0	0	0	0	0	0	291520752	3886284229	7.217422	23.934	70.588769	149.394	279.36	29.025	90	302800	77770.39353	1.333333	228.846	268.235	282.534	304.784	310.106	-0.201519	41.6
101.578125	1112.364081	0.586099	101720000	14280000	960000	1560000	440000	0	0	0	0	0	0	0	0	0	0	0	283175786.9	4169460016	7.182444	23.989	71.300645	149.316	279.303	29.048	90	297400	83446.649	1.333333	228.863	268.254	282.394	304.708	310.08	-0.257275	41.6
108.5625	1109.106263	0.584803	100440000	14280000	1000000	1600000	400000	0	0	0	0	0	0	0	0	0	0	0	281649691.3	4451109707	7.219048	23.949	71.582198	149.342	279.264	29.025	90	294300	89073.29781	1.333333	228.72	268.277	282.436	304.632	309.875	-0.220375	41.2
115.5625	1113.861352	0.58764	101280000	13840000	1160000	1520000	200000	0	0	0	0	0	0	0	0	0	0	0	276887288	4727996995	7.187456	23.914	72.109348	149.087	279.262	29.034	90	295000	94621.05373	1.333333	228.754	268.179	282.491	304.723	310.01	-0.253994	41.2
122.546875	1110.307612	0.585082	109520000	16720000	1520000	1720000	800000	40000	0	0	0	0	0	0	0	0	0	0	327072821.7	5055069817	7.200759	23.95	71.146751	149.052	279.243	29.043	90	325800	101146.3586	1.333333	228.757	268.138	282.38	304.705	310.073	-0.229394	41.2
129.59375	1110.867408	0.585148	103960000	14600000	920000	1320000	280000	80000	0	0	0	0	0	0	0	0	0	0	290320671.7	5345390488	7.163053	23.994	71.885526	149.19	279.2	29.005	90	302900	106956.974	1.333333	228.753	268.115	282.277	304.619	310.026	-0.270394	41.2
136.578125	1112.969152	0.585836	114000000	15920000	1440000	1800000	520000	80000	0	0	0	0	0	0	0	0	0	0	327346743.5	5672737232	7.186485	23.958	72.256945	149.4	279.146	29.002	90	334400	113505.3451	1.333333	228.633	268.21	282.338	304.575	309.891	-0.249894	41.2
143.5625	1107.518291	0.583131	116360000	15360000	1160000	1960000	480000	40000	0	0	0	0	0	0	0	0	0	0	325644742.2	5998381974	7.194357	23.939	71.067245	149.602	279.146	29.031	90	338400	120007.3671	1.333333	228.597	268.223	282.363	304.509	309.853	-0.198238	41.2
150.546875	1108.589729	0.583098	86880000	11920000	1000000	1080000	440000	0	0	0	0	0	0	0	0	0	0	0	240598756.2	6238980730	7.156257	23.944	71.07656	149.369	279.176	29.034	90	253300	124834.9524	1.333333	228.699	268.218	282.256	304.584	309.79	-0.210538	41.2
157.53125	1106.57828	0.586656	106480000	14600000	1120000	1560000	200000	40000	0	0	0	0	0	0	0	0	0	0	291728340.4	6530709071	7.148411	23.92	72.370037	149.572	279.13	29.009	90	310000	130682.7893	1.333333	228.574	268.064	282.335	304.629	309.935	-0.201519	41.6
164.515625	1112.795392	0.586509	118960000	16520000	1200000	1800000	640000	0	0	0	0	0	0	0	0	0	0	0	333062163.1	6863771234	7.179401	23.91	70.461771	149.67	279.137	28.973	90	347800	137371.3188	1.333333	228.555	268	282.341	304.584	309.944	-0.199875	41.6
171.5625	1111.472294	0.586722	134840000	19440000	1280000	1520000	400000	0	0	0	0	0	0	0	0	0	0	0	371923152.1	7235694386	7.175229	23.971	70.223119	149.673	279.105	28.973	90	393700	144798.5233	1.333333	228.617	268.006	282.15	304.546	310.004	-0.208075	41.6
178.546875	1111.376061	0.587771	117920000	16640000	1360000	1480000	520000	40000	0	0	0	40000	0	0	0	0	0	0	359676493.4	7595370879	7.147755	23.971	71.114607	149.65	279.21	28.963	90	345000	151989.7155	1.333333	228.578	268.025	282.131	304.474	309.862	-0.202338	41.6
185.53125	1110.263907	0.584049	116520000	15360000	1120000	2240000	440000	0	0	0	0	0	0	0	0	0	0	0	324649241.1	7920020120	7.180818	23.974	70.459409	149.641	279.251	28.96	90	339200	158481.1524	1.333333	228.471	268.064	282.227	304.464	309.752	-0.200694	41.6
192.515625	1106.51228	0.583131	113520000	16000000	1320000	1800000	640000	40000	0	0	0	0	0	0	0	0	0	0	325701803.2	8245721924	7.163762	23.923	69.360235	149.131	279.344	28.967	90	333300	165000.1591	1.333333	228.526	268.143	282.23	304.445	309.765	-0.198238	41.6
199.5	1104.460072	0.582819	103520000	14320000	760000	1560000	400000	40000	0	0	0	0	0	0	0	0	0	0	286174751.7	8531896675	7.123562	23.9	69.109385	148.557	279.459	28.98	90	301500	170747.4419	1.333333	228.62	268.127	282.144	304.512	309.812	-0.185119	41.2
206.53125	1112.885225	0.583836	103000000	13040000	920000	1520000	440000	0	0	0	0	0	0	0	0	0	0	0	280181381.8	8812078057	7.123641	23.91	69.333732	148.333	279.641	28.96	90	297300	176384.8145	1.333333	228.532	268.029	282.271	304.569	309.941	-0.153956	41.2
213.53125	1107.474174	0.58523	123880000	16840000	1120000	1400000	800000	40000	0	0	0	0	0	0	0	0	0	0	347378963.9	9159457021	7.133402	23.932	71.026968	148.32	279.755	28.967	90	360200	183321.3182	1.333333	228.558	268.041	282.185	304.641	309.982	-0.174456	41.2
220.515625	1112.22678	0.58705	104840000	15000000	1040000	1840000	520000	40000	0	0	0	0	0	0	0	0	0	0	300052261	9459509282	7.170847	23.962	71.117625	148.615	279.612	28.947	90	308200	189342.0708	1.333333	228.549	268.035	282.211	304.629	310.086	-0.198238	41.2
227.5	1108.149284	0.584869	98600000	13800000	720000	1920000	520000	0	40000	0	0	0	0	0	0	0	0	0	286148749.5	9745658032	7.185016	23.968	72.311916	149.053	279.44	28.934	90	289000	195059.3051	1.333333	228.396	268.118	282.325	304.622	309.932	-0.175275	41.2
234.484375	1107.299714	0.583885	98920000	14360000	1040000	2240000	600000	0	0	0	0	0	0	0	0	0	0	0	290319346.6	10035977378	7.194068	23.952	71.942465	149.267	279.347	28.928	90	292900	200881.2112	1.333333	228.354	268.127	282.316	304.578	309.935	-0.209719	41.2
241.46875	1110.499319	0.584459	82320000	12720000	880000	1600000	440000	0	0	0	0	0	0	0	0	0	0	0	240523938.9	10276501317	7.226185	23.92	70.695957	149.264	279.287	28.921	90	244900	205708.2479	1.333333	228.36	268.118	282.328	304.556	309.875	-0.162981	41.6
248.46875	1106.882038	0.582819	99600000	12200000	1120000	1320000	480000	40000	0	0	0	0	0	0	0	0	0	0	273669913.4	10550171230	7.203856	23.936	71.128252	149.267	279.258	28.934	90	286900	211184.6616	1.333333	228.37	268.15	282.3	304.581	309.831	-0.205619	41.6
255.5	1108.755154	0.584688	96280000	14320000	1080000	1840000	480000	40000	0	0	0	0	0	0	0	0	0	0	282659444.8	10832830675	7.197086	23.916	70.902855	149.141	279.165	28.931	90	285100	216859.4497	1.333333	228.383	268.147	282.204	304.565	309.834	-0.172	41.2
262.484375	1110.78492	0.585623	91720000	12720000	960000	1480000	600000	0	0	0	0	0	0	0	0	0	0	0	261026890.5	11093857566	7.183914	23.9	71.68768	149.108	279.137	28.954	90	268700	222091.0804	1.333333	228.412	268.009	282.147	304.572	309.865	-0.199056	40.8
269.46875	1110.025138	0.584541	77640000	11440000	1200000	1200000	280000	0	0	0	0	0	0	0	0	0	0	0	221666883.7	11315524449	7.217317	23.955	71.886838	149.349	279.133	28.963	90	229400	226525.72	1.333333	228.237	267.866	282.189	304.565	309.966	-0.121981	40.4

276.453125	1111.169909	0.587427	95920000	12720000	1000000	1120000	560000	0	0	0	0	0	0	0	0	0	0	0	264355858.2	11579880308	7.224139	23.942	71.135599	149.54	279.143	28.989	90	278300	231818.0097	1.333333	228.27	267.767	282.144	304.543	309.985	-0.158056	40
283.453125	1106.6483	0.581786	117720000	17360000	1280000	2240000	680000	0	0	0	0	0	0	0	0	0	0	0	343147949.8	11923028257	7.207713	23.968	71.183748	149.456	279.082	29.009	90	348200	238680.6056	1.333333	228.283	267.754	282.017	304.455	310.029	-0.165438	40
290.421875	1113.309636	0.585705	86160000	13000000	840000	1360000	200000	40000	0	0	0	0	0	0	0	0	0	0	242156410.6	12165184668	7.206112	23.991	71.42069	149.407	279.066	28.993	90	254000	243543.2648	1.333333	228.253	267.78	281.979	304.433	309.973	-0.1515	40
297.46875	1113.981133	0.584492	92440000	11400000	720000	1600000	160000	0	0	0	0	0	0	0	0	0	0	0	248972090.4	12414156758	7.18436	23.958	72.661165	149.469	279.057	28.999	90	265800	248512.8734	1.333333	228.214	267.792	282.033	304.373	309.799	-0.175275	40
304.421875	1111.397332	0.588247	110000000	14840000	1200000	1400000	200000	0	0	0	0	0	0	0	0	0	0	0	295470663.4	12709627422	7.175989	23.92	72.192921	149.297	279.015	29.009	90	319100	254407.0618	1.333333	228.286	267.792	282.039	304.439	309.812	-0.185938	40
311.46875	1111.501415	0.586902	97600000	13040000	1120000	1800000	240000	0	40000	0	0	0	0	0	0	0	0	0	278813185.1	12988440607	7.223299	23.939	71.17299	149.579	279.006	28.999	90	284600	259981.8895	1.333333	228.185	267.71	282.09	304.414	309.891	-0.224475	40
318.453125	1107.150725	0.581884	111360000	15840000	1320000	1680000	320000	40000	0	0	0	0	0	0	0	0	0	0	312631777.7	13301072385	7.171817	23.984	71.731369	149.751	278.948	28.967	90	326400	266232.3294	1.333333	228.283	267.722	281.871	304.341	309.859	-0.182656	40
325.453125	1107.431204	0.583295	86080000	12400000	920000	1480000	360000	0	0	0	0	0	0	0	0	0	0	0	243642550.2	13544714935	7.214325	23.91	71.849053	149.868	278.942	28.938	90	253100	271122.6111	1.333333	228.133	267.792	282.008	304.262	309.692	-0.181838	40.4
332.421875	1109.81423	0.582261	83800000	13080000	760000	1160000	240000	40000	0	0	0	0	0	0	0	0	0	0	236390740.2	13781105675	7.21729	23.945	70.866645	149.94	278.92	28.967	90	247700	275866.136	1.333333	228.165	267.844	282.023	304.246	309.651	-0.1392	40.4
339.421875	1109.685909	0.58687	91440000	13080000	800000	1880000	360000	0	0	0	0	0	0	0	0	0	0	0	260485177.8	14041590853	7.188742	23.91	71.025	149.793	278.923	28.944	90	268900	281081.9274	1.333333	228.279	267.872	281.95	304.306	309.654	-0.148219	40.8
346.40625	1108.710477	0.584033	105400000	14320000	880000	1560000	520000	40000	0	0	0	0	0	0	0	0	0	0	294227132.7	14335817985	7.196089	23.923	71.254595	149.813	278.936	28.95	90	306800	286974.0278	1.333333	228.292	267.84	281.9	304.281	309.654	-0.189219	40.8
353.390625	1105.302541	0.58441	105520000	13800000	1000000	1640000	520000	0	0	0	0	0	0	0	0	0	0	0	291148551.8	14626966537	7.198529	23.903	72.785802	149.741	278.939	28.902	90	306200	292809.607	1.333333	228.289	267.773	281.941	304.335	309.676	-0.1679	40.8
360.421875	1105.781159	0.584164	122280000	18000000	1120000	1480000	800000	0	0	0	0	0	0	0	0	0	0	0	346847336.6	14973813874	7.248856	23.92	71.243443	149.865	278.974	28.925	90	359200	299783.0087	1.333333	228.205	267.703	282.036	304.363	309.771	-0.136738	40.8
367.40625	1105.544504	0.585722	119960000	18800000	1400000	1320000	440000	0	0	0	0	0	0	0	0	0	0	0	336155725.4	15309969599	7.232037	23.981	71.460841	149.865	279.012	28.915	90	354800	306538.5291	1.333333	228.27	267.665	281.976	304.36	309.787	-0.194138	40.8
374.40625	1110.168479	0.584688	106240000	13560000	1200000	1960000	680000	0	0	0	0	0	0	0	0	0	0	0	300232290.1	15610201889	7.188611	23.974	71.951124	149.947	279.012	28.931	90	309100	312573.4093	1.333333	228.312	267.783	281.843	304.294	309.78	-0.206438	40.8
381.390625	1108.639704	0.584738	101480000	13240000	920000	1760000	600000	0	0	0	0	0	0	0	0	0	0	0	284256426.9	15894458316	7.228285	23.945	71.400748	149.999	278.987	28.925	90	295000	318263.3651	1.333333	228.211	267.856	281.985	304.211	309.576	-0.190038	40.8
388.390625	1108.382757	0.581245	100280000	13920000	920000	1640000	520000	0	0	0	0	0	0	0	0	0	0	0	282042704.5	16176501021	7.207031	23.913	71.433285	149.722	278.952	28.918	90	293200	323916.7939	1.333333	228.354	267.901	281.928	304.287	309.579	-0.1433	41.2
395.375	1110.63763	0.585459	87160000	13160000	1120000	1400000	520000	0	0	0	0	0	0	0	0	0	0	0	253122301	16429623322	7.197112	23.887	72.629153	149.647	278.958	28.896	90	258400	328991.7014	1.333333	228.38	267.84	281.95	304.3	309.664	-0.222838	41.2
402.359375	1110.621355	0.586017	94400000	12920000	1240000	1120000	520000	0	0	0	0	0	0	0	0	0	0	0	263692110.2	16693315432	7.232509	23.952	71.520535	149.806	278.987	28.921	90	275500	334267.7919	1.333333	228.305	267.741	281.998	304.328	309.724	-0.168719	41.2
409.359375	1107.436592	0.582737	94000000	13680000	1240000	1120000	520000	80000	0	0	0	0	0	0	0	0	0	0	272272889.4	16965588321	7.229465	23.981	71.254201	149.712	278.999	28.892	90	276600	339715.651	1.333333	228.37	267.754	281.912	304.331	309.768	-0.174456	41.2
416.34375	1110.157361	0.584984	94360000	12120000	1000000	1000000	520000	0	0	0	0	0	0	0	0	0	0	0	256030727.8	17221619049	7.203252	23.974	72.570508	149.735	278.968	28.915	90	272500	344853.256	1.333333	228.38	267.818	281.877	304.309	309.676	-0.198238	40.8
423.390625	1111.301845	0.586771	92160000	12840000	1120000	1680000	520000	0	0	0	0	0	0	0	0	0	0	0	266794874.3	17488413923	7.220072	23.939	72.283578	149.797	278.926	28.941	90	270800	350193.7376	1.333333	228.25	267.856	281.966	304.24	309.598	-0.194956	40.8
430.375	1108.463053	0.585689	105560000	14760000	1200000	1440000	400000	40000	0	0	0	0	0	0	0	0	0	0	295424709.2	17783838633	7.227996	23.9	71.018046	149.686	278.894	28.963	90	308500	356101.2177	1.333333	228.373	267.93	281.976	304.161	309.506	-0.211356	40.8
437.359375	1108.699149	0.586607	99640000	12160000	1560000	1280000	560000	40000	0	0	0	0	0	0	0	0	0	0	277578469.6	18061417102	7.23634	23.913	71.392877	149.67	278.901	28.973	90	288100	361666.0495	1.333333	228.322	267.92	282.008	304.211	309.469	-0.162156	40.8
444.34375	1109.735706	0.585476	94360000	13520000	1120000	1440000	240000	40000	0	0	0	0	0	0	0	0	0	0	264550939.8	18325968042	7.213354	23.9	71.641105	149.469	278.872	28.967	90	276800	366968.5789	1.333333	228.435	267.914	281.874	304.237	309.532	-0.169538	40.8
451.328125	1109.615998	0.583344	122000000	16240000	1280000	1840000	400000	160000	40000	0	0	0	0	0	0	0	0	0	350676952.6	18676644995	7.21548	23.887	71.727564	149.514	278.846	28.983	90	354900	373990.8105	1.333333	228.458	267.888	281.896	304.243	309.522	-0.168719	40.8
458.3125	1110.94133	0.584918	91840000	12640000	1160000	1720000	360000	0	0	0	0	0	0	0	0	0	0	0	259926298.2	18936571293	7.212252	23.897	71.726777	149.602	278.821	28.983	90	269300	379196.341	1.333333	228.451	267.895	281.916	304.281	309.513	-0.200694	40.4
465.296875	1115.196638	0.586968	97920000	13720000	840000	1280000	320000	0	0	0	0	0	0	0	0	0	0	0	267438272.4	19204009565	7.226605	23.92	72.924871	149.66	278.821	28.96	90	285200	384545.9239	1.333333	228.341	267.732	281.925	304.316	309.55	-0.175275	40.4
472.34375	1112.378553	0.583639	104120000	13400000	840000	1840000	440000	0	0	0	0	0	0	0	0	0	0	0	290153040.5	19494162606	7.249539	23.971	71.706835	149.813	278.885	28.954	90	301600	390327.7252	1.333333	228.386	267.687	281.916	304.278	309.645	-0.1802	40
479.328125	1104.227129	0.580113	105160000	14320000	760000	1360000	400000	0	0	0	0	0	0	0	0	0	0	0	285726081.4	19779888687	7.200681	23.978	72.589269	150.048	278.875	28.918	90	305000	396035.7357	1.333333	228.383	267.78	281.843	304.287	309.579	-0.148219	40
486.3125	1110.332172	0.584197	114320000	16720000	1040000	1280000	760000	40000	0	0	0	0	0	0	0	0	0	0	323077819.2	20102966506	7.198424	23.949	72.851401	150.012	278.856	28.886	90	335400	402537.5748	1.333333	228.322	267.754	281.912	304.265	309.519	-0.1638	40
493.3125	1110.362732	0.583409	127360000	16560000	1080000	1640000	520000	0	0	0	0	0	0	0	0	0	0	0	344881640.9	20447848147	7.188427	23.923	72.844316	149.673	278.849	28.908	90	367900	409440.0465	1.333333	228.36	267.773	281.916	304.294	309.535	-0.145763	40
500.3125	1113.589912	0.586197	111360000	14400000	1320000	1800000	400000	0	0	0	0	0	0	0	0	0	0	0	307261404.9	20755109552	7.234661	24.007	71.301301	149.705	278.904	28.902	90	323200	415589.4165	1.333333	228.393	267.671	281.931	304.303	309.62	-0.186756	40
507.296875	1111.940682	0.585361	107320000	14560000	1280000	1520000	720000	0	0	0	0	0	0	0	0	0	0	0	304706514.8	21059816067	7.160377	23.965	70.395381	149.757	278.964	28.899	90	313500	421669.9815	1.333333	228.435	267.741	281.795	304.294	309.604	-0.1638	40.4
514.28125	1112.374972	0.583606	125360000	16240000	1400000	1480000	440000	80000	0	0	0	0	0	0	0	0	0	0	344031540.8	21403847608	7.085043	23.9	67.224731	149.19	279.309	28.918	90	362500	428545.479	1.333333	228.373	267.942	282.008	304.246	309.327	-0.112144	40.4
521.265625	1109.008466	0.583229	129960000	14360000	800000	1440000	440000	40000	0	0	0	0	0	0	0	0	0	0	336180829.6	21740028437	7.040541	23.903	68.41732	148.486	279.669	28.892	90	367600	435261.4563	1.333333	228.39	267.834	282.042	304.398	309.595	-0.140838	40.4
528.3125	1107.820714	0.585951	106160000	12760000	1040000	1200000	360000	0	40000	0	0	0	0	0	0	0	0	0	288071057.5	22028099495	7.151455	23.958	71.318094	148.391	279.825	28.931	90	303900	441033.801	1.333333	228.493	267.923	281.941	304.426	309.708	-0.209719	40.4
535.296875	1111.835358	0.586607	90800000	12960000	880000	1280000	240000	0	0	40000	0	0	0	0	0	0	0	0	259969967.8	22288069463	7.186459	23.958	70.560824	148.628	279.618	28.918	90	265500	446248.6433	1.333333	228.406	268.073	282.182	304.407	309.607	-0.172	40.8
542.296875	1109.590486	0.582524	111680000	15720000	1400000	1880000	680000	0	0	0	0	0	0	0	0	0	0	0	322099483.1	22610168946	7.17696	23.942	71.499806	148.236	279.634	28.915	90	328400	452686.4367	1.333333	228.519	268.166	282.112	304.537	309.673	-0.170356	40.8
549.28125	1108.226576	0.585164	100760000	14840000	1000000	2040000	480000	80000	0	0	0	0	0	0	0	0	0	0	296172562.1	22906341508	7.201258	23.955	72.589138	148.404	279.564	28.899	90	298000	458618.0057	1.333333	228.425	268.016	282.243	304.61	309.799	-0.204794	40.8
556.265625	1111.507409	0.581917	105400000	16280000	1160000	1840000	160000	0	0	0	0	0	0	0	0	0	0	0	296781515	23203123023	7.21527	23.984	71.7622	148.515	279.478	28.905	90	312100	464569.0854	1.333333	228.435	267.949	282.211	304.705	309.919	-0.205619	41.2
563.25	1107.531117	0.586033	101600000	14840000	1080000	1680000	400000	40000	0	0	0	0	0	0	0	0	0	0	290271677.1	23493394700	7.185252	23.974	72.564866	148.7	279.37	28.896	90	299100	470372.4491	1.333333	228.334	268.022	282.157	304.607	309.806	-0.177738	40.8
570.25	1110.802323	0.58482	104520000	13680000	800000	1240000	640000	0	0	0	0	0	0	0	0	0	0	0	285734066.7	23779128767	7.214247	23.965	71.306811	148.748	279.306	28.915	90	302200	476105.6026	1.333333	228.305	268.067	282.243	304.625	309.705	-0.117063	41.2

577.234375	1107.199818	0.581884	107960000	16160000	960000	1480000	400000	0	0	0	0	0	0	0	0	0	0	0	301456668.3	24080585435	7.056363	23.897	68.553765	148.125	279.44	28.921	90	317400	482136.412	1.333333	228.38	268.009	282.182	304.72	309.828	-0.25235	41.2
584.28125	1106.623046	0.582212	108280000	14120000	920000	1280000	520000	0	0	0	0	0	0	0	0	0	0	0	295063004.1	24375648439	7.080451	24	67.657947	147.872	279.819	28.931	90	312800	488058.5189	1.333333	228.322	267.914	282.16	304.809	309.995	-0.177738	41.2
591.265625	1112.520624	0.582393	111240000	14640000	920000	1440000	560000	40000	0	0	0	40000	0	0	0	0	0	0	334075566.4	24709724005	6.969196	23.939	67.911682	147.642	280.054	28.941	90	322200	494767.128	1.333333	228.175	268.108	282.281	304.733	309.897	-0.152319	41.2
598.234375	1109.59576	0.583032	100000000	13600000	1120000	1640000	520000	40000	0	0	0	0	0	0	0	0	0	0	284267089.2	24993991095	7.055865	23.974	68.536709	147.347	280.324	28.957	90	292300	500445.2667	1.333333	228.182	268.182	282.316	304.761	309.932	-0.215456	41.2
605.21875	1110.796126	0.583229	113120000	14560000	1240000	1800000	280000	40000	0	0	0	0	0	0	0	0	0	0	309515349.6	25303506444	7.049908	23.913	67.278918	146.798	280.498	28.97	90	327600	506644.0277	1.333333	228.302	268.239	282.395	304.888	309.985	-0.1638	40.8
612.203125	1110.888163	0.584459	114160000	13840000	920000	2000000	640000	40000	40000	0	0	0	0	0	0	0	0	0	322485973.9	25625992418	7.038861	23.936	68.690735	146.532	280.667	28.963	90	329100	513095.5761	1.333333	228.296	268.194	282.452	305.084	310.209	-0.275313	40.8
619.25	1107.140505	0.583836	92800000	12520000	960000	1200000	240000	0	0	0	0	0	0	0	0	0	0	0	253369041.5	25879361460	7.063946	23.971	67.333759	146.461	280.794	28.976	90	269300	518163.9739	1.333333	228.276	268.191	282.392	305.147	310.388	-0.224475	40.8
626.234375	1111.937511	0.586132	95280000	13600000	720000	1520000	400000	0	0	0	0	0	0	0	0	0	0	0	264728991.1	26144090451	7.062634	23.978	67.777205	146.438	280.908	28.941	90	278800	523477.542	1.333333	228.143	268.354	282.585	305.144	310.275	-0.273669	40.8
633.21875	1112.357595	0.583409	93600000	15080000	1080000	1960000	720000	80000	0	0	0	0	0	0	0	0	0	0	290092914.8	26434183366	7.006088	23.907	67.707146	145.952	280.997	28.918	90	281300	529275.0884	1.333333	228.289	268.395	282.601	305.358	310.41	-0.185938	40.8
640.203125	1112.210413	0.58605	104360000	16920000	1400000	1560000	560000	40000	0	0	0	0	0	0	0	0	0	0	309650476.9	26743833843	7.054448	23.936	67.552202	146.026	281.127	28.899	90	312100	535461.1581	1.333333	228.156	268.277	282.744	305.459	310.7	-0.212175	40.4
647.203125	1116.292319	0.585607	101160000	14520000	1440000	2280000	520000	40000	0	0	0	0	0	0	0	0	0	0	301542502.2	27045376345	7.044477	23.949	68.404331	146.176	281.197	28.889	90	299900	541486.0473	1.333333	227.993	268.472	282.744	305.462	310.637	-0.208894	40.4
654.1875	1111.67382	0.582114	93360000	15240000	1160000	2040000	680000	0	0	0	0	0	0	0	0	0	0	0	286694292.2	27332070637	7.033955	23.916	67.795573	145.786	281.219	28.925	90	281200	547193.3197	1.333333	228.143	268.485	282.738	305.638	310.697	-0.198238	40.8
661.21875	1112.555148	0.584082	98320000	14880000	1560000	2320000	560000	0	0	0	0	0	0	0	0	0	0	0	298768203.2	27630838840	7.061637	23.945	68.609524	145.864	281.267	28.902	90	294100	553165.6591	1.333333	227.964	268.364	282.877	305.755	310.911	-0.192494	40.8
668.21875	1110.811424	0.586574	97880000	15240000	1480000	1800000	640000	0	0	0	0	0	0	0	0	0	0	0	293740126.9	27924578967	7.025663	23.994	68.040386	145.994	281.381	28.886	90	292600	559032.8365	1.333333	227.96	268.38	282.741	305.783	311.069	-0.193319	40.8
675.203125	1111.378066	0.586115	95880000	15120000	1280000	1800000	680000	40000	0	0	0	0	0	0	0	0	0	0	290393572.8	28214972540	7.069693	23.945	67.615177	145.945	281.378	28.896	90	287000	564842.2748	1.333333	227.83	268.565	282.941	305.821	310.914	-0.183475	40.8
682.1875	1105.031069	0.582311	84760000	13560000	1120000	1880000	600000	40000	0	0	0	0	0	0	0	0	0	0	261128893.8	28476101434	7.034217	23.955	68.963625	145.987	281.454	28.902	90	254900	570063.5982	1.333333	227.752	268.395	282.909	305.953	311.176	-0.1761	40.8
689.1875	1110.448349	0.585508	71280000	11680000	1000000	1000000	240000	40000	0	0	0	0	0	0	0	0	0	0	208297547.9	28684398982	7.017056	23.978	68.246891	146.101	281.498	28.912	90	213100	574252.4709	1.333333	227.762	268.37	282.798	306.038	311.311	-0.199056	40.4
696.171875	1113.514463	0.587624	83440000	12280000	1360000	2040000	520000	40000	40000	0	0	0	0	0	0	0	0	0	260876606.8	28945275588	7.046261	23.926	67.819188	146.059	281.514	28.889	90	249300	579473.117	1.333333	227.647	268.517	282.966	305.941	311.195	-0.210538	40.8
703.15625	1113.707852	0.584524	84600000	14040000	1400000	1920000	640000	40000	0	40000	0	0	0	0	0	0	0	0	278300479.7	29223576068	7.03713	23.926	68.805138	146.107	281.559	28.866	90	256700	585027.1133	1.333333	227.563	268.325	282.989	306.186	311.415	-0.1802	40.4
710.140625	1104.561183	0.582393	70040000	12280000	1000000	1040000	760000	0	0	0	0	0	0	0	0	0	0	0	219642204.6	29443218273	7.05736	23.981	68.255156	146.15	281.568	28.889	90	212800	589409.7149	1.333333	227.527	268.293	282.938	306.234	311.573	-0.1802	40.4
717.1875	1105.695124	0.58336	73040000	11880000	840000	2000000	640000	0	0	0	0	0	0	0	0	0	0	0	230245492.6	29673463765	7.050512	23.994	69.522658	146.357	281.53	28.857	90	221000	594041.9314	1.333333	227.377	268.395	282.928	306.171	311.472	-0.1884	40.4
724.171875	1109.796989	0.584574	66160000	12240000	880000	1640000	360000	0	0	0	0	0	0	0	0	0	0	0	207299743.6	29880763509	7.052401	23.949	67.988957	145.932	281.584	28.889	90	203200	598208.2344	1.333333	227.445	268.466	282.922	306.259	311.444	-0.179375	40.4
731.15625	1110.371503	0.582967	81800000	13960000	1240000	2120000	840000	0	40000	0	0	0	0	0	0	0	0	0	269605696	30150369205	7.077119	23.949	68.031334	146.007	281.594	28.908	90	250000	603606.7332	1.333333	227.354	268.188	282.95	306.378	311.727	-0.1597	40.8
738.140625	1109.323027	0.58482	82160000	14840000	840000	1880000	680000	40000	0	0	0	0	0	0	0	0	0	0	261173929.8	30411543135	7.047442	23.991	68.238363	145.864	281.6	28.902	90	251100	608833.6911	1.333333	227.341	268.236	282.833	306.344	311.796	-0.177738	40.8
745.125	1108.709161	0.582721	79080000	12640000	1200000	1960000	480000	0	0	0	0	0	0	0	0	0	0	0	242384332.3	30653927467	7.056599	23.974	68.88425	145.935	281.543	28.915	90	238400	613689.1916	1.333333	227.139	268.29	282.925	306.303	311.651	-0.250712	40.8
752.125	1108.947004	0.581737	56720000	10320000	1000000	1280000	520000	0	0	0	0	0	0	0	0	0	0	0	183421481.3	30837348948	7.030386	23.92	68.497481	145.523	281.581	28.97	90	174600	617365.5687	1.333333	227.263	268.319	282.868	306.441	311.677	-0.212175	40.8
759.109375	1112.360911	0.58646	66000000	11200000	840000	1400000	280000	80000	0	0	0	0	0	0	0	0	0	0	203634318.2	31040983267	7.066203	24.007	68.077515	145.705	281.632	28.915	90	199500	621446.2029	1.333333	227.133	268.169	282.83	306.501	311.916	-0.1761	40.4
766.125	1110.46244	0.583032	81400000	14400000	1200000	1800000	1040000	40000	0	0	0	0	0	0	0	0	0	0	270064697	31311047964	7.042692	23.923	69.417437	145.66	281.6	28.954	90	249700	626841.4281	1.333333	227.094	268.198	282.881	306.514	311.812	-0.185938	40.8
773.125	1111.080233	0.586115	81320000	12800000	1520000	2240000	320000	0	0	0	0	0	0	0	0	0	0	0	250124022.1	31561171986	7.040173	24.02	68.505878	145.832	281.679	28.934	90	245500	631846.8308	1.333333	227.019	268.121	282.801	306.533	311.976	-0.203975	40.8
780.109375	1114.363629	0.586591	78760000	13840000	680000	1400000	480000	0	0	0	0	0	0	0	0	0	0	0	236672752.6	31797844738	7.068276	23.987	68.409579	145.987	281.616	28.941	90	237900	636580.4174	1.333333	226.833	268.214	282.909	306.517	311.837	-0.185938	40.8
787.09375	1107.89025	0.584606	74240000	13600000	960000	1680000	760000	40000	0	0	0	0	0	0	0	0	0	0	242821087.7	32040665826	7.054133	23.929	69.168948	145.721	281.644	28.921	90	228200	641422.6646	1.333333	226.885	268.06	282.903	306.608	311.954	-0.204794	40.4
794.09375	1111.170257	0.586164	80480000	13320000	880000	1760000	480000	80000	0	0	0	0	0	0	0	0	0	0	248571456.5	32289237283	7.041617	23.991	68.443953	145.819	281.657	28.921	90	242500	646408.5466	1.333333	226.892	268.073	282.7	306.539	312.014	-0.221194	40.8
801.078125	1113.054215	0.585787	70600000	11800000	1160000	1760000	720000	0	0	0	0	0	0	0	0	0	0	0	226623440.6	32515860723	7.071425	23.958	67.982135	145.468	281.616	28.899	90	215100	650940.7742	1.333333	226.781	268.233	282.925	306.545	311.869	-0.246613	40.8
808.078125	1106.901766	0.584016	72240000	11520000	920000	1640000	560000	0	0	0	0	0	0	0	0	0	0	0	222179121.2	32738039844	7.073235	24.02	68.219602	145.471	281.667	28.896	90	217200	655376.5993	1.333333	226.752	267.981	282.782	306.668	312.108	-0.230213	40.4
815.078125	1110.267302	0.586263	64160000	11440000	880000	1520000	480000	0	0	0	0	0	0	0	0	0	0	0	202310085.4	32940349930	7.066518	23.974	68.978843	145.494	281.59	28.879	90	196200	659438.1879	1.333333	226.608	268.089	282.811	306.555	312.039	-0.217094	40.8
822.109375	1106.329882	0.587099	75600000	12240000	1360000	1920000	600000	80000	0	0	0	0	0	0	0	0	0	0	245236909.6	33185586839	7.076463	23.936	68.163843	145.089	281.606	28.899	90	229500	664346.6538	1.333333	226.631	268.118	282.808	306.59	311.932	-0.199056	40.8
829.09375	1107.656457	0.582491	76280000	12080000	760000	1600000	560000	0	0	0	0	40000	0	0	0	0	0	0	257038859	33442625699	7.040357	23.929	69.544436	144.946	281.641	28.883	90	228300	669509.6479	1.333333	226.582	267.958	282.779	306.662	312.086	-0.226113	40.8
836.09375	1110.111746	0.585476	62800000	11040000	920000	1520000	400000	40000	0	0	0	0	0	0	0	0	0	0	1994194330.7	33642045129	7.058331	23.978	68.170665	145.011	281.6	28.87	90	191800	673510.4758	1.333333	226.553	267.869	282.652	306.687	312.225	-0.186756	40.8
843.078125	1111.315685	0.586607	69920000	11240000	1000000	1440000	320000	80000	0	0	0	0	0	0	0	0	0	0	213914537.7	33855959667	7.066833	23.945	68.429652	145.027	281.511	28.866	90	210000	677792.618	1.333333	226.4	267.968	282.757	306.555	312.011	-0.198238	40.8
850.0625	1110.68364	0.586902	75320000	13200000	1200000	2000000	560000	0	0	0	0	0	0	0	0	0	0	0	240680317	34096639984	7.027526	23.923	68.392655	144.647	281.533	28.873	90	230700	682605.3383	1.333333	226.488	267.971	282.62	306.63	312.007	-0.231031	40.4
857.0625	1107.043689	0.584147	68720000	11000000	1040000	1920000	640000	40000	0	0	0	0	0	0	0	0	0	0	221753758.3	34318393742	7.083652	23.949	68.177094	144.865	281.565	28.853	90	208400	687042.1204	1.333333	226.312	267.745	282.722	306.693	312.174	-0.187575	40.4
864.046875	1106.898483	0.584918	74200000	12400000	1560000	2080000	480000	40000	0	0	0	0	0	0	0	0	0	0	239041915.1	34557435657	7.049515	23.971	69.540369	145.121	281.489	28.85	90	226900	691840.5241	1.333333	226.269	267.773	282.576	306.564	312.133	-0.222838	40.4
871.046875	1109.41333	0.583409	74200000	13160000	1400000	2160000	480000	0	0	0	0	0	0	0	0	0	0	0	239677112.5	34797112770	7.044739	23.958	68.86444	144.93	281.432	28.85	90	228500	696652.3096	1.333333	226.286	267.863	282.547	306.621	312.023	-0.195775	40.8

878.03125	1108.036688	0.582589	88600000	14800000	1480000	1840000	640000	0	0	0	0	0	0	0	0	0	0	0	273860051.9	35070972822	7.080398	23.945	69.042868	145.011	281.432	28.866	90	268400	702137.8926	1.333333	226.123	267.633	282.604	306.678	312.171	-0.195775	40.8
885.046875	1106.183959	0.582491	68680000	10920000	720000	1600000	520000	40000	0	0	0	0	0	0	0	0	0	0	212181177.6	35283153999	7.086617	23.92	68.540251	144.998	281.413	28.876	90	206200	706393.2908	1.333333	226.084	267.773	282.611	306.536	312.023	-0.213813	40.4
892.03125	1104.199982	0.583032	63520000	10560000	600000	1280000	280000	40000	0	0	0	0	0	0	0	0	0	0	189785121.9	35472939121	7.061034	23.913	69.776655	144.712	281.349	28.883	90	190700	710205.9	1.333333	226.136	267.665	282.522	306.634	312.127	-0.181838	40.8
899.015625	1109.465515	0.586394	68640000	11200000	1320000	1800000	440000	0	0	0	0	0	0	0	0	0	0	0	214386215.7	35687325337	7.104276	23.978	68.286119	144.777	281.368	28.889	90	208500	714520.4609	1.333333	226.005	267.489	282.487	306.624	312.253	-0.197419	40.8
906.03125	1111.378066	0.583147	78760000	11800000	960000	1760000	480000	0	0	0	0	0	0	0	0	0	0	0	234963665.5	35922289002	7.052716	23.9	68.864702	144.537	281.311	28.896	90	234400	719226.7044	1.333333	226.045	267.636	282.414	306.561	312.052	-0.171181	40.8
913.015625	1111.553766	0.586902	71680000	12240000	840000	1680000	600000	0	0	0	0	0	0	0	0	0	0	0	224149331.2	36146438334	7.091524	23.962	68.841218	144.712	281.298	28.892	90	217600	723708.6142	1.333333	225.826	267.473	282.468	306.561	312.218	-0.194956	40.8
920.015625	1112.026391	0.584	73600000	12600000	960000	1680000	800000	40000	0	0	0	0	0	0	0	0	0	0	238163280.9	36384601614	7.061112	23.984	68.885825	144.729	281.263	28.908	90	224200	728469.9829	1.333333	225.878	267.378	282.268	306.53	312.206	-0.193319	40.8
927	1109.899594	0.584688	78800000	13920000	1080000	1600000	720000	40000	0	0	0	0	0	0	0	0	0	0	251229378.4	36635830993	7.094961	23.955	68.329811	144.631	281.257	28.883	90	240400	733490.4349	1.333333	225.712	267.534	282.376	306.401	311.982	-0.182656	40.4
934	1110.740869	0.584787	78880000	15080000	1040000	1840000	400000	80000	0	0	0	0	0	0	0	0	0	0	254128293.4	36889959286	7.055392	23.949	69.895257	144.333	281.235	28.905	90	243300	738578.5486	1.333333	225.722	267.375	282.328	306.508	312.143	-0.212994	40.4
941	1111.723045	0.585082	73120000	13440000	1040000	1440000	880000	80000	0	0	0	0	0	0	0	0	0	0	243302543.6	37133261830	7.053083	23.991	69.38923	144.433	281.238	28.899	90	225000	743446.2215	1.333333	225.732	267.336	282.179	306.514	312.137	-0.1556	40.8
947.984375	1109.474292	0.584115	86920000	13800000	1400000	2360000	960000	40000	0	0	0	0	40000	0	0	0	0	0	355532819.6	37488794649	7.083967	23.923	68.350278	144.414	281.187	28.889	90	263800	750552.9639	1.333333	225.621	267.429	282.277	306.35	311.966	-0.196594	40.4
954.96875	1109.438941	0.584787	64120000	11080000	1240000	1680000	240000	40000	0	0	0	0	0	0	0	0	0	0	202677920.6	37691472570	7.047232	23.89	70.043641	144.232	281.203	28.879	90	196000	754612.5026	1.333333	225.631	267.314	282.243	306.448	312.077	-0.170356	40.4
962	1107.893233	0.583409	71400000	10960000	680000	1800000	680000	0	0	0	0	0	0	0	0	0	0	0	221034256.7	37912506827	7.086433	23.952	68.464682	144.453	281.228	28.908	90	213800	759039.8507	1.333333	225.572	267.18	282.22	306.495	312.137	-0.193319	40.4
969	1110.591135	0.583508	69000000	11080000	800000	1280000	480000	0	0	0	0	0	0	0	0	0	0	0	206396956.9	38118903784	7.075938	23.942	68.741508	144.54	281.159	28.87	90	206600	763179.7794	1.333333	225.471	267.311	282.211	306.306	311.944	-0.127719	40.4
975.96875	1108.685539	0.583262	62080000	8920000	1040000	1560000	560000	80000	0	0	0	0	0	0	0	0	0	0	196449154.8	38315352938	7.091681	23.955	68.75161	144.339	281.155	28.892	90	185600	767110.6021	1.333333	225.504	267.167	282.125	306.404	312.215	-0.140019	40.4
982.953125	1109.561903	0.584934	70800000	11760000	1120000	1440000	440000	0	0	0	0	0	0	0	0	0	0	0	215883188.4	38531236127	7.070244	23.981	69.652018	144.573	281.079	28.899	90	213900	771437.712	1.333333	225.383	267.202	282.138	306.3	311.995	-0.091644	40.4
990	1108.185873	0.585771	68080000	11640000	1120000	1640000	680000	0	0	0	0	0	0	0	0	0	0	0	220339539.9	38751575667	7.056494	23.936	68.773258	144.372	281.111	28.886	90	207900	775850.6557	1.333333	225.501	267.256	282.052	306.375	311.957	-0.050644	40.4
996.984375	1108.651621	0.582819	81880000	13400000	1040000	2120000	520000	40000	0	0	0	0	0	0	0	0	0	0	254603160	39006178827	7.082025	23.91	69.385688	144.621	281.114	28.873	90	247500	780956.1602	1.333333	225.341	267.03	282.163	306.397	312.133	-0.1023	40
1003.96875	1108.412151	0.587034	68240000	12480000	760000	1480000	560000	0	0	0	0	0	0	0	0	0	0	0	214509930.1	39220688757	7.054448	23.991	69.06399	144.686	281.092	28.866	90	208800	785255.8764	1.333333	225.393	267.046	281.976	306.331	312.178	-0.089181	39.6
1010.96875	1110.446823	0.584524	83280000	14760000	640000	1520000	520000	0	0	0	0	0	0	0	0	0	0	0	250824773.1	39471513530	7.074127	23.997	69.649788	144.777	281.063	28.877	90	251800	790284.5869	1.333333	225.198	267.147	282.032	306.223	311.968	-0.072781	39.6
1017.953125	1107.51252	0.582475	65440000	11600000	840000	1160000	800000	40000	0	0	0	0	0	0	0	0	0	0	211280965.9	39682794496	7.096929	23.92	68.948537	144.547	281.041	28.866	90	199700	794512.7341	1.333333	225.269	267.205	282.096	306.224	311.91	-0.186756	39.6
1024.953125	1105.773575	0.58008	72880000	12760000	1080000	1640000	520000	0	0	0	0	0	0	0	0	0	0	0	228035890.6	39910830387	7.092941	23.974	69.133	144.534	281.057	28.847	90	222200	799088.2708	1.333333	225.256	266.931	281.931	306.328	312.162	-0.199056	39.6
1031.953125	1111.420994	0.586427	63480000	9840000	520000	1160000	600000	0	0	0	0	0	0	0	0	0	0	0	189641641.1	40100472028	7.087772	24	70.48696	144.764	281.025	28.847	90	189000	802899.4116	1.333333	225.139	266.992	281.96	306.268	312.007	-0.195775	39.6
1038.9375	1102.549844	0.58154	62960000	10920000	800000	1560000	400000	0	0	0	0	0	0	0	0	0	0	0	196147978.3	40296620006	7.087745	23.916	69.120799	144.459	280.962	28.818	90	191600	806821.2773	1.333333	225.201	267.113	281.973	306.221	311.891	-0.196594	39.6
1045.9375	1108.812126	0.582229	69800000	11480000	800000	1480000	200000	0	0	0	0	0	0	0	0	0	0	0	204353183.3	40500973189	7.099527	23.949	69.981323	144.628	280.962	28.87	90	209400	810940.0769	1.333333	225.129	266.88	281.976	306.259	312.039	-0.138381	40
1052.921875	1104.99015	0.582557	64080000	11760000	640000	1520000	480000	0	0	0	0	0	0	0	0	0	0	0	201417519.3	40702390709	7.109734	23.974	69.410615	144.602	280.971	28.879	90	196200	814976.7796	1.333333	225.126	266.822	281.916	306.256	312.074	-0.169538	40
1059.90625	1110.436266	0.585787	73960000	11560000	1040000	1720000	320000	40000	0	0	0	0	0	0	0	0	0	0	222433646.8	40924824355	7.048176	24.007	69.914019	144.651	280.936	28.876	90	221600	819450.0954	1.333333	225.145	266.828	281.763	306.208	312.045	-0.171181	40
1066.890625	1110.762493	0.585	78480000	13000000	880000	1000000	280000	0	0	0	0	0	0	0	0	0	0	0	224930271.3	41149754627	7.086355	23.984	70.078933	144.806	280.895	28.883	90	234100	823951.4348	1.333333	224.979	266.921	281.881	306.095	311.903	-0.181019	40
1073.9375	1110.398997	0.585312	73400000	11320000	960000	1320000	360000	40000	0	0	0	0	0	0	0	0	0	0	219222745.2	41368977372	7.102177	23.903	69.317594	144.56	280.876	28.899	90	218500	828337.2658	1.333333	225.022	266.96	281.877	306.073	311.822	-0.212175	40.4
1080.921875	1110.95091	0.585541	62240000	11080000	720000	1040000	480000	0	0	0	0	0	0	0	0	0	0	0	190670037.9	41559647410	7.11102	23.971	69.387131	144.462	280.886	28.925	90	188900	832153.1121	1.333333	225.025	266.754	281.862	306.171	312.011	-0.193319	40.4
1087.90625	1109.295843	0.584393	82200000	11360000	880000	2040000	480000	0	0	0	0	0	0	0	0	0	0	0	241089863.5	41800737273	7.110915	23.965	69.363647	144.43	280.876	28.921	90	242400	836975.6047	1.333333	225.015	266.71	281.735	306.098	312.045	-0.190038	40.4
1094.890625	1112.43619	0.584656	71520000	10400000	720000	1440000	320000	0	0	0	0	0	0	0	0	0	0	0	205267982.2	42006005256	7.068171	24.001	69.73769	144.51	280.869	28.923	90	211000	841087.6824	1.333333	225.034	266.734	281.613	306.011	311.983	-0.175275	40.4
1101.875	1109.219147	0.583754	61800000	11320000	1080000	1320000	520000	0	0	0	0	0	0	0	0	0	0	0	198395819	42204401075	7.094541	23.916	69.517016	144.518	280.806	28.922	90	190100	845050.8724	1.333333	224.943	266.885	281.823	305.98	311.779	-0.202338	40.4
1108.875	1109.850632	0.586443	80880000	11480000	1120000	1360000	720000	0	0	0	0	0	0	0	0	0	0	0	239302813.7	42443703888	7.069089	23.965	70.617108	144.433	280.803	28.88	90	238900	849845.0921	1.333333	224.914	266.709	281.756	306.002	311.927	-0.199056	40.4
1115.875	1110.142134	0.58482	69440000	11320000	1160000	1280000	400000	0	0	0	0	0	0	0	0	0	0	0	209798916	42653502804	7.104722	23.942	69.091148	144.586	280.813	28.887	90	209000	854045.8359	1.333333	224.898	266.853	281.785	305.901	311.729	-0.181838	40.4
1122.859375	1113.161907	0.586033	76760000	11640000	840000	1360000	320000	40000	0	0	0	0	0	0	0	0	0	0	223188242.6	42876691047	7.068643	23.903	70.337654	144.346	280.768	28.896	90	227400	858513.4969	1.333333	224.963	266.744	281.686	306.005	311.826	-0.202338	40.4
1129.859375	1109.0876	0.585492	68120000	9680000	680000	1400000	520000	40000	0	0	0	0	0	0	0	0	0	0	203660638.2	43080351685	7.093466	24.03	69.504684	144.501	280.815	28.907	90	201100	862579.2055	1.333333	224.93	266.573	281.59	305.983	311.98	-0.162156	40.8
1136.890625	1110.179961	0.584918	86880000	13760000	640000	1120000	560000	40000	0	0	0	0	0	0	0	0	0	0	253484292.3	43333835977	7.10404	23.93	69.84186	144.66	280.764	28.874	90	257500	867658.1409	1.333333	224.799	266.772	281.705	305.904	311.756	-0.181019	40.4
1143.890625	1109.467663	0.582917	69200000	11640000	720000	1040000	280000	40000	0	0	0	0	0	0	0	0	0	0	204294069.9	43538130047	7.090081	23.922	70.947987	144.327	280.715	28.856	90	207300	871747.4493	1.333333	224.883	266.598	281.659	305.939	311.819	-0.157238	40.4
1150.875	1111.084994	0.585705	68920000	11040000	960000	1200000	360000	40000	0	0	0	0	0	0	0	0	0	0	206283680.1	43744413727	7.125688	24.007	70.814953	144.47	280.57	28.849	90	206300	875879.2343	1.333333	224.88	266.573	281.48	305.851	311.899	-0.165438	40
1157.875	1109.117379	0.58582	85360000	12960000	960000	1640000	280000	0	0	0	0	0	0	0	0	0	0	0	245905148.3	43990318876	7.200208	23.991	71.537853	144.878	280.197	28.909	90	253000	880797.4528	1.333333	224.777	266.699	281.648	305.801	311.625	-0.134281	40
1164.859375	1109.18777	0.582343	66880000	12000000	1000000	1720000	240000	0	0	0	0	0	0	0	0	0	0	0	207348500.6	44197667376	7.159012	23.93	72.449411	144.975	279.813	28.88	90	204600	884951.8774	1.333333	224.82	266.533	281.506	305.766	311.717	-0.136738	40
1171.84375	1110.587058	0.585443	73600000	12160000	960000	1440000	720000	40000	0	0	0	0	0	0	0	0	0	0	230667532.9	44428334909	7.199211	23.965	71.703687	145.32	279.533	28.819	90	222300	889573.2276	1.333333	224.677	266.329	281.453	305.692	311.772	-0.181019	40

1178.84375	1113.000014	0.582967	85120000	14720000	1160000	2000000	520000	40000	0	0	0	0	0	0	0	0	0	0	267054901.6	44695389811	7.195905	23.947	72.253271	145.725	279.293	28.796	90	258900	894916.8459	1.333333	224.527	266.373	281.377	305.538	311.432	-0.1515	40
1185.84375	1110.966391	0.581032	75160000	14320000	800000	1840000	400000	40000	0	0	0	0	0	0	0	0	0	0	239943085.2	44935332896	7.188374	23.903	73.318332	145.648	279.082	28.773	90	231400	899707.5634	1.333333	224.641	266.236	281.256	305.515	311.424	-0.174456	40
1192.84375	1108.975812	0.583705	64160000	10320000	800000	880000	400000	40000	0	0	0	0	0	0	0	0	0	0	191135875.8	45126468772	7.198923	23.936	72.120631	146.037	278.861	28.776	90	191500	903530.7789	1.333333	224.601	266.022	281.008	305.354	311.424	-0.140838	40.4
1199.828125	1113.776621	0.588608	76800000	12440000	760000	1480000	520000	0	40000	0	0	0	0	0	0	0	0	0	235034187.2	45361502959	7.21855	23.938	72.720073	146.325	278.63	28.822	90	230100	908240.5136	1.333333	224.469	266.081	281.034	305.16	311.051	-0.154781	40.4
1206.8125	1108.872601	0.584377	72520000	11200000	760000	840000	400000	0	40000	0	0	0	0	0	0	0	0	0	212797018.7	45574299978	7.195984	23.883	71.597023	146.118	278.436	28.811	90	214400	912486.2686	1.333333	224.587	265.992	280.835	305.093	310.961	-0.175275	40.4
1213.796875	1109.895398	0.584656	67560000	11440000	680000	1720000	440000	0	0	0	0	0	0	0	0	0	0	0	208054295.5	45782354273	7.208946	23.921	72.756283	146.309	278.283	28.866	90	204600	916655.7546	1.333333	224.489	265.781	280.832	305.021	310.933	-0.1556	40.8
1220.796875	1105.472579	0.585525	82840000	13840000	1320000	1560000	360000	0	40000	0	0	0	0	0	0	0	0	0	254814482.2	46037168755	7.219206	23.991	73.342078	146.569	278.092	28.85	90	249900	921757.6264	1.333333	224.43	265.793	280.676	304.804	310.689	-0.202338	40.4
1227.796875	1111.259363	0.586328	68320000	11920000	1120000	840000	480000	40000	0	0	0	0	0	0	0	0	0	0	208795403.1	46245964158	7.186275	23.918	72.99703	146.306	277.902	28.854	90	206800	925954.834	1.333333	224.625	265.741	280.574	304.734	310.528	-0.132638	40
1234.78125	1113.563851	0.586902	74360000	13720000	1040000	1480000	280000	0	0	0	0	0	0	0	0	0	0	0	227447279.4	46473411438	7.229072	23.933	72.393127	146.713	277.784	28.839	90	227200	930503.1727	1.333333	224.576	265.484	280.551	304.661	310.585	-0.123619	40
1241.78125	1112.006715	0.585984	74560000	12440000	640000	1200000	400000	0	0	0	0	0	0	0	0	0	0	0	219453443.7	46692864881	7.200208	23.954	73.436671	146.971	277.651	28.863	90	223100	934882.5742	1.333333	224.616	265.524	280.327	304.441	310.407	-0.134281	39.6
1248.78125	1107.980128	0.582819	78400000	14280000	1000000	1360000	640000	0	0	0	0	0	0	0	0	0	0	0	244645621.2	46937510503	7.22936	23.888	72.314409	146.96	277.5	28.849	90	239200	939771.5459	1.333333	224.563	265.593	280.344	304.276	310.03	-0.1433	39.2
1255.765625	1113.496957	0.586066	69560000	10880000	880000	1480000	280000	0	0	0	0	0	0	0	0	0	0	0	204398837.7	47141909340	7.240827	23.927	71.752098	147.232	277.375	28.855	90	207700	943871.0746	1.333333	224.576	265.343	280.294	304.285	310.096	-0.172	39.2
1262.765625	1109.818545	0.585131	79320000	12080000	640000	1280000	320000	40000	0	0	0	0	0	0	0	0	0	0	228374642.9	47370283983	7.204013	23.972	73.037176	147.583	277.286	28.823	90	234200	948428.7809	1.333333	224.651	265.349	280.065	304.048	309.879	-0.158881	39.2
1269.765625	1108.530858	0.584541	99680000	15080000	1000000	1640000	560000	0	40000	0	0	0	0	0	0	0	0	0	293843343.4	47664127327	7.182156	23.907	71.012274	147.31	277.26	28.82	90	295000	954312.4923	1.333333	224.793	265.384	280.055	303.977	309.701	-0.131	39.2
1276.75	1111.608929	0.584606	98680000	14440000	840000	1720000	320000	0	0	0	0	0	0	0	0	0	0	0	276303941.3	47940431268	7.219626	23.924	71.370048	147.569	277.307	28.845	90	290000	959851.4339	1.333333	224.717	265.261	280.111	303.947	309.712	-0.195775	39.2
1283.75	1111.197234	0.588214	111960000	15360000	960000	1880000	480000	40000	0	0	0	0	0	0	0	0	0	0	315305926	48255737194	7.200051	23.957	71.973953	147.903	277.23	28.829	90	326700	966154.7283	1.333333	224.759	265.38	280.063	303.776	309.426	-0.1433	39.2
1290.765625	1110.093274	0.585066	122160000	17360000	1440000	2000000	480000	40000	0	0	0	0	0	0	0	0	0	0	348776352.2	48604513546	7.187981	23.982	71.550448	147.913	277.195	28.806	90	358700	973129.7147	1.333333	224.922	265.322	279.885	303.77	309.486	-0.158881	39.6
1297.765625	1109.362123	0.583705	104400000	15160000	1320000	1640000	360000	0	0	0	0	0	0	0	0	0	0	0	295006495.3	48899520042	7.206007	23.94	71.307598	148.107	277.115	28.836	90	307200	979035.2544	1.333333	224.867	265.418	279.98	303.615	309.268	-0.1392	39.6
1304.75	1113.151988	0.584902	91160000	13040000	920000	1080000	320000	0	0	0	0	0	0	0	0	0	0	0	250200472.3	49149720514	7.176462	23.914	72.309161	147.77	277.182	28.842	90	266300	984047.153	1.333333	225.043	265.357	279.968	303.663	309.272	-0.208075	39.6
1311.75	1111.699138	0.585049	90080000	14000000	840000	960000	400000	0	0	0	0	0	0	0	0	0	0	0	253640163.7	49403360678	7.175071	23.944	71.024213	148.01	277.313	28.803	90	265700	989110.6557	1.333333	225.137	265.319	279.85	303.603	309.281	-0.133463	39.6
1318.734375	1108.745636	0.583688	93640000	13200000	1160000	1480000	360000	0	0	0	0	0	0	0	0	0	0	0	263430191.3	49666790869	7.216346	23.895	71.717593	148.039	277.237	28.823	90	274600	994376.4727	1.333333	225.183	265.569	279.965	303.451	309.026	-0.165438	39.6
1325.734375	1110.329631	0.587952	90680000	12160000	880000	1240000	800000	0	0	0	0	0	0	0	0	0	0	0	258543841.3	49925334710	7.21115	23.917	73.736592	148.179	277.148	28.792	90	264400	999558.3814	1.333333	225.252	265.405	279.978	303.54	309.096	-0.149863	39.6
1332.71875	1109.98037	0.582196	102000000	13840000	800000	1600000	320000	40000	0	0	0	0	0	0	0	0	0	0	281237435.9	50206572146	7.231748	23.957	72.315721	148.487	277.141	28.777	90	296500	1005187.089	1.333333	225.352	265.402	279.926	303.524	309.152	-0.170356	39.6
1339.71875	1108.035023	0.58172	101800000	14640000	1120000	1560000	360000	0	0	0	0	0	0	0	0	0	0	0	285362442.5	50491934589	7.24925	23.94	72.334482	148.747	277.058	28.777	90	298700	1010900.152	1.333333	225.326	265.598	280.015	303.337	308.837	-0.158056	39.6
1346.71875	1111.171813	0.588313	107680000	14120000	1440000	2000000	280000	0	0	0	0	0	0	0	0	0	0	0	299160648.4	50791095237	7.225634	23.898	72.548073	148.542	277.013	28.771	90	313800	1016899.975	1.333333	225.57	265.636	279.949	303.378	308.853	-0.124444	40
1353.71875	1110.070909	0.585476	113000000	17360000	1360000	1720000	360000	40000	0	0	0	0	0	0	0	0	0	0	324569413.9	51115664651	7.226343	23.979	72.651981	148.906	277.02	28.813	90	334600	1023391.009	1.333333	225.606	265.527	279.892	303.35	308.947	-0.130181	40
1360.71875	1113.501886	0.582753	116560000	15960000	1360000	2200000	560000	0	0	0	0	0	0	0	0	0	0	0	332044680.7	51447709331	7.24004	23.931	72.603963	149.097	277.007	28.819	90	341600	1030038.125	1.333333	225.531	265.672	280.085	303.305	308.698	-0.121163	40.4
1367.71875	1109.550512	0.584524	76160000	11480000	800000	1080000	280000	0	0	0	0	0	0	0	0	0	0	0	215403227.2	51663112559	7.246469	23.917	72.759694	148.99	276.982	28.795	90	224500	1034336.94	1.333333	225.682	265.55	280.057	303.369	308.834	-0.1392	40.4
1374.703125	1109.5187	0.58482	92600000	12600000	840000	1160000	320000	0	0	0	0	0	0	0	0	0	0	0	251191771.5	51914304330	7.210783	23.957	72.020921	148.935	276.953	28.826	90	268800	1039367.842	1.333333	225.825	265.598	279.961	303.331	308.846	-0.158056	40.4
1381.703125	1111.191521	0.585935	109480000	15200000	1320000	1960000	400000	0	0	0	0	0	0	0	0	0	0	0	308861878.6	52223166209	7.223037	23.927	72.13808	149.029	276.902	28.855	90	320900	1045553.945	1.333333	225.808	265.774	280.069	303.204	308.579	-0.149863	40.4
1388.6875	1108.206836	0.584492	111480000	15680000	840000	1840000	280000	0	0	0	0	0	0	0	0	0	0	0	306171473.7	52529337682	7.197506	23.905	71.659211	148.636	276.959	28.839	90	325300	1051676.931	1.333333	226.007	265.864	280.044	303.261	308.525	-0.1515	40.8
1395.703125	1107.8279	0.58605	141240000	19960000	1400000	1880000	440000	0	40000	0	0	0	0	0	0	0	0	0	394703819.7	52924041502	7.159642	23.908	69.654642	148.708	277.179	28.842	90	412400	1059591.696	1.333333	225.971	265.858	280.177	303.185	308.503	-0.131	40.4
1402.703125	1104.225675	0.584803	131800000	16240000	1240000	2080000	440000	0	0	0	0	0	0	0	0	0	0	0	355281055.9	53279322558	7.161269	23.882	71.524996	148.153	277.335	28.858	90	379500	1066718.375	1.333333	226.222	265.912	280.139	303.283	308.547	-0.132638	40.4
1409.6875	1115.96835	0.586328	111720000	15000000	840000	1400000	480000	0	0	0	0	0	0	0	0	0	0	0	301449320.7	53580771879	7.220623	23.895	71.036939	148.302	277.434	28.839	90	323600	1072784.956	1.333333	226.232	265.883	280.234	303.328	308.679	-0.1474	40.4
1416.6875	1110.015214	0.583688	116800000	16040000	1120000	1880000	520000	0	0	0	0	0	0	0	0	0	0	0	327989679.8	53908761559	7.185829	23.96	72.17206	148.487	277.425	28.816	90	340900	1079316.198	1.333333	226.356	265.96	280.174	303.362	308.642	-0.161338	40.4
1423.671875	1108.616715	0.585492	153520000	18960000	1280000	2160000	640000	0	0	0	0	0	0	0	0	0	0	0	412521323.5	54321282882	7.218182	23.911	71.21248	148.425	277.438	28.829	90	441400	1087574.77	1.333333	226.372	266.156	280.339	303.299	308.44	-0.169538	40.4
1430.640625	1106.806645	0.583245	132320000	16520000	1400000	1880000	200000	0	0	0	0	0	0	0	0	0	0	0	349656602.2	54670939484	7.19315	23.973	72.498087	148.601	277.511	28.823	90	380800	1094583.637	1.333333	226.343	266.159	280.38	303.296	308.516	-0.185119	40
1437.640625	1110.504144	0.583278	136720000	17240000	1880000	1360000	600000	40000	0	0	0	0	0	0	0	0	0	0	371986770.5	55042926255	7.21506	23.908	71.169185	148.403	277.54	28.797	90	394600	1102052.306	1.333333	226.522	266.32	280.45	303.365	308.453	-0.172	40
1444.625	1109.571013	0.584197	106160000	15320000	1280000	1280000	360000	40000	0	0	0	0	0	0	0	0	0	0	296681424.5	55339607679	7.219678	23.927	72.250385	148.588	277.667	28.826	90	311100	1107989.177	1.333333	226.554	266.175	280.479	303.489	308.579	-0.1392	40
1451.671875	1109.822975	0.585771	122280000	17400000	1480000	1800000	840000	0	0	0	0	0	0	0	0	0	0	0	353979817.1	55693587496	7.185304	24.018	71.275193	148.776	277.686	28.845	90	359500	1115078.6	1.333333	226.675	266.188	280.403	303.501	308.711	-0.185119	40
1458.671875	1108.069749	0.584787	131960000	17280000	1160000	2200000	880000	80000	40000	0	0	0	0	0	0	0	0	0	383014901.3	56076602398	7.223824	23.918	70.477908	148.76	277.798	28.816	90	384000	1122747.789	1.333333	226.659	266.409	280.561	303.426	308.471	-0.246613	40
1465.65625	1109.140304	0.586558	108040000	14320000	720000	1280000	480000	40000	0	0	0	0	0	0	0	0	0	0	293189094.9	56369791493	7.175097	23.905	71.678103	148.448	277.913	28.829	90	312200	1128627.666	1.333333	226.724	266.381	280.622	303.584	308.642	-0.190038	40
1472.65625	1111.586174	0.587198	145400000	18160000	1720000	2160000	400000	40000	0	0	0	0	0	0	0	0	0	0	395654166	56765445659	7.1741	23.999	70.982098	148.578	278.082	28.842	90	419700	1136554.81	1.333333	226.851	266.4	280.523	303.628	308.727	-0.123619	40.4

1479.609375	1110.077183	0.583327	124160000	16560000	1320000	1680000	560000	0	0	0	0	0	0	0	0	0	0	0	340529242.1	57105974901	7.205876	23.927	69.865082	148.286	278.184	28.797	90	360700	1143362.484	1.333333	226.896	266.679	280.736	303.606	308.588	-0.172819	40.4
1486.59375	1103.717479	0.580786	123760000	16840000	1360000	1920000	680000	0	40000	0	0	0	0	0	0	0	0	0	353847800	57459822701	7.19092	23.931	70.928045	148.202	278.337	28.794	90	361500	1150446.031	1.333333	226.922	266.515	280.847	303.773	308.752	-0.175275	40.4
1493.59375	1111.772845	0.583967	108920000	13920000	1120000	1440000	560000	0	0	0	0	0	0	0	0	0	0	0	296885849.5	57756708550	7.148621	23.976	70.223775	148.163	278.484	28.781	90	314900	1156423.524	1.333333	227.033	266.615	280.726	303.757	308.871	-0.149038	40.8
1500.59375	1110.63483	0.585607	122880000	17760000	920000	1720000	560000	40000	0	40000	0	0	0	0	0	0	0	0	356651129.6	58113359680	7.201206	23.957	71.577081	147.897	278.526	28.797	90	359800	1163552.301	1.333333	227.069	266.884	280.977	303.786	308.733	-0.176919	40.8
1507.59375	1109.495923	0.58582	115200000	15000000	1280000	1640000	440000	0	0	0	0	0	0	0	0	0	0	0	315761670	58429121350	7.225556	23.989	72.743557	148.159	278.42	28.823	90	333900	1169870.243	1.333333	227.046	266.692	281.063	303.982	308.982	-0.1884	40.8
1514.625	1105.882691	0.58254	98960000	14400000	800000	1520000	480000	80000	0	0	0	0	0	0	0	0	0	0	285317536	58714438886	7.218576	24.005	72.32661	148.386	278.366	28.81	90	290600	1175584.901	1.333333	227.141	266.759	280.968	303.979	309.06	-0.1638	40.8
1521.625	1109.39122	0.583557	117800000	16360000	1160000	2040000	280000	0	0	0	0	0	0	0	0	0	0	0	324807919.7	59039246805	7.200471	23.989	73.685163	148.766	278.309	28.823	90	344100	1182111.772	1.333333	227.04	266.897	281.095	303.982	308.941	-0.148219	40.8
1528.625	1107.379728	0.584688	107480000	16440000	1320000	1720000	480000	0	0	0	0	0	0	0	0	0	0	0	309698576.7	59348945382	7.201862	23.947	72.676909	148.506	278.254	28.816	90	318600	1188315.346	1.333333	227.216	266.942	281.06	304.017	308.938	-0.115419	40.8
1535.609375	1108.322708	0.582491	107560000	14760000	920000	1520000	440000	0	0	0	0	0	0	0	0	0	0	0	294789061.7	59643734444	7.227786	23.96	73.602246	148.591	278.184	28.855	90	313000	1194230.993	1.333333	227.131	266.817	281.187	304.102	309.057	-0.171181	41.2
1542.609375	1109.30548	0.587837	112840000	17360000	1480000	1720000	440000	0	40000	0	0	0	0	0	0	0	0	0	329559708.5	59973294152	7.212252	24.012	72.74277	148.785	278.194	28.858	90	334700	1200838.77	1.333333	227.216	266.849	281.082	304.127	309.142	-0.1556	40.8
1549.59375	1109.846667	0.583918	101240000	16280000	1200000	1760000	480000	0	0	0	0	0	0	0	0	0	0	0	296335497.8	60269629650	7.236734	23.969	72.788295	148.993	278.152	28.868	90	302400	1206775.127	1.333333	227.108	266.952	281.174	304.007	308.919	-0.161338	40.8
1556.59375	1109.413931	0.583262	109000000	15480000	1480000	1480000	440000	40000	0	0	0	0	0	0	0	0	0	0	308873176.4	60578502826	7.195249	23.957	72.908734	148.753	278.171	28.865	90	319800	1212959.629	1.333333	227.3	266.964	281.146	304.134	308.979	-0.149863	40.8
1563.578125	1113.2014	0.585918	104480000	14560000	960000	1800000	280000	0	0	0	0	0	0	0	0	0	0	0	288619054.4	60867121881	7.230016	23.94	73.077454	148.873	278.152	28.855	90	305200	1218740.84	1.333333	227.225	266.83	281.199	304.175	309.054	-0.149038	40.8
1570.5625	1113.575701	0.584951	126360000	18400000	1160000	2320000	760000	40000	0	0	0	0	0	0	0	0	0	0	367813166.5	61234935047	7.226317	24.008	72.42632	148.99	278.232	28.865	90	372600	1226083.291	1.333333	227.271	266.855	281.085	304.191	309.158	-0.121163	40.8
1577.5625	1111.618442	0.587181	97280000	14800000	960000	1600000	640000	40000	0	0	0	0	0	0	0	0	0	0	287027885	61521962932	7.229282	23.999	72.691996	149.149	278.184	28.826	90	288300	1231811.143	1.333333	227.203	267.019	281.225	304.055	308.988	-0.142481	40.8
1584.546875	1118.280458	0.583459	109880000	16960000	880000	1800000	240000	120000	0	0	0	0	0	0	0	0	0	0	316001206.6	61837964139	7.185777	23.918	73.007526	148.912	278.273	28.829	90	324700	1238128.283	1.333333	227.411	267.015	281.19	304.172	309.023	-0.121981	40.8
1591.546875	1113.061569	0.585344	94200000	13480000	800000	1280000	720000	0	0	0	0	0	0	0	0	0	0	0	270927592.7	62108891731	7.23348	23.957	72.262717	149.172	278.277	28.874	90	276200	1243512.096	1.333333	227.333	266.862	281.234	304.21	309.171	-0.127719	40.4
1598.546875	1112.781797	0.583163	111000000	14800000	1360000	1800000	320000	0	0	0	0	0	0	0	0	0	0	0	307562197	62416453928	7.270005	23.947	72.915163	149.386	278.309	28.878	90	323200	1249652.561	1.333333	227.287	267.079	281.276	304.099	308.957	-0.112963	40.4
1605.53125	1109.194914	0.585098	115800000	16240000	1680000	1640000	480000	0	40000	0	0	0	0	0	0	0	0	0	332429320	62748883248	7.203305	23.934	73.968811	149.246	278.36	28.884	90	339700	1256291.165	1.333333	227.372	267.051	281.25	304.225	309.06	-0.142481	40
1612.53125	1110.897882	0.579802	117480000	17640000	1480000	1600000	360000	40000	40000	0	0	0	0	0	0	0	0	0	339020101.8	63087903350	7.229124	23.989	72.436291	149.499	278.391	28.871	90	346600	1263083.281	1.333333	227.45	267.006	281.244	304.27	309.193	-0.1023	40.4
1619.53125	1113.2014	0.582753	111760000	15000000	1120000	1200000	600000	0	0	0	0	0	0	0	0	0	0	0	306932769.8	63394836120	7.244238	23.979	72.236478	149.645	278.455	28.855	90	324200	1269223.115	1.333333	227.405	267.143	281.358	304.146	308.934	-0.1761	40.8
1626.515625	1109.74338	0.585968	118360000	16360000	1240000	1680000	480000	40000	40000	0	0	0	0	0	0	0	0	0	337199330.1	63732035450	7.192914	23.89	72.985484	149.456	278.426	28.859	90	345500	1275954.438	1.333333	227.547	267.164	281.319	304.25	309.016	-0.149863	40.8
1633.515625	1106.804979	0.585033	124680000	16280000	1080000	2040000	400000	0	0	0	0	0	0	0	0	0	0	0	340299839	64072335289	7.204774	23.995	72.406641	149.799	278.444	28.827	90	361200	1282768.823	1.333333	227.566	267.08	281.271	304.281	309.217	-0.1597	40.8
1640.515625	1112.685225	0.586673	117480000	15600000	1120000	2040000	560000	40000	0	0	0	0	0	0	0	0	0	0	330065781.6	64402401071	7.225713	23.937	72.551747	150.001	278.424	28.795	90	342100	1289395.822	1.333333	227.491	267.208	281.417	304.196	308.999	-0.136738	40.8
1647.5	1111.745982	0.585033	143240000	18400000	1440000	2600000	640000	0	0	0	0	0	0	0	0	0	0	0	398580332.6	64800981403	7.206191	23.909	73.348244	149.746	278.38	28.766	90	415800	1297356.151	1.333333	227.687	267.238	281.344	304.283	309.08	-0.144938	40.8
1654.5	1108.747187	0.584754	116920000	15200000	960000	1920000	400000	0	0	0	0	0	0	0	0	0	0	0	319616170	65120597573	7.230594	23.959	72.491525	149.985	278.473	28.775	90	338500	1303744.824	1.333333	227.665	267.216	281.358	304.312	309.26	-0.183475	40.8
1661.5	1106.732081	0.585	114760000	15120000	1080000	2040000	520000	0	40000	0	0	0	0	0	0	0	0	0	325565263.7	65446162837	7.228363	23.982	73.3653	150.253	278.473	28.791	90	333900	1310270.012	1.333333	227.632	267.309	281.488	304.315	309.036	-0.179375	40.8
1668.484375	1113.235685	0.587657	133560000	16160000	1560000	2360000	560000	0	0	0	0	0	0	0	0	0	0	0	365614589.9	65811777427	7.203515	23.893	73.356116	149.808	278.492	28.782	90	385500	1317611.236	1.333333	227.856	267.359	281.491	304.391	309.099	-0.185938	40.8
1675.484375	1114.588211	0.587919	125200000	17040000	1480000	1720000	480000	0	0	0	0	0	0	0	0	0	0	0	347278906.2	66159056333	7.248489	23.951	70.966617	149.871	278.566	28.8	90	364800	1324543.559	1.333333	227.825	267.245	281.473	304.38	309.271	-0.148219	40.8
1682.46875	1112.764732	0.58541	121640000	16480000	1080000	1600000	480000	40000	0	0	40000	0	0	0	0	0	0	0	357663435.6	66516719769	7.221462	23.955	73.620483	149.768	278.755	28.786	90	353400	1331674.512	1.333333	227.787	267.425	281.585	304.4	309.158	-0.196594	40.8
1689.46875	1106.944581	0.583983	113240000	13920000	1280000	1960000	360000	0	0	0	0	0	0	0	0	0	0	0	309825309.6	66826545078	7.207582	23.875	73.090967	149.408	278.737	28.768	90	326900	1337861.81	1.333333	228.007	267.528	281.596	304.462	309.161	-0.156419	40.8
1696.453125	1108.814578	0.584082	110600000	14720000	1280000	1640000	320000	0	40000	0	0	0	0	0	0	0	0	0	307573530.6	67134118609	7.225188	23.953	72.669168	149.603	278.779	28.759	90	321500	1344036.435	1.333333	228.036	267.41	281.59	304.538	309.337	-0.1679	40.8
1703.46875	1105.257926	0.583869	113520000	16440000	1360000	1920000	560000	40000	0	0	0	0	0	0	0	0	0	0	328475632.9	67462594242	7.219127	23.886	72.261799	149.491	278.739	28.813	90	334600	1350619.554	1.333333	228.063	267.673	281.676	304.491	309.23	-0.210538	40.8
1710.453125	1112.321002	0.588345	124160000	16480000	1120000	2320000	640000	0	0	40000	0	0	0	0	0	0	0	0	358142113.1	67820736355	7.243162	23.888	73.197761	149.817	278.753	28.781	90	361900	1357820.329	1.333333	228.033	267.487	281.771	304.601	309.359	-0.150681	40.8
1717.453125	1111.233617	0.585459	118760000	15680000	1080000	1840000	560000	0	0	0	0	0	0	0	0	0	0	0	329088295.9	68149824651	7.195905	23.93	73.886813	150.033	278.768	28.825	90	344800	1364394.936	1.333333	228.169	267.556	281.681	304.517	309.348	-0.187575	40.8
1724.453125	1113.593583	0.585574	125560000	16200000	1000000	2040000	520000	0	0	40000	0	0	0	0	0	0	0	0	355258998	68505083649	7.222984	23.894	72.398244	149.84	278.768	28.812	90	363400	1371499.332	1.333333	228.182	267.779	281.795	304.542	309.282	-0.162981	40.8
1731.4375	1110.97703	0.586722	143440000	18400000	1240000	1520000	560000	0	0	0	0	0	0	0	0	0	0	0	383517051.1	68888600700	7.158959	23.909	71.131269	149.793	278.901	28.813	90	412900	1379152.574	1.333333	228.174	267.567	281.86	304.654	309.403	-0.131	40.8
1738.421875	1108.458438	0.582803	139920000	17040000	1480000	1840000	560000	120000	0	0	0	0	0	0	0	0	0	0	384048754.5	69272649454	7.067751	23.907	69.201616	149.317	279.33	28.799	90	402400	1386834.476	1.333333	228.292	267.677	281.744	304.656	309.483	-0.124444	40.4
1745.46875	1107.197255	0.579736	123720000	15880000	960000	1400000	360000	40000	0	0	0	0	0	0	0	0	0	0	332180756.8	69604830211	7.064287	23.895	68.384258	148.606	279.678	28.797	90	355900	1393493.99	1.333333	228.357	267.964	281.943	304.687	309.388	-0.136738	40.4
1752.421875	1110.307998	0.582343	129280000	14520000	1160000	1600000	440000	0	0	0	0	0	0	0	0	0	0	0	334697636.7	69939527848	7.216267	23.934	72.199087	148.557	279.75	28.814	90	367500	1400211.606	1.333333	228.378	267.82	282.06	304.828	309.667	-0.134281	40.4
1759.453125	1107.946327	0.584918	107680000	15520000	1000000	1800000	280000	0	0	0	0	0	0	0	0	0	0	0	3012028880.9	70240730729	7.201573	23.967	74.093579	148.937	279.545	28.786	90	315700	1406240.021	1.333333	228.349	267.968	282.059	304.797	309.583	-0.1679	40.4
1766.453125	1113.216757	0.583639	97360000	13040000	1200000	1200000	440000	0	0	0	0	0	0	0	0	0	0	0	268275705.7	70509006435	7.228626	23.915	72.591762	148.901	279.527	28.786	90	283100	1411620.861	1.333333	228.43	268.132	282.171	304.878	309.606	-0.193319	40.4
1773.453125	1111.339427	0.585541	99040000	14600000	680000	1840000	560000	40000	0	0	0	0	0	0	0	0	0	0	287765677.1	70796772112	7.240486	23.944	72.723353	149.001	279.507	28.816	90	291900	1417365.289	1.333333	228.458	267.885	282.246	305.012	309.822	-0.1761	40.4

1780.40625	1107.592211	0.583705	107840000	14600000	1080000	2320000	600000	0	40000	0	0	0	0	0	0	0	0	0	314289549	71111061661	7.19441	23.91	73.170604	148.845	279.465	28.798	90	316200	1423649.788	1.333333	228.503	268.13	282.176	304.989	309.686	-0.138381	40.4
1787.40625	1110.818182	0.586804	97120000	12280000	1280000	1480000	680000	0	40000	0	0	0	0	0	0	0	0	0	279804635.9	71390866296	7.255075	23.941	72.761925	148.978	279.431	28.807	90	282200	1429263.66	1.333333	228.452	267.901	282.198	305.059	309.897	-0.161338	40
1794.40625	1111.272368	0.584623	89760000	10960000	680000	1640000	440000	0	0	0	0	0	0	0	0	0	0	0	246570799.8	71637437096	7.233611	23.952	72.868588	149.15	279.363	28.798	90	258700	1434196.377	1.333333	228.344	268.118	282.268	304.96	309.714	-0.170356	40
1801.390625	1109.271455	0.585722	118160000	15040000	880000	2200000	720000	0	0	0	0	0	0	0	0	0	0	0	330253257.3	71967690354	7.206401	23.942	74.039395	148.982	279.337	28.795	90	342500	1440800.483	1.333333	228.418	267.99	282.23	305.096	309.856	-0.1515	40.4

Figure E.1 Block diagram showing VI in LabVIEW program

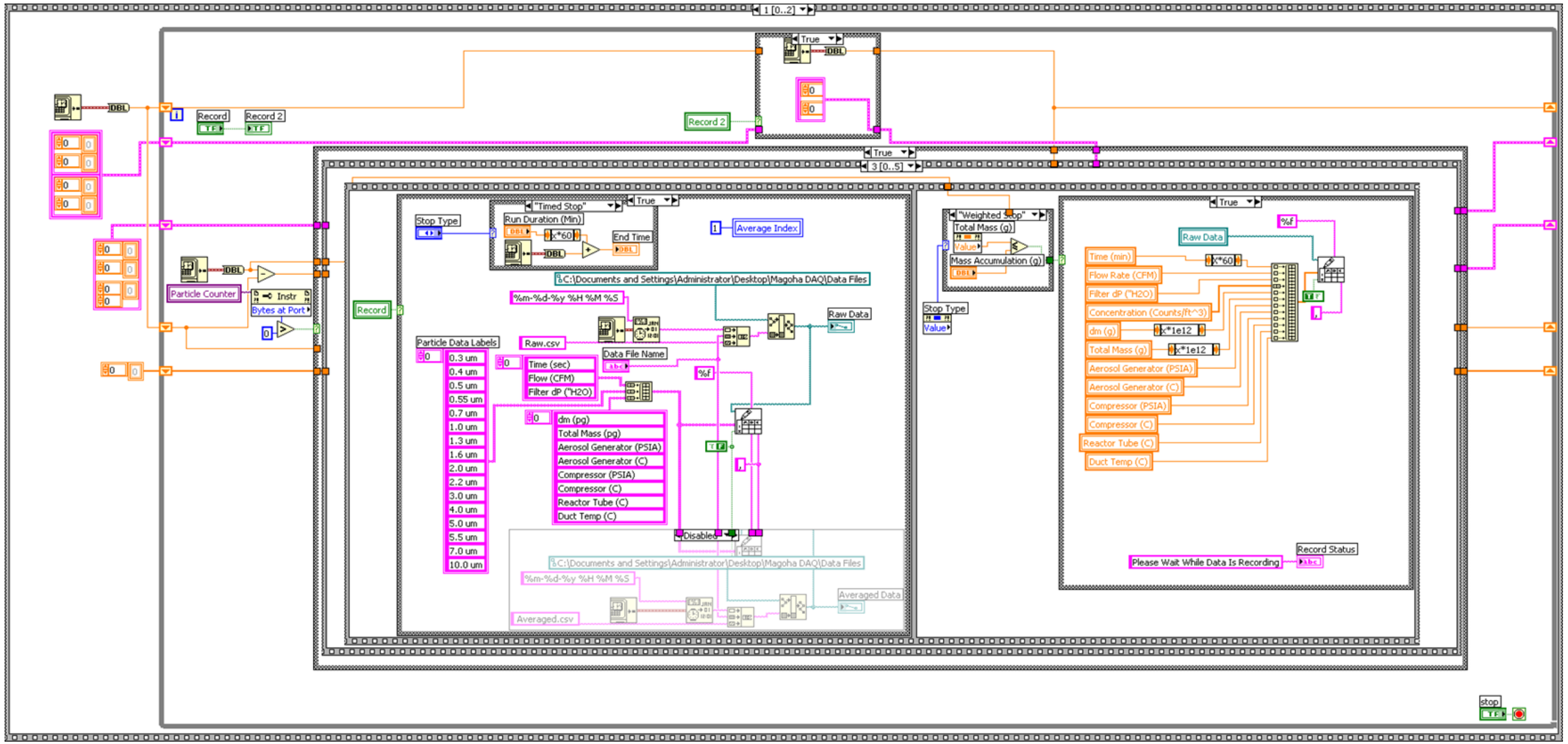
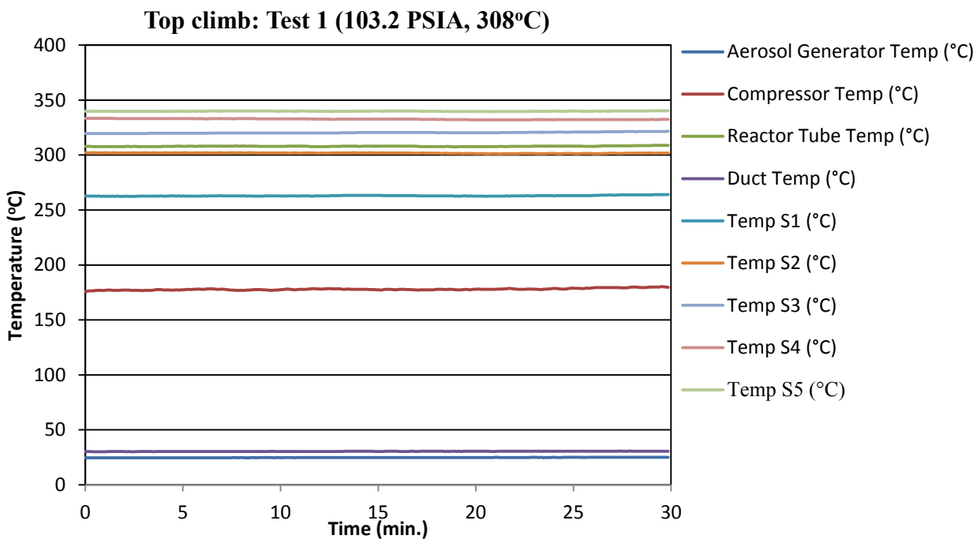
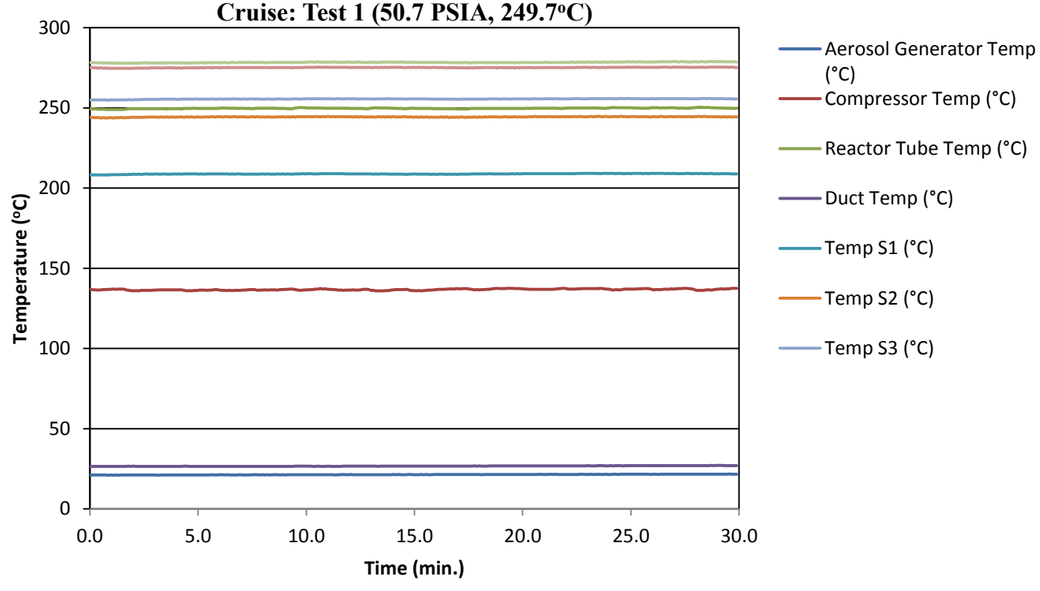
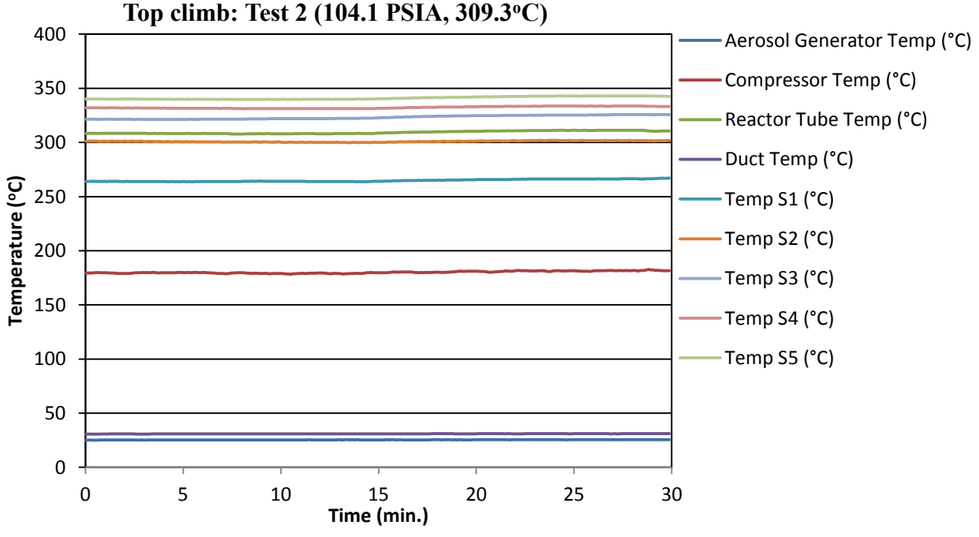


Figure E.2 Block showing VI in LabVIEW Program

E.1 Temperature and pressure trends in aircraft engine BAS and duct system







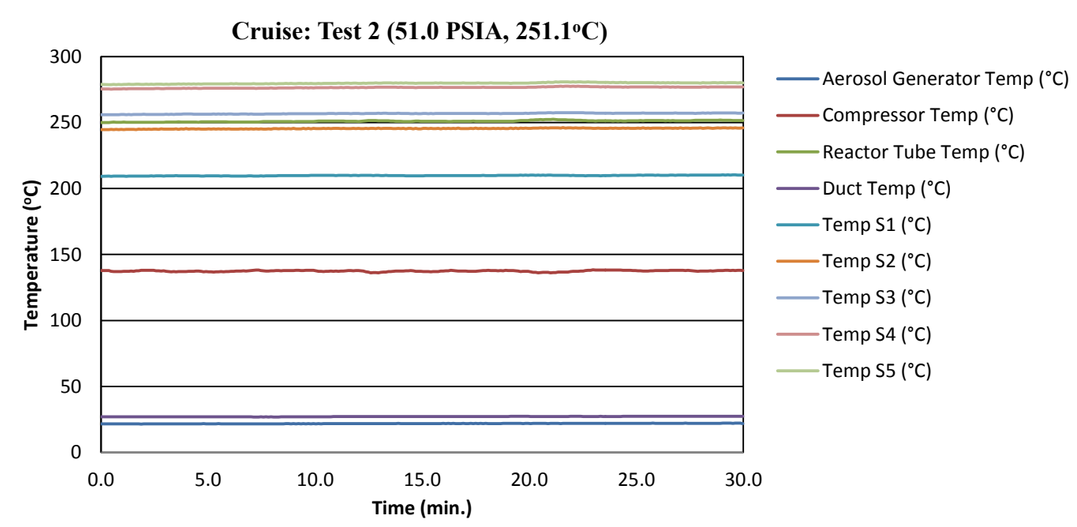
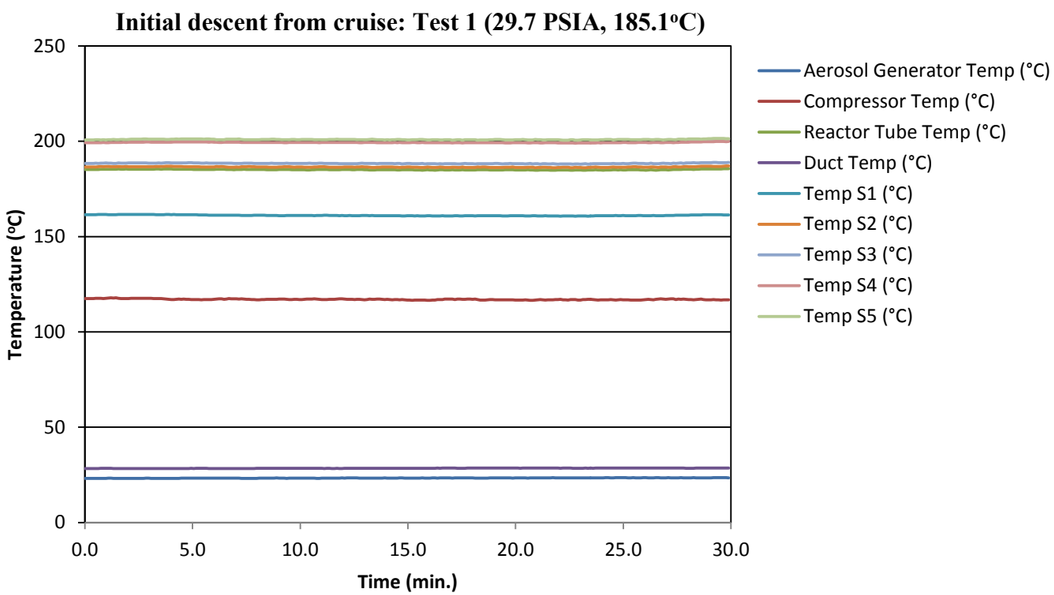
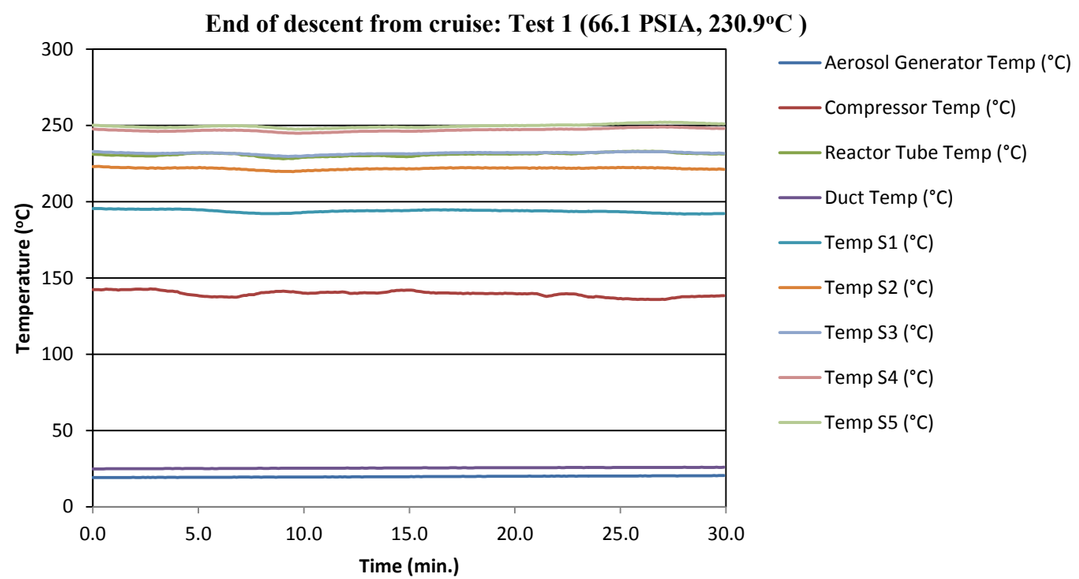
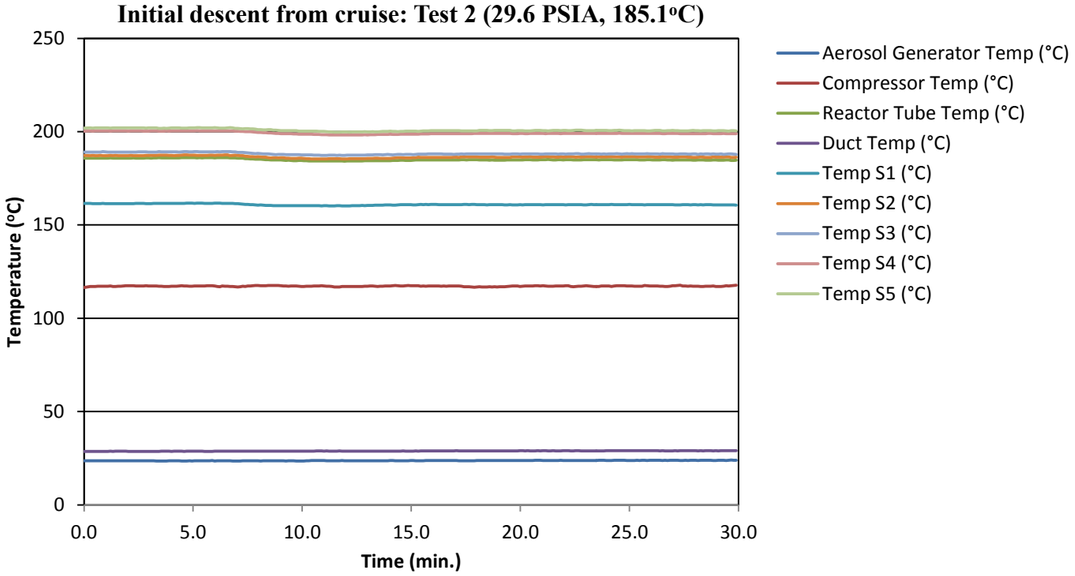


Figure E.3 Temperature profiles in BAS during modeling pyrolysis of Mobil Jet Oil II at top climb and cruise speed conditions (OPC: One nozzle open)







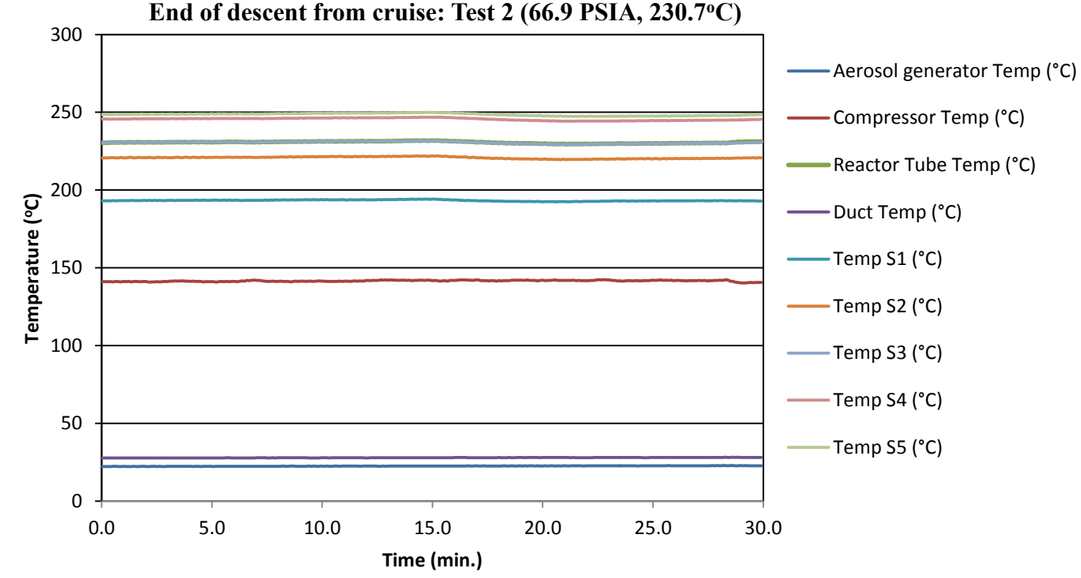
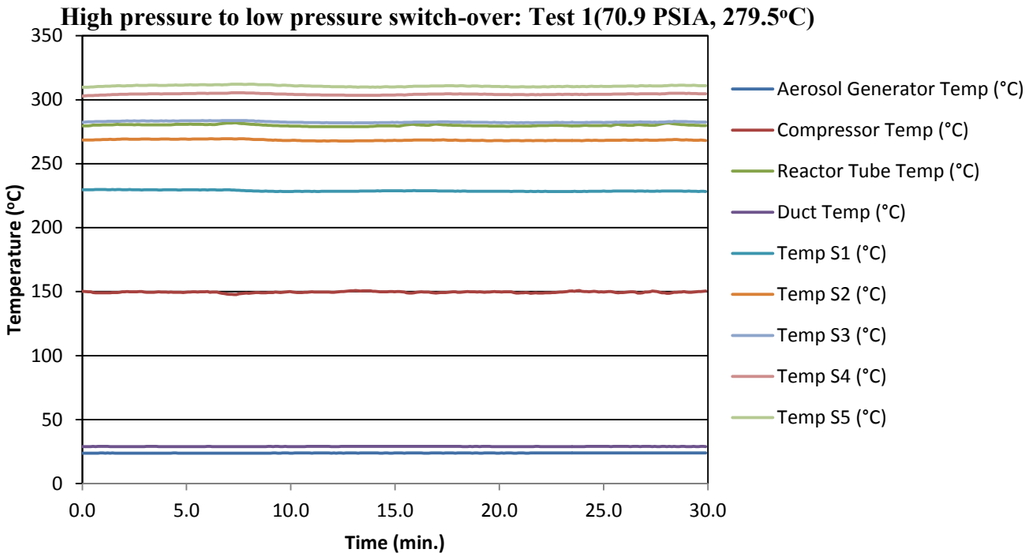
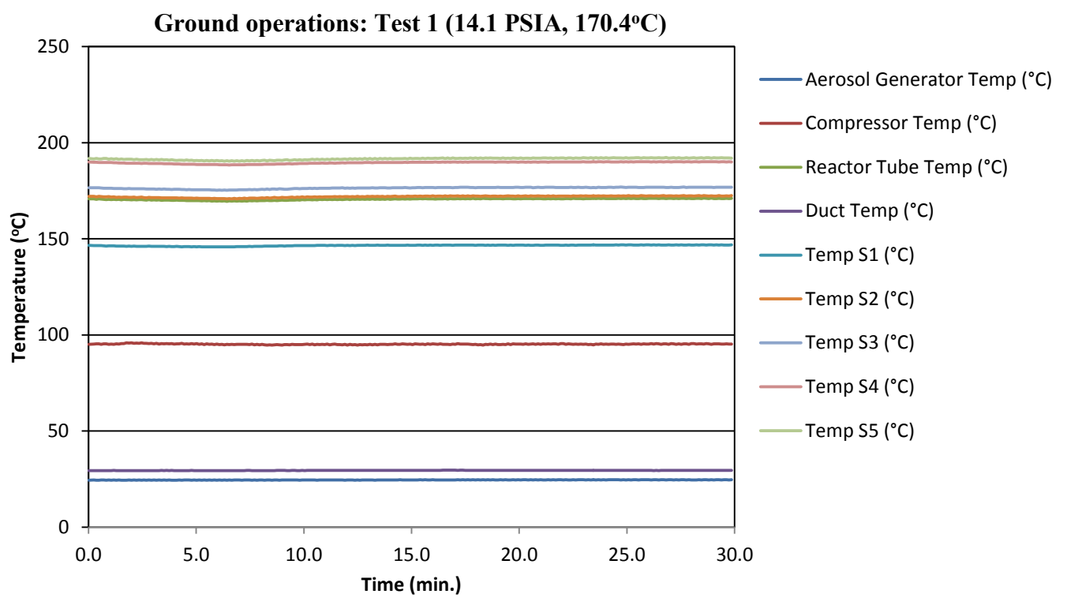
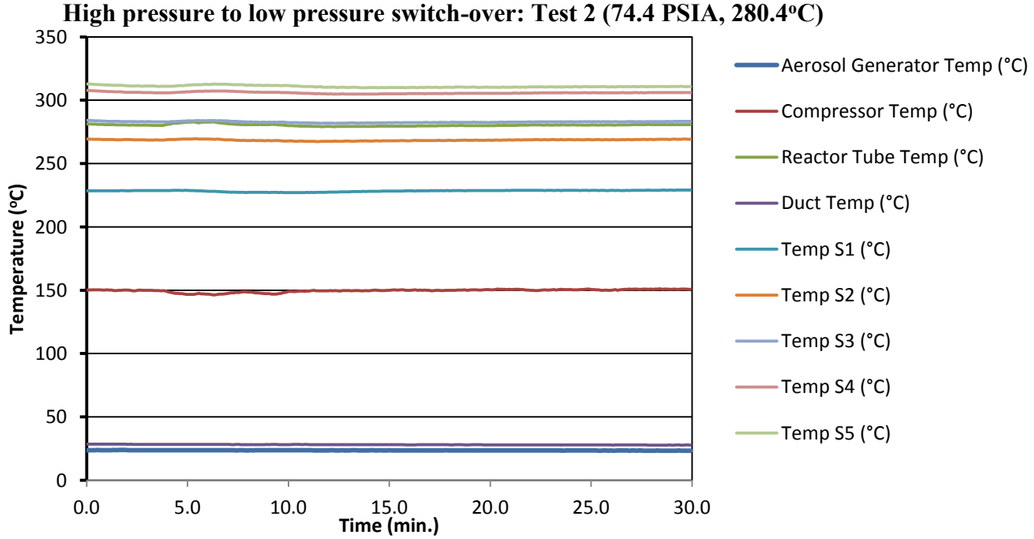


Figure E.4 BAS temperature profiles during modeling of pyrolysis of Mobil Jet Oil II at initial descent and end of descent from cruise conditions (OPC: One nozzle open)







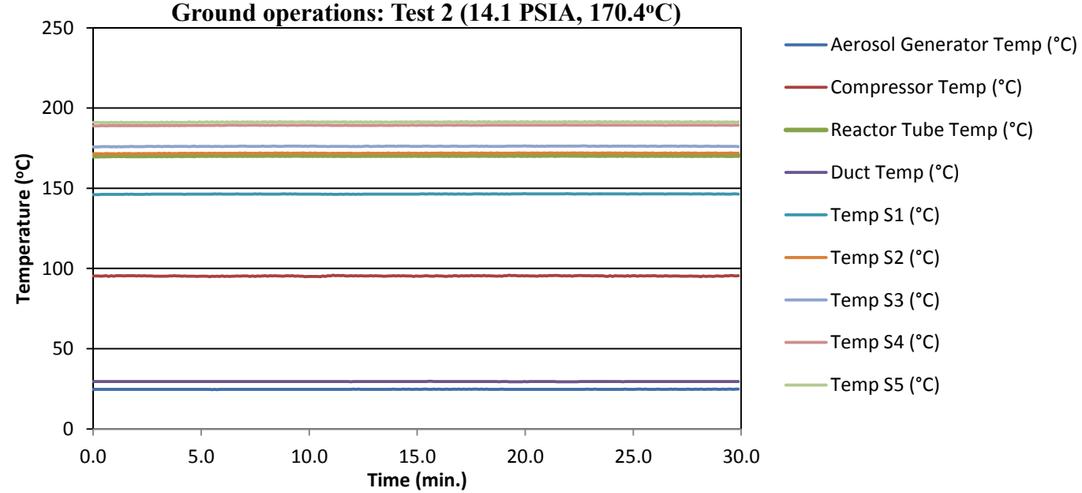
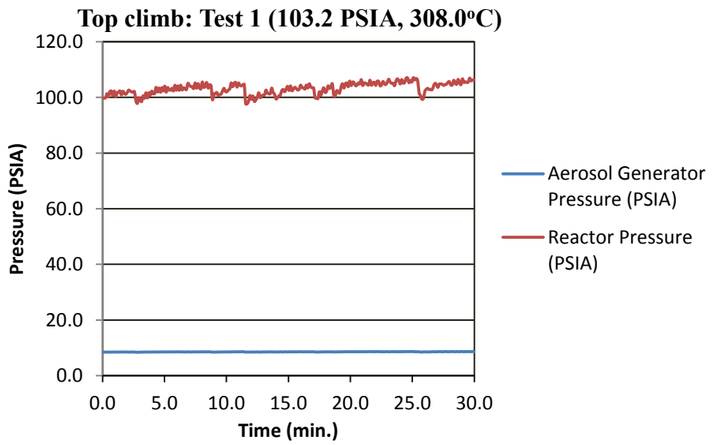
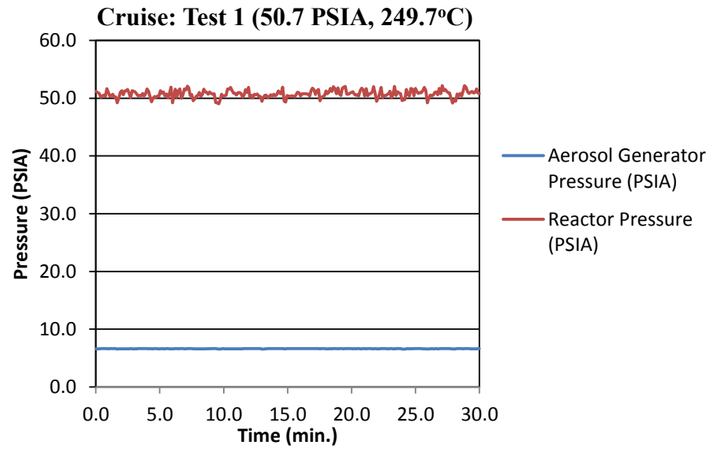
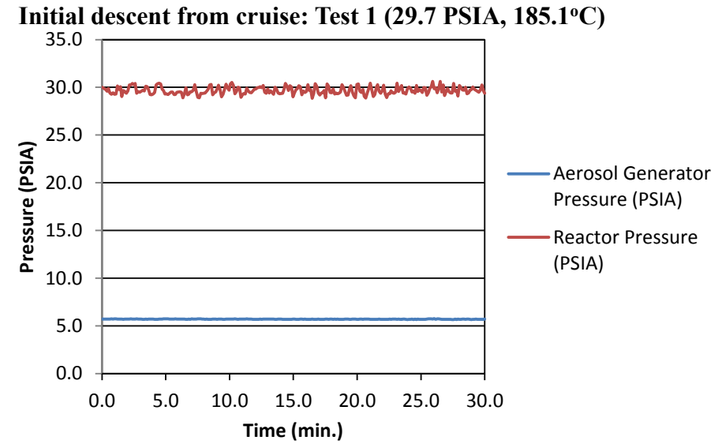
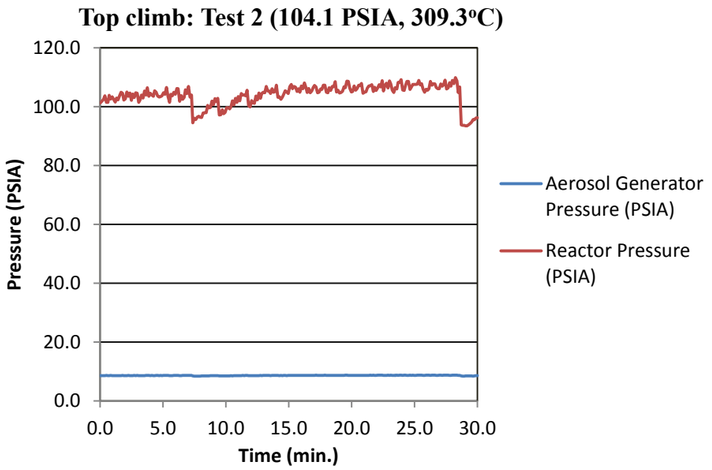


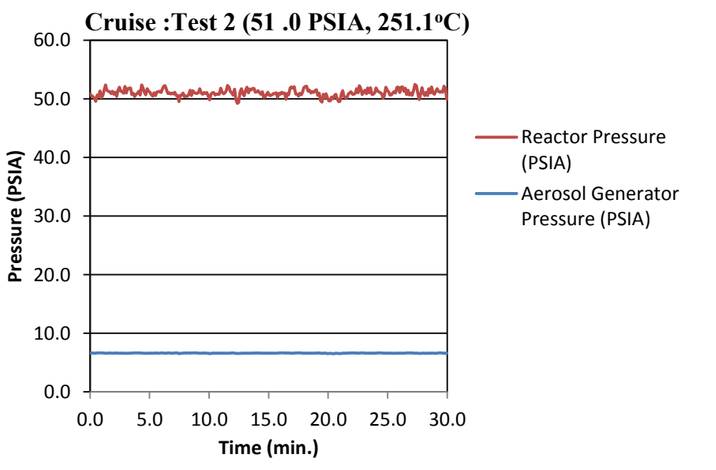
Figure E.5 BAS temperature profiles during modeling of pyrolysis of Mobil Jet Oil II at high pressure to low pressure switch-over and ground operations (OPC: One nozzle open)











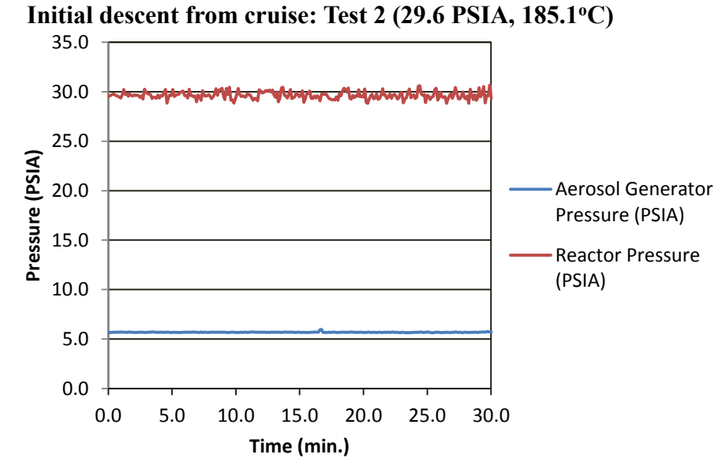
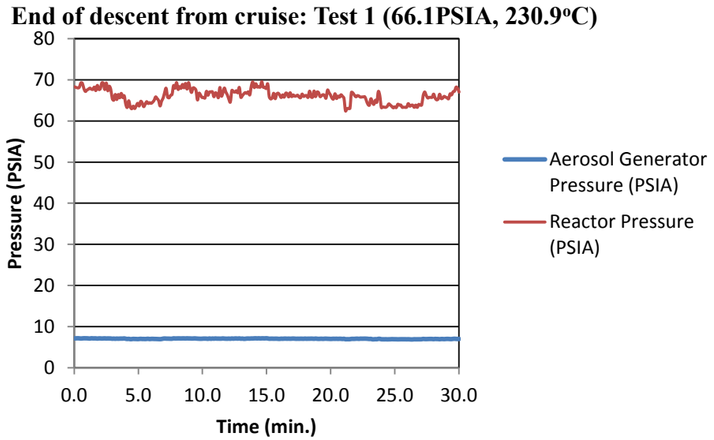
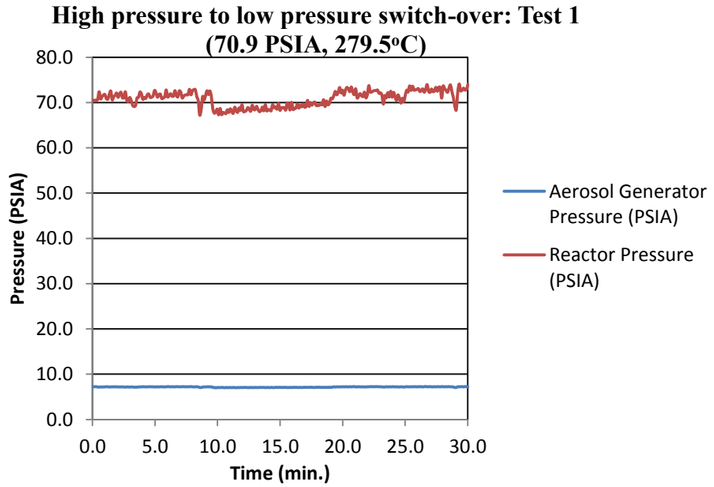
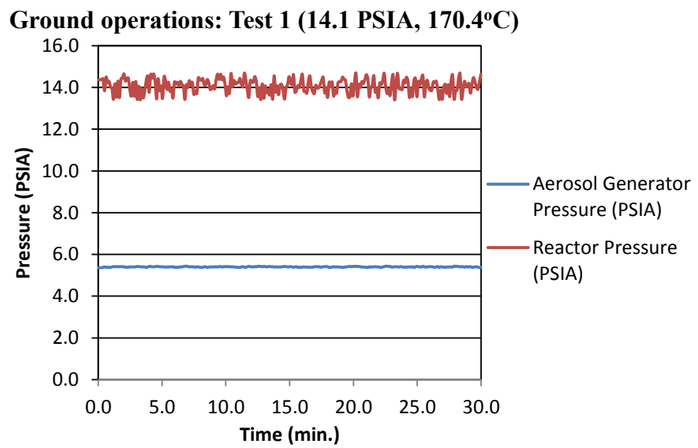
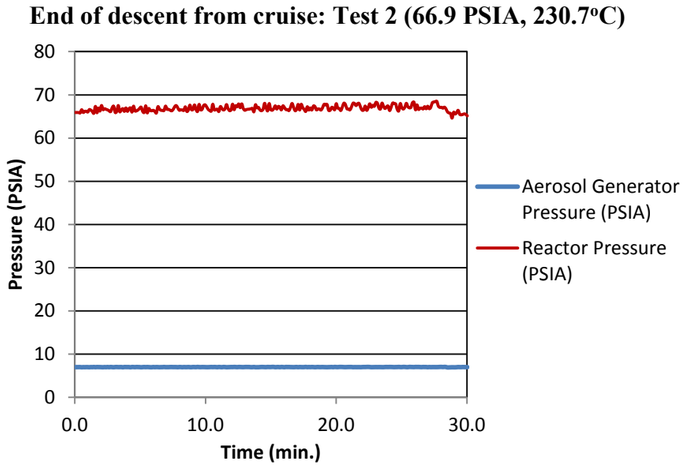


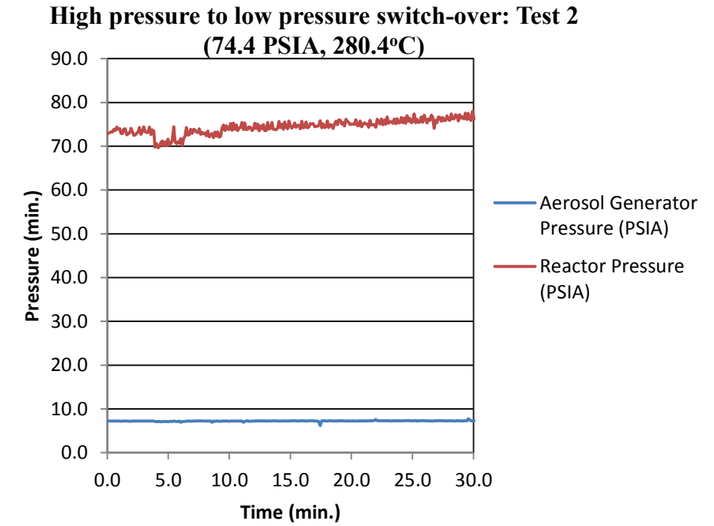
Figure E.6 Trends in pressure profiles of pyrolysis of Mobil Jet Oil II at simulated top climb, cruise and initial descent from cruise











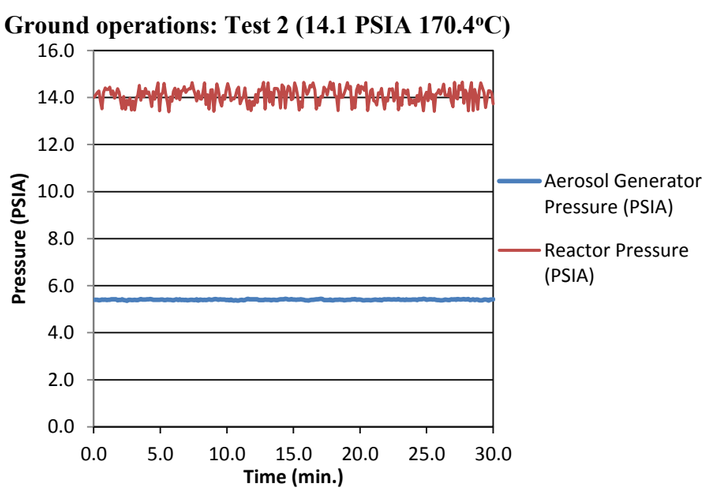


Figure E.7 Trends in pressure profiles of pyrolysis of Mobil Jet Oil II at simulated high pressure to low pressure switch over and ground operations (cold tests)