COMPUTER SIMULATION AND INTERFACE OF HUMAN THERMOREGULATORY AND CIRCULATORY SYSTEMS WITH EXERCISE FORCING

by

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This report is dedicated to my wife, Janice, for her support during the long hours.

1. INTRODUCTION

The goal of this study was the design and implementation of a sweating interface between the KSU-Stolwijk Thermoregulatory System Model (1,2) and the Guyton Circulatory System Model (3,4). Implementation of this interface resulted in a more flexible research vehicle which is capable of simulating response to a variety of environmental conditions.

Guyton's long term circulation program does not account for electrolyte and body fluid changes due to thermoregulatory activity. An interface is proposed to simulate this activity. Such an interface is necessary since evaporation is a major thermoregulatory mechanism. Heat stress can be caused by any combination of metabolic heat production, environmental temperature, and humidity. Regardless of thermal conditions, the average human loses 350 milliliters of water per day through skin diffusion and another 350 milliliters per day by evaporation through the lungs.

At 68°F, only 100 milliliters of water per day is lost as sweat (5). The sodium content of this excreted water is very low due to active reabsorption of sodium ions by the sweat ducts. Potassium concentration in the sweat reaches 1.2 times the plasma concentration but total potassium loss is low due to the low sweat rate.

Under high heat stress, reabsorption in the sweat ducts becomes less effective and large quantities of body salts are excreted. The salt and water losses during profuse sweating are important factors in the body fluid balance. Sweat is hypotonic; therefore, plasma salt concentrations increase at high sweat rates. Drinking water replaces the lost fluid but supplemental intake of salts, such as tablets or food, is necessary under tropical conditions in order to replace lost electrolytes and maintain tonicity. Maximal sweat rates of 1.5 liters per hour in unacclimatized subjects which increase to 3.5 liters per hour after acclimatization are possible (5). Sweating can require a significant fraction of the body fluid under prolonged heat forcing. These fluid and electrolyte losses must be included in the long term circulatory model. In the original model (3), only excretion due to renal function was considered. Maximal sweating in acclimatized subjects can amount to ten times the maximum renal output.

This project was undertaken to improve the original Guyton Circulatory System Model (3) by providing significant thermal sweating data to the model. The interface is designed to force thermal response in the Circulatory System Simulation thereby increasing the scope of the model.

2. LITERATURE SEARCH

Implementation of a sweating interface between the circulatory and thermoregulatory models required information on the chemical composition of the sweat solution excreted during the thermoregulatory process. Loss of sodium and potassium ions during sweating is well documented in the literature (7,8,9). The concentration of chloride ions in sweat has been a subject of much research interest (6,10,12). Indeed, most of the water soluble substances found in the plasma are excreted in sweat, some in greater and some in lesser concentrations than they appear in the plasma (13). Sodium and potassium are the only significant sweat solutes in the Guyton Circulatory System Model; therefore, discussion of previous research efforts is limited to these electrolytes.

2.1 Sodium Ion Loss

The most concentrated solute in sweat is sodium chloride (13). Sodium ion clearance increases with increasing sweat rate. Normal sodium concentration in sweat is much lower than the plasma concentration due to the filtration action of the eccrine sweat glands. Plasma concentrations of sodium ion increase during sweating since maximum ion concentration in the secreted fluid is limited to that of the plasma concentration (5).

Guyton (5) indicates by an example that exercise and extreme sweating will result in a body sodium concentration considerably below normal. He further states that the rate of aldosterone secretion increases under these conditions and that the appetite for salt increases because of extreme sweating. A drop in the extracellular sodium concentration is not an expected result of sweating since the solution secreted by the eccrine sweat gland is lower in sodium ion concentration than the plasma. During profuse sweating the hypotonic excretory fluid will effectively increase the ratio of total sodium ion to total body water.

Cage and Dobson (14) developed an idealized relationship between the sweat rate and the rate of sodium ion clearance, as shown in Figure 1. The postulated relation is curve ACD. The line AB represents the sodium clearance rate with no active transport mechanism. The curve has an initial nonlinear portion AC and then becomes linear on CD. The initial nonlinearity corresponds to the breakdown of the active transport mechanism that filters secretions from the eccrine sweat gland. This mechanism conserves sodium ions by actively transporting them out of the sweat solution before the solution leaves the duct at the skin surface. Sodium reabsorption reaches a maximum at point C. Any increase in the sweat rate after this point causes the solute to pass unaltered through the duct; therefore the curve becomes linear and parallel to the line AB. According to Cage and Dobson (14) the sodium reabsorption mechanism is rate limited. A maximum rate of sodium reabsorption in milliequivalents per square meter of surface area is reached at point C and reabsorption continues at this same rate for all sweat rates greater than point G.

Elizondo, Banerjee and Bullard (9) found a direct relationship between the sodium concentration of sweat and the sweat rate. This finding is also in accord with a breakdown of the sodium ion transport mechanism. The sodium concentration of sweat increases with increasing sweat rate due to the high flow rate of the excretory fluid. The low exposure time of the solution within the ducts cripples the transport mechanism. Under this regime a high sweat rate can be readily associated with a sodium concentration at essentially the plasma level.

The sodium control model of Cage and Dobson differs from the model of

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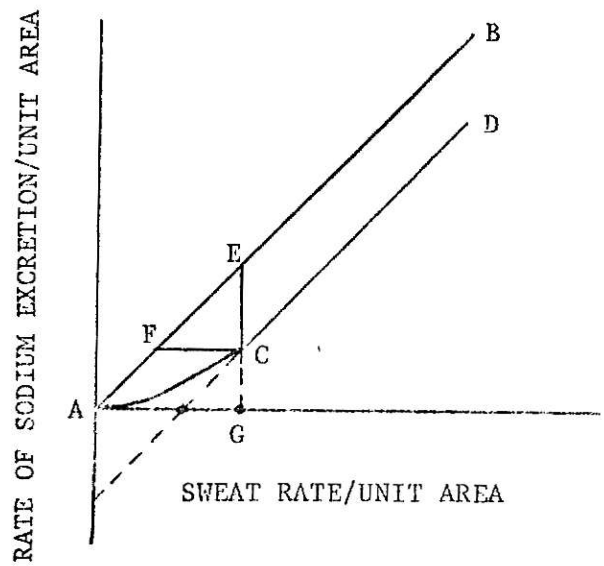

Figure 1. RELATIONSHIP OF RATE OF SODIUM EXCRETION TO SWEAT RATE

Elizondo et al. in that Cage's model assumes a linear relationship between sodium clearance rate and sweat rate whereas Elizondo assumes a linear relationship between sodium concentration and sweat rate. In both cases the sodium ion clearance rate (Naloss) can be expressed in terms of the sweat rate (SR) as

$$\text{Naloss (meq/min)} = Y + \text{Naconc (meq/l)} * \text{SR (l/min)} \tag{2-1}$$

where Naconc is the sodium ion concentration in the excretory fluid and Y is the y-intercept of the linear relationship. Elizondo states that sodium concentration is a function of the sweat rate

$$\text{Naconc (meq/l)} = Y_1 + A * \text{SR (l/min)} \tag{2-2}$$

Here A is the slope of the relationship and Y_1 is the y-intercept. The sodium ion clearance rate as a function of the sweat rate alone is expressed as

$$\text{Naloss (meq/min)} = Y + Y_1 * \text{SR (l/min)} + A * \text{SR}^2 \ (\text{l}^2/\text{min}^2) \tag{2-3}$$

Sodium ion clearance is shown to be a general nonlinear function of the sweat rate. Data given by Cage (14) supports Elizondo's linear relationship between concentration and sweat rate. Simultaneous experimental determination of a subject's sweat rate and sweat electrolyte concentrations is very difficult. Sweat must be collected immediately upon excretion to determine electrolyte concentrations or evaporation will degrade results. If sweat is not allowed to evaporate on the skin, local heating will increase the sweat rate, again degrading the experimental data. Because of these problems, data is available in the literature (7, 15, 16) to support each of the sodium loss models presented.

Sodium concentration in thermal sweat is extremely variable between subjects sweating at the same rate. Acclimatization, dietary habits and sex (13) account for some variation but individual sweat concentrations are markedly variable even within these categories (14).

2.2 Potassium Ion Loss

It is generally agreed that potassium concentration in the sweat decreases with increasing sweat rate. Elizondo et al. (9) developed a relationship between the logarithm of the potassium concentration and the sweat rate. Though potassium concentration decreased with increased sweat rate, the actual potassium clearance as measured in milliequivalents per minute was found to increase with increasing sweat rate. This increase is due to the increased flow rate which more than offsets the decrease in concentration. Guyton (5) lists 1.2 times the plasma concentration as the maximum potassium ion concentration in sweat.

3. SALT LOSS FORMULATIONS

In this study, the sodium loss in sweating is calculated using the method of Elizondo (9). Data for the linear approximation to the sodium ion concentration was taken from Cage and Dobson (14). This data was presented as graphs of sodium ion concentration plotted against sweat rate for six subjects. The subject designated FP was not considered in this study because of his low maximum sweat rate. In all other cases a straight line was drawn to fit the graphically presented sweat data. The slope and y-intercept of each line was determined and an average of the slopes and y-intercepts calculated. An equation of the form

$$\text{Naconc (meq/l)} = Y + A * SR\ (\text{ml/m}^2/\text{min}) \quad (3\text{-}1)$$

where $Y=10.8$

$A=2.565$

was constructed using this data. This equation determines sodium ion concentration in sweat water.

Potassium ion concentration in sweat is calculated using the data and method of Elizondo (9). These tables listed the slope of the base ten logarithm of the potassium ion concentration as plotted against sweat rate. The slopes for the three subjects were averaged to yield -0.6327. Sweat rate was expressed in units of milligrams/centimeter squared/minute. Therefore, a factor of 0.1 was included with the computer formulation to account for slope as expressed in the thermal subroutine.

The y-intercept used in the equation is that of subject RF as derived from the graph presented in the forementioned publication (9). Intercepts were not listed in the tables for the other two subjects. The equation for the base ten logarithm of the potassium ion concentration is

$$Kfac = Y + 0.1 * A * SR \ (ml/m^2 min) \qquad (3.2)$$

where $Y = 1.0$

$A = -0.6237$

The potassium concentration is computed as the antilogarithm of Kfac.

Sweat salt losses are calculated as the product of the ion concentration and the total sweat water loss over a single time increment. These losses are expressed in milliequivalents. The mass of salt lost is computed with the assumption that all sodium and potassium is lost as chloride, since chloride is the most common anion in the plasma.

The total sweat water loss is computed as the integral of the sweat rate over the iteration timestep in the thermal subroutine. Salt and water losses are modelled as being directly removed from the extracellular fluids.

4. IMPLEMENTATION

4.1 Guyton's Circulatory System

This section is an overview of the variables and feedback loops directly connected with the operation of the sweating interface. Guyton provides a complete description of the circulatory system (3).

The thermoregulatory program calculates the body water loss rates due to sweating and due to evaporation in the respiratory tract. Using the relationships defined in Chapter 3, the sodium and potassium ion losses are computed from the sweat rate. The sodium and potassium losses are entered in the Guyton circulatory program as incremental changes in the total extracellular ion levels. The sweat water loss is entered as an incremental change in the interstitial fluid volume.

A diagram of the circulatory system model is presented in Figure 2. The symbols used are defined in Appendix 3. This is an interactive model in which one or more mathematical expressions simulate a single aspect of a physiological mechanism. Groupings of expressions simulate glandular functions, organs or physiological regulatory mechanisms. The model used in this study is as shown in Figure 2 with two exceptions:

1. The continuous drinking section of the Thirst and Drinking block was changed to a periodic input with a definite drinking interval.
2. The expressions for total sodium, total extracellular potassium and for changes for the plasma volume have been altered to account for terms from the sweating interface and the periodic drinking mechanism.

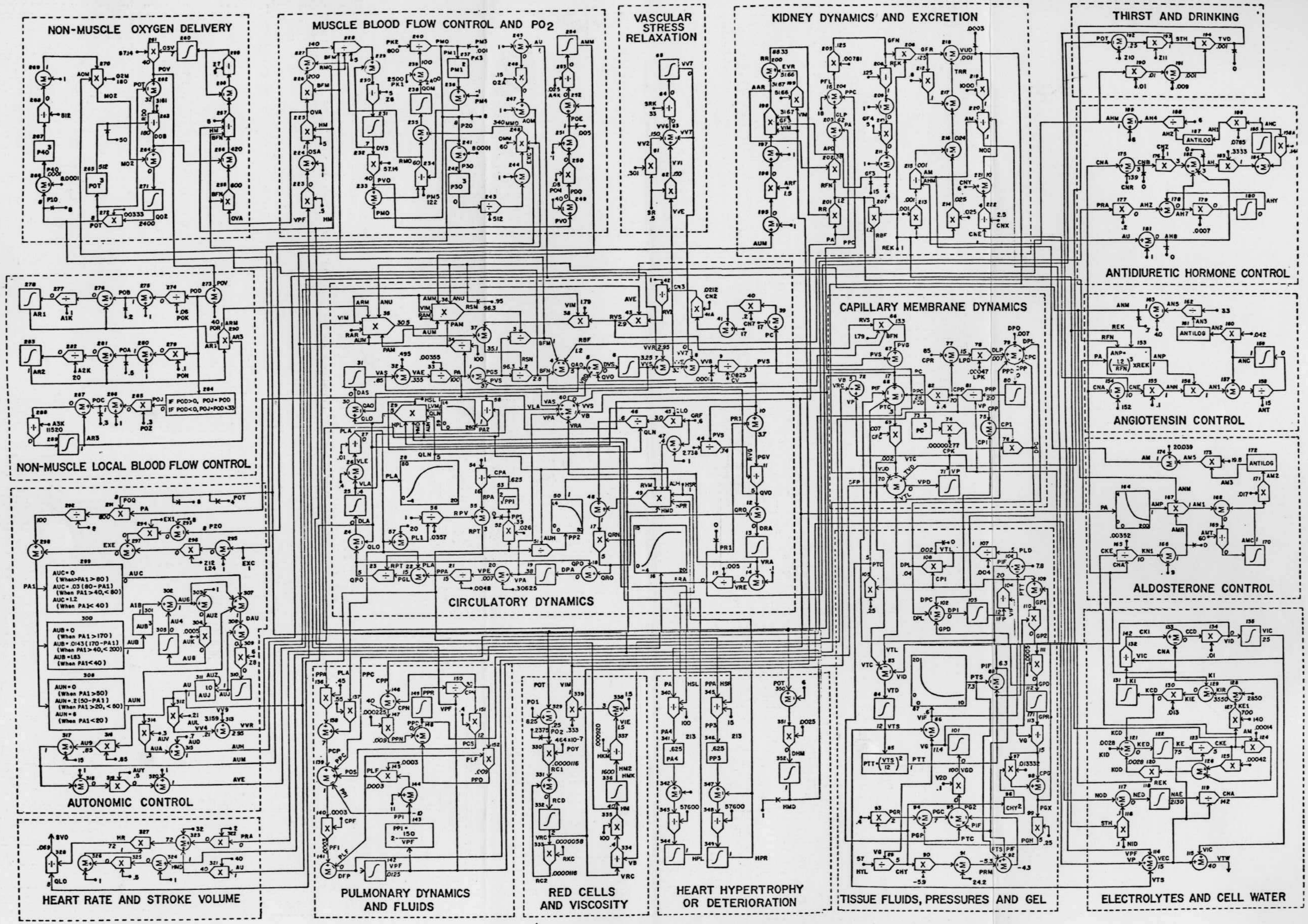

Figure 2. GUYTON CIRCULATORY SYSTEM MODEL

These modifications will be fully discussed in Section 4.3 of this chapter.

Changes in the interstitial fluid volume directly affect the plasma volume. Changes in the plasma volume affect the size of the variable integration step used in the program. A large change in the plasma volume, VPD, gives rise to a shorter length for the integration step. A short integration step results during high heat stress when the sweating causes significent water loss from the plasma.

```
I1 = ABS(VP1/VPD/I)                    (4-1)
If (I1.LT.I) I=I1
```

Decreases in the plasma volume give rise to equivalent decreases in the values for extracellular fluid volume, VEC, and blood volume, VB. Extracellular fluid volume is a factor in the expression for the extracellular sodium, CNA, and potassium, CKE, concentrations.

$$
\begin{aligned}
VEC &= VTS + VP + VPF \\
CNA &= NAE/VEC \\
CKE &= KE/VEC
\end{aligned}
\qquad (4\text{-}2)
$$

The amounts of extracellular sodium and potassium are the other factors in the concentration expressions.

Changes in the blood volume are the cause for changes in the levels of the main blood reservoirs. The volumes of the left and right atria, the pulmonary arteries, the systemic arteries and the venous vascular volume are all directly effected by sweat water loss. The left atrial volume is directly related to the pressure in the left atrium. Left atrial pressure is the controlling variable in the functional expression for the basic left ventricular output. The basic left ventricular output governs the total cardiac output of the model. Increased blood volume in the left atrium causes increased pressure. This increased left atrial pressure increases the efficiency of the left ventricle so the result is a higher cardiac output.

The extracellular sodium concentration controls the body levels of the antidiuretic hormone, AHM, and the angiotensin, ANM. The antidiuretic hormone directly affects the volume of urinary discharge while angiotensin is a factor in the rate of aldosterone production, AM1, and in vascular stress relaxation. Aldosterone production is also influenced by the ratio of the extracellular sodium and potassium levels. Low plasma sodium concentrations, high plasma potassium concentrations and high angiotensin levels all cause increases in the aldosterone level.

$$\text{AMR} = \text{CKE/CNA/0.00352-9.0} \qquad (4\text{-}3)$$

$$\text{AM1} = \text{(ANM*AMP*AMR-AM1)/Z}$$

Increased aldosterone causes increased reabsorption in the kidney, thus resulting in conservation of sodium and water, in addition to a lower urinary output. Reabsorption of sodium by the kidney produces an electric field gradient which results in increased loss of potassium in the urine as the potassium ions diffuse outward to replace the sodium ions that are reabsorbed.

The drinking mechanism has the opposite effect as that of sweating. In drinking, the plasma volume is increased. Extracellular sodium and potassium levels are increased when solutions containing these salts are ingested. The final effect of drinking on the body salt concentrations will depend on the drink composition and the plasma concentrations when drinking occurs. A pure water drinking input will raise the plasma volume and thereby lower the extracellular salt concentrations. A drinking solution high in salts may increase these concentrations. Drinking inputs affect the same variables and feedback loops as described above for sweating.

4.2 KSU-Stolwijk Thermoregulatory Model

The KSU-Stolwijk model of thermoregulation is basically a heat balance of specified body segments. The body is divided into compartments consisting of separate core, fat, muscle and skin compartments for the head, torso, arms, legs, hands and feet. The blood is considered a separate single compartment for a total of 25 segments. Each segment is assigned a thermal capacitance and is assumed to have a uniform temperature. The controller of the model contains set point temperatures for each compartment. The difference between each compartment's temperature and its set point temperature is calculated as the driving force for thermal regulation. In the case of body temperatures above the set points, an efferent sweating command is calculated as the difference between the head core temperature and its set point times a sensitivity factor, the central sweating coefficient. This command is modified by the sum of the differences between the skin segment temperatures and their respective set point temperatures times another sensitivity factor, the skin sweating coefficient. In the formulation under study the central and skin commands add to produce the total sweating drive. The central sweating coefficient is weighted approximately 11 times greater than the peripharal coefficient to model the sensitivity of core temperature regulation.

The efferent sweating command controls evaporative heat loss (watts) from the skin. The sweat rate is determined by the heat of vaporization of sweat which is calculated for the specific environmental conditions which are input to the program. The calculation is done in subroutine SWVP. The rate of respiratory water loss is calculated as the basic rate of respiratory heat loss divided by the evaporative specific heat, which is computed for a 100% wet respiratory tract.

Changes in the body temperature directly affect the metabolic rate. Chemical reactions increase the rate of reaction approximately 130% for each 10°C rise in temperature (5). Increased metabolic rate due to high body temperature is refered to as the "Q10 Effect". Q10 Effect in each body compartment is determined as the difference between the actual compartment temperature and the set point temperature multiplied by the factor 0.126/°C to account for increased chemical activity. This product multiplied by the compartment's basal metabolic rate yields the Q10 Effect for that compartment. The total Q10 Effect for the body is determined as the sum of the effects for each body compartment. The Q10 Effect for any compartment can be negative, due to below normal temperature in the compartment.

Drinking inputs affect the trunk core compartment of the heat balance model. The drinking solution is considered to be pure water. The mass and temperature of the water causes a change in the average temperature of the segment. Heat is considered to flow into a cool drink solution from the trunk core. The rate of heat transfer is determined by the heat transfer period, the mass of the drink and the difference between the drink temperature and the core temperature.

The KSU-Stolwijk program used here is the version of July 22, 1975 with modifications to enhance its use as a subroutine within the Guyton model.

4.3 Computational Interface

4.3.1 Drinking Interface

The mechanism of the drinking interface is diagrammed by the flow chart, Figure 3. The appetite factor for drinking (STH) is continuously computed in subroutine MISC2. In the original program (3), and further detailed by Figure 2, STH was tied directly to the rate of drinking (TVD) computation in subroutine MISC1. This relationship resulted in a continuous drinking cycle. A continuous fluid and salt input is not physiologically sound since drinking is a discrete process with inputs on the order of a half liter with significant time intervals between these inputs. Many test and exercise schemes regulate the subject's drinking habits (17,8) or forbid drinking entirely during the experimental period.

In this study continuous drinking was replaced with a periodic drinking mechanism to allow simulation of realistic experimental regimes. The bond between the appetite mechanism and the drinking cycle was broken. STH is computed as before; however, after computation the value of STH is summed into a variable called THIRST. Then STH is reset to zero. At drinking intervals specified by TIMEDR in minutes, the appetite factor is set equal to THIRST, which will represent the summed appetite for water during the last drinking interval. When STH is set equal to THIRST, THIRST is reset to zero to prepare for a new interval and the integer flag IDRINK is set to one to alert subroutine MISC1 that drinking is in progress.

In subroutine MISC1 the variable CALC stores the amount of the water drunk in liters. CALC is first assigned the value in AMOUNT, which is a read-in value to allow specified drink amounts in exercise regimes. IFLAG is an integer flag which is read into the program as zero if a standard drinking volume AMOUNT is specified and as one if the drink amounts are to

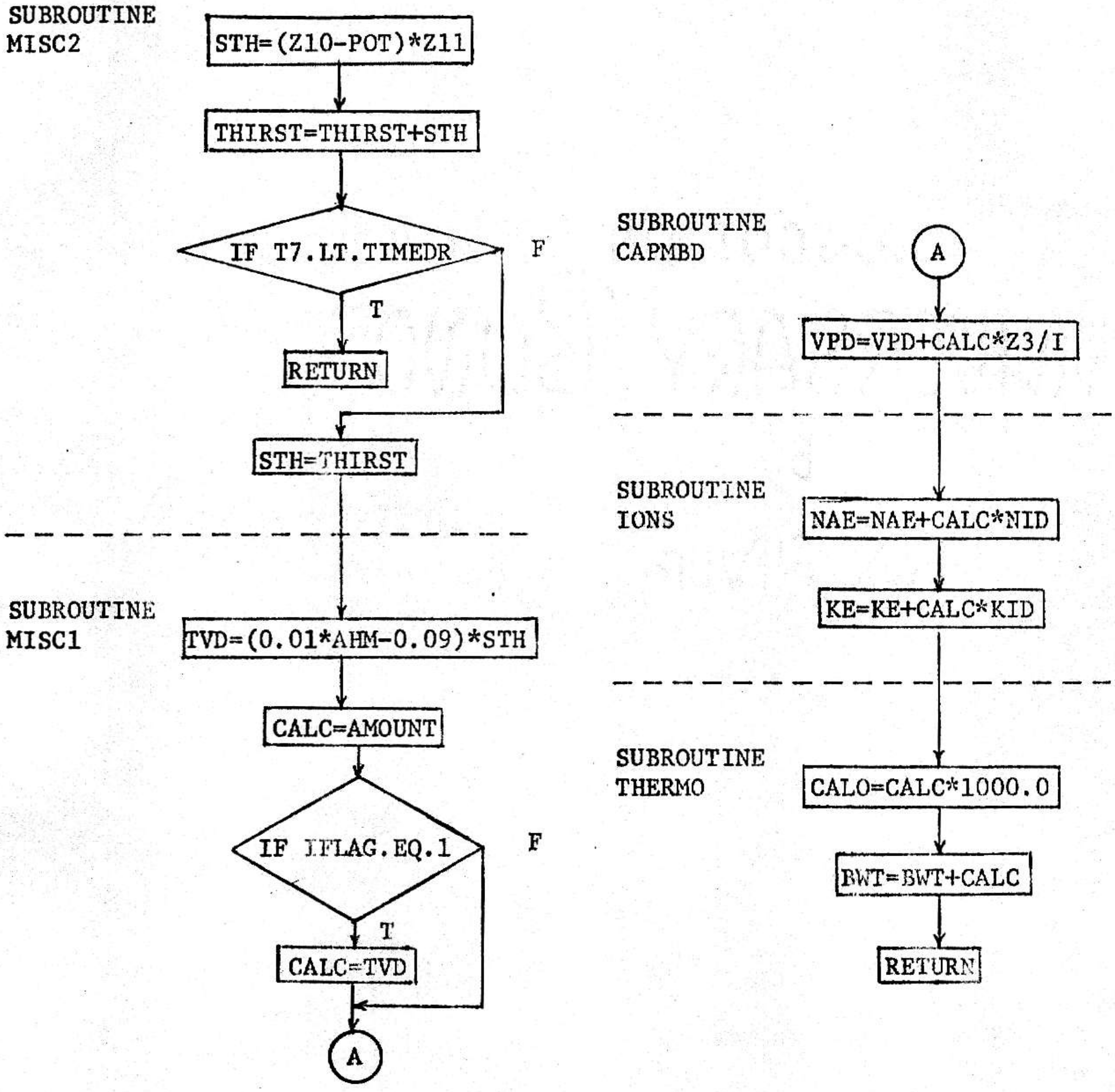

Figure 3. DRINKING INTERFACE CALCULATIONS

be calculated from the appetite factor. For IFLAG equal to one, CALC is assigned the value of the integral of TVD, the computed drinking rate.

CALC now contains the amount of the drink input. This value is added to the change in plasma volume, VPD, to simulate water entering the blood upon ingestion. CALC is multiplied with NID, the sodium ion concentration of the drinking solution, to give the mass of sodium input to the system in the drink. This amount is added to the total sodium, NAE, in subroutine IONS. The amount of potassium in the drink solution is calculated as CALC times KID, the potassium ion concentration in the drinking solution. This amount is added to the total extracellular potassium in subroutine IONS. This completes the drinking cycle within the circulatory model and the variable HOLD is set equal to CALC for transfer to the thermal model.

The values of CALC and IDRINK are passed to the thermal model via the subroutine call. Since the value of CALC is in liters, another variable, CALO, is assigned this value in milliliters for use in the Stolwijk Model. CALO holds this value for the calculation of the heat flow from the trunk core segment into the drink volume. The total body weight is updated to include the mass of the drink input. The entire drinking cycle is now complete and the value of IDRINK is reset to zero.

4.3.2 Q10 Metabolic Effect

QUAT is the total body Q10 Effect expressed in watts as determined in subroutine THERMO. This value is passed to the controller as an argument in the subroutine call statement. The variable EXQ is assigned the value of QUAT as expressed in units of exercise. EXQ is treated as an additional exercise input in the same manner as EXC. Negative values of QUAT are not considered and will give rise to a default EXQ value of zero.

4.3.3 Sweating Interface

A diagram of the sweating interface is presented in Figure 3. The calculations for sweat rate and ion concentration are contained within the thermal subroutine. Sweating data are computed during each integration step of the subroutine THERMO and are summed over the transfer interval. The data transfer interval for data transfer from the thermal section to the circulatory section is the thermal printing interval or five minutes (subjective time), whichever is shorter. After data are transferred, the circulatory program operates for the next time interval on this average data until it catches up to the exit time (TIME) from the thermal section. When the circulatory system's internal time equals the thermal time, subroutine THERMO is recalled to compute sweating data for another interval.

The sweat rate for each integration step, SR, is computed as the sum of the skin segment water loss rates, EG(J+3), divided by 60 and divided by the total body surface area, SA. This calculation yields SR in units of milliliters per minute per square meter of surface area. The total surface water loss for each integration step is WATER. WATER is computed as the sum of the integrals of the skin segment water loss rates divided by 1000 to yield a value in liters. Both SR and WATER are restricted to values greater than or equal to zero since the thermal program treats some conditions as a negative heat loss, and consequently a negative water loss from the skin. This would cause a negative sweat rate if uncontrolled.

The sodium ion concentration, NACONC, and the potassium ion concentration, KCONC, of the secreted sweat are computed as described in Chapter 2. The maximum value of NACONC is limited to the plasma sodium concentration, CNA, and the maximum value of KCONC is limited to 1.2 times the extracellular potassium concentration, CKE. NACONC and KCONC are expressed in milliequivalents per liter.

The sodium ion loss in each integration cycle is expressed as NAMEQ and is computed as the product of NACONC and WATER which yields units of milliequivalents. The potassium loss is computed using KCONC and KMEQ and is also expressed in milliequivalents. NACLMG and KCLMG are the masses of the equivalent weights of sodium chloride and potassium chloride lost in each integration step. These masses are expressed in milligrams and are computed as the product of the milliequivalent loss and the atomic weight of the salt.

The actual thermal water loss over an integration cycle includes skin losses and respiratory loss. WATER1 is the total thermal water loss expressed in liters and is computed for each integration cycle as WATER plus the integral of the respiratory water loss rate, EG(5). The terms SUBNA, SUBK and SUBH2O are the transfer period summations of NACLMG, KCLMG, and WATER1 respectively. These SUB- variables have the same units as the integration step variables.

The variable FLO stores the length of the transfer interval in minutes. At the time of transfer, TERMWA will contain the value of the thermal water loss rate as averaged over the last transfer period and expressed in liters per minute. TERMNA and TERMK hold the values of the sodium ion and potassium ion loss rates expressed in milliequivalents per minute. The TERM- variables are used for data transfer into the circulatory model as explained below. For a nonprinting transfer to the circulatory program, the values of the SUB- variables are summed and stored as SIB- variables, with the same units. The SUB- variables are destroyed upon reentry to the thermal model and store data for one transfer period. The SIB- variables store data for one print cycle.

When printing occurs the values stored in the SIB- variables are added to the SUB- values to yield the thermal losses for the last printing interval. The values contained in the SUB- variables at this time are also added to the TOT- variables, which contain the total system losses since the simulation was initialized. Since these are systemic totals, the variables GUYNA, GUYK and GUYH2O are included to provide for renal losses in the circulatory program. Sample outputs of the simulation are provided in Appendix 1.

Within the circulatory model, the TERM- variables are considered as additional, undamped avenues for loss from the plasma. TERMNA is integrated and subtracted from NAE, the total body sodium level. TERMK is integrated and subtracted from the total extracellular potassium level, KE. TERMWA is integrated and subtracted directly from the interstitial fluid volume, VTS.

5. RESULTS AND DISCUSSION

The interface was tested under a heat and exercise forcing condition to demonstrate overall response. Initially the simulation was run under basal conditions to establish a data base for comparison of the heat and exercise simulation.

5.1 Basal Conditions

Input conditions for the basal values are as listed in Appendix 4. To summarize the important subject conditions, the simulation used a subject 25 years of age, weighing 70 kilograms and standing 173 centimeters. The environmental conditions were air with a radiant temperature of 24°C, air velocity of 0.45 meters per second, relative humidity of 40%, and barometric pressure of 736 millimeters of mercury. Basal metabolic rate was associated with EXC equal to one. For the subject as described above, the thermal subroutine calculated a basal metabolic rate of 86 watts.

The sample output of the simulation at basal conditions shows that the extracellular sodium concentration falls. Kidney action removes sodium ions in the urine at a higher molar concentration than is present in the drinking fluid. This net loss results in a decrease in the extracellular sodium concentration as the circulatory system model provides no buffer to changes in sodium level. Potassium level is well regulated. Cardiac output remains at approximately 5 liters per minute, the normal value. The drinking data printed at 20 minutes in the thermal routine show that the appetite section computed an input in excess of the system loss. This printout also demonstrates that a drinking solution of 24 milliequivalents of sodium per liter is not adequate for replacement of basal urinary losses. This sodium deficit would eventually affect appetite through the antidiuretic hormone and would cause an increased input. Lower extracellular sodium concentration would affect the aldosterone level to conserve sodium in the urine so the system would eventually return to normal with a higher urinary water output.

Under basal conditions minimal sweating occurs with all significant water and salt loss occurring through urination.

5.2 Heat and Exercise Forcing

Input conditions for heat and exercise forcing were identical to those of the basal simulation for the first three minutes of simulation. This time allowed the simulation to reach an initial steady state condition and provided a meaningful basis for comparison with the basal results.

After three minutes heat forcing was supplied by raising the air and radiant temperatures from 24°C to 43.3°C while simultaneously increasing the relative humidity from 40% to 55%. Exercise was imposed at a work rate of EXC equal to 100, which converts to a metabolic rate of 279 watts as compared to 86 watts basal. Other changes in input variables were as listed in Appendix 1 and will be discussed in Section 5.3.

Program control passes from the circulatory system model to the thermoregulatory system model at five minute intervals as determined by the variable FLO in the thermal subroutine, unless a shorter print interval for thermal data is specified. When control is passed to the thermal subroutine, the Stolwijk model uses the data available at that time and simulates thermal activity for the next FLO interval, usually five minutes. When control is returned to the circulatory system routine, this thermal data is used until the thermal routine is reentered. Changes in environmental conditions and work rate will not act on the thermal state until the thermal routine is called for at the next normal iteration cycle. Changes in work rate will have an immediate effect on the circulatory system section through increased oxygen consumption and autonomic stimulation.

During heat and exercise forcing the cardiac output initially increases 28% during the first two minutes due to increased autonomic stimulation. At the onset of exercise autonomic stimulation increased to 800% of normal. Increased oxygen consumption is not an immediate factor in increased cardiac output due to transportation delays in blood flow. Two minutes after the onset of exercise the cardiac output increases to 200% of normal as the effect of lower oxygen pressure in the venous blood becomes apparent. At this time the cardiac output is 12.5 liters per minute. This increase is a response to exercise activity in the circulatory system routine before the thermal routine is entered at 5 minutes. With thermal forcing cardiac output reaches a steady state value of 13.5 liters per minute at 25 minutes of subjective time. This one liter per minute increase is caused by thermal influence. These thermal effects have a much longer time constant than the initial circulatory system effects. Autonomic system changes experience almost no time delay. Reaction to oxygen deficit is delayed on the order of the circulation delay time. Here the delay is the time for blood to move from the muscles under exercise to the carotid and aortic bodies. Since the blood volume is 5 liters and the initial cardiac output is 5 liters per minute, the delay is on the order of one minute. Thermal effects are governed principally by the heat capacitance of the body. The thermal routine does not reach steady state after 35 minutes, so thermal effects on the circulatory system model are still developing 30 minutes after the onset of exercise.

In this formulation thermal influence on the cardiac output is transmitted through the antidiuretic hormone concentration as a factor in vascular resistance. Changes in the body electrolyte concentrations and fluid volumes also affect the cardiac output; however, these effects may be masked by disease conditions or exotic drinking regimes imposed by the user.

5.3 Variable Changes for Implementation

In addition to the basic controller variables mentioned in Section 5.2, sensitivity values in the controlled system of the Guyton routine were changed to better simulate exercise activity. The most basic change required was the change in the variable Z, the damping factor for nineteen processes in the circulatory simulation. The value of Z was changed from 1.0 to 5.0. This modification slows system reaction to 20% of normal. At the same time, the damping factor for muscle venous oxygen saturation, Z6, was increased from 5.0 to 10.0 and the time constant for autonomic response, Z8, was increased from 1.0 to 3.0. These modifications were introduced to alternate the system's response to exercise inputs. Without these changes the circulatory system simulation exhibits excessive response to low level exercise forcing. These same modifications make the system less sensitive to thermal stimulation during exercise.

These changes of controlled system variables were recommended by Dr. Ronald White (11), who also suggested the following modifications as used during NASA operation of the simulation. The time constant for local muscle vascular response, A4K, was decreased from 1.0 to 0.025. This forty fold decrease in the time constant provides much more rapid local vascular resistance changes to offset the change in Z6, which slowed reaction to overall muscle venous oxygen saturation. A change in Z5, the time constant to calculate oxygen content in the muscle cells, was recommended to decrease the lag time in response to oxygen utilization. The change of Z5 from 10.0 to 1.0 resulted in system instability in the oxygen transport subroutine. The rate of oxygen transport to the tissues, RMO, became negative for exercise levels of EXC equal to 50.0 or above with Z5 equal to 7.0 or below. A negative value of RMO implies oxygen transfer out of the muscle cells to the venous blood which is clearly not the case during exercise forcing. Therefore, the level of Z5 was left unchanged for this study.

After implementation of the thermal interface, further parameter modification within the circulatory system model was required. The sensitivity of the appetite section for drinking was markedly reduced, from 4.0 to 0.1, to account for the increased forcing received from the thermal subroutine. This change resulted in a simulated response within 10% of water loss data in the literature (5).

Neural sensitivities were also markedly reduced after implementation of the interface. The values of AUQ, AUV, and AUS were modified to reduce cardiac output during exercise to a more justifiable level. Prior to modification cardiac outputs of 35 liters per minute were calculated for EXC levels of 100. As this is the work level of a brisk walk, a 550% increase in heart function is clearly inappropriate. Variables AUQ, AUV, and AUS are the sensitivities for sympathetic control of peripheral circulation, heart function, and heart rate, respectively. Each variable was reduced to approximately 10% of its preinterface value. This correction brought cardiac output within reasonable bounds for the exercise conditions under observation.

5.4 Discussion

The change in cardiac output attributable to interface activity is approximately 7.6% under the heat and exercise forcing conditions simulated. More heat effects are expected under these conditions, demonstrating that the present simulation does not adequately reflect thermal response. No neural component for heat stress is included in the circulatory simulation though such a component may be physiologically sound. Changes in the blood flow occur during heat stress, most notably increased skin blood flow, which cannot be modelled using the present parameters of the circulatory routine. A separate skin layer in the circulatory model to handle these changes may be required.

Cardiac output as calculated in the thermal subroutine is uniformly lower than that of the circulatory system model. In experiments by Konz, Hwang, et al. (2), the KSU-Stolwijk Thermoregulatory System Model cardiac output predictions were compared to measured data for exercising subjects. The thermal routine produced a 19% rise in cardiac output as compared to a 32% measured increase in the experimental subjects. In the present study correction for this lower calculated cardiac output yields a final cardiac output value of 13.2 liters per minute in the thermal subroutine which is a good agreement with the 13.5 liters per minute steady state value calculated in the circulatory routine with interface forcing.

The only direct thermal effect on the cardiac output is transmitted through the variable ANM, the angiotensin multiplier, which reacts to changes in the sodium ion concentration. This variable is a factor in computing vascular stress relaxation. The thermal effect of the angiotension multiplier can be masked by changes in kidney function or high user imposed drinking levels. Overall, pathological changes in the body fluid and electrolyte balances can completely mask thermal stress reaction at low stimulation levels. In order to completely simulate heat stress activity the circulatory routine must be modified to include a distinct heat sensitive subroutine to implement skin blood flow and neurological changes to cardiac output.

The present interface does transfer important information to the circulatory model. Sweating during heat and exercise forcing is an important factor in the fluid balance. During 25 minutes of simulation, basal fluid losses were 14.3 milliliters while in the same period there was loss of 45.9 milliliters under heat and exercise forcing. Without the interface in operation a lower fluid loss would be calculated under exercise since urination, the major fluid loss mechanism under basal conditions, is inhibited during exercise. This additional information is vital in any exercise study.

The results of this study show that the plasma concentration of sodium ions increases during sweating, a result in disagreement with one of Guyton's assertions (5).

Without the thermal information from the interface, the circulatory system model would calculate sodium ion concentration dependent only on urinary output. This could lead to a calculated decrease in the sodium concentration.

The results of drinking calculations in this study are in complete agreement with Guyton's data (5). The drinking input calculated for the first 15 minutes of the basal condition simulation was 24.15 milliliters or approximately 2.3 liters per day. This compares to 2.4 liters per day in other research (5). The calculated drink volume for the same time period during heat and exercise forcing was 64.14 milliliters for a rate of 6.15 liters per day. Again this compares well with Guyton's value of 6.7 liters per day for prolonged heavy exercise forcing.

The water and electrolyte totals printed during the thermal subroutine output cycle show the updated system status. This data may be misleading as the cumulative totals are computed from the circulatory information at the time of entry into the thermal subroutine plus the thermal-generated information current at the time of exit from the thermal subroutine. To compute the system status as of the THERMO call, the data given for heat generated losses during the current print cycle must be subtracted from the cumulative totals printed in that cycle.

5.5 Areas for Further Study

In its present form the simulation does not satisfactorily respond to thermal stimuli. A skin block within the circulatory system model is suggested. This block should be controlled by the inputs from the thermal subroutine as well as information from the circulatory system. A separate block is necessary to simulate changes in the skin blood flow and cardiac output during stress.

The output section of the KSU-Stolwijk thermoregulatory system model should be modified to allow data selection for the printout section. Printout now includes shivering data during heat forcing, etc.

The combined circulatory and thermoregulatory system model should be combined with the Grodin respiratory system model. This combination would improve response within the Muscle Oxygen Utilization Block of the circulatory system simulation. This three-model combination would allow long term simulation of additional forcing conditions.

The most important area for research is the experimental validation of the interface calculations by direct measurement of human subjects. The acclimatization state is the most important variable in physiological heat stress response. The subjects degree of acclimatization was not addressed in this study.

6. SPECIAL CONSIDERATIONS FOR USERS

When using the combined circulatory system-thermoregulatory system simulation, the user should be aware of certain special requirements imposed by the construction of the interface. These peculiarities are listed here to aid independent users of the simulation.

The drinking section of the thermal subroutine computes heat transfer from the water input to the trunk core using a drinking interval of 30 minutes for complete heat transfer. If a second drink input is allowed within this 30 minute interval, the heat transfer information from the first input will be destroyed at that time. Changes in the thermal subroutine body weight are made immediately upon drinking so no mass information will be lost. If the specified temperature of the drinking solution is much different from the subject's core temperature, reaction to the drinking input will include significant heat flux. In this case the drinking interval should be specified as greater than thirty minutes, allowing time to achieve thermal equilibrium between the drinking input mass and the trunk core before the next input. The drinking interval should also be specified as an integral multiple of FLO so that a drinking input will be processed by the thermal subroutine as soon as it is input to the circulatory system.

The thermal subroutine operates separately from the circulatory system model, using a separate time step. In terms of simulation time, the thermal subroutine is five minutes ahead of the circulatory system routine. Consider the following example: T is time as measured in the circulatory system simulation, and TIME is time as measured in the thermoregulatory system simulation. Both times are in units of minutes.

At T=10.1 the circulatory system routine calls the thermal routine, since TIME=10.0. The thermal routine will then operate for one FLO interval, five minutes in this study, using the input data available in the subroutine call. When TIME=15 data is prepared and converted for transfer to the circulatory system routine through the subroutine call. When the thermal subroutine releases control back to the circulatory system model, internal time in the thermal subroutine is five minutes advanced. On return T=10.1 as previously determined. The circulatory system routine will iterate using the data from the Stolwijk model until T is again greater than TIME to cause another control transfer. Any change in input conditions during the circulatory routine will immediately affect the Guyton routine. The Stolwijk routine will not be affected until the next control transfer, so a radient temperature change at T=11.0 will cause no change in thermal data until the Stolwijk subroutine is entered at T=15.1, when T is greater than TIME. Data changes, including drinking inputs, should be timed to affect both routines within a short time interval.

Any change in the metabolic level EXC in the combined system simulation is interpreted as a change in the work rate within the thermal subroutine. Immediately after the run time/print interval card for the circulatory simulation controller, the user must insert a job identification card to be read by the thermal subroutine when a change in work rate is detected. Since both routines use variable time steps, care must be taken in imposing exercise changes close to the circulatory-thermal control transfer. If a job identification card is read by the PUTOUT subroutine in the circulatory simulation it will be interpreted as a blank field which is the input for termination of the combined simulation. The duration of an exercise level should be at least as long as the transfer time FLO. Then the job data card must be read by the thermal subroutine.

The Guyton model exhibits an initial transient response due to the approximate values of the initial input variables. In this study thirty seconds of subjective time is allowed for damping of the initial transients. After the stabilization period, time in the circulatory simulation is reset to zero. Subroutine THERMO is called and initial thermal data is read after the circulatory system routine is stabilized.

7. CONCLUSIONS

The sweating interface developed for this study provides significant data on the body fluid and electrolyte balances. These data are transmitted to the circulatory system model and displayed for the user. Sweating and drinking phenomena are adequately simulated by the proposed interface. Additional modification of the circulatory system model is required for complete thermal reaction within the circulatory system.

The combined thermoregulatory and circulatory system model provides a means to develop long term heat and exercise training regimes and to deal with water and electrolyte requirements under heat stress. The simulation program as listed in Appendix 4 will provide a subjective to real time ratio of more than 100 to 1 using FORTRAN H.

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APPENDIX 1

Sample Results Output

ILLEGIBLE DOCUMENT

THE FOLLOWING DOCUMENT(S) IS OF POOR LEGIBILITY IN THE ORIGINAL

THIS IS THE BEST COPY AVAILABLE

EXP 1 COMBINED THERMOREGULATORY-CIRCULATORY SIMULATION- BASAL CONDITIONS

0 SECS

QLC =	5.0000	AU =	1.0000	AM =	1.0000	AHM =	1.0000	ANM =	1.0000
VP =	3.0000	VUD =	0.0010	NAE =	2136.0000	KE =	75.0000	KI =	3550.0000
VEC =	15.0000	VIC =	25.0000	CNA =	142.0000	CKE =	5.0000	CKI =	142.0000
EXC =	0.0	RMO =	60.0000						

47 SECS

QLO =	5.1961	AU =	1.0662	AM =	0.9579	AHM =	0.9942	ANM =	1.0042
VP =	2.9990	VUD =	0.0011	NAE =	2135.9150	KE =	75.0049	KI =	3549.9929
VEC =	15.0149	VIC =	24.9980	CNA =	142.2532	CKE =	4.9950	CKI =	141.9997
EXO =	0.0	RMO =	60.1055						

CONSTANT DATA ************************************

TIME=0.0 ************************************

AGE OF THE SUBJECT,AGE= 25.00 YEARS

WEIGHT OF THE SUBJECT,WT= 70.00 KG

HEIGHT OF THE SUBJECT,HT= 173.00 CM

SURFACE AREA OF THE SUBJECT,SA= 1.94 SQ M

SPECIFIC HEAT (THERMAL CAPACITY) OF FAT,SHF= 0.640 WATT-HR/KG-C

SPECIFIC HEAT (THERMAL CAPACITY) OF BONE,SHB= 0.592 WATT-HR/KG-C

SPECIFIC HEAT (THERMAL CAPACITY) OF TISSUE,SHT= 1.058 WATT-HR/KG-C

SPECIFIC HEAT (THERMAL CAPACITY) OF SKIN,SHS= 0.896 WATT-HR/KG-C

SURFACE AREA OF DRY ICE FACING SKIN,SAF= 0.0 SQ. CM.

PCT(J), % DISTRIBUTION, BY WEIGHT, OF DIFFERENT TISSUE TYPES

	CORE			MUSCLE			FAT			SKIN		
	FAT	BONE	TISSUE	FAT	BONE	TISSUE	FAT	BONE	TISSUE	FAT	BONE	TISSUE
HEAD	0.0	2.14	2.13	0.0	0.0	0.51	0.50	0.0	0.0	0.0	0.0	0.36
TRUNK	0.0	3.30	12.98	0.0	0.0	24.35	9.60	0.0	0.0	0.0	0.0	1.82
ARMS	0.0	2.02	1.00	0.0	0.0	4.58	1.30	0.0	0.0	0.0	0.0	0.65
HANDS	0.0	0.31	0.04	0.0	0.0	0.10	0.19	0.0	0.0	0.0	0.0	0.26
LEGS	0.0	6.73	2.64	0.0	0.0	13.82	3.23	0.0	0.0	0.0	0.0	1.62
FEET	0.0	0.50	0.07	0.0	0.0	0.11	0.29	0.0	0.0	0.0	0.0	0.34

CENTRAL BLOOD 3.37 TISSUE

WTPCT(J), KG. OF TISSUE FOR 73.4 KG. MALE -ASSUMING 15% BODY FAT

	CORE FAT	CORE BONE	CORE TISSUE	MUSCLE FAT	MUSCLE BONE	MUSCLE TISSUE	FAT FAT	FAT BONE	FAT TISSUE	SKIN FAT	SKIN BONE	SKIN TISSUE
HEAD	0.0	1.57	1.56	0.0	0.0	0.37	0.37	0.0	0.0	0.0	0.0	0.26
TRUNK	0.0	2.42	9.53	0.0	0.0	17.87	7.05	0.0	0.0	0.0	0.0	1.34
ARMS	0.0	1.48	0.73	0.0	0.0	3.36	0.95	0.0	0.0	0.0	0.0	0.48
HANDS	0.0	0.23	0.03	0.0	0.0	0.07	0.14	0.0	0.0	0.0	0.0	0.19
LEGS	0.0	4.94	1.94	0.0	0.0	10.14	2.37	0.0	0.0	0.0	0.0	1.19
FEET	0.0	0.37	0.05	0.0	0.0	0.03	0.21	0.0	0.0	0.0	0.0	0.25

CENTRAL BLOOD 2.47 TISSUE

NWT(J), KG. OF TISSUE FOR THIS MALE BF=11.98%

	CORE FAT	CORE BONE	CORE TISSUE	MUSCLE FAT	MUSCLE BONE	MUSCLE TISSUE	FAT FAT	FAT BONE	FAT TISSUE	SKIN FAT	SKIN BONE	SKIN TISSUE
HEAD	0.0	1.57	1.56	0.0	0.0	0.37	0.29	0.0	0.0	0.0	0.0	0.26
TRUNK	0.0	2.42	9.53	0.0	0.0	17.87	5.59	0.0	0.0	0.0	0.0	1.34
ARMS	0.0	1.48	0.73	0.0	0.0	3.36	0.76	0.0	0.0	0.0	0.0	0.48
HANDS	0.0	0.23	0.03	0.0	0.0	0.07	0.11	0.0	0.0	0.0	0.0	0.19
LEGS	0.0	4.94	1.94	0.0	0.0	10.14	1.38	0.0	0.0	0.0	0.0	1.19
FEET	0.0	0.37	0.05	0.0	0.0	0.08	0.17	0.0	0.0	0.0	0.0	0.25

CENTRAL BLOOD 2.47 TISSUE

PCTN(J), NEW CALCULATED WEIGHT PERCENTAGES

	CORE FAT	CORE BONE	CORE TISSUE	MUSCLE FAT	MUSCLE BONE	MUSCLE TISSUE	FAT FAT	FAT BONE	FAT TISSUE	SKIN FAT	SKIN BONE	SKIN TISSUE
HEAD	0.0	2.19	2.18	0.0	0.0	0.52	0.41	0.0	0.0	0.0	0.0	0.37
TRUNK	0.0	3.38	13.28	0.0	0.0	24.92	7.79	0.0	0.0	0.0	0.0	1.86
ARMS	0.0	2.07	1.02	0.0	0.0	4.69	1.05	0.0	0.0	0.0	0.0	0.67
HANDS	0.0	0.32	0.04	0.0	0.0	0.10	0.15	0.0	0.0	0.0	0.0	0.27
LEGS	0.0	6.89	2.70	0.0	0.0	14.14	2.62	0.0	0.0	0.0	0.0	1.66
FEET	0.0	0.51	0.07	0.0	0.0	0.11	0.24	0.0	0.0	0.0	0.0	0.35

CENTRAL BLOOD 3.45 TISSUE

C(N), HEAT CAPACITANCE, WATT HR/DEG C

	CORE	MUSCLE	FAT	SKIN
HEAD	2.449	0.378	0.224	0.267
TRUNK	10.957	12.034	4.301	1.348
ARMS	1.564	3.392	0.582	0.481
HANDS	0.150	0.074	0.085	0.193
LEGS	4.697	10.235	1.447	1.200
FEET	0.256	0.081	0.130	0.252

CENTRAL BLOOD
2.114

PROPORTION OF BASAL METABOLISM, PQB(N)

	CORE	MUSCLE	FAT	SKIN
HEAD	0.1729	0.0014	0.0015	0.0010
TRUNK	0.6086	0.0672	0.0288	0.0054
ARMS	0.0095	0.0128	0.0023	0.0017
HANDS	0.0010	0.0027	0.0003	0.0007
LEGS	0.0300	0.0384	0.0058	0.0043
FEET	0.0017	0.0002	0.0050	0.0009

QB(N), BASAL METABOLIC HEAT PRODUCTION, WATTS

	CORE	MUSCLE	FAT	SKIN
HEAD	14.670	0.120	0.129	0.086
TRUNK	52.341	5.779	2.477	0.464
ARMS	0.817	1.101	0.198	0.146
HANDS	0.066	0.222	0.026	0.060
LEGS	2.580	3.302	0.499	0.370
FEET	0.146	0.017	0.516	0.077

EB(N), BASAL EVAPORATIVE HEAT LOSS (DIFFUSION), WATTS

	CORE	MUSCLE	FAT	SKIN
HEAD	0.0	0.0	0.0	0.810
TRUNK	0.0	0.0	0.0	3.780
ARMS	0.0	0.0	0.0	1.400
HANDS	0.0	0.0	0.0	0.520
LEGS	0.0	0.0	0.0	3.320
FEET	0.0	0.0	0.0	0.720

****EB(5),RESPIRATORY HEAT LOSS, IS NOT CONSTANT. SO, IT HAS BEEN INITIALIZED AS ZERO AND LATER CALCULATED BY RWET

PROPORTION OF CARDIAC OUTPUT,PBCO(N)

	CORE	MUSCLE	FAT	SKIN
HEAD	0.1076	0.0059	0.0018	0.0087
TRUNK	0.5021	0.1397	0.0348	0.0127
ARMS	0.0020	0.0267	0.0048	0.0030
HANDS	0.0002	0.0006	0.0007	0.0121
LEGS	0.0064	0.0811	0.0117	0.0172
FEET	0.0004	0.0006	0.0011	0.0182

BFB(N), BASAL EFFECTIVE BLOOD FLOW, LITRES/HR

	CORE	MUSCLE	FAT	SKIN
HEAD	46.987	2.576	0.786	3.759
TRUNK	219.260	61.005	15.197	5.546
ARMS	0.873	11.659	2.096	1.310
HANDS	0.087	0.262	0.306	5.284
LEGS	2.795	35.415	5.109	7.511
FEET	0.175	0.262	0.480	7.948

WEIGHT PER SEGMENT,SEGWT(N) GM

	CORE	MUSCLE	FAT	SKIN
HEAD	3059.438	365.293	283.939	257.854
TRUNK	11660.746	17440.961	5451.641	1303.597
ARMS	2163.112	3280.430	738.242	465.571
HANDS	250.692	71.626	107.897	136.228
LEGS	6711.367	9898.742	1834.249	1160.345
FEET	400.269	78.789	164.685	243.529

VLL(N), VOLUME OF SUBJECT,CUBIC CENTIMETERS

	SHAPE	CORE	MUSCLE	FAT	SKIN
HEAD	SPHERE	3059.438	3423.732	3707.671	3965.525
TRUNK	CYLINDER	11660.746	29101.707	34553.348	35856.941
ARMS	CYLINDER	2163.112	5443.590	6181.832	6647.402
HANDS	CYLINDER	250.692	322.318	430.215	616.443
LEGS	CYLINDER	6711.367	16610.109	18444.355	19604.699

FEET	CYLINDER	408.269	487.058	651.742	895.271

OUTSIDE SURFACE AREA,AREA(N) SQ CM

	CORE	MUSCLE	FAT	SKIN
HEAD	0.0	0.0	0.0	1357.998
TRUNK	0.0	0.0	0.0	6987.863
ARMS	0.0	0.0	0.0	2601.535
HANDS	0.0	0.0	0.0	969.998
LEGS	0.0	0.0	0.0	6157.547
FEET	0.0	0.0	0.0	1330.837

LTH(N), LENGTH OF PARTS OF THE BODY,CM.

	CORE	MUSCLE	FAT	SKIN
HEAD	0.0	0.0	0.0	0.0
TRUNK	108.369	108.369	108.369	108.369
ARMS (2)	81.021	81.021	81.021	81.021
HANDS (2)	121.461	121.461	121.461	121.461
LEGS (2)	153.902	153.902	153.902	153.902
FEET (2)	157.429	157.429	157.429	157.429

RAD(N), RADIUS OF PARTS OF THE BODY, CM.

	CORE	MUSCLE	FAT	SKIN
HEAD	7.696	8.158	8.484	8.760
TRUNK	5.952	9.246	10.074	10.263
ARMS	2.915	4.625	4.529	5.110
HANDS	0.311	0.919	1.062	1.271
LEGS	3.726	5.861	6.176	6.368
FEET	0.909	0.992	1.148	1.345

CENTER OF MASS RADIUS,CMRAD(N) CM

	CORE	MUSCLE	FAT	SKIN
HEAD	6.108	7.934	8.324	8.625
TRUNK	4.645	7.912	9.678	10.169
ARMS	2.314	3.954	4.781	5.021
HANDS	0.643	0.868	0.996	1.176
LEGS	2.957	5.020	6.023	6.273
FEET	0.721	0.952	1.076	1.254

DELX(K), DELTA X, ABOUT RAD(I),CM.

	CORE-MUSCLE	MUSCLE-FAT	FAT-SKIN
HEAD	1.826	0.351	0.300
TRUNK	3.267	1.765	0.492
ARMS	1.641	0.827	0.240
HANDS	0.225	0.127	0.130
LEGS	2.063	1.003	0.251
FEET	0.231	0.123	0.179

MIDPOINT RADIUS,MPR(K) CM

	CORE-MUSCLE	MUSCLE-FAT	FAT-SKIN
HEAD	7.021	8.129	8.474
TRUNK	6.279	8.795	9.523
ARMS	3.134	4.368	4.901
HANDS	0.756	0.932	1.066
LEGS	3.989	5.522	6.148

FEET	0.837	1.014	1.165

HEAT TRANSFER OF SURFACE AREA,HTSA(K) SQ CM

	CORE-MUSCLE	MUSCLE-FAT	FAT-SKIN
HEAD	619.407	830.339	902.479
TRUNK	4275.207	5988.570	6756.934
ARMS	1595.476	2223.512	2494.967
HANDS	576.771	711.176	328.522
LEGS	3857.098	5239.410	5945.231
FEET	827.646	1003.048	1152.484

COND(K), CONDUCTIVITY,W/CM C

	CORE-MUSCLE	MUSCLE-FAT	FAT-SKIN
HEAD	0.00419	0.00278	0.00205
TRUNK	0.00419	0.00335	0.00205
ARMS	0.00419	0.00335	0.00205
HANDS	0.00419	0.00278	0.00205
LEGS	0.00419	0.00335	0.00205
FEET	0.00419	0.00278	0.00205

TC(K), THERMAL CONDUCTANCE BETWEEN ADJACENT ELEMENTS, WATTS/DEG C

	CORE-MUSCLE	MUSCLE-FAT	FAT-SKIN
HEAD	1.422	5.906	6.164
TRUNK	5.482	11.365	28.172
ARMS	4.075	5.010	21.334
HANDS	10.747	15.523	9.427
LEGS	7.833	17.842	48.639
FEET	15.000	22.584	13.223

TSETWS(N) SET POINT FOR RECEPTORS FOR SEDENTARY WARM CONDITION, DEG C

	CORE	MUSCLE	FAT	SKIN
HEAD	36.660	34.360	34.040	33.760
TRUNK	36.590	35.810	33.560	32.350
ARMS	35.240	32.940	32.080	31.520
HANDS	36.120	34.850	34.120	33.390
LEGS	35.520	34.870	32.350	32.080
FEET	34.850	34.660	33.110	32.990
CENTRAL BLOOD				
36.410				

TSETC(N), SET POINT FOR RECEPTORS FOR COLD CONDITION, DEG C

	CORE	MUSCLE	FAT	SKIN
HEAD	36.660	34.360	34.040	33.760
TRUNK	36.590	35.810	33.560	32.350
ARMS	35.240	32.940	32.080	31.520
HANDS	36.120	34.850	34.120	33.390
LEGS	35.520	34.870	32.350	32.080
FEET	34.850	34.660	33.110	32.990
CENTRAL BLOOD				
36.410				

RATE(N), DYNAMIC SENSITIVITY OF THERMORECEPTORS

	CORE	MUSCLE	FAT	SKIN
HEAD	0.0	0.0	0.0	0.0

TRUNK	0.0	0.0	0.0	0.0
ARMS	0.0	0.0	0.0	0.0
HANDS	0.0	0.0	0.0	0.0
LEGS	0.0	0.0	0.0	0.0
FEET	0.0	0.0	0.0	0.0

CENTRAL BLOOD
0.0

	HEAD	TRUNK	ARMS	HANDS	LEGS	FEET	BODY	UNITS
PAREA(I)	7.00	36.02	13.41	5.00	31.74	6.86		%AGE AREA BY SECTION
S(I)	0.1552	0.7178	0.2522	0.0970	0.5626	0.1164		SQ. M
HR(I)	4.800	4.800	4.200	3.600	4.200	4.000		WATTS/SQ. M/DEG C
HCSL(I)	3.000	2.100	2.100	4.000	2.100	4.000	2.339	WATTS/SQ. M/DEG C
HC(I)	2.948	2.063	2.063	3.930	2.063	3.930	2.298	WATTS/SQ. M/DEG C
SKINR(I)	0.210	0.420	0.100	0.040	0.200	0.030		
SKINS(I)	0.081	0.481	0.154	0.031	0.218	0.035		
SKINV(I)	0.132	0.322	0.095	0.121	0.230	0.100		
SKINC(I)	0.010	0.050	0.190	0.200	0.200	0.350		
CHILM(I)	0.020	0.850	0.050	0.0	0.070	0.0		
NSTM(I)	0.0	1.000	0.0	0.0	0.0	0.0		

S(I)= SURFACE AREA OF EACH SEGMENT
HR(I)= LINEAR RADIANT HEAT TRANSFER COEFFICIENT
HCSL(I)= CONVECTIVE AND CONDUCTIVE HEAT TRANSFER COEFFICIENT - AT SEA LEVEL
HC(I)= CONVECTIVE AND CONDUCTIVE HEAT TRANSFER COEFFICIENT
SKINR(I)= FRACTION OF ALL SKIN THERMAL RECEPTORS IN EACH SEGMENT
SKINS(I)= FRACTION OF SWEATING COMMAND APPLICABLE TO EACH SKIN SEGMENT
SKINV(I)= FRACTION OF VASODILATION COMMAND APPLICATION TO EACH SKIN SEGMENT
SKINC(I)= FRACTION OF VASOCONSTRICTION COMMAND APPLICATION TO EACH SKIN SEGMENT
WORKM(I)= FRACTION OF TOTAL WORK DONE BY MUSCLE IN EACH SEGMENT
CHILM(I)= FRACTION OF TOTAL SHIVERING OCCURING IN EACH SEGMENT
NSTM(I)= PROPORTION OF NON-SHIVERING THERMOGENESIS FOR EACH SEGMENT

INITIAL INPUT TEMPERATURES, DEG C

	CORE	MUSCLE	FAT	SKIN
HEAD	36.660	34.260	34.040	33.760
TRUNK	36.590	35.810	33.560	32.350
ARMS	35.240	32.940	32.080	31.520
HANDS	36.120	34.850	34.120	33.350
LEGS	35.520	34.870	32.350	32.080
FEET	34.850	34.660	33.110	32.990

CENTRAL BLOOD
36.410

BASAL METABOLISM, WORKB= 86.00 WATTS

OUTPUT INTERVAL,INT= 5 MINUTES

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SUBLIMATION RATE OF DRY-ICE FOR EACH PERIOD OF 30 MINUTES,GM/HR
 0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0
COOLING EFFICIENCY OF JACKET,CEFF=   0.5500
CLO VALUE OF CLOTHING,CLO =   0.0    0.300  0.050  0.0    0.300  0.100
 DRY BULB AIR TEMPERATURE, TAAR=   24.00DEG C
AIR VELOCITY,V=    0.45  M/SEC
 BAROMETRIC PRESSURE,BARO= 736.0 MM
RELATIVE HUMIDITY,RH=    0.40
MEAN RADIENT TEMPERATURE,TR=  24.000
TOTAL METABOLIC ACTIVITY,WORKT=   86.00  WATTS
WORKM(I)    0.0     0.150    0.020    0.0     0.780    0.050 (STANDING)
MECHANICAL EFFICIENCY, WEFF=   0.0



TIME=      5.  MINUTES
 DRY BULB AIR TEMPERATURE, TAAR=   24.00DEG C
TOTAL METABOLIC ACTIVITY,WORKT=   86.00  WATTS
AIR VELOCITY,V=    0.45  M/SEC
 BAROMETRIC PRESSURE,BARO= 736.0 MM
RELATIVE HUMIDITY,RH=    0.40
MEAN RADIENT TEMPERATURE,TR=  24.000
DURING THE LAST     5 MINUTES OF SIMULATION THE SUBJECT LOST:
     0.8647 MILLIGRAMS OF SODIUM CHLORIDE
     0.5545 MILLIGRAMS OF POTASSIUM CHLORIDE
     2.2658 MILLILITERS OF WATER
THROUGH RESPIRATION AND SWEATING.
 THE CUMULATIVE LOSSES DURING THE SIMULATION ARE:
     5.8211 MILLIGRAMS OF SODIUM CHLORIDE
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0.7583 MILLIGRAMS OF POTASSIUM CHLORIDE

2.4774 MILLILITERS OF WATER

THESE TOTALS INCLUDE RESPIRATION, URINE AND SWEAT OUTPUTS AND DRINKING INPUTS.

	HEAD	TRUNK	ARMS	HANDS	LEGS	FEET	TOTAL	UNITS
CONVECTIVE HEAT TRANSFER COEFFICIENT(MIXED),HCMIX= 5.44 W/SQ M-C								
CONVECTIVE HEAT TRANSFER COEFFICIENT(SEATED),HCSEAT= 7.78 W/SQ M-C								
CONVECTIVE HEAT TRANSFER COEFFICIENT(WALKING),HCWALK= 13.83 W/SQ M-C								
PSKIN(I)	40.391	38.787	36.370	41.275	37.930	41.560		MM HG
EMAX(I)	69.192	212.569	68.631	59.283	161.820	71.767		WATTS
SWPCP(I)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	SWEAT,HEAT REMOVAL COMMAND/SKIN SEGMENT, WATTS
SWCG	0.0	0.0	0.0	0.0	0.0	0.0	0.0	SWEAT,HEAT REMOVAL COMMAND/SKIN SEGMENT, GM/HR
EWET(I)	0.012	0.018	0.020	0.009	0.021	0.010		RATIO OF WET/DRY SURFACE
H(I)	0.970	3.140	1.103	0.808	2.461	0.970		WATTS/DEG C

TEMPERATURES,T(N), DEG C

	CORE	MUSCLE	FAT	SKIN
HEAD	36.024	35.364	34.336	34.227
TRUNK	35.930	35.826	33.887	33.457
ARMS	34.928	33.883	32.497	32.324
HANDS	35.834	35.844	34.681	34.667
LEGS	35.506	35.152	33.154	33.105
FEET	34.944	34.949	34.867	34.835
CENTRAL BLOOD 35.543				

BLOOD FLOWS,BF,(N), LITERS/HR

	CORE	MUSCLE	FAT	SKIN
HEAD	46.987	2.734	0.786	3.799
TRUNK	219.260	67.114	15.197	5.546
ARMS	0.873	12.135	2.056	1.310
HANDS	0.087	0.291	0.306	5.284
LEGS	2.795	36.023	5.109	7.511
FEET	0.175	0.263	0.480	7.548

DPQ10(N) Q10 METABOLIC EFFECT,W

	CORE	MUSCLE	FAT	SKIN
HEAD	-1.085	0.014	0.004	0.005
TRUNK	-3.964	0.014	0.087	0.061
ARMS	-0.029	0.117	0.005	0.014
HANDS	-0.003	0.029	0.002	0.009
LEGS	-0.004	0.106	0.045	0.044
FEET	0.001	0.001	0.109	0.017

TOTAL OF CH910(N)= -4.399

METABOLIC HEAT PRODUCTION,Q(N), WATTS

	CORE	MUSCLE	FAT	SKIN
HEAD	13.785	0.278	0.133	0.091
TRUNK	48.376	11.888	2.564	0.525
ARMS	0.788	1.576	0.207	0.160
HANDS	0.063	0.261	0.023	0.070
LEGS	2.576	3.911	0.543	0.413
FEET	0.148	0.018	0.625	0.055

NON-SHIVERING THERMOGENESIS,NST(N), WATTS

	CORE	MUSCLE	FAT	SKIN
HEAD	0.0	0.0	0.0	0.0
TRUNK	0.0	0.0	0.0	0.0
ARMS	0.0	0.0	0.0	0.0
HANDS	0.0	0.0	0.0	0.0
LEGS	0.0	0.0	0.0	0.0
FEET	0.0	0.0	0.0	0.0

EVAPORATIVE HEAT LOSS,E(N), WATTS

	CORE	MUSCLE	FAT	SKIN
HEAD	0.0	0.0	0.0	0.810
TRUNK	6.927	0.0	0.0	3.780
ARMS	0.0	0.0	0.0	1.400
HANDS	0.0	0.0	0.0	0.520
LEGS	0.0	0.0	0.0	3.320
FEET	0.0	0.0	0.0	0.720

EVAPORATIVE HEAT LOSS, EG(N), GM/HR

	CORE	MUSCLE	FAT	SKIN
HEAD	0.0	0.0	0.0	1.174
TRUNK	10.302	0.0	0.0	5.103
ARMS	0.0	0.0	0.0	2.012
HANDS	0.0	0.0	0.0	0.763
LEGS	0.0	0.0	0.0	4.535
FEET	0.0	0.0	0.0	1.043

FILM ON SKIN FORMED BY OVER-SWEATING,FILM(N), MICRONS

	CORE	MUSCLE	FAT	SKIN
HEAD	0.0	0.0	0.0	0.0
TRUNK	0.0	0.0	0.0	0.0
ARMS	0.0	0.0	0.0	0.0
HANDS	0.0	0.0	0.0	0.0
LEGS	0.0	0.0	0.0	0.0
FEET	0.0	0.0	0.0	0.0

DRIP=EXCESS SWEAT-FILM-CLOWAT,DRIP(N) GM/HR

	CORE	MUSCLE	FAT	SKIN
HEAD	0.0	0.0	0.0	0.0
TRUNK	0.0	0.0	0.0	0.0
ARMS	0.0	0.0	0.0	0.0
HANDS	0.0	0.0	0.0	0.0
LEGS	0.0	0.0	0.0	0.0

FEET	0.0	0.0	0.0	0.0

SWEAT THAT SOAKS INTO CLOTHES,CLOWAT(N), GM/HR

	CORE	MUSCLE	FAT	SKIN
HEAD	0.0	0.0	0.0	0.0
TRUNK	0.0	0.0	0.0	0.0
ARMS	0.0	0.0	0.0	0.0
HANDS	0.0	0.0	0.0	0.0
LEGS	0.0	0.0	0.0	0.0
FEET	0.0	0.0	0.0	0.0

CONVECTIVE HEAT TRANSFER BETWEEN CENTRAL BLOOD AND ELEMENTS,BC(N), WATTS

	CORE	MUSCLE	FAT	SKIN
HEAD	24.114	-0.745	-0.590	-5.158
TRUNK	92.370	17.537	-26.282	-11.844
ARMS	-0.535	-21.658	-6.570	-4.333
HANDS	0.022	0.077	-0.282	-4.908
LEGS	-0.171	-15.542	-12.814	-19.161
FEET	-0.112	-0.165	-0.373	-6.284

CONDUCTIVE HEAT TRANSFER BETWEEN SUCCESSIVE ELEMENTS,TD(N), WATTS

	CORE	MUSCLE	FAT	SKIN
HEAD	1.117	0.0	0.603	0.0
TRUNK	0.877	0.0	11.441	0.0
ARMS	4.776	0.0	3.693	0.0
HANDS	-0.108	0.0	0.046	0.0
LEGS	2.986	0.0	2.093	0.0
FEET	-0.079	0.0	0.186	0.0

RATE OF HEAT FLOW INTO OR FROM AN ELEMENT,HF(N), WATTS

	CORE	MUSCLE	FAT	SKIN
HEAD	-11.446	2.140	0.521	0.371
TRUNK	-53.001	-4.772	17.405	7.283
ARMS	-3.454	28.011	3.094	2.555
HANDS	0.168	0.077	0.264	0.448
LEGS	-0.240	22.839	11.264	8.796
FEET	0.338	0.105	0.812	1.158
CENTRAL BLOOD				
-4.209				

RATE OF CHANGE OF TEMPERATURE OF AN ELEMENT,F(N), DEG C/HR

	CORE	MUSCLE	FAT	SKIN
HEAD	-4.673	5.665	2.325	1.390
TRUNK	-4.837	-0.265	4.047	5.403
ARMS	-2.209	8.258	5.295	5.308
HANDS	1.030	1.034	3.102	2.326
LEGS	-0.051	2.231	7.784	7.332
FEET	1.325	1.290	6.251	4.758
CENTRAL BLOOD				
-1.991				

TSETWA(N) SET POINT FOR RECEPTORS FOR ACTIVITY WARM CONDITION, DEG C

	CORE	MUSCLE	FAT	SKIN
HEAD	36.660	34.360	34.040	33.760

```
TRUNK         36.590      35.810      33.560      32.390
ARMS          35.240      32.940      32.080      31.520
HANDS         36.120      34.650      34.120      33.390
LEGS          35.520      34.870      32.350      32.080
FEET          34.850      34.660      33.110      32.950
CENTRAL BLOOD
    36.410

 CARDIAC OUTPUT,CO=    7.402  LITERS/MINUTE

 HEART RATE, HEARTR=    91.948  BEATS/MINUTE

 SKIN BLOOD FLOWS,SBF =     0.523  LITERS/MINUTE

 HEAT PRODUCTION(METABOLISM+SHIVERING),HP=   85.140  WATTS

 TOTAL EVAPORATIVE HEAT LOSS,EV=E+RWET=   24.404  WATTS

 TOTAL EVAPORATIVE LOSS, TEVG=EV/EVCP=   24.931  GM/HR

 CUMULATIVE WATER LOSS,CEVG=    2.266 GM

 MEAN SKIN TEMPERATURE,TS=   33.423 DEG C

 MEAN BODY TEMPERATURE,TB=   35.217 DEG C


                                         2 MINS

QLO  =    4.6129     AU   =    1.0262     AM   =    0.9974     AHM  =    1.0134     ANM  =    1.0035
VP   =    2.9993     VUD  =    0.0010     NAE  = 2135.6831     KE   =   75.0146     KI   = 3549.9736
VEC  =   15.0151     VIC  =   24.9535     CNA  =  142.2359     CKE  =    4.9955     CKI  =  142.0215
EXO  =    0.0        RMO  =   60.2219

                                         3 MINS

QLO  =    4.6533     AU   =    1.0269     AM   =    0.9979     AHM  =    1.0232     ANM  =    1.0035
VP   =    3.0002     VUD  =    0.0009     NAE  = 2135.5503     KE   =   75.0170     KI   = 3549.9648
VEC  =   15.0130     VIC  =   24.9904     CNA  =  142.2469     CKE  =    4.9965     CKI  =  142.0357
EXO  =    0.0        RMO  =   60.5359

                                         5 MINS

QLO  =    4.7136     AU   =    1.0285     AM   =    0.9986     AHM  =    1.0336     ANM  =    1.0038
VP   =    3.0007     VUD  =    0.0008     NAE  = 2135.4033     KE   =   75.0189     KI   = 3549.9551
VEC  =   15.0127     VIC  =   24.9872     CNA  =  142.2398     CKE  =    4.9967     CKI  =  142.0526
EXO  =    0.0        RMO  =   60.5717

                                         7 MINS

QLO  =    4.7657     AU   =    1.0307     AM   =    0.9998     AHM  =    1.0430     ANM  =    1.0043
VP   =    3.0006     VUD  =    0.0007     NAE  = 2135.2402     KE   =   75.0223     KI   = 3549.9424
VEC  =   15.0140     VIC  =   24.9841     CNA  =  142.2162     CKE  =    4.9964     CKI  =  142.0705
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TIME=     10.  MINUTES
 DRY BULB AIR TEMPERATURE, TAAR=   24.00DEG C
TOTAL METABOLIC ACTIVITY,WORKT=   86.00  WATTS
AIR VELOCITY,V=    0.45  M/SEC
 BAROMETRIC PRESSURE,BARO= 736.0 MM
RELATIVE HUMIDITY,PH=    0.40
MEAN RADIENT TEMPERATURE,TR=  24.000
DURING THE LAST    5 MINUTES OF SIMULATION THE SUBJECT LOST:
     0.8744 MILLIGRAMS OF SODIUM CHLORIDE
     0.6013 MILLIGRAMS OF POTASSIUM CHLORIDE
     2.2923 MILLILITERS OF WATER
THROUGH RESPIRATION AND SWEATING.
 THE CUMULATIVE LOSSES DURING THE SIMULATION ARE:
    44.7840 MILLIGRAMS OF SODIUM CHLORIDE
     2.9012 MILLIGRAMS OF POTASSIUM CHLORIDE
     6.3997 MILLILITERS OF WATER
THESE TOTALS INCLUDE RESPIRATION, URINE AND SWEAT OUTPUTS AND DRINKING INPUTS.

          HEAD      TRUNK     ARMS      HANDS     LEGS       FEET     TOTAL  UNITS
CONVECTIVE HEAT TRANSFER COEFFICIENT(MIXED),HCMIX=   5.46 W/SQ M-C
CONVECTIVE HEAT TRANSFER COEFFICIENT(SEATED),HCSEAT=   7.78 W/SQ M-C
CONVECTIVE HEAT TRANSFER COEFFICIENT(WALKING),HCWALK=  13.83 W/SQ M-C
PSKIN(I)  40.507    35.482    37.178    41.356    38.989    41.836          MM HG
EMAX(I)   69.447   217.524    70.654    59.432   167.739    72.376          WATTS
SWPCP(I)    0.0       0.0       0.0       0.0       0.0       0.0      0.0  SWEAT,HEAT REMOVAL COMMAND/SKIN SEGMENT,  WATTS
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SWCG	0.0	0.0	0.0	0.0	0.0	0.0	0.0	SWEAT,HEAT REMOVAL COMMAND/SKIN SEGMENT, GM/HR
EWET(I)	0.012	0.017	0.020	0.009	0.020	0.010		RATIO OF WET/DRY SURFACE
H(I)	0.970	3.140	1.103	0.808	2.461	0.970		WATTS/DEG C

TEMPERATURES,T(N), DEG C

	CORE	MUSCLE	FAT	SKIN
HEAD	35.786	35.589	34.417	34.267
TRUNK	35.686	35.784	34.193	33.813
ARMS	34.931	34.459	32.883	32.710
HANDS	35.914	35.924	34.701	34.670
LEGS	35.511	35.298	33.678	33.681
FEET	35.050	35.053	34.974	34.907

CENTRAL BLOOD
35.446

BLOOD FLOWS,BF,(N), LITERS/HR

	CORE	MUSCLE	FAT	SKIN
HEAD	46.987	2.806	0.786	3.759
TRUNK	219.260	69.971	15.197	5.546
ARMS	0.873	12.387	2.096	1.310
HANDS	0.087	0.293	0.306	5.264
LEGS	2.795	36.324	5.109	7.511
FEET	0.175	0.263	0.480	7.948

QRQ10(N) Q10 METABOLIC EFFECT,W

	CORE	MUSCLE	FAT	SKIN
HEAD	-1.591	0.018	0.006	0.005
TRUNK	-5.800	-0.013	0.183	0.081
ARMS	-0.041	0.199	0.019	0.021
HANDS	-0.002	0.031	0.002	0.010
LEGS	-0.003	0.170	0.079	0.066
FEET	0.003	0.001	0.122	0.019

TOTAL OF QRQ10(N)= -6.417

METABOLIC HEAT PRODUCTION,Q(N), WATTS

	CORE	MUSCLE	FAT	SKIN
HEAD	13.278	0.350	0.135	0.051
TRUNK	46.540	14.746	2.660	0.545
ARMS	0.776	1.828	0.216	0.167
HANDS	0.084	0.263	0.028	0.070
LEGS	2.577	4.211	0.578	0.437
FEET	0.153	0.018	0.638	0.096

NON-SHIVERING THERMOGENESIS,NST(N), WATTS

	CORE	MUSCLE	FAT	SKIN
HEAD	0.0	0.0	0.0	0.0
TRUNK	0.0	0.0	0.0	0.0
ARMS	0.0	0.0	0.0	0.0
HANDS	0.0	0.0	0.0	0.0
LEGS	0.0	0.0	0.0	0.0
FEET	0.0	0.0	0.0	0.0

EVAPORATIVE HEAT LOSS,E(N), WATTS

	CORE	MUSCLE	FAT	SKIN
HEAD	0.0	0.0	0.0	0.810
TRUNK	6.927	0.0	0.0	3.780
ARMS	0.0	0.0	0.0	1.400
HANDS	0.0	0.0	0.0	0.520
LEGS	0.0	0.0	0.0	3.320
FEET	0.0	0.0	0.0	0.720

EVAPORATIVE HEAT LOSS, EG(N), GM/HR

	CORE	MUSCLE	FAT	SKIN
HEAD	0.0	0.0	0.0	1.174
TRUNK	10.299	0.0	0.0	5.103
ARMS	0.0	0.0	0.0	2.012
HANDS	0.0	0.0	0.0	0.763
LEGS	0.0	0.0	0.0	4.534
FEET	0.0	0.0	0.0	1.043

FILM ON SKIN FORMED BY OVER-SWEATING,FILM(N), MICRONS

	CORE	MUSCLE	FAT	SKIN
HEAD	0.0	0.0	0.0	0.0
TRUNK	0.0	0.0	0.0	0.0
ARMS	0.0	0.0	0.0	0.0
HANDS	0.0	0.0	0.0	0.0
LEGS	0.0	0.0	0.0	0.0
FEET	0.0	0.0	0.0	0.0

DRIP=EXCESS SWEAT-FILM-CLOWAT,DRIP(N) GM/HR

	CORE	MUSCLE	FAT	SKIN
HEAD	0.0	0.0	0.0	0.0
TRUNK	0.0	0.0	0.0	0.0
ARMS	0.0	0.0	0.0	0.0
HANDS	0.0	0.0	0.0	0.0
LEGS	0.0	0.0	0.0	0.0
FEET	0.0	0.0	0.0	0.0

SWEAT THAT SOAKS INTO CLOTHES,CLOWAT(N), GM/HR

	CORE	MUSCLE	FAT	SKIN
HEAD	0.0	0.0	0.0	0.0
TRUNK	0.0	0.0	0.0	0.0
ARMS	0.0	0.0	0.0	0.0
HANDS	0.0	0.0	0.0	0.0
LEGS	0.0	0.0	0.0	0.0
FEET	0.0	0.0	0.0	0.0

CONVECTIVE HEAT TRANSFER BETWEEN CENTRAL BLOOD AND ELEMENTS,BC(N), WATTS

	CORE	MUSCLE	FAT	SKIN
HEAD	16.549	0.319	-0.822	-4.530
TRUNK	55.283	23.400	-19.940	-9.369
ARMS	-0.542	-13.421	-5.521	-3.677
HANDS	0.039	0.132	-0.229	-4.124
LEGS	0.142	-6.568	-9.475	-14.483
FEET	-0.074	-0.111	-0.230	-4.351

CONDUCTIVE HEAT TRANSFER BETWEEN SUCCESSIVE ELEMENTS,TD(N), WATTS

	CORE	MUSCLE	FAT	SKIN
HEAD	0.339	0.0	0.904	0.0
TRUNK	-0.451	0.0	10.629	0.0
ARMS	1.985	0.0	3.684	0.0
HANDS	-0.060	0.0	0.307	0.0
LEGS	1.815	0.0	3.582	0.0
FEET	-0.047	0.0	0.914	0.0

RATE OF HEAT FLOW INTO OR FROM AN ELEMENT,HF(N), WATTS

	CORE	MUSCLE	FAT	SKIN
HEAD	-3.610	0.370	0.053	0.019
TRUNK	-16.423	-9.106	11.971	3.561
ARMS	-0.567	17.134	2.054	1.696
HANDS	0.105	0.071	-0.051	-0.090
LEGS	0.619	12.594	6.471	5.088
FEET	0.271	0.082	-0.046	-0.064
CENTRAL BLOOD	-1.602			

RATE OF CHANGE OF TEMPERATURE OF AN ELEMENT,F(N), DEG C/HR

	CORE	MUSCLE	FAT	SKIN
HEAD	-1.474	0.979	0.236	0.070
TRUNK	-1.499	-0.505	2.783	2.642
ARMS	-0.363	5.051	3.527	3.524
HANDS	0.673	0.963	-0.600	-0.466
LEGS	0.132	1.231	4.472	4.241
FEET	1.061	1.036	-0.357	-0.253
CENTRAL BLOOD	-0.758			

TSETWA(N) SET POINT FOR RECEPTORS FOR ACTIVITY WARM CONDITION, DEG C

	CORE	MUSCLE	FAT	SKIN
HEAD	36.660	34.360	34.040	33.760
TRUNK	36.590	35.810	33.560	32.390
ARMS	35.240	32.940	32.080	31.520
HANDS	36.120	34.850	34.120	33.390
LEGS	35.520	34.870	32.350	32.080
FEET	34.950	34.660	33.110	32.990
CENTRAL BLOOD	36.410			

CARDIAC OUTPUT,CO= 7.460 LITERS/MINUTE

HEART RATE, HEARTR= 92.669 BEATS/MINUTE

SKIN BLOOD FLOWS,SBF = 0.523 LITERS/MINUTE

HEAT PRODUCTION(METABOLISM+SHIVERING),HP= 90.482 WATTS

TOTAL EVAPORATIVE HEAT LOSS,EV=E+RWET= 24.404 WATTS

TOTAL EVAPORATIVE LOSS, TEVG=EV/EVCP= 24.926 GM/HR

CUMULATIVE WATER LOSS,CEVG= 4.558 GM

MEAN SKIN TEMPERATURE,TS=   33.753 DEG C

MEAN BODY TEMPERATURE,TB=   35.260 DEG C

9 MINS

QLC	=	4.8062	AU	=	1.0336	AM	=	1.0017	AHM	=	1.0501	ANM	=	1.0053
VP	=	2.9999	VUD	=	0.0007	NAE	=	2135.0605	KE	=	75.0289	KI	=	3549.9248
VEC	=	15.0165	VIC	=	24.9818	CNA	=	142.1812	CKE	=	4.9957	CKI	=	142.0871
EXC	=	0.0	PMO	=	60.9699									

11 MINS

QLC	=	4.8342	AU	=	1.0372	AM	=	1.0045	AHM	=	1.0534	ANM	=	1.0066
VP	=	2.9987	VUD	=	0.0006	NAE	=	2134.9490	KE	=	75.0346	KI	=	3549.9114
VEC	=	15.0196	VIC	=	24.9810	CNA	=	142.1441	CKE	=	4.9952	CKI	=	142.1000
EXQ	=	0.0	PMO	=	61.2406									

TIME=   15. MINUTES

DRY BULB AIR TEMPERATURE, TAAR=   24.00DEG C

TOTAL METABOLIC ACTIVITY,WORKT=   86.00 WATTS

AIR VELOCITY,V=   0.45 M/SEC

BAROMETRIC PRESSURE,BARO= 736.0 MM

RELATIVE HUMIDITY,RH=   0.40

MEAN RADIENT TEMPERATURE,TR= 24.000

DURING THE LAST   5 MINUTES OF SIMULATION THE SUBJECT LOST:

0.6627 MILLIGRAMS OF SODIUM CHLORIDE

0.4556 MILLIGRAMS OF POTASSIUM CHLORIDE

1.7374 MILLILITERS OF WATER

THROUGH RESPIRATION AND SWEATING.

THE CUMULATIVE LOSSES DURING THE SIMULATION ARE:

61.7072 MILLIGRAMS OF SODIUM CHLORIDE

4.2391 MILLIGRAMS OF POTASSIUM CHLORIDE

8.8099 MILLILITERS OF WATER

THESE TOTALS INCLUDE RESPIRATION, URINE AND SWEAT OUTPUTS AND DRINKING INPUTS.

	HEAD	TRUNK	ARMS	HANDS	LEGS	FEET	TOTAL	UNITS
CONVECTIVE HEAT TRANSFER COEFFICIENT(MIXED),HCMIX= 5.47 W/SQ M-C								
CONVECTIVE HEAT TRANSFER COEFFICIENT(SEATED),HCSEAT= 7.78 W/SQ M-C								
CONVECTIVE HEAT TRANSFER COEFFICIENT(WALKING),HCWALK= 13.83 W/SQ M-C								
PSKIN(I)	40.509	39.833	37.652	41.308	39.537	41.808		MM HG
EMAX(I)	69.452	220.029	71.843	59.343	170.804	72.314		WATTS
SWPCP(I)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	SWEAT,HEAT REMOVAL COMMAND/SKIN SEGMENT, WATTS
SWCG	0.0	0.0	0.0	0.0	0.0	0.0	0.0	SWEAT,HEAT REMOVAL COMMAND/SKIN SEGMENT, GM/HR
EWET(I)	0.012	0.017	0.019	0.009	0.019	0.010		RATIO OF WET/DRY SURFACE
H(I)	0.970	3.140	1.103	0.808	2.461	0.970		WATTS/DEG C

TEMPERATURES,T(N), DEG C

	CORE	MUSCLE	FAT	SKIN
HEAD	35.724	35.611	34.417	34.259
TRUNK	35.623	35.750	34.351	33.962
ARMS	34.843	34.739	33.087	32.915
HANDS	35.982	35.927	34.687	34.626
LEGS	35.524	35.365	33.920	33.829
FEET	35.115	35.128	34.967	34.864

CENTRAL BLOOD
35.503

BLOOD FLOWS,BF,(N), LITERS/HR

	CORE	MUSCLE	FAT	SKIN
HEAD	46.987	2.824	0.786	3.799
TRUNK	219.260	70.685	15.197	5.546
ARMS	0.873	12.475	2.096	1.310
HANDS	0.087	0.295	0.306	5.284
LEGS	2.795	36.417	5.109	7.511
FEET	0.175	0.263	0.430	7.948

Q8Q10(N) Q10 METABOLIC EFFECT,W

	CORE	MUSCLE	FAT	SKIN
HEAD	-1.725	0.019	0.006	0.005
TRUNK	-6.276	-0.038	0.239	0.051
ARMS	-0.041	0.243	0.024	0.025
HANDS	-0.002	0.033	0.002	0.010
LEGS	0.031	0.202	0.096	0.080
FEET	0.005	0.001	0.119	0.019

TOTAL OF Q8Q10(N)= -6.862

METABOLIC HEAT PRODUCTION,Q(N), WATTS

	CORE	MUSCLE	FAT	SKIN
HEAD	13.144	0.368	0.135	0.051
TRUNK	46.065	15.459	2.716	0.555
ARMS	0.776	1.916	0.222	0.171
HANDS	0.084	0.265	0.028	0.070
LEGS	2.381	4.305	0.595	0.450
FEET	0.151	0.018	0.635	0.096

NON-SHIVERING THERMOGENESIS,NST(N), WATTS

	CORE	MUSCLE	FAT	SKIN
HEAD	0.0	0.0	0.0	0.0
TRUNK	0.0	0.0	0.0	0.0
ARMS	0.0	0.0	0.0	0.0
HANDS	0.0	0.0	0.0	0.0
LEGS	0.0	0.0	0.0	0.0
FEET	0.0	0.0	0.0	0.0

EVAPORATIVE HEAT LOSS,E(N), WATTS

	CORE	MUSCLE	FAT	SKIN
HEAD	0.0	0.0	0.0	0.810
TRUNK	6.927	0.0	0.0	3.780
ARMS	0.0	0.0	0.0	1.400
HANDS	0.0	0.0	0.0	0.520
LEGS	0.0	0.0	0.0	3.320
FEET	0.0	0.0	0.0	0.720

EVAPORATIVE HEAT LOSS, EG(N), GM/HR

	CORE	MUSCLE	FAT	SKIN
HEAD	0.0	0.0	0.0	1.174
TRUNK	10.298	0.0	0.0	5.102
ARMS	0.0	0.0	0.0	2.012
HANDS	0.0	0.0	0.0	0.763
LEGS	0.0	0.0	0.0	4.533
FEET	0.0	0.0	0.0	1.043

FILM ON SKIN FORMED BY OVER-SWEATING,FILM(N), MICRONS

	CORE	MUSCLE	FAT	SKIN
HEAD	0.0	0.0	0.0	0.0
TRUNK	0.0	0.0	0.0	0.0
ARMS	0.0	0.0	0.0	0.0
HANDS	0.0	0.0	0.0	0.0
LEGS	0.0	0.0	0.0	0.0
FEET	0.0	0.0	0.0	0.0

DRIP=EXCESS SWEAT-FILM-CLOWAT,DRIP(N) GM/HR

	CORE	MUSCLE	FAT	SKIN
HEAD	0.0	0.0	0.0	0.0
TRUNK	0.0	0.0	0.0	0.0
ARMS	0.0	0.0	0.0	0.0
HANDS	0.0	0.0	0.0	0.0
LEGS	0.0	0.0	0.0	0.0
FEET	0.0	0.0	0.0	0.0

SWEAT THAT SOAKS INTO CLOTHES,CLOWAT(N), GM/HR

	CORE	MUSCLE	FAT	SKIN
HEAD	0.0	0.0	0.0	0.0
TRUNK	0.0	0.0	0.0	0.0
ARMS	0.0	0.0	0.0	0.0
HANDS	0.0	0.0	0.0	0.0
LEGS	0.0	0.0	0.0	0.0
FEET	0.0	0.0	0.0	0.0

CONVECTIVE HEAT TRANSFER BETWEEN CENTRAL BLOOD AND ELEMENTS,BC(N), WATTS

	CORE	MUSCLE	FAT	SKIN
HEAD	15.773	0.591	-0.774	-4.317
TRUNK	51.506	25.023	-16.365	-8.120
ARMS	-0.494	-8.832	-4.923	-3.304
HANDS	0.047	0.171	-0.225	-3.958
LEGS	0.330	-1.754	-7.767	-12.074
FEET	-0.052	-0.079	-0.219	-4.023

CONDUCTIVE HEAT TRANSFER BETWEEN SUCCESSIVE ELEMENTS,TD(N), WATTS

	CORE	MUSCLE	FAT	SKIN
HEAD	0.180	0.0	0.932	0.0
TRUNK	-0.653	0.0	10.910	0.0
ARMS	0.579	0.0	3.694	0.0
HANDS	-0.413	0.0	0.131	0.0
LEGS	1.303	0.0	4.244	0.0
FEET	0.052	0.0	0.661	0.0

RATE OF HEAT FLOW INTO OR FROM AN ELEMENT,HF(N), WATTS

	CORE	MUSCLE	FAT	SKIN
HEAD	-2.809	-0.043	-0.023	-0.166
TRUNK	-12.919	-10.216	8.172	2.372
ARMS	0.691	11.327	1.451	1.219
HANDS	0.450	-0.319	0.121	-0.423
LEGS	0.947	7.362	4.119	3.071
FEET	0.151	0.149	0.194	-0.639
CENTRAL BLOOD				
16.162				

RATE OF CHANGE OF TEMPERATURE OF AN ELEMENT,F(N), DEG C/HR

	CORE	MUSCLE	FAT	SKIN
HEAD	-1.147	-0.114	-0.103	-0.622
TRUNK	-1.179	-0.567	1.900	1.760
ARMS	0.442	3.339	2.492	2.533
HANDS	2.885	-4.302	1.421	-2.197
LEGS	0.202	0.719	2.846	2.559
FEET	0.591	1.825	1.494	-2.538
CENTRAL BLOOD				
7.646				

TSETWA(N) SET POINT FOR RECEPTORS FOR ACTIVITY WARM CONDITION, DEG C

	CORE	MUSCLE	FAT	SKIN
HEAD	36.660	34.360	34.040	33.760
TRUNK	36.590	35.810	33.560	32.390
ARMS	35.240	32.940	32.080	31.520

HANDS	36.120	34.850	34.120	33.390
LEGS	35.520	34.870	32.350	32.080
FEET	34.950	34.660	33.110	32.950
CENTRAL BLOOD				
36.410				

CARDIAC OUTPUT,CO= 7.475 LITERS/MINUTE

HEART RATE, HEARTR= 92.859 BEATS/MINUTE

SKIN BLOOD FLOWS,SBF = 0.523 LITERS/MINUTE

HEAT PRODUCTION(METABOLISM+SHIVERING),HP= 90.897 WATTS

TOTAL EVAPORATIVE HEAT LOSS,EV=E+RWET= 24.404 WATTS

TOTAL EVAPORATIVE LOSS, TEVG=EV/EVCP= 24.924 GM/HR

CUMULATIVE WATER LOSS,CEVG= 6.295 GM

MEAN SKIN TEMPERATURE,TS= 33.501 DEG C

MEAN BODY TEMPERATURE,TB= 35.293 DEG C

13 MINS

QLC =	4.8490	AU =	1.0416	AM =	1.0069	AHM =	1.0530	ANM =	1.0077
VP =	2.9977	VUD =	0.0006	NAE =	2134.8303	KE =	75.0430	KI =	3549.8945
VEC =	15.0217	VIC =	24.9807	CNA =	142.1167	CKE =	4.9949	CKI =	142.1037
EXO =	0.0	RMO =	61.5536						

14 MINS

QLO =	4.8616	AU =	1.0467	AM =	1.0103	AHM =	1.0509	ANM =	1.0093
VP =	2.9961	VUD =	0.0005	NAE =	2134.7673	KE =	75.0489	KI =	3549.8833
VEC =	15.0251	VIC =	24.9810	CNA =	142.0804	CKE =	4.9944	CKI =	142.1048
EXQ =	0.0	RMO =	61.6812						

16 MINS

QLC =	4.3602	AU =	1.0526	AM =	1.0127	AHM =	1.0484	ANM =	1.0104
VP =	2.9953	VUD =	0.0004	NAE =	2134.7029	KE =	75.0557	KI =	3549.8704
VEC =	15.0260	VIC =	24.9816	CNA =	142.0672	CKE =	4.9945	CKI =	142.1025
EXO =	0.0	RMO =	61.9451						

TIME= 20. MINUTES

DRY BULB AIR TEMPERATURE, TAAR= 24.00DEG C

TOTAL METABOLIC ACTIVITY,WORKT= 86.00 WATTS

AIR VELOCITY,V= 0.45 M/SEC

BAROMETRIC PRESSURE,BARO= 736.0 MM

RELATIVE HUMIDITY,PH= 0.40

MEAN RADIENT TEMPERATURE,TR= 24.000

DURING THE LAST 5 MINUTES OF SIMULATION THE SUBJECT LOST:

0.7916 MILLIGRAMS OF SODIUM CHLORIDE

0.5373 MILLIGRAMS OF POTASSIUM CHLORIDE

2.0491 MILLILITERS OF WATER

THROUGH RESPIRATION AND SWEATING.

THE CUMULATIVE LOSSES DURING THE SIMULATION ARE:

76.1993 MILLIGRAMS OF SODIUM CHLORIDE

5.7852 MILLIGRAMS OF POTASSIUM CHLORIDE

11.4481 MILLILITERS OF WATER

THESE TOTALS INCLUDE RESPIRATION, URINE AND SWEAT OUTPUTS AND DRINKING INPUTS.

	HEAD	TRUNK	ARMS	HANDS	LEGS	FEET	TOTAL	UNITS
CONVECTIVE HEAT TRANSFER COEFFICIENT(MIXED),HCMIX= 5.48 W/SQ M-C								
CONVECTIVE HEAT TRANSFER COEFFICIENT(SEATED),HCSEAT= 7.78 W/SQ M-C								
CONVECTIVE HEAT TRANSFER COEFFICIENT(WALKING),HCWALK= 13.83 W/SQ M-C								
PSKIN(I)	40.455	40.127	38.061	41.250	39.950	41.746		MM HG
EMAX(I)	69.422	222.130	72.867	59.237	173.110	72.178		WATTS
SWPCP(I)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	SWEAT,HEAT REMOVAL COMMAND/SKIN SEGMENT, WAT
SWCG	0.0	0.0	0.0	0.0	0.0	0.0	0.0	SWEAT,HEAT REMOVAL COMMAND/SKIN SEGMENT, GM/
EWET(I)	0.012	0.017	0.019	0.009	0.019	0.010		RATIO OF WET/DRY SURFACE
H(I)	0.970	3.140	1.103	0.808	2.461	0.970		WATTS/DEG C

TEMPERATURES,T(N), DEG C

	CORE	MUSCLE	FAT	SKIN
HEAD	35.726	35.621	34.417	34.265
TRUNK	35.625	35.725	34.492	34.096
ARMS	34.906	34.970	33.271	33.097

HANDS	36.005	36.037	34.658	34.654
LEGS	35.546	35.424	34.112	34.014
FEET	35.193	35.184	34.939	34.900

CENTRAL BLOOD
35.403

BLOOD FLOWS,BF,(N), LITERS/HR

	CORE	MUSCLE	FAT	SKIN
HEAD	46.987	2.829	0.786	3.759
TRUNK	219.260	70.881	15.197	5.546
ARMS	0.373	12.523	2.096	1.310
HANDS	0.087	0.295	0.306	5.234
LEGS	2.795	36.461	5.109	7.511
FEET	0.175	0.263	0.480	7.948

QBQ10(N) Q10 METABOLIC EFFECT,W

	CORE	MUSCLE	FAT	SKIN
HEAD	-1.769	0.019	0.006	0.005
TRUNK	-6.432	-0.062	0.287	0.099
ARMS	-0.035	0.279	0.029	0.029
HANDS	-0.001	0.033	0.002	0.009
LEGS	0.008	0.228	0.110	0.099
FEET	0.006	0.001	0.120	0.018

TOTAL OF QBQ10(N)= -6.922

METABOLIC HEAT PRODUCTION,Q(N), WATTS

	CORE	MUSCLE	FAT	SKIN
HEAD	13.100	0.373	0.135	0.091
TRUNK	45.909	15.455	2.763	0.563
ARMS	0.782	1.964	0.227	0.175
HANDS	0.085	0.266	0.039	0.070
LEGS	2.588	4.349	0.603	0.459
FEET	0.152	0.018	0.636	0.096

NON-SHIVERING THERMOGENESIS,NST(N), WATTS

	CORE	MUSCLE	FAT	SKIN
HEAD	0.0	0.0	0.0	0.0
TRUNK	0.0	0.0	0.0	0.0
ARMS	0.0	0.0	0.0	0.0
HANDS	0.0	0.0	0.0	0.0
LEGS	0.0	0.0	0.0	0.0
FEET	0.0	0.0	0.0	0.0

EVAPORATIVE HEAT LOSS,E(N), WATTS

	CORE	MUSCLE	FAT	SKIN
HEAD	0.0	0.0	0.0	0.810
TRUNK	6.927	0.0	0.0	3.780
ARMS	0.0	0.0	0.0	1.400
HANDS	0.0	0.0	0.0	0.520
LEGS	0.0	0.0	0.0	3.320
FEET	0.0	0.0	0.0	0.720

EVAPORATIVE HEAT LOSS, EG(N), GM/HR

	CORE	MUSCLE	FAT	SKIN
HEAD	0.0	0.0	0.0	1.174
TRUNK	10.298	0.0	0.0	5.102
ARMS	0.0	0.0	0.0	2.011
HANDS	0.0	0.0	0.0	0.763
LEGS	0.0	0.0	0.0	4.533
FEET	0.0	0.0	0.0	1.043

FILM ON SKIN FORMED BY OVER-SWEATING,FILM(N), MICRONS

	CORE	MUSCLE	FAT	SKIN
HEAD	0.0	0.0	0.0	0.0
TRUNK	0.0	0.0	0.0	0.0
ARMS	0.0	0.0	0.0	0.0
HANDS	0.0	0.0	0.0	0.0
LEGS	0.0	0.0	0.0	0.0
FEET	0.0	0.0	0.0	0.0

DRIP=EXCESS SWEAT-FILM-CLOWAT,DRIP(N) GM/HR

	CORE	MUSCLE	FAT	SKIN
HEAD	0.0	0.0	0.0	0.0
TRUNK	0.0	0.0	0.0	0.0
ARMS	0.0	0.0	0.0	0.0
HANDS	0.0	0.0	0.0	0.0
LEGS	0.0	0.0	0.0	0.0
FEET	0.0	0.0	0.0	0.0

SWEAT THAT SOAKS INTO CLOTHES,CLOWAT(N), GM/HR

	CORE	MUSCLE	FAT	SKIN
HEAD	0.0	0.0	0.0	0.0
TRUNK	0.0	0.0	0.0	0.0
ARMS	0.0	0.0	0.0	0.0
HANDS	0.0	0.0	0.0	0.0
LEGS	0.0	0.0	0.0	0.0
FEET	0.0	0.0	0.0	0.0

CONVECTIVE HEAT TRANSFER BETWEEN CENTRAL BLOOD AND ELEMENTS,BC(N), WATTS

	CORE	MUSCLE	FAT	SKIN
HEAD	9.974	0.322	-0.655	-4.722
TRUNK	24.406	15.701	-15.580	-7.882
ARMS	-0.928	-6.943	-4.717	-3.175
HANDS	0.045	0.144	-0.252	-4.633
LEGS	0.112	-3.125	-7.197	-11.321
FEET	-0.056	-0.082	-0.260	-5.056

CONDUCTIVE HEAT TRANSFER BETWEEN SUCCESSIVE ELEMENTS,TC(N), WATTS

	CORE	MUSCLE	FAT	SKIN
HEAD	0.140	0.0	0.959	0.0
TRUNK	-0.604	0.0	11.158	0.0
ARMS	-0.706	0.0	3.694	0.0
HANDS	0.283	0.0	0.502	0.0
LEGS	0.984	0.0	4.802	0.0
FEET	-0.195	0.0	1.243	0.0

RATE OF HEAT FLOW INTO OR FROM AN ELEMENT,HF(N), WATTS

	CORE	MUSCLE	FAT	SKIN
HEAD	2.987	0.191	0.031	0.268
TRUNK	13.976	-0.650	7.185	2.159
ARMS	1.516	8.701	1.250	0.993
HANDS	-0.243	0.405	-0.223	0.634
LEGS	1.492	8.458	3.003	2.674
FEET	0.403	-0.095	-0.346	0.989

CENTRAL BLOOD
-25.680

RATE OF CHANGE OF TEMPERATURE OF AN ELEMENT,F(N), DEG C/HR

	CORE	MUSCLE	FAT	SKIN
HEAD	1.219	0.505	0.138	1.006
TRUNK	1.275	-0.036	1.671	1.631
ARMS	0.970	2.565	2.147	2.062
HANDS	-1.561	5.464	-2.617	3.292
LEGS	0.318	0.826	2.076	2.229
FEET	1.575	-1.165	-2.663	3.927

CENTRAL BLOOD
-12.149

TSETWA(N) SET POINT FOR RECEPTORS FOR ACTIVITY WARM CONDITION, DEG C

	CORE	MUSCLE	FAT	SKIN
HEAD	36.660	34.360	34.040	33.760
TRUNK	36.590	35.810	33.560	32.390
ARMS	35.240	32.540	32.080	31.520
HANDS	36.120	34.850	34.120	33.350
LEGS	35.520	34.870	32.350	32.080
FEET	34.850	34.660	33.110	32.950

CENTRAL BLOOD
36.410

CARDIAC OUTPUT,CO= 7.480 LITERS/MINUTE

HEART RATE, HEARTR= 92.920 BEATS/MINUTE

SKIN BLOOD FLOWS,SBF = 0.523 LITERS/MINUTE

HEAT PRODUCTION(METABOLISM+SHIVERING),HP= 91.094 WATTS

TOTAL EVAPORATIVE HEAT LOSS,EV=E+RWET= 24.404 WATTS

TOTAL EVAPORATIVE LOSS, TEVG=EV/EVCP= 24.923 GM/HR

CUMULATIVE WATER LOSS,CEVG= 8.344 GM

MEAN SKIN TEMPERATURE,TS= 34.036 DEG C

MEAN BODY TEMPERATURE,TB= 35.331 DEG C

17 MINS

QLU	=	5.2844	AU	=	1.0638	AM	=	1.0164	AHM	=	1.0391	ANM	=	1.0124
VP	=	3.0171	VUD	=	0.0005	NAE	=	2135.2498	KE	=	75.1576	KI	=	3549.8613
VEC	=	15.0540	VIC	=	24.5833	CNA	=	141.8397	CKE	=	4.9924	CKI	=	142.0922
EXQ	=	0.0	RMC	=	62.7021									

18 MINS

QLO	=	5.2977	AU	=	1.0694	AM	=	1.0172	AHM	=	1.0307	ANM	=	1.0131
VP	=	3.0155	VUD	=	0.0005	NAE	=	2135.2065	KE	=	75.1649	KI	=	3549.8496
VEC	=	15.0560	VIC	=	24.9857	CNA	=	141.8174	CKE	=	4.9921	CKI	=	142.0809
EXQ	=	0.0	RMC	=	62.8624									

19 MINS

QLO	=	5.2556	AU	=	1.0729	AM	=	1.0181	AHM	=	1.0223	ANM	=	1.0138
VP	=	3.0140	VUD	=	0.0005	NAE	=	2135.1609	KE	=	75.1729	KI	=	3549.8372
VEC	=	15.0576	VIC	=	24.9882	CNA	=	141.7995	CKE	=	4.9920	CKI	=	142.0684
EXQ	=	0.0	RMC	=	63.0653									

20 MINS

QLO	=	5.2770	AU	=	1.0763	AM	=	1.0193	AHM	=	1.0111	ANM	=	1.0148
VP	=	3.0120	VUD	=	0.0004	NAE	=	2135.0952	KE	=	75.1843	KI	=	3549.8196
VEC	=	15.0594	VIC	=	24.9921	CNA	=	141.7782	CKE	=	4.9920	CKI	=	142.0498
EXQ	=	0.0	RMC	=	63.4290									

TIME= 25. MINUTES

DRY BULB AIR TEMPERATURE, TAAR= 24.00DEG C

TOTAL METABOLIC ACTIVITY,WORKT= 86.00 WATTS

AIR VELOCITY,V= 0.45 M/SEC

BAROMETRIC PRESSURE,BARO= 736.0 MM

RELATIVE HUMIDITY,RH= 0.40

MEAN RADIENT TEMPERATURE,TR= 24.000

DURING THE LAST 5 MINUTES OF SIMULATION THE SUBJECT LOST:

0.9289 MILLIGRAMS OF SODIUM CHLORIDE

0.6382 MILLIGRAMS OF POTASSIUM CHLORIDE

2.4353 MILLILITERS OF WATER

THROUGH RESPIRATION AND SWEATING.

THE CUMULATIVE LOSSES DURING THE SIMULATION ARE:

53.4379 MILLIGRAMS OF SODIUM CHLORIDE

0.0580 MILLIGRAMS OF POTASSIUM CHLORIDE

-9.8233 MILLILITERS OF WATER

THE NEGATIVE AMOUNTS ABOVE SHOW DRINKING INPUT EXCEEDED SYSTEM LOSS.

THE SUBJECT DRANK 0.02415 LITERS DURING THIS OUTPUT CYCLE

THESE TOTALS INCLUDE RESPIRATION, URINE AND SWEAT OUTPUTS AND DRINKING INPUTS.

	HEAD	TRUNK	ARMS	HANDS	LEGS	FEET	TOTAL	UNITS
CONVECTIVE HEAT TRANSFER COEFFICIENT(MIXED),HCMIX= 5.49 W/SQ M-C								
CONVECTIVE HEAT TRANSFER COEFFICIENT(SEATED),HCSEAT= 7.78 W/SQ M-C								
CONVECTIVE HEAT TRANSFER COEFFICIENT(WALKING),HCWALK= 13.83 W/SQ M-C								
PSKIN(I)	40.524	40.356	38.374	41.300	40.237	41.802		MM HG
EMAX(I)	69.486	223.763	73.653	59.329	174.713	72.300		WATTS
SWPCP(I)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	SWEAT,HEAT REMOVAL COMMAND/SKIN SEGMENT, WAT
SWCG	0.0	0.0	0.0	0.0	0.0	0.0	0.0	SWEAT,HEAT REMOVAL COMMAND/SKIN SEGMENT, GM/
EWET(I)	0.012	0.017	0.019	0.009	0.019	0.010		RATIO OF WET/DRY SURFACE
H(I)	0.970	3.140	1.103	0.808	2.461	0.970		WATTS/DEG C

TEMPERATURES,T(N), DEG C

	CORE	MUSCLE	FAT	SKIN
HEAD	35.749	35.637	34.429	34.286
TRUNK	35.648	35.710	34.616	34.213
ARMS	35.011	35.160	33.432	33.257
HANDS	36.059	36.095	34.672	34.682
LEGS	35.576	35.480	34.262	34.159
FEET	35.280	35.242	34.954	34.931
CENTRAL BLOOD 35.405				

BLOOD FLOWS,BF,(N), LITERS/HR

	CORE	MUSCLE	FAT	SKIN
HEAD	46.987	2.824	0.786	3.799
TRUNK	219.260	70.631	15.197	5.546
ARMS	0.873	12.534	2.056	1.310
HANDS	0.087	0.297	0.306	5.264
LEGS	2.795	36.463	5.109	7.511
FEET	0.175	0.263	0.480	7.548

QBQ10(N) Q10 METABOLIC EFFECT,W

	CORE	MUSCLE	FAT	SKIN
HEAD	-1.734	0.019	0.006	0.006
TRUNK	-6.312	-0.073	0.323	0.166
ARMS	-0.026	0.304	0.033	0.032
HANDS	-0.001	0.035	0.002	0.010
LEGS	0.016	0.249	0.119	0.056
FEET	0.007	0.001	0.121	0.019

TOTAL OF QB010(N)= -6.643

METABOLIC HEAT PRODUCTION,Q(N), WATTS

	CORE	MUSCLE	FAT	SKIN
HEAD	13.135	0.368	0.135	0.092
TRUNK	46.028	15.405	2.800	0.570
ARMS	0.751	1.975	0.231	0.178
HANDS	0.085	0.268	0.028	0.070
LEGS	2.557	4.351	0.618	0.466
FEET	0.154	0.019	0.637	0.096

NON-SHIVERING THERMOGENESIS,NST(N), WATTS

	CORE	MUSCLE	FAT	SKIN
HEAD	0.0	0.0	0.0	0.0
TRUNK	0.0	0.0	0.0	0.0
ARMS	0.0	0.0	0.0	0.0
HANDS	0.0	0.0	0.0	0.0
LEGS	0.0	0.0	0.0	0.0
FEET	0.0	0.0	0.0	0.0

EVAPORATIVE HEAT LOSS,E(N), WATTS

	CORE	MUSCLE	FAT	SKIN
HEAD	0.0	0.0	0.0	0.810
TRUNK	6.927	0.0	0.0	3.780
ARMS	0.0	0.0	0.0	1.400
HANDS	0.0	0.0	0.0	0.520
LEGS	0.0	0.0	0.0	3.320
FEET	0.0	0.0	0.0	0.720

EVAPORATIVE HEAT LOSS, EG(N), GM/HR

	CORE	MUSCLE	FAT	SKIN
HEAD	0.0	0.0	0.0	1.174
TRUNK	10.298	0.0	0.0	5.102
ARMS	0.0	0.0	0.0	2.011
HANDS	0.0	0.0	0.0	0.763
LEGS	0.0	0.0	0.0	4.532
FEET	0.0	0.0	0.0	1.043

FILM ON SKIN FORMED BY OVER-SWEATING,FILM(N), MICRONS

	CORE	MUSCLE	FAT	SKIN
HEAD	0.0	0.0	0.0	0.0
TRUNK	0.0	0.0	0.0	0.0
ARMS	0.0	0.0	0.0	0.0
HANDS	0.0	0.0	0.0	0.0
LEGS	0.0	0.0	0.0	0.0
FEET	0.0	0.0	0.0	0.0

DRIP=EXCESS SWEAT-FILM-CLOWAT,DRIP(N)   GM/HR

	CORE	MUSCLE	FAT	SKIN
HEAD	0.0	0.0	0.0	0.0
TRUNK	0.0	0.0	0.0	0.0
ARMS	0.0	0.0	0.0	0.0
HANDS	0.0	0.0	0.0	0.0
LEGS	0.0	0.0	0.0	0.0
FEET	0.0	0.0	0.0	0.0

SWEAT THAT SOAKS INTO CLOTHES,CLOWAT(N),   GM/HR

	CORE	MUSCLE	FAT	SKIN
HEAD	0.0	0.0	0.0	0.0
TRUNK	0.0	0.0	0.0	0.0
ARMS	0.0	0.0	0.0	0.0
HANDS	0.0	0.0	0.0	0.0
LEGS	0.0	0.0	0.0	0.0
FEET	0.0	0.0	0.0	0.0

CONVECTIVE HEAT TRANSFER BETWEEN CENTRAL BLOOD AND ELEMENTS,BC(N),   WATTS

	CORE	MUSCLE	FAT	SKIN
HEAD	10.856	0.359	-0.847	-4.668
TRUNK	20.394	14.552	-13.801	-7.266
ARMS	-0.447	-4.574	-4.396	-2.976
HANDS	0.049	0.164	-0.249	-4.505
LEGS	0.188	-1.242	-6.458	-10.276
FEET	-0.044	-0.062	-0.255	-4.842

CONDUCTIVE HEAT TRANSFER BETWEEN SUCCESSIVE ELEMENTS,TD(N),   WATTS

	CORE	MUSCLE	FAT	SKIN
HEAD	0.148	0.0	0.931	0.0
TRUNK	-0.420	0.0	11.224	0.0
ARMS	-0.565	0.0	3.711	0.0
HANDS	0.069	0.0	0.370	0.0
LEGS	0.795	0.0	5.065	0.0
FEET	-0.208	0.0	1.037	0.0

RATE OF HEAT FLOW INTO OR FROM AN ELEMENT,HF(N),   WATTS

	CORE	MUSCLE	FAT	SKIN
HEAD	2.131	0.156	0.051	0.181
TRUNK	9.923	0.434	5.277	1.605
ARMS	1.303	6.084	0.916	0.736
HANDS	-0.032	0.172	-0.093	0.364
LEGS	1.614	6.387	2.011	1.751
FEET	0.405	-0.128	-0.145	0.557
CENTRAL BLOOD				
-12.444				

RATE OF CHANGE OF TEMPERATURE OF AN ELEMENT,F(N),   DEG C/HR

	CORE	MUSCLE	FAT	SKIN
HEAD	0.870	0.414	0.228	0.678
TRUNK	0.906	0.024	1.227	1.190
ARMS	1.153	1.794	1.573	1.528
HANDS	-0.206	2.319	-1.096	1.888
LEGS	0.344	0.624	1.390	1.459

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FEET            1.587          -1.568          -1.116           2.214
CENTRAL BLOOD
     -5.888

  TSETWA(N)  SET POINT FOR RECEPTORS FOR ACTIVITY WARM CONDITION,  DEG C

              CORE          MUSCLE          FAT           SKIN
HEAD         36.660         34.360         34.040         33.760
TRUNK        36.590         35.810         33.560         32.390
ARMS         35.240         32.940         32.090         31.520
HANDS        36.120         34.650         34.120         33.390
LEGS         35.520         34.870         32.350         32.080
FEET         34.850         34.660         33.110         32.950
CENTRAL BLOOD
     36.410

  CARDIAC OUTPUT,CO=     7.476  LITERS/MINUTE

  HEART RATE, HEARTR=     92.870  BEATS/MINUTE

  SKIN BLOOD FLOWS,SBF =      0.523  LITERS/MINUTE

  HEAT PRODUCTION(METABOLISM+SHIVERING),HP=    91.094  WATTS

  TOTAL EVAPORATIVE HEAT LOSS,EV=E+RWET=    24.404  WATTS

  TOTAL EVAPORATIVE LOSS, TEVG=EV/EVCP=    24.923  GM/HR

  CUMULATIVE WATER LOSS,CEVG=    10.780 GM

  MEAN SKIN TEMPERATURE,TS=    34.151 DEG C

  MEAN BODY TEMPERATURE,TB=    35.376 DEG C


                                                 21 MINS

 CLO  =     5.2605       AU   =     1.0781      AM   =     1.0201      AHM  =     1.0044      ANM  =      1.015
 VP   =     3.0108       VUD  =     0.0004      NAE  =  2135.0515      KE   =    75.1913      KI   =  3549.808
 VEC  =    15.0604       VIC  =    24.9946      CNA  =   141.7662      CKE  =     4.9921      CKI  =   142.037
 EXO  =     0.0          RMO  =    63.6494


                                                 22 MINS

 CLO  =     5.2389       AU   =     1.0799      AM   =     1.0211      AHM  =     0.9969      ANM  =      1.016
 VP   =     3.0033       VUD  =     0.0004      NAE  =  2134.9595      KE   =    75.1993      KI   =  3549.795
 VEC  =    15.0614       VIC  =    24.9976      CNA  =   141.7529      CKE  =     4.9922      CKI  =   142.022
 EXO  =     0.0          RMO  =    63.9032


                                                 23 MINS

 OLO  =     5.2121       AU   =     1.0813      AM   =     1.0223      AHM  =     0.9887      ANM  =      1.017
 VP   =     3.0076       VUD  =     0.0004      NAE  =  2134.9441      KE   =    75.2075      KI   =  3549.781
 VEC  =    15.0625       VIC  =    25.0008      CNA  =   141.7387      CKE  =     4.9923      CKI  =   142.005
 EXO  =     0.0          RMO  =    64.1909
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24 MINS

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QLO =     5.1802     AU  =     1.0839     AM  =    1.0237     AHM =    0.9807     ANM =    1.0181
VP  =     3.0058     VUD =     0.0004     NAE = 2134.8916     KE  =   75.2147     KI  = 3549.7688
VEC =    15.0635     VIC =    25.0038     CNA =  141.7258     CKE =    4.9925     CKI =  141.9863
EXQ =     0.0        RMC =    64.5130
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26 MINS

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QLO =     5.1470     AU  =     1.0862     AM  =    1.0251     AHM =    0.9737     ANM =    1.0190
VP  =     3.0042     VUD =     0.0004     NAE = 2134.8369     KE  =   75.2218     KI  = 3549.7559
VEC =    15.0644     VIC =    25.0070     CNA =  141.7144     CKE =    4.9927     CKI =  141.9686
EXQ =     0.0        RMC =    64.8253
```

TIME=   30. MINUTES

DRY BULB AIR TEMPERATURE, TAAR=   24.00DEG C

TOTAL METABOLIC ACTIVITY,WORKT=   86.00 WATTS

AIR VELOCITY,V=   0.45 M/SEC

BAROMETRIC PRESSURE,BARO= 736.0 MM

RELATIVE HUMIDITY,RH=   0.40

MEAN RADIENT TEMPERATURE,TR= 24.000

DURING THE LAST   5 MINUTES OF SIMULATION THE SUBJECT LOST:

0.6546 MILLIGRAMS OF SODIUM CHLORIDE

0.4499 MILLIGRAMS OF POTASSIUM CHLORIDE

1.7163 MILLILITERS OF WATER

THROUGH RESPIRATION AND SWEATING.

THE CUMULATIVE LOSSES DURING THE SIMULATION ARE:

68.0535 MILLIGRAMS OF SODIUM CHLORIDE

1.6989 MILLIGRAMS OF POTASSIUM CHLORIDE

-7.4902 MILLILITERS OF WATER

THE NEGATIVE AMOUNTS ABOVE SHOW DRINKING INPUT EXCEEDED SYSTEM LOSS.

THESE TOTALS INCLUDE RESPIRATION, URINE AND SWEAT OUTPUTS AND DRINKING INPUTS.

	HEAD	TRUNK	ARMS	HANDS	LEGS	FEET	TOTAL	UNITS
CONVECTIVE HEAT TRANSFER COEFFICIENT(MIXED),HCMIX= 5.50 W/SQ M-C								
CONVECTIVE HEAT TRANSFER COEFFICIENT(SEATED),HCSEAT= 7.78 W/SQ M-C								
CONVECTIVE HEAT TRANSFER COEFFICIENT(WALKING),HCWALK= 13.83 W/SQ M-C								
PSKIN(I)	40.581	40.523	38.596	41.407	40.428	41.921		MM HG
EMAX(I)	69.510	224.950	74.207	59.525	175.780	72.563		WATTS
SWPCP(I)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	SWEAT,HEAT REMOVAL COMMAND/SKIN SEGMENT, WAT
SWCG	0.0	0.0	0.0	0.0	0.0	0.0	0.0	SWEAT,HEAT REMOVAL COMMAND/SKIN SEGMENT, GM/
EWET(I)	0.012	0.017	0.019	0.009	0.019	0.010		RATIO OF WET/DRY SURFACE
H(I)	0.970	3.140	1.103	0.808	2.451	0.970		WATTS/DEG C

TEMPERATURES,T(N), DEG C

	CORE	MUSCLE	FAT	SKIN
HEAD	35.764	35.652	34.445	34.256
TRUNK	35.662	35.707	34.683	34.277
ARMS	35.092	35.259	33.519	33.345
HANDS	36.108	36.105	34.716	34.660
LEGS	35.600	35.512	34.338	34.230
FEET	35.315	35.351	34.595	34.924

CENTRAL BLOOD
35.531

BLOOD FLOWS,BF,(N), LITERS/HR

	CORE	MUSCLE	FAT	SKIN
HEAD	46.587	2.814	0.786	3.799
TRUNK	219.260	70.204	15.197	5.546
ARMS	0.873	12.526	2.096	1.310
HANDS	0.087	0.299	0.306	5.284
LEGS	2.755	36.445	5.109	7.511
FEET	0.175	0.263	0.460	7.543

CPQ10(N) Q10 METABOLIC EFFECT,W

	CORE	MUSCLE	FAT	SKIN
HEAD	-1.666	0.020	0.007	0.006
TRUNK	-6.069	-0.074	0.349	0.110
ARMS	-0.016	0.321	0.036	0.034
HANDS	-0.002	0.027	0.002	0.010
LEGS	0.025	0.267	0.125	0.160
FEET	0.009	0.001	0.121	0.019

TOTAL OF CPQ10(N)= -6.227

METABOLIC HEAT PRODUCTION,Q(N), WATTS

	CORE	MUSCLE	FAT	SKIN
HEAD	13.204	0.358	0.136	0.092
TRUNK	46.271	14.978	2.826	0.575
ARMS	0.801	1.967	0.234	0.180
HANDS	0.086	0.270	0.023	0.070
LEGS	2.605	4.333	0.623	0.470
FEET	0.155	0.018	0.637	0.097

NON-SHIVERING THERMOGENESIS,NST(N), WATTS

	CORE	MUSCLE	FAT	SKIN
HEAD	0.0	0.0	0.0	0.0
TRUNK	0.0	0.0	0.0	0.0
ARMS	0.0	0.0	0.0	0.0
HANDS	0.0	0.0	0.0	0.0
LEGS	0.0	0.0	0.0	0.0
FEET	0.0	0.0	0.0	0.0

EVAPORATIVE HEAT LOSS,E(N), WATTS

	CORE	MUSCLE	FAT	SKIN
HEAD	0.0	0.0	0.0	0.810
TRUNK	6.927	0.0	0.0	3.780
ARMS	0.0	0.0	0.0	1.400
HANDS	0.0	0.0	0.0	0.520
LEGS	0.0	0.0	0.0	3.320
FEET	0.0	0.0	0.0	0.720

EVAPORATIVE HEAT LOSS, EG(N), GM/HR

	CORE	MUSCLE	FAT	SKIN
HEAD	0.0	0.0	0.0	1.174
TRUNK	10.299	0.0	0.0	5.102
ARMS	0.0	0.0	0.0	2.011
HANDS	0.0	0.0	0.0	0.763
LEGS	0.0	0.0	0.0	4.532
FEET	0.0	0.0	0.0	1.043

FILM ON SKIN FORMED BY OVER-SWEATING,FILM(N), MICRONS

	CORE	MUSCLE	FAT	SKIN
HEAD	0.0	0.0	0.0	0.0
TRUNK	0.0	0.0	0.0	0.0
ARMS	0.0	0.0	0.0	0.0
HANDS	0.0	0.0	0.0	0.0
LEGS	0.0	0.0	0.0	0.0
FEET	0.0	0.0	0.0	0.0

DRIP=EXCESS SWEAT-FILM-CLOWAT,DRIP(N) GM/HR

	CORE	MUSCLE	FAT	SKIN
HEAD	0.0	0.0	0.0	0.0
TRUNK	0.0	0.0	0.0	0.0
ARMS	0.0	0.0	0.0	0.0
HANDS	0.0	0.0	0.0	0.0
LEGS	0.0	0.0	0.0	0.0
FEET	0.0	0.0	0.0	0.0

SWEAT THAT SOAKS INTO CLOTHES,CLOWAT(N), GM/HR

	CORE	MUSCLE	FAT	SKIN
HEAD	0.0	0.0	0.0	0.0
TRUNK	0.0	0.0	0.0	0.0
ARMS	0.0	0.0	0.0	0.0
HANDS	0.0	0.0	0.0	0.0
LEGS	0.0	0.0	0.0	0.0
FEET	0.0	0.0	0.0	0.0

CONVECTIVE HEAT TRANSFER BETWEEN CENTRAL BLOOD AND ELEMENTS,BC(N), WATTS

	CORE	MUSCLE	FAT	SKIN
HEAD	15.946	0.626	-0.776	-4.291
TRUNK	52.259	19.464	-11.426	-6.419
ARMS	-0.303	-2.227	-4.018	-2.741
HANDS	0.058	0.208	-0.226	-3.851
LEGS	0.466	2.902	-5.611	-9.041
FEET	-0.016	-0.047	-0.219	-3.810

CONDUCTIVE HEAT TRANSFER BETWEEN SUCCESSIVE ELEMENTS,TD(N), WATTS

	CORE	MUSCLE	FAT	SKIN
HEAD	0.166	0.0	0.878	0.0
TRUNK	-0.213	0.0	11.427	0.0
ARMS	-0.687	0.0	3.736	0.0
HANDS	-0.347	0.0	-0.096	0.0
LEGS	0.681	0.0	5.131	0.0
FEET	1.356	0.0	0.310	0.0

RATE OF HEAT FLOW INTO OR FROM AN ELEMENT,HF(N), WATTS

	CORE	MUSCLE	FAT	SKIN
HEAD	-2.909	-0.101	0.034	-0.263
TRUNK	-13.905	-4.699	2.925	0.756
ARMS	1.790	3.508	0.515	0.473
HANDS	0.375	-0.286	0.350	-0.775
LEGS	1.458	2.112	1.104	0.487
FEET	-1.185	1.422	0.546	-1.226

CENTRAL BLOOD
36.908

RATE OF CHANGE OF TEMPERATURE OF AN ELEMENT,F(N), DEG C/HR

	CORE	MUSCLE	FAT	SKIN
HEAD	-1.138	-0.267	0.151	-0.985
TRUNK	-1.269	-0.261	0.657	0.561
ARMS	1.145	1.034	0.885	0.983
HANDS	2.405	-3.860	4.108	-4.026
LEGS	0.310	0.206	0.763	0.406
FEET	-4.627	17.454	4.206	-4.868

CENTRAL BLOOD
17.462

TSETWA(N) SET POINT FOR RECEPTORS FOR ACTIVITY WARM CONDITION, DEG C

	CORE	MUSCLE	FAT	SKIN
HEAD	36.660	34.360	34.040	33.760
TRUNK	36.590	35.810	33.560	32.390
ARMS	35.240	32.940	32.080	31.520
HANDS	36.120	34.850	34.120	33.390
LEGS	35.520	34.870	32.350	32.080

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FEET          34.850          34.660          33.110          32.950
CENTRAL BLOOD
    36.410

 CARDIAC OUTPUT,CO=     7.468  LITERS/MINUTE

 HEART RATE, HEARTR=     92.774  BEATS/MINUTE

 SKIN BLOOD FLOWS,SBF =      0.523  LITERS/MINUTE

 HEAT PRODUCTION(METABOLISM+SHIVERING),HP=    91.013  WATTS

 TOTAL EVAPORATIVE HEAT LOSS,EV=E+RWET=    24.404  WATTS

 TOTAL EVAPORATIVE LOSS, TEVG=EV/EVCP=    24.923  GM/HR

 CUMULATIVE WATER LOSS,CEVG=    12.496 GM

 MEAN SKIN TEMPERATURE,TS=    34.208 DEG C

 MEAN BODY TEMPERATURE,TB=    35.407 DEG C


                                             27 MINS

QLO  =     5.1165      AU   =    1.0886      AM   =     1.0268      AHM  =     0.9670      ANM  =     1.0200
VP   =     3.0024      VUD  =    0.0004      NAE  =  2134.7678      KE   =    75.2287      KI   =  3549.7441
VEC  =    15.0554      VIC  =   25.0100      CNA  =   141.7017      CKE  =     4.9929      CKI  =   141.9499
EXQ  =     0.0         RMO  =   65.0857


                                             28 MINS

QLO  =     5.0850      AU   =    1.0912      AM   =     1.0285      AHM  =     0.9612      ANM  =     1.0210
VP   =     3.0009      VUD  =    0.0004      NAE  =  2134.7373      KE   =    75.2355      KI   =  3549.7319
VEC  =    15.0662      VIC  =   25.0132      CNA  =   141.6504      CKE  =     4.9931      CKI  =   141.9324
EXQ  =     0.0         RMO  =   65.3701


                                             29 MINS

QLO  =     5.0571      AU   =    1.0939      AM   =     1.0306      AHM  =     0.9556      ANM  =     1.0221
VP   =     2.9992      VUD  =    0.0003      NAE  =  2134.6931      KE   =    75.2414      KI   =  3549.7209
VEC  =    15.0671      VIC  =   25.0161      CNA  =   141.6788      CKE  =     4.9933      CKI  =   141.9139
EXQ  =     0.0         RMO  =   65.6143


                                             31 MINS

QLO  =     5.0284      AU   =    1.0970      AM   =     1.0326      AHM  =     0.9508      ANM  =     1.0231
VP   =     2.9977      VUD  =    0.0003      NAE  =  2134.6484      KE   =    75.2474      KI   =  3549.7092
VEC  =    15.0679      VIC  =   25.0192      CNA  =   141.6685      CKE  =     4.9934      CKI  =   141.8970
EXQ  =     0.0         RMO  =   65.8870
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EXP 2 COMBINED THERMOREGULATORY-CIRCULATORY SIMULATION- HEAT AND EXERCISE

0 SECS

QLO =	5.0000	AU =	1.0000	AM =	1.0000	AHM =	1.0000	ANM =	1.0000
VP =	3.0000	VUD =	0.0010	NAE =	2136.0000	KE =	75.0000	KI =	3550.0000
VEC =	15.0000	VIC =	25.0000	CNA =	142.0000	CKE =	5.0000	CKI =	142.0000
EXQ =	0.0	RMO =	60.0000						

47 SECS

QLO =	5.1961	AU =	1.0662	AM =	0.9579	AHM =	0.9942	ANM =	1.0042
VP =	2.9990	VUD =	0.0011	NAE =	2135.9150	KE =	75.0049	KI =	3549.9529
VEC =	15.0149	VIC =	24.9980	CNA =	142.2532	CKE =	4.9950	CKI =	141.9997
EXQ =	0.0	RMC =	60.1055						

CONSTANT DATA ************************************

TIME=0.0 ************************************

AGE OF THE SUBJECT,AGE= 25.00 YEARS

WEIGHT OF THE SUBJECT,WT= 70.00 KG

HEIGHT OF THE SUBJECT,HT= 173.00 CM

SURFACE AREA OF THE SUBJECT,SA= 1.94 SQ M

SPECIFIC HEAT (THERMAL CAPACITY) OF FAT,SHF= 0.640 WATT-HR/KG-C

SPECIFIC HEAT (THERMAL CAPACITY) OF BONE,SHB= 0.582 WATT-HR/KG-C

SPECIFIC HEAT (THERMAL CAPACITY) OF TISSUE,SHT= 1.058 WATT-HR/KG-C

SPECIFIC HEAT (THERMAL CAPACITY) OF SKIN,SHS= 0.896 WATT-HR/KG-C

SURFACE AREA OF DRY ICE FACING SKIN,SAF= 0.0 SQ. CM.

PCT(J), % DISTRIBUTION, BY WEIGHT, OF DIFFERENT TISSUE TYPES

	CORE			MUSCLE			FAT			SKIN		
	FAT	BONE	TISSUE	FAT	BONE	TISSUE	FAT	BONE	TISSUE	FAT	BONE	TISSUE
HEAD	0.0	2.14	2.13	0.0	0.0	0.51	0.50	0.0	0.0	0.0	0.0	0.36
TRUNK	0.0	3.30	12.93	0.0	0.0	24.35	9.60	0.0	0.0	0.0	0.0	1.82
ARMS	0.0	2.02	1.00	0.0	0.0	4.58	1.30	0.0	0.0	0.0	0.0	0.65
HANDS	0.0	0.31	0.04	0.0	0.0	0.10	0.19	0.0	0.0	0.0	0.0	0.26
LEGS	0.0	6.73	2.64	0.0	0.0	13.82	3.23	0.0	0.0	0.0	0.0	1.62
FEET	0.0	0.50	0.07	0.0	0.0	0.11	0.29	0.0	0.0	0.0	0.0	0.34

CENTRAL BLOOD 3.37 TISSUE

WTPCT(J), KG. OF TISSUE FOR 73.4 KG. MALE -ASSUMING 15% BODY FAT

	CORE			MUSCLE			FAT			SKIN		
	FAT	BONE	TISSUE	FAT	BONE	TISSUE	FAT	BONE	TISSUE	FAT	BONE	TISSUE
HEAD	0.0	1.57	1.56	0.0	0.0	0.37	0.37	0.0	0.0	0.0	0.0	0.26
TRUNK	0.0	2.42	9.53	0.0	0.0	17.87	7.05	0.0	0.0	0.0	0.0	1.34
ARMS	0.0	1.48	0.73	0.0	0.0	3.36	0.95	0.0	0.0	0.0	0.0	0.48
HANDS	0.0	0.23	0.03	0.0	0.0	0.07	0.14	0.0	0.0	0.0	0.0	0.19
LEGS	0.0	4.94	1.94	0.0	0.0	10.14	2.37	0.0	0.0	0.0	0.0	1.19
FEET	0.0	0.37	0.05	0.0	0.0	0.08	0.21	0.0	0.0	0.0	0.0	0.25
CENTRAL BLOOD	2.47 TISSUE											

NWT(J), KG. OF TISSUE FOR THIS MALE BF=11.98%

	CORE			MUSCLE			FAT			SKIN		
	FAT	BONE	TISSUE	FAT	BONE	TISSUE	FAT	BONE	TISSUE	FAT	BONE	TISSUE
HEAD	0.0	1.57	1.56	0.0	0.0	0.37	0.29	0.0	0.0	0.0	0.0	0.26
TRUNK	0.0	2.42	9.53	0.0	0.0	17.87	5.59	0.0	0.0	0.0	0.0	1.34
ARMS	0.0	1.48	0.73	0.0	0.0	3.36	0.76	0.0	0.0	0.0	0.0	0.48
HANDS	0.0	0.23	0.03	0.0	0.0	0.07	0.11	0.0	0.0	0.0	0.0	0.19
LEGS	0.0	4.94	1.94	0.0	0.0	10.14	1.88	0.0	0.0	0.0	0.0	1.19
FEET	0.0	0.37	0.05	0.0	0.0	0.08	0.17	0.0	0.0	0.0	0.0	0.25
CENTRAL BLOOD	2.47 TISSUE											

PCTN(J), NEW CALCULATED WEIGHT PERCENTAGES

	CORE			MUSCLE			FAT			SKIN		
	FAT	BONE	TISSUE	FAT	BONE	TISSUE	FAT	BONE	TISSUE	FAT	BONE	TISSUE
HEAD	0.0	2.19	2.18	0.0	0.0	0.52	0.41	0.0	0.0	0.0	0.0	0.37
TRUNK	0.0	3.38	13.23	0.0	0.0	24.92	7.79	0.0	0.0	0.0	0.0	1.86
ARMS	0.0	2.07	1.02	0.0	0.0	4.69	1.05	0.0	0.0	0.0	0.0	0.67
HANDS	0.0	0.32	0.04	0.0	0.0	0.10	0.15	0.0	0.0	0.0	0.0	0.27
LEGS	0.0	6.89	2.70	0.0	0.0	14.14	2.62	0.0	0.0	0.0	0.0	1.66
FEET	0.0	0.51	0.07	0.0	0.0	0.11	0.24	0.0	0.0	0.0	0.0	0.35
CENTRAL BLOOD	3.45 TISSUE											

C(N), HEAT CAPACITANCE, WATT HR/DEG C

	CORE	MUSCLE	FAT	SKIN
HEAD	2.449	0.378	0.224	0.267
TRUNK	10.557	19.034	4.301	1.348
ARMS	1.564	3.392	0.592	0.481
HANDS	0.156	0.074	0.085	0.193
LEGS	4.697	10.235	1.447	1.200
FEET	0.256	0.081	0.130	0.252
CENTRAL BLOOD 2.114				

PROPORTION OF BASAL METABOLISM, PQB(N)

	CORE	MUSCLE	FAT	SKIN
HEAD	0.1729	0.0014	0.0015	0.0010
TRUNK	0.6086	0.0672	0.0288	0.0054
ARMS	0.0095	0.0128	0.0023	0.0017
HANDS	0.0010	0.0027	0.0003	0.0007
LEGS	0.0300	0.0384	0.0058	0.0043
FEET	0.0017	0.0002	0.0000	0.0009

QB(N), BASAL METABOLIC HEAT PRODUCTION, WATTS

	CORE	MUSCLE	FAT	SKIN
HEAD	14.670	0.120	0.129	0.066
TRUNK	52.341	5.779	2.477	0.464
ARMS	0.917	1.101	0.198	0.146
HANDS	0.086	0.232	0.026	0.060
LEGS	2.580	3.302	0.499	0.370
FEET	0.146	0.017	0.516	0.077

EB(N), BASAL EVAPORATIVE HEAT LOSS (DIFFUSION), WATTS

	CORE	MUSCLE	FAT	SKIN
HEAD	0.0	0.0	0.0	0.810
TRUNK	0.0	0.0	0.0	3.780
ARMS	0.0	0.0	0.0	1.400
HANDS	0.0	0.0	0.0	0.520
LEGS	0.0	0.0	0.0	3.320
FEET	0.0	0.0	0.0	0.720

****EB(5),RESPIRATORY HEAT LOSS, IS NOT CONSTANT. SO, IT HAS BEEN INITIALIZED AS ZERO AND LATER CALCULATED BY RWET

PROPORTION OF CARDIAC OUTPUT,PBCC(N)

	CORE	MUSCLE	FAT	SKIN
HEAD	0.1076	0.0059	0.0018	0.0087
TRUNK	0.5021	0.1397	0.0348	0.0127
ARMS	0.0020	0.0267	0.0048	0.0030
HANDS	0.0002	0.0006	0.0007	0.0121
LEGS	0.0064	0.0811	0.0117	0.0172
FEET	0.0004	0.0006	0.0011	0.0182

BFB(N), BASAL EFFECTIVE BLOOD FLOW, LITRES/HR

	CORE	MUSCLE	FAT	SKIN
HEAD	46.987	2.576	0.786	3.799
TRUNK	219.260	61.005	15.197	5.546
ARMS	0.873	11.659	2.096	1.310
HANDS	0.087	0.262	0.306	5.284
LEGS	2.795	35.415	5.109	7.511
FEET	0.175	0.262	0.480	7.948

WEIGHT PER SEGMENT,SEGWT(N) GM

	CORE	MUSCLE	FAT	SKIN
HEAD	3058.438	365.293	232.539	257.854
TRUNK	11660.746	17440.961	5451.641	1303.597
ARMS	2163.112	3280.480	738.242	465.571
HANDS	250.692	71.626	107.997	186.228
LEGS	6711.367	5858.742	1834.249	1160.345
FEET	408.269	78.789	164.685	243.529

VCL(N), VOLUME OF SUBJECT,CUBIC CENTIMETERS

	SHAPE	CORE	MUSCLE	FAT	SKIN
HEAD	SPHERE	3058.438	3423.732	3707.671	3965.525
TRUNK	CYLINDER	11660.746	29101.707	34553.348	35856.941
ARMS	CYLINDER	2163.112	5443.590	6181.832	6647.402
HANDS	CYLINDER	250.692	322.318	430.215	616.443
LEGS	CYLINDER	6711.367	16610.109	18444.355	19604.699

FEET	CYLINDER	408.269	467.058	651.742	895.271

OUTSIDE SURFACE AREA,AREA(N) SQ CM

	CORE	MUSCLE	FAT	SKIN
HEAD	0.0	0.0	0.0	1357.958
TRUNK	0.0	0.0	0.0	6987.863
ARMS	0.0	0.0	0.0	2601.535
HANDS	0.0	0.0	0.0	969.958
LEGS	0.0	0.0	0.0	6157.547
FEET	0.0	0.0	0.0	1320.837

LTH(N). LENGTH OF PARTS OF THE BODY,CM.

	CORE	MUSCLE	FAT	SKIN
HEAD	0.0	0.0	0.0	0.0
TRUNK	108.369	108.369	108.369	108.369
ARMS (2)	81.021	81.021	81.021	81.021
HANDS (2)	121.461	121.461	121.461	121.461
LEGS (2)	153.902	153.902	153.902	153.902
FEET (2)	157.429	157.429	157.429	157.429

RAD(N), RADIUS OF PARTS OF THE BODY, CM.

	CORE	MUSCLE	FAT	SKIN
HEAD	7.696	8.158	8.484	8.760
TRUNK	5.852	9.246	10.074	10.263
ARMS	2.915	4.625	4.928	5.110
HANDS	0.811	0.919	1.062	1.271
LEGS	3.726	5.861	6.176	6.368
FEET	0.909	0.992	1.143	1.345

CENTER OF MASS RADIUS,CMRAD(N) CM

	CORE	MUSCLE	FAT	SKIN
HEAD	6.108	7.934	8.324	8.625
TRUNK	4.645	7.912	9.678	10.169
ARMS	2.314	3.954	4.781	5.021
HANDS	0.643	0.868	0.996	1.176
LEGS	2.957	5.020	6.023	6.273
FEET	0.721	0.952	1.076	1.254

DELX(K), DELTA X, ABOUT RAD(I),CM.

	CORE-MUSCLE	MUSCLE-FAT	FAT-SKIN
HEAD	1.826	0.351	0.300
TRUNK	3.267	1.765	0.492
ARMS	1.641	0.827	0.240
HANDS	0.225	0.127	0.180
LEGS	2.063	1.003	0.251
FEET	0.231	0.123	0.179

MIDPOINT RADIUS,MPR(K) CM

	CORE-MUSCLE	MUSCLE-FAT	FAT-SKIN
HEAD	7.021	8.129	8.474
TRUNK	6.279	8.755	9.923
ARMS	3.134	4.368	4.901
HANDS	0.756	0.932	1.086
LEGS	3.989	5.522	6.148

TRUNK	0.0	0.0	0.0	0.0
ARMS	0.0	0.0	0.0	0.0
HANDS	0.0	0.0	0.0	0.0
LEGS	0.0	0.0	0.0	0.0
FEET	0.0	0.0	0.0	0.0

CENTRAL BLOOD
0.0

	HEAD	TRUNK	ARMS	HANDS	LEGS	FEET	BODY	UNITS
PAREA(I)	7.00	36.02	13.41	5.00	31.74	6.86		%AGE AREA BY SECTION
S(I)	0.1552	0.7178	0.2522	0.0970	0.5626	0.1164		SQ. M
HR(I)	4.800	4.800	4.200	3.600	4.200	4.000		WATTS/SQ. M/DEG C
HCSL(I)	3.000	2.100	2.100	4.000	2.100	4.000	2.339	WATTS/SQ. M/DEG C
HC(I)	2.948	2.063	2.063	3.930	2.063	3.930	2.298	WATTS/SQ. M/DEG C
SKINR(I)	0.210	0.420	0.100	0.040	0.200	0.030		
SKINS(I)	0.081	0.481	0.154	0.031	0.218	0.035		
SKINV(I)	0.132	0.322	0.095	0.121	0.230	0.100		
SKINC(I)	0.050	0.050	0.150	0.200	0.200	0.350		
CHILM(I)	0.020	0.850	0.050	0.0	0.070	0.0		
NSTM(I)	0.0	1.000	0.0	0.0	0.0	0.0		

S(I)= SURFACE AREA OF EACH SEGMENT
HR(I)= LINEAR RADIANT HEAT TRANSFER COEFFICIENT
HCSL(I)= CONVECTIVE AND CONDUCTIVE HEAT TRANSFER COEFFICIENT - AT SEA LEVEL
HC(I)= CONVECTIVE AND CONDUCTIVE HEAT TRANSFER COEFFICIENT
SKINR(I)= FRACTION OF ALL SKIN THERMAL RECEPTORS IN EACH SEGMENT
SKINS(I)= FRACTION OF SWEATING COMMAND APPLICABLE TO EACH SKIN SEGMENT
SKINV(I)= FRACTION OF VASODILATION COMMAND APPLICATION TO EACH SKIN SEGMENT
SKINC(I)= FRACTION OF VASOCONSTRICTION COMMAND APPLICATION TO EACH SKIN SEGMENT
WORKM(I)= FRACTION OF TOTAL WORK DONE BY MUSCLE IN EACH SEGMENT
CHILM(I)= FRACTION OF TOTAL SHIVERING OCCURING IN EACH SEGMENT
NSTM(I)= PROPORTION OF NON-SHIVERING THERMOGENESIS FOR EACH SEGMENT

INITIAL INPUT TEMPERATURES, DEG C

	CORE	MUSCLE	FAT	SKIN
HEAD	36.660	34.360	34.040	33.760
TRUNK	36.590	35.810	33.560	32.390
ARMS	35.240	32.940	32.080	31.520
HANDS	36.120	34.850	34.120	33.390
LEGS	35.520	34.870	32.350	32.080
FEET	34.850	34.660	33.110	32.950

CENTRAL BLOOD
36.410

BASAL METABOLISM, WORKB= 86.00 WATTS

OUTPUT INTERVAL,INT= 5 MINUTES

FEET	0.837	1.014	1.165

HEAT TRANSFER OF SURFACE AREA,HTSA(K) SQ CM

	CORE-MUSCLE	MUSCLE-FAT	FAT-SKIN
HEAD	619.407	830.389	902.479
TRUNK	4275.207	5988.570	6756.534
ARMS	1595.476	2223.512	2494.967
HANDS	576.771	711.176	828.522
LEGS	3857.088	5339.410	5945.281
FEET	827.646	1003.048	1152.484

CCND(K), CONDUCTIVITY,W/CM C

	CORE-MUSCLE	MUSCLE-FAT	FAT-SKIN
HEAD	0.00419	0.00278	0.00205
TRUNK	0.00419	0.00335	0.00205
ARMS	0.00419	0.00335	0.00205
HANDS	0.00419	0.00278	0.00205
LEGS	0.00419	0.00335	0.00205
FEET	0.00419	0.00278	0.00205

TC(K), THERMAL CONDUCTANCE BETWEEN ADJACENT ELEMENTS, WATTS/DEG C

	CORE-MUSCLE	MUSCLE-FAT	FAT-SKIN
HEAD	1.422	5.906	6.164
TRUNK	5.482	11.365	28.172
ARMS	4.975	5.010	21.334
HANDS	10.747	15.523	9.427
LEGS	7.833	17.842	48.639
FEET	15.000	22.584	13.223

TSETWS(N) SET POINT FOR RECEPTORS FOR SEDENTARY WARM CONDITION, DEG C

	CORE	MUSCLE	FAT	SKIN
HEAD	36.660	34.360	34.040	33.760
TRUNK	36.590	35.810	33.560	32.390
ARMS	35.240	32.940	32.080	31.520
HANDS	36.120	34.850	34.120	33.350
LEGS	35.520	34.870	32.350	32.080
FEET	34.850	34.660	33.110	32.990

CENTRAL BLOOD
36.410

TSETC(N), SET POINT FOR RECEPTORS FOR COLD CONDITION, DEG C

	CORE	MUSCLE	FAT	SKIN
HEAD	36.660	34.360	34.040	33.760
TRUNK	36.590	35.810	33.560	32.390
ARMS	35.240	32.940	32.080	31.520
HANDS	36.120	34.850	34.120	33.350
LEGS	35.520	34.870	32.350	32.080
FEET	34.850	34.660	33.110	32.990

CENTRAL BLOOD
36.410

RATE(N), DYNAMIC SENSITIVITY OF THERMORECEPTORS

	CORE	MUSCLE	FAT	SKIN
HEAD	0.0	0.0	0.0	0.0

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SUBLIMATION RATE OF DRY-ICE FOR EACH PERIOD OF 30 MINUTES,GM/HR
 0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
COOLING EFFICIENCY OF JACKET,CEFF=   0.5500
CLO VALUE OF CLOTHING,CLO =   0.0     0.300   0.050   0.0     0.300   0.100
 DRY BULB AIR TEMPERATURE, TAAR=   24.00DEG C
AIR VELOCITY,V=    0.45  M/SEC
 BAROMETRIC PRESSURE,BARO= 736.0 MM
RELATIVE HUMIDITY,RH=    0.40
MEAN RADIENT TEMPERATURE,TR=  24.000
TOTAL METABOLIC ACTIVITY,WORKT=   86.00  WATTS
WORKM(I)    0.0     0.150    0.020    0.0     0.780    0.050 (STANDING)
MECHANICAL EFFICIENCY, WEFF=   0.0


TIME=      5.  MINUTES
 DRY BULB AIR TEMPERATURE, TAAR=   24.00DEG C
TOTAL METABOLIC ACTIVITY,WORKT=   86.00  WATTS
AIR VELOCITY,V=    0.45  M/SEC
 BAROMETRIC PRESSURE,BARO= 736.0 MM
RELATIVE HUMIDITY,RH=    0.40
MEAN RADIENT TEMPERATURE,TR=  24.000
DURING THE LAST    5 MINUTES OF SIMULATION THE SUBJECT LOST:
     0.8647 MILLIGRAMS OF SODIUM CHLORIDE
     0.5545 MILLIGRAMS OF POTASSIUM CHLORIDE
     2.2658 MILLILITERS OF WATER
THROUGH RESPIRATION AND SWEATING.
 THE CUMULATIVE LOSSES DURING THE SIMULATION ARE:
     5.8211 MILLIGRAMS OF SODIUM CHLORIDE
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0.7583 MILLIGRAMS OF POTASSIUM CHLORIDE

2.4774 MILLILITERS OF WATER

THESE TOTALS INCLUDE RESPIRATION, URINE AND SWEAT OUTPUTS AND DRINKING INPUTS.

	HEAD	TRUNK	ARMS	HANDS	LEGS	FEET	TOTAL	UNITS
CONVECTIVE HEAT TRANSFER COEFFICIENT(MIXED),HCMIX= 5.44 W/SQ M-C								
CONVECTIVE HEAT TRANSFER COEFFICIENT(SEATED),HCSEAT= 7.78 W/SQ M-C								
CONVECTIVE HEAT TRANSFER COEFFICIENT(WALKING),HCWALK= 13.83 W/SQ M-C								
PSKIN(I)	40.391	38.787	36.370	41.275	37.930	41.560		MM HG
EMAX(I)	69.192	212.569	68.631	59.283	161.820	71.767		WATTS
SWPCP(I)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	SWEAT,HEAT REMOVAL COMMAND/SKIN SEGMENT, WATTS
SWCG	0.0	0.0	0.0	0.0	0.0	0.0	0.0	SWEAT,HEAT REMOVAL COMMAND/SKIN SEGMENT, GM/HR
EWET(I)	0.012	0.018	0.020	0.009	0.021	0.010		RATIO OF WET/DRY SURFACE
H(I)	0.970	3.140	1.103	0.808	2.461	0.970		WATTS/DEG C

TEMPERATURES,T(N), DEG C

	CORE	MUSCLE	FAT	SKIN
HEAD	36.024	35.364	34.336	34.227
TRUNK	35.930	35.826	33.987	33.497
ARMS	34.928	33.883	32.497	32.324
HANDS	35.834	35.844	34.681	34.667
LEGS	35.506	35.152	33.154	33.105
FEET	34.944	34.949	34.867	34.835

CENTRAL BLOOD
35.543

BLOOD FLOWS,BF,(N), LITERS/HR

	CORE	MUSCLE	FAT	SKIN
HEAD	46.987	2.734	0.786	3.799
TRUNK	219.260	67.114	15.197	5.546
ARMS	0.875	12.135	2.096	1.310
HANDS	0.087	0.291	0.306	5.284
LEGS	2.795	36.023	5.109	7.511
FEET	0.175	0.263	0.480	7.948

Q10Q10(N) Q10 METABOLIC EFFECT,W

	CORE	MUSCLE	FAT	SKIN
HEAD	-1.085	0.014	0.004	0.005
TRUNK	-3.964	0.014	0.087	0.061
ARMS	-0.029	0.117	0.009	0.014
HANDS	-0.003	0.029	0.002	0.009
LEGS	-0.004	0.106	0.045	0.044
FEET	0.001	0.001	0.109	0.017

TOTAL OF CBQ10(N)= -4.399

METABOLIC HEAT PRODUCTION,Q(N), WATTS

	CORE	MUSCLE	FAT	SKIN
HEAD	13.785	0.278	0.133	0.091
TRUNK	48.376	11.888	2.564	0.525
ARMS	0.788	1.576	0.207	0.160
HANDS	0.083	0.261	0.028	0.070
LEGS	2.576	3.911	0.543	0.413
FEET	0.148	0.018	0.625	0.095

NON-SHIVERING THERMOGENESIS,NST(N), WATTS

	CORE	MUSCLE	FAT	SKIN
HEAD	0.0	0.0	0.0	0.0
TRUNK	0.0	0.0	0.0	0.0
ARMS	0.0	0.0	0.0	0.0
HANDS	0.0	0.0	0.0	0.0
LEGS	0.0	0.0	0.0	0.0
FEET	0.0	0.0	0.0	0.0

EVAPORATIVE HEAT LOSS,E(N), WATTS

	CORE	MUSCLE	FAT	SKIN
HEAD	0.0	0.0	0.0	0.810
TRUNK	6.927	0.0	0.0	3.780
ARMS	0.0	0.0	0.0	1.400
HANDS	0.0	0.0	0.0	0.520
LEGS	0.0	0.0	0.0	3.320
FEET	0.0	0.0	0.0	0.720

EVAPORATIVE HEAT LOSS, EG(N), GM/HR

	CORE	MUSCLE	FAT	SKIN
HEAD	0.0	0.0	0.0	1.174
TRUNK	10.302	0.0	0.0	5.103
ARMS	0.0	0.0	0.0	2.012
HANDS	0.0	0.0	0.0	0.763
LEGS	0.0	0.0	0.0	4.535
FEET	0.0	0.0	0.0	1.043

FILM ON SKIN FORMED BY OVER-SWEATING,FILM(N), MICRONS

	CORE	MUSCLE	FAT	SKIN
HEAD	0.0	0.0	0.0	0.0
TRUNK	0.0	0.0	0.0	0.0
ARMS	0.0	0.0	0.0	0.0
HANDS	0.0	0.0	0.0	0.0
LEGS	0.0	0.0	0.0	0.0
FEET	0.0	0.0	0.0	0.0

DRIP=EXCESS SWEAT-FILM-CLOWAT,DRIP(N) GM/HR

	CORE	MUSCLE	FAT	SKIN
HEAD	0.0	0.0	0.0	0.0
TRUNK	0.0	0.0	0.0	0.0
ARMS	0.0	0.0	0.0	0.0
HANDS	0.0	0.0	0.0	0.0
LEGS	0.0	0.0	0.0	0.0

FEET	0.0	0.0	0.0	0.0

SWEAT THAT SOAKS INTO CLOTHES,CLOWAT(N), GM/HR

	CORE	MUSCLE	FAT	SKIN
HEAD	0.0	0.0	0.0	0.0
TRUNK	0.0	0.0	0.0	0.0
ARMS	0.0	0.0	0.0	0.0
HANDS	0.0	0.0	0.0	0.0
LEGS	0.0	0.0	0.0	0.0
FEET	0.0	0.0	0.0	0.0

CONVECTIVE HEAT TRANSFER BETWEEN CENTRAL BLOOD AND ELEMENTS,BC(N), WATTS

	CORE	MUSCLE	FAT	SKIN
HEAD	24.114	-0.745	-0.590	-5.158
TRUNK	92.370	17.537	-26.282	-11.844
ARMS	-0.535	-21.658	-6.570	-4.333
HANDS	0.022	0.077	-0.282	-4.908
LEGS	-0.171	-15.942	-12.814	-15.161
FEET	-0.112	-0.166	-0.373	-6.284

CONDUCTIVE HEAT TRANSFER BETWEEN SUCCESSIVE ELEMENTS,TC(N), WATTS

	CORE	MUSCLE	FAT	SKIN
HEAD	1.117	0.0	0.603	0.0
TRUNK	0.977	0.0	11.441	0.0
ARMS	4.776	0.0	3.693	0.0
HANDS	-0.108	0.0	0.046	0.0
LEGS	2.986	0.0	2.093	0.0
FEET	-0.079	0.0	0.186	0.0

RATE OF HEAT FLOW INTO CB FROM AN ELEMENT,HF(N), WATTS

	CORE	MUSCLE	FAT	SKIN
HEAD	-11.446	2.140	0.521	0.371
TRUNK	-53.001	-4.772	17.405	7.283
ARMS	-3.454	28.011	3.084	2.555
HANDS	0.168	0.077	0.264	0.448
LEGS	-0.240	22.839	11.264	8.796
FEET	0.338	0.105	0.812	1.198
CENTRAL BLOOD				
-4.209				

RATE OF CHANGE OF TEMPERATURE OF AN ELEMENT,F(N), DEG C/HR

	CORE	MUSCLE	FAT	SKIN
HEAD	-4.673	5.665	2.325	1.390
TRUNK	-4.837	-0.265	4.047	5.403
ARMS	-2.209	8.258	5.295	5.308
HANDS	1.090	1.034	3.102	2.326
LEGS	-0.051	2.231	7.784	7.332
FEET	1.325	1.290	6.251	4.758
CENTRAL BLOOD				
-1.991				

TSETWA(N) SET POINT FOR RECEPTORS FOR ACTIVITY WARM CONDITION, DEG C

	CORE	MUSCLE	FAT	SKIN
HEAD	36.660	34.360	34.040	33.760

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TRUNK         36.590        35.210        33.560        32.350
ARMS          35.240        32.940        32.080        31.520
HANDS         36.120        34.850        34.120        33.390
LEGS          35.520        34.870        32.350        32.080
FEET          34.850        34.660        33.110        32.950
CENTRAL BLOOD
     36.410

  CARDIAC OUTPUT,CC=    7.402  LITERS/MINUTE

  HEART RATE, HEARTR=    91.948  BEATS/MINUTE

  SKIN BLOOD FLOWS,SBF =      0.523  LITERS/MINUTE

  HEAT PRODUCTION(METABOLISM+SHIVERING),HP=   89.140  WATTS

  TOTAL EVAPORATIVE HEAT LOSS,EV=E+RWET=   24.404  WATTS

  TOTAL EVAPORATIVE LOSS, TEVG=EV/EVCP=   24.931  GM/HR

  CUMULATIVE WATER LOSS,CEVG=    2.266  GM

  MEAN SKIN TEMPERATURE,TS=   33.423 DEG C

  MEAN BODY TEMPERATURE,TB=   35.217 DEG C


                                              2 MINS

QLO  =     4.6129      AU  =     1.0262     AM  =    0.9974      AHM  =     1.0134      ANM  =     1.0035
VP   =     2.9993      VUD =     0.0010     NAE = 2135.6831      KE   =    75.0146      KI   =  3549.9736
VEC  =    15.0151      VIC =    24.9935     CNA =  142.2359      CKE  =     4.9955      CKI  =   142.0215
EXO  =     0.0         RHO =    60.2219
          AT    2 MINS INTO THE SIMULATION, THE VALUE OF TR   WAS CHANGED FROM     24.000   TO     43.300

          AT    2 MINS INTO THE SIMULATION, THE VALUE OF TAAPWAS CHANGED FROM     24.000   TO     43.300

          AT    2 MINS INTO THE SIMULATION, THE VALUE OF PH   WAS CHANGED FROM      0.400   TO      0.550

          AT    2 MINS INTO THE SIMULATION, THE VALUE OF AUQ  WAS CHANGED FROM      1.000   TO      0.150

          AT    2 MINS INTO THE SIMULATION, THE VALUE OF AUV  WAS CHANGED FROM      0.300   TO      0.030

          AT    2 MINS INTO THE SIMULATION, THE VALUE OF AUS  WAS CHANGED FROM      1.000   TO      0.100

          AT    2 MINS INTO THE SIMULATION, THE VALUE OF Z6   WAS CHANGED FROM      5.000   TO     10.000

          AT    2 MINS INTO THE SIMULATION, THE VALUE OF Z8   WAS CHANGED FROM      1.000   TO      3.000

          AT    2 MINS INTO THE SIMULATION, THE VALUE OF EXC  WAS CHANGED FROM      1.000   TO    100.000
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AT    2 MINS INTO THE SIMULATICN, THE VALUE CF Z   WAS CHANGED FROM      1.000  TO      5.000

AT    2 MINS INTO THE SIMULATICN, THE VALUE CF A4K WAS CHANGED FROM      1.000  TO      0.025


                                         3 MINS

QLO  =    5.7398       AU   =    8.2959      AM   =    0.9567      AHM  =    1.0219      ANM  =    1.0034
VP   =    2.9985       VUD  =    0.0010      NAE  = 2135.5593      KE   =   75.0191      KI   = 3549.9636
VEC  =   15.0178       VIC  =   24.9910      CNA  =  142.2018      CKE  =    4.9949      CKI  =  142.0356
EXQ  =    0.0          RMO  =   61.3576

                                         4 MINS

CLO  =    5.9149       AU   =    9.6925      AM   =    0.9508      AHM  =    1.0612      ANM  =    1.0030
VP   =    2.9921       VUD  =    0.0009      NAE  = 2135.4575      KE   =   75.0253      KI   = 3549.9526
VEC  =   15.0379       VIC  =   24.9855      CNA  =  142.0049      CKE  =    4.9888      CKI  =  142.0545
EXQ  =    0.0          RMC  = 4148.8672

                                         5 MINS

QLO  =   12.5208       AU   =    9.8958      AM   =    0.9517      AHM  =    1.0890      ANM  =    1.0030
VP   =    2.9830       VUD  =    0.0002      NAE  = 2135.3281      KE   =   75.0412      KI   = 3549.9304
VEC  =   15.0500       VIC  =   24.9888      CNA  =  141.8823      CKE  =    4.9854      CKI  =  142.0596
EXQ  =    0.0          RMO  = -3501.0630
TOTAL METABOLIC ACTIVITY,WORKT=  279.00  WATTS

WCRKM(I)    0.010    0.200    0.020    0.0     0.670    0.100 (PEDALING)

MECHANICAL EFFICIENCY, WEFF=   0.210




TIME=     10.  MINUTES

 DRY BULB AIR TEMPERATURE, TAAR=   43.30DEG C

TOTAL METABOLIC ACTIVITY,WORKT=  279.00  WATTS

AIR VELOCITY,V=     0.45  M/SEC

 BAROMETRIC PRESSURE,BARO= 736.0 MM

RELATIVE HUMIDITY,RH=    0.55
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MEAN RACIENT TEMPERATURE,TR= 43.300

DURING THE LAST 5 MINUTES CF SIMULATICN THE SUBJECT LOST:

0.5943 MILLIGRAMS OF SODIUM CHLORIDE

0.4101 MILLIGRAMS OF POTASSIUM CHLORICE

1.4930 MILLILITERS OF WATER

THROUGH RESPIRATION AND SWEATING.

THE CUMULATIVE LOSSES DURING THE SIMULATICN ARE:

35.6409 MILLIGRAMS OF SODIUM CHLORIDE

2.3707 MILLIGRAMS OF POTASSIUM CHLORICE

5.2413 MILLILITERS OF WATER

THESE TOTALS INCLUDE RESPIRATICN, URINE AND SWEAT CUTPUTS AND DRINKING INPUTS.

	HEAD	TRUNK	ARMS	HANDS	LEGS	FEET	TOTAL	UNITS
CONVECTIVE HEAT TRANSFER COEFFICIENT(MIXED),HCMIX= 5.40 W/SQ M-C								
CONVECTIVE HEAT TRANSFER COEFFICIENT(SEATED),HCSEAT= 7.78 W/SQ M-C								
CONVECTIVE HEAT TRANSFER COEFFICIENT(WALKING),HCWALK= 13.63 W/SQ M-C								
PSKIN(I)	43.052	40.963	38.711	44.074	40.204	44.141		MM HG
EMAX(I)	14.826	33.100	5.987	14.231	21.701	17.226		WATTS
SWPCP(I)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	SWEAT,HEAT REMOVAL COMMAND/SKIN SEGMENT, WATTS
SWCG	0.0	0.0	0.0	0.0	0.0	0.0	0.0	SWEAT,HEAT REMOVAL COMMAND/SKIN SEGMENT, GM/HR
EWET(I)	0.055	0.114	0.234	0.037	0.153	0.042		RATIO OF WET/DRY SURFACE
H(I)	0.970	3.140	1.103	0.808	2.461	0.970		WATTS/DEG C

TEMPERATURES,T(N), DEG C

	CORE	MUSCLE	FAT	SKIN
HEAD	35.542	35.832	35.161	35.438
TRUNK	35.868	35.967	34.352	34.526
ARMS	34.863	34.546	33.384	33.450
HANDS	35.916	35.927	35.751	35.821
LEGS	35.562	35.971	34.042	34.170
FEET	37.269	37.613	35.821	35.842
CENTRAL BLOOD				
35.755				

BLOOD FLOWS,BF,(N), LITERS/HR

	CORE	MUSCLE	FAT	SKIN
HEAD	46.587	4.296	0.786	3.799

TRUNK	219.260	98.912	15.157	5.546
ARMS	0.873	15.359	2.096	1.310
HANDS	0.087	0.253	0.306	5.284
LEGS	2.795	138.618	5.109	7.511
FEET	0.175	4.716	0.480	7.948

CBQ10(N) Q10 METABOLIC EFFECT,W

	CORE	MUSCLE	FAT	SKIN
HEAD	-1.361	0.022	0.017	0.018
TRUNK	-4.921	0.065	0.237	0.123
ARMS	-0.039	0.218	0.031	0.035
HANDS	-0.002	0.031	0.005	0.018
LEGS	0.012	0.443	0.103	0.095
FEET	0.043	0.006	0.174	0.027

TOTAL OF CBQ10(N)= -4.499

METABOLIC HEAT PRODUCTION,Q(N), WATTS

	CORE	MUSCLE	FAT	SKIN
HEAD	13.509	1.840	0.146	0.104
TRUNK	47.520	43.686	2.714	0.587
ARMS	0.776	4.800	0.229	0.181
HANDS	0.084	0.264	0.031	0.078
LEGS	2.592	106.506	0.602	0.465
FEET	0.189	15.270	0.690	0.105

NON-SHIVERING THERMOGENESIS,NST(N), WATTS

	CORE	MUSCLE	FAT	SKIN
HEAD	0.0	0.0	0.0	0.0
TRUNK	0.0	0.0	0.0	0.0
ARMS	0.0	0.0	0.0	0.0
HANDS	0.0	0.0	0.0	0.0
LEGS	0.0	0.0	0.0	0.0
FEET	0.0	0.0	0.0	0.0

EVAPORATIVE HEAT LOSS,E(N), WATTS

	CORE	MUSCLE	FAT	SKIN
HEAD	0.0	0.0	0.0	0.810
TRUNK	4.927	0.0	0.0	3.780
ARMS	0.0	0.0	0.0	1.400
HANDS	0.0	0.0	0.0	0.520
LEGS	0.0	0.0	0.0	3.320
FEET	0.0	0.0	0.0	0.720

EVAPORATIVE HEAT LOSS, EG(N), GM/HR

	CORE	MUSCLE	FAT	SKIN
HEAD	0.0	0.0	0.0	0.783
TRUNK	7.327	0.0	0.0	5.566
ARMS	0.0	0.0	0.0	0.538
HANDS	0.0	0.0	0.0	0.461
LEGS	0.0	0.0	0.0	4.525
FEET	0.0	0.0	0.0	0.779

FILM ON SKIN FORMED BY OVER-SWEATING,FILM(N), MICRONS

	CORE	MUSCLE	FAT	SKIN
HEAD	0.0	0.0	0.0	0.0
TRUNK	0.0	0.0	0.0	0.0
ARMS	0.0	0.0	0.0	0.001
HANDS	0.0	0.0	0.0	0.0
LEGS	0.0	0.0	0.0	0.0
FEET	0.0	0.0	0.0	0.0

DRIP=EXCESS SWEAT-FILM-CLOWAT,DRIP(N) GM/HR

	CORE	MUSCLE	FAT	SKIN
HEAD	0.0	0.0	0.0	0.0
TRUNK	0.0	0.0	0.0	0.0
ARMS	0.0	0.0	0.0	0.0
HANDS	0.0	0.0	0.0	0.0
LEGS	0.0	0.0	0.0	0.0
FEET	0.0	0.0	0.0	0.0

SWEAT THAT SOAKS INTO CLOTHES,CLOWAT(N), GM/HR

	CORE	MUSCLE	FAT	SKIN
HEAD	0.0	0.0	0.0	0.0
TRUNK	0.0	0.0	0.0	0.0
ARMS	0.0	0.0	0.0	0.0
HANDS	0.0	0.0	0.0	0.0
LEGS	0.0	0.0	0.0	0.0
FEET	0.0	0.0	0.0	0.0

CONVECTIVE HEAT TRANSFER BETWEEN CENTRAL BLOOD AND ELEMENTS,BC(N), WATTS

	CORE	MUSCLE	FAT	SKIN
HEAD	9.116	0.302	-0.495	-1.314
TRUNK	26.206	15.843	-21.570	-6.944
ARMS	-0.766	-18.875	-5.053	-3.071
HANDS	0.015	0.053	-0.009	0.231
LEGS	-0.514	27.150	-8.542	-12.169
FEET	0.250	8.440	0.022	0.553

CONDUCTIVE HEAT TRANSFER BETWEEN SUCCESSIVE ELEMENTS,TC(N), WATTS

	CORE	MUSCLE	FAT	SKIN
HEAD	0.176	0.0	-1.747	0.0
TRUNK	-0.223	0.0	-4.712	0.0
ARMS	1.434	0.0	-1.415	0.0
HANDS	-0.118	0.0	-0.689	0.0
LEGS	-2.975	0.0	-6.318	0.0
FEET	-5.401	0.0	-0.322	0.0

RATE OF HEAT FLOW INTO OR FROM AN ELEMENT,HF(N), WATTS

	CORE	MUSCLE	FAT	SKIN
HEAD	4.217	1.714	2.388	2.477
TRUNK	20.242	27.620	28.557	10.949
ARMS	0.110	25.110	6.657	5.510
HANDS	0.187	0.092	0.729	1.504
LEGS	6.030	76.381	15.862	12.721
FEET	5.341	1.429	0.590	1.740

CENTRAL BLOOD
8.458

RATE OF CHANGE OF TEMPERATURE OF AN ELEMENT,F(N), DEG C/HR

	CORE	MUSCLE	FAT	SKIN
HEAD	1.722	4.538	10.663	9.252
TRUNK	1.847	1.532	6.742	8.123
ARMS	0.070	7.403	11.499	11.446
HANDS	1.199	1.246	8.561	7.811
LEGS	1.295	7.463	10.961	10.603
FEET	20.899	17.537	7.623	6.911
CENTRAL BLOOD	4.001			

TSETWA(N) SET POINT FOR RECEPTORS FOR ACTIVITY WARM CONDITION, DEG C

	CORE	MUSCLE	FAT	SKIN
HEAD	36.660	34.360	34.040	33.760
TRUNK	36.590	35.310	33.560	32.390
ARMS	35.240	32.940	32.080	31.520
HANDS	36.120	34.850	34.120	33.390
LEGS	35.520	34.870	32.350	32.080
FEET	34.950	34.660	33.110	32.950
CENTRAL BLOOD	36.410			

CARDIAC OUTPUT,CO= 9.796 LITERS/MINUTE

HEART RATE, HEARTR= 94.675 BEATS/MINUTE

SKIN BLOOD FLOWS,SBF = 0.523 LITERS/MINUTE

HEAT PRODUCTION(METABOLISM+SHIVERING),HP= 242.969 WATTS

TOTAL EVAPORATIVE HEAT LOSS,EV=E+RWET= 20.404 WATTS

TOTAL EVAPORATIVE LOSS, TEVG=EV/EVCP= 19.975 GM/HR

CUMULATIVE WATER LOSS,CEVG= 3.759 GM

MEAN SKIN TEMPERATURE,TS= 34.494 DEG C

MEAN BODY TEMPERATURE,TB= 35.541 DEG C

6 MINS

QLO =	12.4607	AU =	9.9099	AM =	1.0044	AHM =	1.1057	ANM =	1.0123
VP =	2.9896	VUD =	0.0002	NAE =	2135.2568	KE =	75.0549	KI =	3549.9128
VEC =	15.0454	VIC =	24.9889	CNA =	141.9211	CKE =	4.9876	CKI =	142.0599
EXO =	0.0	RMO =	-1653.2224						

7 MINS

QLO =	12.4804	AU =	9.9146	AM =	1.0269	AHM =	1.1224	ANM =	1.0321
VP =	2.9940	VUD =	0.0002	NAE =	2135.2271	KE =	75.0609	KI =	3549.9048
VEC =	15.0314	VIC =	24.9850	CNA =	142.0511	CKE =	4.9932	CKI =	142.0591
EXO =	0.0	RMO =	-414.2656						

8 MINS

QLC = 12.5851	AU = 9.9238	AM = 1.0599	AHM = 1.1385	ANM = 1.0633
VP = 3.0005	VUD = 0.0002	NAE = 2135.1699	KE = 75.0705	KI = 3549.8904
VEC = 15.0113	VIC = 24.5887	CNA = 142.2377	CKE = 5.0007	CKI = 142.0586
EXO = 0.0	RMO = 886.6904			

9 MINS

QLC = 12.7092	AU = 9.9329	AM = 1.1021	AHM = 1.1556	ANM = 1.1037
VP = 3.0002	VUD = 0.0002	NAE = 2135.1272	KE = 75.0708	KI = 3549.8857
VEC = 14.9881	VIC = 24.5874	CNA = 142.4549	CKE = 5.0087	CKI = 142.0625
EXO = 0.0	RMC = 1381.1289			

10 MINS

QLC = 12.8359	AU = 9.9419	AM = 1.1493	AHM = 1.1749	ANM = 1.1479
VP = 3.0160	VUD = 0.0002	NAE = 2135.0918	KE = 75.0601	KI = 3549.8921
VEC = 14.9663	VIC = 24.5846	CNA = 142.6603	CKE = 5.0157	CKI = 142.0741
EXO = 0.0	RMO = 1562.7915			

TIME= 15. MINUTES

DRY BULB AIR TEMPERATURE, TAAR= 43.30DEG C

TOTAL METABOLIC ACTIVITY,WORKT= 279.00 WATTS

AIR VELOCITY,V= 0.45 M/SEC

BARCMETRIC PRESSURE,BARO= 736.0 MM

RELATIVE HUMIDITY,RH= 0.55

MEAN RADIENT TEMPERATURE,TR= 43.300

DURING THE LAST 5 MINUTES OF SIMULATION THE SUBJECT LOST:

0.7288 MILLIGRAMS OF SODIUM CHLORIDE

0.5044 MILLIGRAMS OF POTASSIUM CHLORIDE

1.7425 MILLILITERS OF WATER

THROUGH RESPIRATION AND SWEATING.

THE CUMULATIVE LOSSES DURING THE SIMULATION ARE:

53.5238 MILLIGRAMS OF SODIUM CHLORIDE

3.8832 MILLIGRAMS OF POTASSIUM CHLORIDE

7.2213 MILLILITERS OF WATER

THESE TOTALS INCLUDE RESPIRATION, URINE AND SWEAT OUTPUTS AND DRINKING INPUTS.

	HEAD	TRUNK	ARMS	HANDS	LEGS	FEET	TOTAL	UNITS
CONVECTIVE HEAT TRANSFER COEFFICIENT(MIXED),HCMIX= 5.34 W/SQ M-C								
CONVECTIVE HEAT TRANSFER COEFFICIENT(SEATED),HCSEAT= 7.78 W/SQ M-C								
CONVECTIVE HEAT TRANSFER COEFFICIENT(WALKING),HCWALK= 13.83 W/SQ M-C								
PSKIN(I)	44.650	42.116	40.426	45.293	41.754	45.265		MM HG
EMAX(I)	18.346	41.325	10.284	16.469	30.367	19.701		WATTS
SWPCP(I)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	SWEAT,HEAT REMOVAL COMMAND/SKIN SEGMENT, WATTS
SWCG	0.0	0.0	0.0	0.0	0.0	0.0	0.0	SWEAT,HEAT REMOVAL COMMAND/SKIN SEGMENT, GM/HR
EWET(I)	0.044	0.091	0.136	0.032	0.109	0.037		RATIO OF WET/DRY SURFACE
H(I)	0.970	3.140	1.103	0.808	2.461	0.970		WATTS/DEG C

TEMPERATURES,T(N), DEG C

	CORE	MUSCLE	FAT	SKIN
HEAD	36.202	36.179	35.876	36.064
TRUNK	36.131	36.077	34.904	35.097
ARMS	34.936	35.055	34.259	34.319
HANDS	36.034	36.049	36.251	36.293
LEGS	35.707	36.470	34.850	34.953
FEET	38.469	38.644	36.286	36.281
CENTRAL BLOOD 36.108				

BLOOD FLOWS,BF,(N), LITERS/HR

	CORE	MUSCLE	FAT	SKIN
HEAD	46.987	4.236	0.786	3.759
TRUNK	219.260	96.259	15.197	5.546
ARMS	0.873	15.269	2.096	1.310
HANDS	0.097	0.297	0.306	5.264
LEGS	2.795	138.592	5.109	7.511
FEET	0.175	4.716	0.480	7.948

CBQ10(N) Q10 METABOLIC EFFECT,W

	CORE	MUSCLE	FAT	SKIN
HEAD	-0.928	0.027	0.029	0.024
TRUNK	-3.270	0.177	0.400	0.155
ARMS	-0.033	0.291	0.052	0.050
HANDS	-0.001	0.035	0.007	0.022
LEGS	0.054	0.645	0.152	0.130

FEET	0.065	0.008	0.204	0.032

TOTAL OF C3010(N)= -1.674

METABOLIC HEAT PRODUCTION,Q(N), WATTS

	CORE	MUSCLE	FAT	SKIN
HEAD	13.941	1.780	0.158	0.110
TRUNK	49.071	41.034	2.877	0.619
ARMS	0.784	4.711	0.250	0.196
HANDS	0.085	0.267	0.033	0.082
LEGS	2.634	106.480	0.651	0.500
FEET	0.211	15.273	0.720	0.109

NON-SHIVERING THERMOGENESIS,NST(N), WATTS

	CORE	MUSCLE	FAT	SKIN
HEAD	0.0	0.0	0.0	0.0
TRUNK	0.0	0.0	0.0	0.0
ARMS	0.0	0.0	0.0	0.0
HANDS	0.0	0.0	0.0	0.0
LEGS	0.0	0.0	0.0	0.0
FEET	0.0	0.0	0.0	0.0

EVAPORATIVE HEAT LOSS,E(N), WATTS

	CORE	MUSCLE	FAT	SKIN
HEAD	0.0	0.0	0.0	0.810
TRUNK	4.927	0.0	0.0	3.780
ARMS	0.0	0.0	0.0	1.400
HANDS	0.0	0.0	0.0	0.520
LEGS	0.0	0.0	0.0	3.320
FEET	0.0	0.0	0.0	0.720

EVAPORATIVE HEAT LOSS, EG(N), GM/HR

	CORE	MUSCLE	FAT	SKIN
HEAD	0.0	0.0	0.0	0.917
TRUNK	7.328	0.0	0.0	5.616
ARMS	0.0	0.0	0.0	1.011
HANDS	0.0	0.0	0.0	0.523
LEGS	0.0	0.0	0.0	4.835
FEET	0.0	0.0	0.0	0.849

FILM ON SKIN FORMED BY OVER-SWEATING,FILM(N), MICRONS

	CORE	MUSCLE	FAT	SKIN
HEAD	0.0	0.0	0.0	0.0
TRUNK	0.0	0.0	0.0	0.0
ARMS	0.0	0.0	0.0	0.001
HANDS	0.0	0.0	0.0	0.0
LEGS	0.0	0.0	0.0	0.0
FEET	0.0	0.0	0.0	0.0

DRIP=EXCESS SWEAT-FILM-CLOWAT,DRIP(N) GM/HR

	CORE	MUSCLE	FAT	SKIN
HEAD	0.0	0.0	0.0	0.0
TRUNK	0.0	0.0	0.0	0.0
ARMS	0.0	0.0	0.0	0.0

HANDS	0.0	0.0	0.0	0.0
LEGS	0.0	0.0	0.0	0.0
FEET	0.0	0.0	0.0	0.0

SWEAT THAT SOAKS INTO CLOTHES,CLOWAT(N), GM/HR

	CORE	MUSCLE	FAT	SKIN
HEAD	0.0	0.0	0.0	0.0
TRUNK	0.0	0.0	0.0	0.0
ARMS	0.0	0.0	0.0	0.0
HANDS	0.0	0.0	0.0	0.0
LEGS	0.0	0.0	0.0	0.0
FEET	0.0	0.0	0.0	0.0

CONVECTIVE HEAT TRANSFER BETWEEN CENTRAL BLOOD AND ELEMENTS,BC(N), WATTS

	CORE	MUSCLE	FAT	SKIN
HEAD	4.614	0.313	-0.204	-0.241
TRUNK	6.095	-1.225	-18.604	-5.710
ARMS	-0.999	-15.710	-3.984	-2.410
HANDS	-0.004	-0.010	0.042	0.982
LEGS	-1.060	49.050	-6.643	-8.977
FEET	0.402	11.740	0.084	1.361

CONDUCTIVE HEAT TRANSFER BETWEEN SUCCESSIVE ELEMENTS,TD(N), WATTS

	CORE	MUSCLE	FAT	SKIN
HEAD	0.034	0.0	-1.208	0.0
TRUNK	0.222	0.0	-5.482	0.0
ARMS	-0.471	0.0	-1.306	0.0
HANDS	-0.157	0.0	-0.409	0.0
LEGS	-5.742	0.0	-5.108	0.0
FEET	-2.798	0.0	0.044	0.0

RATE OF HEAT FLOW INTO OR FROM AN ELEMENT,HF(N), WATTS

	CORE	MUSCLE	FAT	SKIN
HEAD	9.293	1.501	1.570	1.671
TRUNK	41.455	42.481	26.962	8.235
ARMS	2.254	19.950	5.540	4.547
HANDS	0.246	0.120	0.399	0.879
LEGS	9.437	51.688	12.402	9.976
FEET	2.607	0.735	0.592	1.117
CENTRAL BLOOD	8.887			

RATE OF CHANGE OF TEMPERATURE OF AN ELEMENT,F(N), DEG C/HR

	CORE	MUSCLE	FAT	SKIN
HEAD	3.794	3.974	7.007	6.268
TRUNK	3.783	2.356	6.269	6.110
ARMS	1.442	5.881	9.512	9.446
HANDS	1.576	1.621	4.693	4.567
LEGS	2.009	5.050	8.571	8.315
FEET	10.202	9.021	4.556	4.438
CENTRAL BLOOD	4.205			

TSETWA(N) SET POINT FOR RECEPTORS FOR ACTIVITY WARM CONDITION, DEG C

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                 CORE          MUSCLE          FAT           SKIN
HEAD            36.660         34.360        34.040         33.760
TRUNK           36.590         35.810        33.560         32.390
ARMS            35.240         32.940        32.080         31.520
HANDS           36.120         34.850        34.120         33.390
LEGS            35.520         34.870        32.350         32.080
FEET            34.850         34.660        33.110         32.990
CENTRAL BLOOD
     36.410

  CARDIAC OUTPUT,CC=    9.749  LITERS/MINUTE

  HEART RATE, HEARTR=    94.220  BEATS/MINUTE

  SKIN BLOOD FLOWS,SBF =     0.523  LITERS/MINUTE

  HEAT PRODUCTION(METABOLISM+SHIVERING),HP=  242.574  WATTS

  TOTAL EVAPORATIVE HEAT LOSS,EV=E+RWET=    20.404  WATTS

  TOTAL EVAPORATIVE LOSS, TEVG=EV/EVCP=    21.079  GM/HR

  CUMULATIVE WATER LOSS,CEVG=      5.501  GM

  MEAN SKIN TEMPERATURE,TS=    35.161 DEG C

  MEAN BODY TEMPERATURE,TB=    35.887 DEG C


                                                   11 MINS

 QLO  =      12.3970        AU   =      9.9463      AM   =      1.1745      AHM  =      1.1857      ANM  =      1.1709
 VP   =       3.0197        VUD  =      0.0002      NAE  =   2135.0754      KE   =     75.0500      KI   =   3549.8997
 VEC  =      14.9552        VIC  =     24.9826      CNA  =    142.7551      CKE  =      5.0186      CKI  =    142.0833
 EXQ  =       0.0           RMO  =   1604.4629


                                                   12 MINS

 QLC  =      13.0146        AU   =      9.9595      AM   =      1.2286      AHM  =      1.2103      ANM  =      1.2189
 VP   =       3.0273        VUD  =      0.0002      NAE  =   2135.0449      KE   =     75.0206      KI   =   3549.9238
 VEC  =      14.9380        VIC  =     24.9771      CNA  =    142.9267      CKE  =      5.0232      CKI  =    142.1100
 EXQ  =       0.0           RMO  =   1650.1311


                                                   13 MINS

 QLC  =      13.1058        AU   =      9.9681      AM   =      1.2876      AHM  =      1.2389      ANM  =      1.2689
 VP   =       3.0340        VUD  =      0.0002      NAE  =   2135.0161      KE   =     74.9791      KI   =   3549.9597
 VEC  =      14.9228        VIC  =     24.9657      CNA  =    143.0706      CKE  =      5.0259      CKI  =    142.1481
 EXQ  =       0.0           RMO  =   1665.8489


                                                   14 MINS

 QLC  =      13.1415        AU   =      9.9766      AM   =      1.3191      AHM  =      1.2546      ANM  =      1.2947
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VP   =    3.0373      VUD  =     0.0002      NAE  = 2135.0022      KE   =   74.9545      KI   = 3549.9814
VEC  =   14.9164      VIC  =    24.9652      CNA  =  143.1315      CKE  =    5.0266      CKI  =  142.1718
EXQ  =    0.0         PMC  =  1674.0601

                                          15 MINS

QLO  =   13.2065      AU   =     9.9850      AM   =    1.3855      AHM  =    1.2879      ANM  =    1.3467
VP   =    3.0436      VUD  =     0.0002      NAE  = 2134.9741      KE   =   74.8970      KI   = 3550.0327
VEC  =   14.9061      VIC  =    24.9548      CNA  =  143.2282      CKE  =    5.0265      CKI  =  142.2279
EXQ  =    0.0         PMC  =  1677.8040
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TIME=     20.  MINUTES
 DRY BULB AIR TEMPERATURE, TAAR=   43.30DEG C
TOTAL METABOLIC ACTIVITY,WORKT=  279.00  WATTS
AIR VELOCITY,V=    0.45  M/SEC
 BAROMETRIC PRESSURE,BARO= 736.0 MM
RELATIVE HUMIDITY,RH=     0.55
MEAN RADIENT TEMPERATURE,TR=  43.300
DURING THE LAST     5 MINUTES OF SIMULATION THE SUBJECT LOST:
     2.9212 MILLIGRAMS OF SODIUM CHLORIDE
     1.7662 MILLIGRAMS OF POTASSIUM CHLORIDE
     4.5838 MILLILITERS OF WATER
THROUGH RESPIRATION AND SWEATING.
THE CUMULATIVE LOSSES DURING THE SIMULATION ARE:
    62.5268 MILLIGRAMS OF SODIUM CHLORIDE
     6.7308 MILLIGRAMS OF POTASSIUM CHLORIDE
    12.0455 MILLILITERS OF WATER
THESE TOTALS INCLUDE RESPIRATION, URINE AND SWEAT OUTPUTS AND DRINKING INPUTS.

          HEAD     TRUNK     ARMS     HANDS     LEGS     FEET     TOTAL  UNITS
CONVECTIVE HEAT TRANSFER COEFFICIENT(MIXED),HCMIX=   5.31 W/SQ M-C
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CONVECTIVE HEAT TRANSFER COEFFICIENT(SEATED),HCSEAT= 7.78 W/SQ M-C

CONVECTIVE HEAT TRANSFER COEFFICIENT(WALKING),HCWALK= 13.83 W/SQ M-C

PSKIN(I)	45.292	42.931	41.752	45.850	43.253	45.890		MM HG
EMAX(I)	19.761	47.135	13.608	17.492	38.747	21.078		WATTS
SWPCP(I)	3.955	23.487	7.520	1.514	10.645	1.709	48.829	SWEAT,HEAT REMOVAL COMMAND/SKIN SEGMENT, WATTS
SWCG	5.252	34.910	11.172	1.735	15.812	2.198	71.080	SWEAT,HEAT REMOVAL COMMAND/SKIN SEGMENT, GM/HR
EWET(I)	0.349	0.912	1.000	0.177	0.580	0.183		RATIO OF WET/DRY SURFACE
H(I)	0.970	3.140	1.103	0.808	2.461	0.970		WATTS/DEG C

TEMPERATURES,T(N), DEG C

	CORE	MUSCLE	FAT	SKIN
HEAD	36.547	36.520	36.301	36.154
TRUNK	36.473	36.308	35.410	35.247
ARMS	35.113	35.561	34.572	34.852
HANDS	36.192	36.209	36.461	36.409
LEGS	35.909	36.860	35.456	35.464
FEET	39.143	39.171	36.526	36.433

CENTRAL BLOOD
36.460

BLOOD FLOWS,BF,(N), LITERS/HR

	CORE	MUSCLE	FAT	SKIN
HEAD	46.987	4.146	0.786	3.799
TRUNK	219.260	92.331	15.197	15.822
ARMS	0.373	15.098	2.056	4.342
HANDS	0.087	0.301	0.306	9.146
LEGS	2.795	138.429	5.109	14.651
FEET	0.175	4.716	0.490	11.139

QBQ10(N) Q10 METABOLIC EFFECT,W

	CORE	MUSCLE	FAT	SKIN
HEAD	-0.264	0.032	0.037	0.027
TRUNK	-0.956	0.346	0.566	0.173
ARMS	-0.015	0.358	0.071	0.062
HANDS	0.001	0.039	0.008	0.023
LEGS	0.119	0.315	0.195	0.158
FEET	0.078	0.010	0.223	0.034

TOTAL OF QBQ10(N)= 2.139

METABOLIC HEAT PRODUCTION,Q(N), WATTS

	CORE	MUSCLE	FAT	SKIN
HEAD	14.606	1.690	0.166	0.113
TRUNK	51.385	37.135	3.043	0.637
ARMS	0.302	4.539	0.269	0.208
HANDS	0.087	0.272	0.033	0.063
LEGS	2.699	106.316	0.694	0.528
FEET	0.224	15.274	0.739	0.111

NON-SHIVERING THERMOGENESIS,NST(N), WATTS

	CORE	MUSCLE	FAT	SKIN
HEAD	0.0	0.0	0.0	0.0
TRUNK	0.0	0.0	0.0	0.0
ARMS	0.0	0.0	0.0	0.0
HANDS	0.0	0.0	0.0	0.0
LEGS	0.0	0.0	0.0	0.0
FEET	0.0	0.0	0.0	0.0

EVAPORATIVE HEAT LOSS,E(N), WATTS

	CORE	MUSCLE	FAT	SKIN
HEAD	0.0	0.0	0.0	6.897
TRUNK	4.927	0.0	0.0	42.950
ARMS	0.0	0.0	0.0	13.608
HANDS	0.0	0.0	0.0	3.097
LEGS	0.0	0.0	0.0	22.475
FEET	0.0	0.0	0.0	3.847

EVAPORATIVE HEAT LOSS, EG(N), GM/HR

	CORE	MUSCLE	FAT	SKIN
HEAD	0.0	0.0	0.0	9.158
TRUNK	7.331	0.0	0.0	63.859
ARMS	0.0	0.0	0.0	20.216
HANDS	0.0	0.0	0.0	3.550
LEGS	0.0	0.0	0.0	33.386
FEET	0.0	0.0	0.0	4.948

FILM ON SKIN FORMED BY OVER-SWEATING,FILM(N), MICRONS

	CORE	MUSCLE	FAT	SKIN
HEAD	0.0	0.0	0.0	0.0
TRUNK	0.0	0.0	0.0	0.0
ARMS	0.0	0.0	0.0	1.796
HANDS	0.0	0.0	0.0	0.0
LEGS	0.0	0.0	0.0	0.0
FEET	0.0	0.0	0.0	0.0

DRIP=EXCESS SWEAT-FILM-CLOWAT,DRIP(N) GM/HR

	CORE	MUSCLE	FAT	SKIN
HEAD	0.0	0.0	0.0	0.0
TRUNK	0.0	0.0	0.0	0.0
ARMS	0.0	0.0	0.0	0.0
HANDS	0.0	0.0	0.0	0.0
LEGS	0.0	0.0	0.0	0.0
FEET	0.0	0.0	0.0	0.0

SWEAT THAT SOAKS INTO CLOTHES,CLOWAT(N), GM/HR

	CORE	MUSCLE	FAT	SKIN
HEAD	0.0	0.0	0.0	0.0
TRUNK	0.0	0.0	0.0	0.0
ARMS	0.0	0.0	0.0	0.0
HANDS	0.0	0.0	0.0	0.0
LEGS	0.0	0.0	0.0	0.0
FEET	0.0	0.0	0.0	0.0

CONVECTIVE HEAT TRANSFER BETWEEN CENTRAL BLOOD AND ELEMENTS,BC(N), WATTS

	CORE	MUSCLE	FAT	SKIN
HEAD	6.932	0.454	-0.050	-0.465
TRUNK	16.360	-7.897	-15.163	-16.186
ARMS	-1.117	-12.860	-2.585	-6.514
HANDS	-0.017	-0.053	0.032	0.827
LEGS	-1.351	63.425	-4.658	-13.366
FEET	0.472	13.448	0.079	1.175

CONDUCTIVE HEAT TRANSFER BETWEEN SUCCESSIVE ELEMENTS,TD(N), WATTS

	CORE	MUSCLE	FAT	SKIN
HEAD	0.042	0.0	0.365	0.0
TRUNK	0.878	0.0	0.710	0.0
ARMS	-1.740	0.0	1.628	0.0
HANDS	-0.201	0.0	0.148	0.0
LEGS	-7.376	0.0	-0.566	0.0
FEET	-2.279	0.0	0.788	0.0

RATE OF HEAT FLOW INTO OR FROM AN ELEMENT,HF(N), WATTS

	CORE	MUSCLE	FAT	SKIN
HEAD	7.582	1.238	-0.149	-2.728
TRUNK	32.952	45.930	17.496	-14.738
ARMS	3.658	15.659	1.626	-0.940
HANDS	0.305	0.124	-0.147	-1.086
LEGS	11.427	35.516	5.517	-0.853
FEET	2.031	-0.453	-0.128	-1.180
CENTRAL BLOOD 20.613				

RATE OF CHANGE OF TEMPERATURE OF AN ELEMENT,F(N), DEG C/HR

	CORE	MUSCLE	FAT	SKIN
HEAD	3.095	3.278	-0.666	-10.233
TRUNK	2.998	2.547	4.063	-10.912
ARMS	2.340	4.617	2.791	-1.952
HANDS	1.955	1.672	-1.723	-5.638
LEGS	2.433	3.470	4.099	-0.711
FEET	7.948	-5.558	-0.587	-4.688
CENTRAL BLOOD 9.752				

TSETWA(N) SET POINT FOR RECEPTORS FOR ACTIVITY WARM CONDITION, DEG C

	CORE	MUSCLE	FAT	SKIN
HEAD	36.660	34.360	34.040	33.760
TRUNK	36.590	35.810	33.560	32.390
ARMS	35.240	32.940	32.080	31.520
HANDS	36.120	34.850	34.120	33.390
LEGS	35.520	34.870	32.350	32.080
FEET	34.850	34.660	33.110	32.950
CENTRAL BLOOD 36.410				

CARDIAC OUTPUT,CO= 10.139 LITERS/MINUTE

HEART RATE, HEARTR= 97.990 BEATS/MINUTE

SKIN BLOOD FLOWS,SBF = 0.985 LITERS/MINUTE

HEAT PRODUCTION(METABOLISM+SHIVERING),HP= 241.673 WATTS

TOTAL EVAPORATIVE HEAT LOSS,EV=E+RWET= 102.768 WATTS

TOTAL EVAPORATIVE LOSS, TEVG=EV/EVCP= 142.498 GM/HR

CUMULATIVE WATER LOSS,CEVG= 10.085 GM

MEAN SKIN TEMPERATURE,TS= 35.470 DEG C

MEAN BODY TEMPERATURE,TB= 36.218 DEG C

16 MINS

QLO =	13.5449	AU =	10.0667	AM =	1.4550	AHM =	1.3147	ANM =	1.3993
VP =	3.1120	VUD =	0.0002	NAE =	2136.4900	KE =	75.1136	KI =	3550.0652
VEC =	14.9656	VIC =	24.9495	CNA =	142.7599	CKE =	5.0197	CKI =	142.2832
EXQ =	0.5154	RMO =	1706.3855						

17 MINS

QLO =	13.5526	AU =	10.0776	AM =	1.4989	AHM =	1.3227	ANM =	1.4325
VP =	3.1129	VUD =	0.0002	NAE =	2136.4656	KE =	75.0716	KI =	3550.0991
VEC =	14.9664	VIC =	24.9445	CNA =	142.7507	CKE =	5.0170	CKI =	142.3090
EXQ =	0.5154	RMO =	1698.4949						

18 MINS

QLC =	13.5741	AU =	10.0882	AM =	1.5454	AHM =	1.3292	ANM =	1.4669
VP =	3.1135	VUD =	0.0002	NAE =	2136.4402	KE =	75.0304	KI =	3550.1321
VEC =	14.9679	VIC =	24.9395	CNA =	142.7352	CKE =	5.0141	CKI =	142.3344
EXQ =	0.5154	RMO =	1696.4768						

19 MINS

QLO =	13.6060	AU =	10.1021	AM =	1.6130	AHM =	1.3364	ANM =	1.5147
VP =	3.1140	VUD =	0.0002	NAE =	2136.4041	KE =	74.9766	KI =	3550.1736
VEC =	14.9706	VIC =	24.9329	CNA =	142.7062	CKE =	5.0099	CKI =	142.3689
EXQ =	0.5154	RMO =	1697.5925						

20 MINS

QLC =	13.6171	AU =	10.1089	AM =	1.6572	AHM =	1.3400	ANM =	1.5445
VP =	3.1142	VUD =	0.0002	NAE =	2136.3805	KE =	74.9453	KI =	3550.1968
VEC =	14.9728	VIC =	24.9289	CNA =	142.6843	CKE =	5.0072	CKI =	142.3901
EXC =	0.5154	RMO =	1697.0542						

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TIME=     25.  MINUTES
 DRY BULB AIR TEMPERATURE, TAAR=   43.30DEG C
TOTAL METABOLIC ACTIVITY,WORKT=  279.00  WATTS
AIR VELOCITY,V=    0.45  M/SEC
 BAROMETRIC PRESSURE,BAPO= 736.0 MM
RELATIVE HUMIDITY,RH=    0.55
MEAN RADIENT TEMPERATURE,TR=  43.300
DURING THE LAST    5 MINUTES OF SIMULATION THE SUBJECT LOST:
    10.8692 MILLIGRAMS OF SODIUM CHLORIDE
     5.7180 MILLIGRAMS OF POTASSIUM CHLORIDE
    13.3141 MILLILITERS OF WATER
THROUGH RESPIRATION AND SWEATING.
 THE CUMULATIVE LOSSES DURING THE SIMULATION ARE:
   -12.0959 MILLIGRAMS OF SODIUM CHLORIDE
    -5.4045 MILLIGRAMS OF POTASSIUM CHLORIDE
   -38.5152 MILLILITERS OF WATER
THE NEGATIVE AMOUNTS ABOVE SHOW DRINKING INPUT EXCEEDED SYSTEM LOSS.
THE SUBJECT DRANK 0.06414 LITERS DURING THIS OUTPUT CYCLE
THESE TOTALS INCLUDE RESPIRATION, URINE AND SWEAT OUTPUTS AND DRINKING INPUTS.

            HEAD      TRUNK     ARMS      HANDS     LEGS      FEET     TOTAL  UNITS
 CONVECTIVE HEAT TRANSFER COEFFICIENT(MIXED),HCMIX=   5.32 W/SQ M-C
 CONVECTIVE HEAT TRANSFER COEFFICIENT(SEATED),HCSEAT=   7.78 W/SQ M-C
 CONVECTIVE HEAT TRANSFER COEFFICIENT(WALKING),HCWALK=  13.83 W/SQ M-C
 PSKIN(I)   42.985    42.765    42.145    45.277    43.048    45.330           MM HG
 EMAX(I)    14.679    45.951    14.593    16.440    37.596    19.845           WATTS
 SWPCP(I)   10.046    59.656    19.100     3.845    27.037     4.341  124.025 SWEAT,HEAT REMOVAL COMMAND/SKIN SEGMENT,  WATTS
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SWCG	14.910	88.663	28.381	4.856	40.188	5.901	182.898	SWEAT,HEAT REMOVAL COMMAND/SKIN SEGMENT, GM/HR
EWET(I)	0.960	1.000	1.000	0.415	1.000	0.422		RATIO OF WET/DRY SURFACE
H(I)	0.970	3.149	1.103	0.808	2.461	0.970		WATTS/DEG C

TEMPERATURES,T(N), DEG C

	CORE	MUSCLE	FAT	SKIN
HEAD	36.759	36.742	35.771	35.296
TRUNK	36.675	36.498	35.588	35.307
ARMS	35.306	35.874	35.139	35.072
HANDS	36.336	36.355	36.262	36.251
LEGS	36.097	37.088	35.514	35.401
FEET	39.433	39.556	36.334	36.265

CENTRAL BLOOD
36.533

BLOOD FLOWS,BF,(N), LITERS/HR

	CORE	MUSCLE	FAT	SKIN
HEAD	46.587	4.137	0.786	3.799
TRUNK	219.260	91.988	15.157	24.336
ARMS	0.873	15.112	2.096	6.854
HANDS	0.087	0.306	0.306	12.345
LEGS	2.795	138.465	5.109	20.933
FEET	3.175	4.716	0.480	13.783

CBQ10(N) Q10 METABOLIC EFFECT,W

	CORE	MUSCLE	FAT	SKIN
HEAD	0.153	0.036	0.029	0.017
TRUNK	0.447	0.489	0.628	0.169
ARMS	0.005	0.403	0.076	0.065
HANDS	0.002	0.044	0.007	0.022
LEGS	0.182	0.915	0.199	0.154
FEET	0.084	0.010	0.211	0.032

TOTAL OF CBQ10(N)= 4.380

METABOLIC HEAT PRODUCTION,Q(N), WATTS

	CORE	MUSCLE	FAT	SKIN
HEAD	15.022	1.681	0.158	0.103
TRUNK	52.787	36.763	3.105	0.634
ARMS	0.822	4.554	0.274	0.211
HANDS	0.088	0.276	0.033	0.082
LEGS	2.762	106.373	0.658	0.524
FEET	0.231	15.275	0.727	0.109

NON-SHIVERING THERMOGENESIS,NST(N), WATTS

	CORE	MUSCLE	FAT	SKIN
HEAD	0.0	0.0	0.0	0.0
TRUNK	0.0	0.0	0.0	0.0
ARMS	0.0	0.0	0.0	0.0
HANDS	0.0	0.0	0.0	0.0
LEGS	0.0	0.0	0.0	0.0
FEET	0.0	0.0	0.0	0.0

EVAPORATIVE HEAT LOSS,E(N), WATTS

	CORE	MUSCLE	FAT	SKIN
HEAD	0.0	0.0	0.0	14.084
TRUNK	4.027	0.0	0.0	45.551
ARMS	0.0	0.0	0.0	14.593
HANDS	0.0	0.0	0.0	6.823
LEGS	0.0	0.0	0.0	37.556
FEET	0.0	0.0	0.0	8.373

EVAPORATIVE HEAT LOSS, EG(N), GM/HR

	CORE	MUSCLE	FAT	SKIN
HEAD	0.0	0.0	0.0	20.903
TRUNK	7.332	0.0	0.0	68.294
ARMS	0.0	0.0	0.0	21.684
HANDS	0.0	0.0	0.0	8.617
LEGS	0.0	0.0	0.0	55.882
FEET	0.0	0.0	0.0	11.383

FILM ON SKIN FORMED BY OVER-SWEATING,FILM(N), MICRONS

	CORE	MUSCLE	FAT	SKIN
HEAD	0.0	0.0	0.0	0.0
TRUNK	0.0	0.0	0.0	105.057
ARMS	0.0	0.0	0.0	34.764
HANDS	0.0	0.0	0.0	0.0
LEGS	0.0	0.0	0.0	29.569
FEET	0.0	0.0	0.0	0.0

DRIP=EXCESS SWEAT-FILM-CLOWAT,DRIP(N) GM/HR

	CORE	MUSCLE	FAT	SKIN
HEAD	0.0	0.0	0.0	0.0
TRUNK	0.0	0.0	0.0	0.0
ARMS	0.0	0.0	0.0	0.0
HANDS	0.0	0.0	0.0	0.0
LEGS	0.0	0.0	0.0	0.0
FEET	0.0	0.0	0.0	0.0

SWEAT THAT SOAKS INTO CLOTHES,CLOWAT(N), GM/HR

	CORE	MUSCLE	FAT	SKIN
HEAD	0.0	0.0	0.0	0.0
TRUNK	0.0	0.0	0.0	0.0
ARMS	0.0	0.0	0.0	0.0
HANDS	0.0	0.0	0.0	0.0
LEGS	0.0	0.0	0.0	0.0
FEET	0.0	0.0	0.0	0.0

CONVECTIVE HEAT TRANSFER BETWEEN CENTRAL BLOOD AND ELEMENTS,BC(N), WATTS

	CORE	MUSCLE	FAT	SKIN
HEAD	8.364	0.665	-0.574	-4.541
TRUNK	20.666	-7.507	-15.059	-31.136
ARMS	-1.114	-10.800	-3.027	-10.388
HANDS	-0.021	-0.068	-0.087	-3.966
LEGS	-1.350	70.132	-5.367	-24.524
FEET	0.501	13.640	-0.102	-4.148

CONDUCTIVE HEAT TRANSFER BETWEEN SUCCESSIVE ELEMENTS,TC(N), WATTS

	CORE	MUSCLE	FAT	SKIN
HEAD	0.025	0.0	2.870	0.0
TRUNK	0.964	0.0	8.126	0.0
ARMS	-2.285	0.0	1.522	0.0
HANDS	-0.186	0.0	0.345	0.0
LEGS	-7.750	0.0	5.994	0.0
FEET	-0.385	0.0	1.184	0.0

RATE OF HEAT FLOW INTO OR FROM AN ELEMENT,HF(N), WATTS

	CORE	MUSCLE	FAT	SKIN
HEAD	6.634	1.040	-2.138	-2.941
TRUNK	29.863	45.233	10.038	4.778
ARMS	4.221	13.069	1.779	1.754
HANDS	0.256	0.157	-0.225	0.260
LEGS	11.862	28.491	0.171	1.722
FEET	0.115	1.249	-0.356	0.103
CENTRAL BLOOD -9.609				

RATE OF CHANGE OF TEMPERATURE OF AN ELEMENT,F(N), DEG C/HR

	CORE	MUSCLE	FAT	SKIN
HEAD	2.708	2.754	-9.547	-11.029
TRUNK	2.725	2.508	2.334	3.545
ARMS	2.700	3.853	3.055	3.644
HANDS	1.856	2.124	-2.641	1.351
LEGS	2.525	2.784	0.118	1.435
FEET	0.450	15.337	-2.740	0.409
CENTRAL BLOOD -4.641				

TSETWA(N) SET POINT FOR RECEPTORS FOR ACTIVITY WARM CONDITION, DEG C

	CORE	MUSCLE	FAT	SKIN
HEAD	36.660	34.360	34.040	33.760
TRUNK	36.590	35.810	33.560	32.390
ARMS	35.240	32.940	32.080	31.520
HANDS	36.120	34.850	34.120	33.390
LEGS	35.520	34.870	32.350	32.080
FEET	34.850	34.660	33.110	32.950
CENTRAL BLOOD 36.410				

CARDIAC OUTPUT,CO= 10.516 LITERS/MINUTE

HEART RATE, HEARTR= 101.634 BEATS/MINUTE

SKIN BLOOD FLOWS,SBF = 1.367 LITERS/MINUTE

HEAT PRODUCTION(METABOLISM+SHIVERING),HP= 243.290 WATTS

TOTAL EVAPORATIVE HEAT LOSS,EV=E+RWET= 137.275 WATTS

TOTAL EVAPORATIVE LOSS, TEVG=EV/EVCP= 194.097 GM/HR

CUMULATIVE WATER LOSS,CEVG= 23.399 GM

MEAN SKIN TEMPERATURE,TS= 35.419 DEG C

MEAN BODY TEMPERATURE,TB= 36.398 DEG C

21 MINS

CLC = 13.6215	AU = 10.1156	AM = 1.7098	AHM = 1.3433	ANM = 1.5786
VP = 3.1142	VUD = 0.0002	NAE = 2136.3201	KE = 74.8994	KI = 3550.2202
VEC = 14.9739	VIC = 24.9244	CNA = 142.6696	CKE = 5.0038	CKI = 142.4139
EXQ = 1.0555	RMO = 1695.8232			

23 MINS

QLO = 13.6162	AU = 10.1222	AM = 1.7724	AHM = 1.3461	ANM = 1.6169
VP = 3.1139	VUD = 0.0002	NAE = 2136.2473	KE = 74.8506	KI = 3550.2419
VEC = 14.9756	VIC = 24.9155	CNA = 142.6483	CKE = 4.9999	CKI = 142.4404
EXC = 1.0555	RMO = 1693.6477			

25 MINS

CLC = 13.6026	AU = 10.1319	AM = 1.8464	AHM = 1.3481	ANM = 1.6593
VP = 3.1133	VUD = 0.0002	NAE = 2136.1604	KE = 74.8038	KI = 3550.2590
VEC = 14.9782	VIC = 24.9142	CNA = 142.6178	CKE = 4.9955	CKI = 142.4693
EXQ = 1.0555	RMO = 1693.8777			

TIME= 30. MINUTES

DRY BULB AIR TEMPERATURE, TAAR= 43.30DEG C

TOTAL METABOLIC ACTIVITY,WORKT= 279.00 WATTS

AIR VELOCITY,V= 0.45 M/SEC

BAROMETRIC PRESSURE,BARO= 736.0 MM

RELATIVE HUMIDITY,RH= 0.55

MEAN RADIENT TEMPERATURE,TR= 43.300

DURING THE LAST 5 MINUTES OF SIMULATION THE SUBJECT LOST:

17.1954 MILLIGRAMS OF SODIUM CHLORIDE

8.6497 MILLIGRAMS OF POTASSIUM CHLORIDE

20.0647 MILLILITERS OF WATER

THROUGH RESPIRATION AND SWEATING.

THE CUMULATIVE LOSSES DURING THE SIMULATION ARE:

8.3840 MILLIGRAMS OF SODIUM CHLORIDE

4.3418 MILLIGRAMS OF POTASSIUM CHLORIDE

-18.2308 MILLILITERS OF WATER

THE NEGATIVE AMOUNTS ABOVE SHOW DRINKING INPUT EXCEEDED SYSTEM LOSS.

THESE TOTALS INCLUDE RESPIRATION, URINE AND SWEAT OUTPUTS AND DRINKING INPUTS.

	HEAD	TRUNK	ARMS	HANDS	LEGS	FEET	TOTAL	UNITS
CONVECTIVE HEAT TRANSFER COEFFICIENT(MIXED),HCMIX= 5.30 W/SQ M-C								
CONVECTIVE HEAT TRANSFER COEFFICIENT(SEATED),HCSEAT= 7.78 W/SQ M-C								
CONVECTIVE HEAT TRANSFER COEFFICIENT(WALKING),HCWALK= 13.83 W/SQ M-C								
PSKIN(I)	41.966	43.455	42.900	45.177	43.448	45.109		MM HG
EMAX(I)	12.433	50.875	16.485	16.256	39.835	19.358		WATTS
SWPCP(I)	15.590	92.575	29.640	5.966	41.557	6.736	192.464	SWEAT,HEAT REMOVAL COMMAND/SKIN SEGMENT, WATTS
SWCG	23.163	137.623	44.053	8.258	62.373	9.636	285.106	SWEAT,HEAT REMOVAL COMMAND/SKIN SEGMENT, GM/HR
EWET(I)	1.000	1.000	1.000	0.630	1.000	0.642		RATIO OF WET/DRY SURFACE
H(I)	0.970	3.140	1.103	0.808	2.461	0.970		WATTS/DEG C

TEMPERATURES,T(N), DEG C

	CORE	MUSCLE	FAT	SKIN
HEAD	36.950	36.951	35.224	34.959
TRUNK	36.865	36.716	35.820	35.597
ARMS	35.574	36.196	35.444	35.386
HANDS	36.523	36.542	36.217	36.232
LEGS	36.337	37.293	35.646	35.586
FEET	39.684	39.781	36.243	36.191

CENTRAL BLOOD
36.671

BLOOD FLOWS,BF,(N), LITERS/HR

	CORE	MUSCLE	FAT	SKIN
HEAD	46.587	4.140	0.786	3.799
TRUNK	219.260	92.132	15.157	32.518
ARMS	0.873	15.153	2.096	9.170
HANDS	0.087	0.311	0.306	15.419
LEGS	2.795	138.564	5.109	26.777
FEET	0.175	4.716	0.480	16.324

CBQ10(N) Q10 METABOLIC EFFECT,W

THROUGH RESPIRATION AND SWEATING.

THE CUMULATIVE LOSSES DURING THE SIMULATION ARE:

8.3840 MILLIGRAMS OF SODIUM CHLORIDE

4.3418 MILLIGRAMS OF POTASSIUM CHLORIDE

-18.2308 MILLILITERS OF WATER

THE NEGATIVE AMOUNTS ABOVE SHOW DRINKING INPUT EXCEEDED SYSTEM LOSS.

THESE TOTALS INCLUDE RESPIRATION, URINE AND SWEAT OUTPUTS AND DRINKING INPUTS.

CONVECTIVE HEAT TRANSFER COEFFICIENT(MIXED),HCMIX= 5.30 W/SQ M-C

CONVECTIVE HEAT TRANSFER COEFFICIENT(SEATED),HCSEAT= 7.78 W/SQ M-C

CONVECTIVE HEAT TRANSFER COEFFICIENT(WALKING),HCWALK= 13.83 W/SQ M-C

	HEAD	TRUNK	ARMS	HANDS	LEGS	FEET	TOTAL	UNITS
PSKIN(I)	41.966	43.455	42.900	45.177	43.448	45.109		MM HG
EMAX(I)	12.433	50.875	16.485	16.256	39.835	19.358		WATTS
SWPCP(I)	15.590	92.575	29.640	5.966	41.957	6.736	192.464	SWEAT,HEAT REMOVAL COMMAND/SKIN SEGMENT, WATTS
SWCG	23.163	137.623	44.053	8.258	62.373	9.636	285.106	SWEAT,HEAT REMOVAL COMMAND/SKIN SEGMENT, GM/HR
EWET(I)	1.000	1.000	1.000	0.630	1.000	0.642		RATIO OF WET/DRY SURFACE
H(I)	0.970	3.140	1.103	0.808	2.461	0.970		WATTS/DEG C

TEMPERATURES,T(N), DEG C

	CORE	MUSCLE	FAT	SKIN
HEAD	36.950	36.951	35.224	34.959
TRUNK	36.865	36.716	35.820	35.597
ARMS	35.574	36.196	35.444	35.386
HANDS	36.523	36.542	36.217	36.232
LEGS	36.337	37.293	35.646	35.586
FEET	39.684	39.781	36.243	36.191

CENTRAL BLOOD
36.671

BLOOD FLOWS,BF,(N), LITERS/HR

	CORE	MUSCLE	FAT	SKIN
HEAD	46.587	4.140	0.786	3.799
TRUNK	219.260	92.132	15.157	32.518
ARMS	0.873	15.153	2.096	9.170
HANDS	0.087	0.311	0.306	15.419
LEGS	2.795	133.564	5.109	26.777
FEET	0.175	4.716	0.480	16.324

C9Q10(N) Q10 METABOLIC EFFECT,W

	CORE	MUSCLE	FAT	SKIN
HEAD	0.482	0.039	0.020	0.013
TRUNK	1.599	0.633	0.692	0.185
ARMS	0.030	0.445	0.083	0.070
HANDS	0.004	0.049	0.007	0.021
LEGS	0.252	0.994	0.205	0.161
FEET	0.039	0.011	0.205	0.031

TOTAL OF CRO10(N) = 6.321

METABOLIC HEAT PRODUCTION,Q(N), WATTS

	CORE	MUSCLE	FAT	SKIN
HEAD	15.353	1.684	0.149	0.099
TRUNK	53.940	36.907	3.169	0.649
ARMS	0.947	4.595	0.280	0.216
HANDS	0.090	0.231	0.033	0.082
LEGS	2.833	106.452	0.704	0.531
FEET	0.235	15.275	0.721	0.108

NON-SHIVERING THERMOGENESIS,NST(N), WATTS

	CORE	MUSCLE	FAT	SKIN
HEAD	0.0	0.0	0.0	0.0
TRUNK	0.0	0.0	0.0	0.0
ARMS	0.0	0.0	0.0	0.0
HANDS	0.0	0.0	0.0	0.0
LEGS	0.0	0.0	0.0	0.0
FEET	0.0	0.0	0.0	0.0

EVAPORATIVE HEAT LOSS,E(N), WATTS

	CORE	MUSCLE	FAT	SKIN
HEAD	0.0	0.0	0.0	12.433
TRUNK	4.927	0.0	0.0	50.875
ARMS	0.0	0.0	0.0	16.485
HANDS	0.0	0.0	0.0	10.236
LEGS	0.0	0.0	0.0	39.835
FEET	0.0	0.0	0.0	12.424

EVAPORATIVE HEAT LOSS, EG(N), GM/HR

	CORE	MUSCLE	FAT	SKIN
HEAD	0.0	0.0	0.0	18.474
TRUNK	7.333	0.0	0.0	75.631
ARMS	0.0	0.0	0.0	24.501
HANDS	0.0	0.0	0.0	14.168
LEGS	0.0	0.0	0.0	59.219
FEET	0.0	0.0	0.0	17.773

FILM ON SKIN FORMED BY OVER-SWEATING,FILM(N), MICRONS

	CORE	MUSCLE	FAT	SKIN
HEAD	0.0	0.0	0.0	13.013
TRUNK	0.0	0.0	0.0	216.452
ARMS	0.0	0.0	0.0	76.713
HANDS	0.0	0.0	0.0	0.0
LEGS	0.0	0.0	0.0	88.265
FEET	0.0	0.0	0.0	0.0

DRIP=EXCESS SWEAT-FILM-CLOWAT,DRIP(N) GM/HR

	CORE	MUSCLE	FAT	SKIN
HEAD	0.0	0.0	0.0	0.0
TRUNK	0.0	0.0	0.0	0.0
ARMS	0.0	0.0	0.0	0.0
HANDS	0.0	0.0	0.0	0.0
LEGS	0.0	0.0	0.0	0.0
FEET	0.0	0.0	0.0	0.0

SWEAT THAT SOAKS INTO CLOTHES,CLOWAT(N), GM/HR

	CORE	MUSCLE	FAT	SKIN
HEAD	0.0	0.0	0.0	0.0
TRUNK	0.0	0.0	0.0	0.0
ARMS	0.0	0.0	0.0	0.0
HANDS	0.0	0.0	0.0	0.0
LEGS	0.0	0.0	0.0	0.0
FEET	0.0	0.0	0.0	0.0

CONVECTIVE HEAT TRANSFER BETWEEN CENTRAL BLOOD AND ELEMENTS,BC(N), WATTS

	CORE	MUSCLE	FAT	SKIN
HEAD	10.586	0.930	-1.126	-6.530
TRUNK	30.666	-1.202	-13.889	-37.242
ARMS	-1.018	-8.294	-2.726	-12.443
HANDS	-0.018	-0.057	-0.142	-7.535
LEGS	-1.107	78.537	-5.516	-30.739
FEET	0.518	14.200	-0.209	-8.359

CONDUCTIVE HEAT TRANSFER BETWEEN SUCCESSIVE ELEMENTS,TD(N), WATTS

	CORE	MUSCLE	FAT	SKIN
HEAD	0.001	0.0	1.764	0.0
TRUNK	0.838	0.0	6.517	0.0
ARMS	-2.519	0.0	1.201	0.0
HANDS	-0.191	0.0	0.236	0.0
LEGS	-7.541	0.0	3.320	0.0
FEET	-0.694	0.0	1.043	0.0

RATE OF HEAT FLOW INTO CR FROM AN ELEMENT,FF(N), WATTS

	CORE	MUSCLE	FAT	SKIN
HEAD	4.766	0.755	-0.489	-0.231
TRUNK	21.141	38.547	10.541	4.010
ARMS	4.383	10.370	1.805	1.455
HANDS	0.298	0.147	-0.061	0.321
LEGS	11.481	20.374	2.900	2.970
FEET	0.411	0.381	-0.113	0.157
CENTRAL BLOOD -2.755				

RATE OF CHANGE OF TEMPERATURE OF AN ELEMENT,F(N), DEG C/HR

	CORE	MUSCLE	FAT	SKIN
HEAD	1.946	1.999	-2.185	-0.865
TRUNK	1.929	2.160	2.451	2.975
ARMS	2.803	3.057	3.100	3.022
HANDS	1.912	1.987	-0.721	1.668
LEGS	2.444	1.991	2.004	2.476

FEET	1.610	4.674	-0.870	0.781
CENTRAL BLOOD -1.303				

TSETWA(N) SET POINT FOR RECEPTORS FOR ACTIVITY WARM CONDITION, DEG C

	CORE	MUSCLE	FAT	SKIN
HEAD	36.660	34.360	34.040	33.760
TRUNK	36.590	35.810	33.560	32.390
ARMS	35.240	32.940	32.080	31.520
HANDS	36.120	34.850	34.120	33.390
LEGS	35.520	34.870	32.350	32.080
FEET	34.850	34.660	33.110	32.950
CENTRAL BLOOD 36.410				

CARDIAC OUTPUT,CO= 10.886 LITERS/MINUTE

HEART RATE, HEARTR= 105.215 BEATS/MINUTE

SKIN BLOOD FLOWS,SBF = 1.733 LITERS/MINUTE

HEAT PRODUCTION(METABOLISM+SHIVERING),HP= 245.231 WATTS

TOTAL EVAPORATIVE HEAT LOSS,EV=E+PWET= 152.143 WATTS

TOTAL EVAPORATIVE LOSS, TEVG=EV/EVCP= 217.098 GM/HR

CUMULATIVE WATER LOSS,CEVG= 43.463 GM

MEAN SKIN TEMPERATURE,TS= 35.594 DEG C

MEAN BODY TEMPERATURE,TB= 36.607 DEG C

26 MINS

QLC =	13.5646	AU =	10.1383	AM =	1.9335	AHM =	1.3490	ANM =	1.70
VP =	3.1121	VUD =	0.0002	NAE =	2136.0364	KE =	74.7476	KI =	3550.26
VEC =	14.9757	VIC =	24.9057	CNA =	142.5556	CKE =	4.9908	CKI =	142.49
EXQ =	1.5231	RMO =	1688.9436						

28 MINS

QLC =	13.5093	AU =	10.1477	AM =	2.0185	AHM =	1.3487	ANM =	1.74
VP =	3.1104	VUD =	0.0002	NAE =	2135.9478	KE =	74.7170	KI =	3550.26
VEC =	14.9819	VIC =	24.9069	CNA =	142.5687	CKE =	4.9873	CKI =	142.52
EXQ =	1.5231	RMO =	1635.6123						

29 MINS

QLC =	13.4310	AU =	10.1539	AM =	2.0783	AHM =	1.3477	ANM =	1.77
VP =	3.1090	VUD =	0.0002	NAE =	2135.3481	KE =	74.6907	KI =	3550.25
VEC =	14.9637	VIC =	24.9044	CNA =	142.5449	CKE =	4.9844	CKI =	142.54
EXQ =	1.5231	RMC =	1677.8630						

APPENDIX 2

Stolwijk Model Variable Listing

APPENDIX 2

List of symbols used in KSU-Stolwijk program with definitions and dimensions.

Symbol	Definition	Dimension
AEWET	Total body wet/dry ratio	N.D.*
AGE	Subject age	years
AVDELT	Average temperature difference between skin and air	°C
BARO	Barometric pressure	mm.Hg
BC(N)	Convective heat transfer between central blood and compartment N	W
BF(N)	Total effective blood flow to compartment N	$L.h^{-1}$
BFB(N)	Basal effective blood flow to compartment N	$L.h^{-1}$
BWT	Body weight (Changing during exposure)	kg
C(N)	Heat capacitance of compartment N	$W.h.\ °C^{-1}$
CALC	Volume of drinking input	L.
CARDI	Cardiac index	$L.min^{-1}.\ m^{-2}$
CCHIL	Shivering coefficient from head core	$W.\ °C^{-1}$
CCON	Vasoconstriction coefficient from head core	$W.\ °C^{-1}$
CDIL	Vasodilation coefficient from head core	$L.h^{-1}\ .\ °C^{-1}$
CEFF	Cooling efficiency of jacket	N.D.*
CEVG	Cumulative evaporative heat loss	gm.
CHILL	Total efferent shivering command	W
CHILM(I)	Fraction of total shivering occuring in muscle of segment I	N.D.*
CLO(I)	Clo value at segment I	
CLOWAT(I)	Sweat absorbed into clothes at segment I	gm

Symbol	Definition	Dimension
CMRAD(N)	Center of mass radius for compartment N	cm.
CO	Cardiac output	$L.min.^{-1}$
COLD(N)	Output from cold receptors in compartment N	°C
COLDS	Integrated output from skin cold receptors	°C
COND(K)	Thermal conductivity of tissues between adjacent compartments	$W.C_m^{-1}$ $°C^{-1}$
CSW	Sweating coefficient from head core	$W.$ $°C^{-1}$
CUSLAT	Cummulative salt loss	gm
CWW	Cummulative drinking water	gm
DELTAT(I)	Temp. difference between skin and suit by segment	°C
DELX(K)	Distance between adjacent center of mass radii	cm
DILAT	Total efferent skin vasodilation command	$L.h^{-1}$
DRIP(I)	Sweat dripped from segment I (unevaporated)	gm
DRY(I)	Heat loss through clothing at segment I	W
DT	Integration step	h
DTM	Integration step	min
DUBOIS	DUBOIS Surface area	m^2
E(N)	Total evaporative heat loss from compartment N	W
EB(N)	Basal evaporative heat loss from compartment N	W
EG(N)	Rate of total evaporative water loss from compartment N	$gm.h^{-1}$
EMAX(I)	Calculated maximum rate of evaporative heat loss from segment I	W
ERROR(N)	Output from thermoreceptors in compartment N	°C
EVCP(I)	Heat of vaporization of sweat for segment I	$W.h.gm.^{-1}$
EWET(I)	Ratio of wet/dry skin surface for segment I	N.D.*

Symbol	Definition	Dimension
F(N)	Rate of change of temperature in compartment N	$°C.h^{-1}$
FACL(I)	Factor increases radiation area of body by 15%/ clo at segment I	
FCL(I)	Burton clothing efficiency factor at segment I	N.D.
FILM(I)	Thickness of film formed by unevaporated sweat at segment I	microns
FILMW(I)	Weight of unevaporated film at segment I	gm
GUYH20	Total water lost through urination in one iteration	ml.
GUYK	Total potassium ion lost through urination in one iteration	meq.
GUYNA	Total sodium ion lost through urination in one iteration	meq.
HCMIX	Convective heat transfer coefficient (mixed)	$W.m^{-2}.°C^{-1}$
HCSEAT	Convective heat transfer coefficient (seated)	$W.m^{-2}.°C^{-1}$
HCWALK	Convective heat transfer coefficient (Walking)	$W.m^{-2}.°C^{-1}$
H(I)	Total environmental heat transfer coefficient for segment I	$W.°C^{-1}$
HC(I)	Convective and conductive heat transfer coefficient for segment I	$W.m^{-2}.°C^{-1}$
HCSL(I)	Convective and conductive heat transfer coefficient for segment I, at sea level	$W.m^{-2}.°C^{-1}$
HCSLTB	Convective heat transfer coefficient at sea level total body	$W.m^{-2}.°C^{-1}$
HCTB	Convective heat transfer coefficient at local barometric pressure total body	$W.m^{-2}.°C^{-1}$
HEARTR	Heart rate	$Beats.min^{-1}$
HEATIM	Time for water from stomach to body	min.
HF(N)	Rate of heat flow into or from compartment N	W

Symbol	Definition	Dimension
HP	Heat production (metabolism + shivering)	W
HR(I)	Linear radiation heat transfer coefficient for segment I	$W.m.^{-2}.°C^{-1}$
HT	Height of subject	cm
HTSA(K)	Heat transfer surface area	cm^2
HVAPS	Heat of vaporization of sweat	$W.h.gm^{-1}$
HVP	Heat of vaporization for evaporative loss in respiratory tract	$W.h.gm^{-1}$
IDRINK	Flag variable for drinking	N.D.*
INT	Interval between outputs	min.
ITIME	Elapsed time (output time)	min.
JOB	Flag representing type of work subject is doing	N.D.*
KCLMG	Mass of potassium chloride lost in one iteration	mg.
KCONC	Concentration of potassium in sweat	$meq.L^{-1}$
KMEQ	Total potassium ion lost in one iteration	meq.
LR	Lewis relation	$°Cmm.Hg^{-1}$
LTH(I)	Length of segment I	cm
LTIME	Elapsed time (integration time)	min.
MPR(K)	Center of mass midpoint radius	cm
NACLMG	Mass of sodium chloride lost in one iteration	mg.
NACONC	Concentration of sodium in sweat	$meq.L^{-1}$
NAMEQ	Total sodium ion lost in one iteration	meq.
NST	Non-shivering thermogenesis	watts.
NSTM(I)	Proportion of non-shivering thermogenesis for each segment	N.D.*
NWT(K)	New calculated weight distribution of subject	kg

Symbol	Definition	Dimension
P(K)	Vapor pressure table from 5-50°C	mm.Hg
PAIR(I)	Vapor pressure in environment (for segment I)	mm.Hg
PAREA(I)	Percent of total skin area for segment I	%
PBCO(N)	Proportion of Basal blood flow in compartment N	N.D.*
PCHIL	Shivering coefficient from skin and head core (multiply)	$W.°C^{-1}$
PCON	Vasoconstriction coefficient from skin and head core (multiply)	$°C^{-2}$
PCT(K)	Percent distribution by weight of different tissue types	N.D.*
PCTBF	Percent body fat of subject	%
PCTN(K)	Percent distribution by weight of body segments of subject	gm.
PDIL	Vasodilation coefficient from skin and head core (multiply)	$L.h^{-1}.°C^{-2}$
PPHG	PSKIN(I)	mm.Hg
PQB(N)	Proportion of basal heat production in compartment N	N.D.*
PRSALT	Proportion of salt in sweat	N.D.*
PS(I)	Proportion of total body surface area given to segment I.	N.D.*
PSKIN(I)	Saturated water vapor pressure at skin temperature I for segment I	mm.Hg
PSW	Sweating coefficient from skin and head core (multiply)	$W.°C^{-2}$
PWET	EWET	N.D.*
Q(N)	Total metabolic heat production in compartment N	W
QB(N)	Basal metabolic heat production in compartment N	W
QBQ10(N)	Q10 effect in compartment N	W
QUAT	Sum of Q10 effect	W

Symbol	Definition	Dimension
RAD(I)	Radius of segment I	cm
RATE(N)	Dynamic sensitivity of thermoreceptors in compartment N	h
RELV	Relative velocity	$m.sec^{-1}$
RDRX	Respiratory dry loss	W
RH	Relative humidity in environment	N.D.*
ROE	Density of sweat	$gm.cc^{-1}$
RWET	Respiratory wet loss	W
SAF	Surface area of dry ice facing skin	cm^2
S(I)	Surface area of segment I	m^2
SBF	Skin blood flow	$L.min.^{-1}$
SCHIL	Shivering coefficient from skin	$W.°C^{-1}$
SCON	Vasoconstriction coefficient from skin	$W.°C^{-1}$
SDIL	Vascodilation coefficient from skin	$L.h^{-1}.°C^{-1}$
SEGWT(I)	Weight of segment I	gm
SHB	Specific heat (thermal capacity) of bone	$W.hr.kg^{-1}°C^{-1}$
SHF	Specific heat (thermal capacity) of fat	$W.hr.kg^{-1}°C^{-1}$
SHS	Specific heat (thermal capacity) of skin	$W.hr.kg^{-1}°C^{-1}$
SHT	Specific heat (thermal capacity) of tissue	$W.hr.kg^{-1}°C^{-1}$
SKINC(I)	Fraction of vasoconstriction command applicable to skin of segment I	N.D.*
SKINR(I)	Fraction of all skin receptors in segment I	N.D.*
SKINS(I)	Fraction of sweat command applicable to skin segment I	N.D.*
SKINV(I)	Fraction of vasodilation command applicable to skin segment I	N.D.*

Symbol	Definition	Dimension
SPGRV	Specific gravity of subject	N.D.*
SR	Sweat rate	$mg.m^{-2}min^{-1}$
SSW	Sweating command coefficient from the skin	$W.°C^{-1}$
STMLKG	Stroke volume per min per kg of body wt.	$ml.min^{-1}.kg.^{-1}$
STRIC	Total efferent skin vasodilation command	N.D.*
STROV	Stroke volume	$L.Stroke^{-1}$
SUBRAT	Sublimation rate	$gm.h^{-1}$
SVP	EMAX	W
SWCG(I)	Sweat, heat removal command for segment I in 9/hr	$gm.h^{-1}$
SWEAT	Total efferent sweat command	N.D.*
SWPCP(I)	Sweat, heat removal command for segment I in W	W
SEX	Subject's sex	N.D.*
T(N)	Temperature of compartment N	°C
TAAR	Air temperature	°C
TAIR(I)	Dry bulb temperature external to skin of segment I	°C
TB	Mean body temperature	°C
TBFYM	Proportion of total body of a young male that is fat	N.D.*
TC(N)	Thermal conductance between compartments N and N+1	$W.°C^{-1}$
TD(N)	Conductive heat transfer between compartments N and N+1	W
TEMP	T(N+3) = skin temperature	°C
TERMK	Rate of potassium ion excretion through sweating	$meq.min^{-1}$
TERMNA	Rate of sodium ion excretion through sweating	$meq.min^{-1}$

Symbol	Definition	Dimension
TERMWA	Rate of thermal water loss	$L.min^{-1}$
TIME	Elapsed time (LTIME)	h
TO	Operative temperature	°C
TOTALH	Total heat transfer coefficinet	$W.m.^{-2}.-°C^{-1}$
TR	Mean radiant temperature	°C
TS	Mean skin temperature	°C
TSETC(N)	"Set Point" or threshold temperature for cold receptors in compartment N	°C
TSETWS(N)	"Set Point" or threshold temperature for warm receptors in compartment N (sedentary activity)	°C
TSETWA(N)	"Set Point" or threshold temperature for warm receptors in compartment N (exercising activity)	°C
TW	Temperature of drinking water	°C
URZ4	Flag variable to terminate simulation	N.D.*
URZ5	Work rate	W
V	Air velocity	$m.sec^{-1}$
VOL(I)	Volume of segment I	cm^3
VWALK	Velocity of walking	$m.sec^{-1}$
WARM(I)	Warm output of segment I	°C
WARMS	Integrated output from skin warm receptors	°C
WATER	Volume of water lost through skin in one iteration	L.
WATER1	Volume of water lost through skin and respiration in one iteration	L.
WEFF	Mechanical efficiency of work	N.D.*
WK1(I)	Fraction of total work done by muscle in segment I (walking)	N.D.*

Symbol	Definition	Dimension
WK2(I)	Fraction of total work done by muscle in segment I (standing)	N.D.*
WK3(I)	Fraction of total work done by muscle in segment I (pedaling)	N.D.*
WK4(I)	Fraction of total work done by muscle in segment I (sitting)	N.D.*
WORKT	Total metabolic rate required	W
WORKA	Activity metabolism	W
WORKB	Basal metabolism	W
WORKM(I)	Fraction of total work done by muscles in segment I	N.D.*
WRATE	Water in stomach "delay rate"	Min.
WT	Initial weight of the subject	kg.
WTPCT(N)	Tissue weight distribution of standard body	kg.

*N.D. = Dimensionless

APPENDIX 3

Guyton Model Variable Listing

APPENDIX 3

List of symbols used in Guyton Circulatory System program with definitions. Independent variables (never calculated by the program) are indicated by *. Units used are: volume in liters, mass in grams, time in minutes, chemical units in milliequivalents, pressure in millimeters of mercury, and control factors as ratio to normal.

Symbol	Definition
AAR	Afferent arteriolar resistance
AGK*	Constant concerned with effect of renin on angiotensin formation
AH	Antidiuretic hormone secretion rate
AHC	Antidiuretic hormone concentration
AHK*	Constant used in calculating antidiuretic hormone concentration
AHM	Antidiuretic hormone multiplier
AHY	Adapted effect of right atrial pressure on antidiuretic hormone secretion rate
AHZ	Basic effect of right atrial pressure on antidiuretic hormone secretion rate
AH8	Effect of autonomic stimulation on antidiuretic hormone secretion rate
ALO*	Maximum aortic arterial oxygen saturation
AM	Aldosterone multiplier
AMC	Aldosterone concentration
AMM	Muscle vascular constriction caused by local tissue control, ratio to resting state
AMP	Effect of arterial pressure on rate of aldosterone secretion
AMR	Effect of sodium to potassium ratio on rate of aldosterone secretion

AMT* Time constant of aldosterone accumulation and destruction

AM1 Rate of aldosterone secretion

ANC Angiotensin concentration

ANM Angiotensin multiplier effect on vascular resistance, ratio to normal

ANP Effect of renal blood flow on angiotensin formation

ANR Effect of glomerular filtration and sodium concentration on renin formation with consequent effect on angiotensin formation

ANT* Time constant of angiotensin accumulation and destruction

ANU Non-renal effect of angiotensin

ANV* Constant used in calculating effect of renin formation on angiotensin formation

ANW Partial effect of renin on angiotensin formation

ANY* Constant used to calculate angiotensin effect on venous volume

ANZ* Constant used to calculate angiotensin effect on venous resistance

AN1 Rate of angiotensin formation

AOM Autonomic effect on tissue oxygen utilization

APD Afferent arteriolar pressure drop

ARF* Intensity of sympathetic effects on renal function

ARM Vasoconstrictor effect of all types of autoregulation

AR1 Vasoconstrictor effect of rapid autoregulation

AR2 Vasoconstrictor effect of intermediate autoregulation

AR3 Vasoconstrictor effect of long-term autoregulation

AU Overall activity of autonomic system

AUB Effect of baroreceptors on autoregulation

AUC Effect of chemoreceptors on autonomic stimulation

AUH Autonomic stimulation of heart

AUJ Basic overall autonomic stimulation

AUK* Time constant of baroreceptor adaptation

AUL* Sensitivity of sympathetic control of vascular capacitance

AUM Sympathetic vasoconstrictor effect on arteries

AUN Effect of CNS ischemic reflex on autoregulation

AUO Fractional departure of overall activity of autonomic system from normal

AUP Autonomic stimulation of peripheral circulatory sensitivity

AUQ* Sensitivity of sympathetic control of peripheral circulation

AUR Autonomic stimulation for heart rate

AUS* Sensitivity of sympathetic control of heart rate

AUV* Sensitivity of sympathetic control on heart function

AUX* Sensitivity of baroreceptors

AUY* Sensitivity of sympathetic control of veins

AUZ* Overall sensitivity of autonomic control

AU4 Degree of adjustment of baroreceptor response

AU6 Adapted baroreceptor response

AU8 Rate of adaptation baroreceptors

AVE Effect of autonomic stimulation on venous resistance

A1B Sensitivity parameter for baroreceptor drive

A1K* Time constant of rapid autoregulation

A2K* Time constant of intermediate autoregulation

A3K* Time constant of long-term autoregulation

A4K* Time constant for muscle local vascular response to metabolic activity

BFM Muscle blood flow

BFN Blood flow in non-muscle, non-renal tissues

CALC Volume of drinking input

CCD Concentration gradient across cell membrane

CFC*	Capillary filtration coefficient
CHY	Concentration of hyaluronic acid in tissue fluids
CKE	Extracellular potassium concentration
CKL	Intracellular potassium concentration
CNA	Extracellular sodium concentration
CNB	Difference between extracellular sodium concentration and set point used to calculate antidiuretic hormone secretion rate
CNR*	Reference sodium concentration used in determining effect of sodium on antidiuretic hormone secretion rate
CNE	Sodium concentration abnormality causing third factor effect
CNX*	Constant used in calculation of renal excretion rate of sodium
CNY*	Constant used in calculation of renal excretion rate of sodium
CNZ*	Sensitivity of antidiuretic hormone production rate to extracellular sodium concentration
CN2*	Constant used in calculation of venous resistance
CN3	Dummy variable used in calculation of the effect of capillary pressure on venous resistance
CN7*	Constant used in calculation of venous resistance
CPF*	Sensitivity of rate of transfer of fluid across pulmonary capillaries to pressure gradient
CPG	Concentration of protein in tissue gel
CPL	Concentration of protein in free interstitial fluid
CPK*	Rate constant used in determining loss of plasma protein through systemic capillaries
CPN	Concentration of protein in pulmonary fluids
CPP	Plasma protein concentration
CPR*	Reference plasma protein concentration governing protein production by liver
CV*	Venous capacitance
DAS	Rate of volume increase of systemic arteries

DAU	Autonomic stimulation drive
DFP	Rate of increase in pulmonary free fluid
DHM	Rate of cardiac deterioration caused by hypoxia
DLA	Rate of volume increase in pulmonary veins and left atrium
DLP	Rate of formation of plasma protein by liver
DLZ	Undamped plasma protein concentration differential causing protein production by liver
DOB	Rate of oxygen delivery to non-muscle cells
DPA	Rate of increase in pulmonary volume
DPC	Rate of loss of plasma proteins through systemic capillaries
DPI	Rate of change of protein in free interstitial fluid
DPL	Rate of systemic lymphatic return of protein
DPO*	Rate of loss of plasma protein
DRA	Rate of increase in right atrial volume
DVS	Rate of increase in venous vascular volume
EXC*	Exercise activity, ratio to normal at rest
EXE	Exercise effect on autonomic stimulation
EX1*	Constant concerned with effect of muscle cell P_{O_2} on autonomic stimulation during exercise
EXQ	Q10 metabolic effect expressed as exercise activity, ratio to normal at rest
FIS*	Fistula parameter
GBL*	Goldblatt hypertension parameter
GFN	Glomerular filtration rate of undamaged kidney
GFR	Glomerular filtration rate
GF1	Value of GFN on previous iteration
GF2*	Constant used in calculation of glomerular filtration rate
GF3	Degree of autoregulatory feedback at macular densa

GF4* Constant controlling the feedback loop for GF3

GLP Glomerular pressure

GPD Rate of increase of protein in gel

GPR Total protein in gel

HKM* Constant used in calculation of portion of blood viscosity caused by red blood cells

HM Hematocrit

HMD Cardiac depressant effect of hypoxia

HMK* Constant used in calculation of portion of blood viscosity caused by red blood cells

HPL Hypertrophy effect on left ventricle

HPR Hypertrophy effect on right ventricle

HR Heart rate

HSL* Basic left ventricular strength

HSR* Basic right ventricular strength

HYL* Quantity of hyaluronic acid in tissues

I Integration step size

IFP Interstitial fluid protein

I1 Variable integration step size utilized on stable asymptote

I2* Normal increment on time

I3* Maximum time increment for stable asymptote

KCD Rate of change of intracellular potassium concentration

KE Total extracellular fluid potassium

KED Rate of change of extracellular potassium concentration

KI Total intracellular potassium

KID* Concentration of potassium in drinking solution

KIE Excess potassium concentration causing change in intracellular potassium level

KIR	Total expected level of potassium in the intracellular fluid under equilibrium conditions
KOD	Rate of renal loss of potassium
LPK*	Rate constant for plasma protein production by liver
LVM	Effect of aortic pressure on left ventricular output
MMO	Rate of oxygen utilization by muscle cells
MO2	Rate of oxygen utilization by non-muscle cells
NAE	Total extracellular sodium
NED	Rate of change of sodium in extracellular fluids
NID*	Concentration of sodium ion in drinking solution
NOD	Rate of renal excretion of sodium
NOZ	Effect of urinary output, aldosterone, and sodium level on renal excretion rate for sodium
OMM*	Muscle oxygen utilization at rest
OSA	Aortic oxygen saturation
OSV	Non-muscle venous oxygen saturation
OVA	Oxygen volume in aortic blood
OVS	Muscle venous oxygen saturation
O2A*	Sensitivity of the effect of autonomic stimulation on metabolism
O2M*	Basic oxygen utilization in non-muscle body tissues
PA	Aortic pressure
PAM	Effect of arterial pressure in distending arteries, ratio to normal
PAR	Renal arterial pressure
PA1	Effective pressure drive on autonomic system
PA2	Effective arterial pressure on left ventricle
PC	Capillary pressure
PCD	Net pressure gradient across capillary membrane

PCE* Capillary pressure exponent

PCP Pulmonary capillary pressure

PDO Difference between muscle venous oxygen P_{O_2} and normal venous oxygen P_{O_2}

PFI Rate of transfer of fluid across pulmonary capillaries

PFL Renal filtration pressure

PGC Colloid osmotic pressure of tissue gel

PGH Absorbency effect of gel caused by recoil of gel reticulum

PGL Pressure gradient in lungs

PGP Colloid osmotic pressure of tissue gel caused by entrapped protein

PGR Colloid osmotic pressure of interstitial gel caused by Donnan equilibrium

PGS Pressure difference between arteries and veins

PGV Venous pressure gradient

PGX Activity factor for protein in the interstitial fluid

PIF Interstitial fluid pressure

PK1* Constant used in calculating muscle cell P_{O_2} from total volume of oxygen in muscle cells

PK2* Constant used in calculating muscle cell P_{O_2} from total volume of oxygen in muscle cells

PK3* Constant used in calculating rate of oxygen transport to muscle cells

PLA Left atrial pressure

PLD Pressure gradient to cause lymphatic flow

PLF Pulmonary lymphatic flow

PMC Mean circulatory pressure

PMO Muscle cell P_{O_2}

PMP Mean pulmonary pressure

PMS Mean systemic pressure

PM1 Effective muscle cell P_{O_2}

PM3*	Minimum value allowed for PM1
PM4*	Constant used in calculating rate of oxygen transport to muscle cells
PM5*	Constant used in calculating rate of oxygen transport to muscle cells
POA	Rate of change of intermediate autoregulation vasoconstrictor effect
POB	Rate of change of rapid autoregulation vasoconstrictor effect
POC	Rate of change of long-term autoregulation vasoconstrictor effect
POD	Non-muscle venous P_{O_2} minus normal value
POE	Sensitivity control for oxygen feedback control loop
POK*	Sensitivity of rapid system of autoregulation
POM*	Sensitivity of oxygen feedback control loop
PON*	Sensitivity of intermediate autoregulation
POQ	Effective non-muscle cell P_{O_2}
POR*	Reference value of capillary P_{O_2} in non-muscle tissue
POS	Pulmonary interstitial fluid colloid osmotic pressure
POT	Non-muscle cell P_{O_2}
POV	Non-muscle venous P_{O_2}
POY*	Sensitivity of red cell production
POZ*	Sensitivity of long-term autoregulation
PO1*	Constant used in determining oxygen deficit factor causing red cell production
PO2	Oxygen deficit factor causing red cell production
PPA	Pulmonary arterial pressure
PPC	Plasma colloid osmotic pressure
PPD	Rate of change of protein in pulmonary fluids
PPI	Pulmonary interstitial fluid pressure
PPN	Rate of pulmonary capillary protein loss

PPO	Pulmonary lymph protein flow
PPR	Total protein in pulmonary fluids
PP1	Variable used to empirically relate pulmonary arterial pressure and pulmonary arterial resistance
PP2	Effective pulmonary arterial pressure
PRA	Right atrial pressure
PRM	Pressure caused by compression of interstitial fluid gel reticulum
PRP	Total plasma protein
PR1	Effective right atrial pressure
PTC	Interstitial fluid colloid osmotic pressure
PTS	Solid tissue pressure
PTT	Total tissue pressure
PVG	Venous pressure gradient
PVO	Muscle venous P_{O_2}
PVS	Average venous pressure
P1O	Tissue P_{O_2} effective in oxygen utilization
P2O	Muscle cell P_{O_2} effective in depressing rate of metabolism
QAO	Blood flow in the systemic arterial system
QLN	Basic left ventricular output
QLO	Output of left ventricle (cardiac output)
QOM	Total volume of oxygen in muscle cells
QO2	Non-muscle total cellular oxygen
QPO	Rate of blood flow into pulmonary veins and left atrium
QRF*	Feedback effect of left ventricular function on right function
QRN	Basic right ventricular output
QRO	Actual right ventricular output
QVO	Rate of blood flow from veins into right atrium

RAM*	Basic vascular resistance of muscles
RAR*	Basic resistance of non-muscular and non-renal arteries
RBF	Renal blood flow
RCD	Rate of change of red cell mass
RC1	Red cell production rate
RC2	Red cell destruction rate
RDO	Resistance of diffusion of oxygen from capillaries to cells
REK*	Fraction of normal renal function
RFN	Renal blood flow if kidney is not damaged
RKC*	Rate constant for red cell destruction
RMO	Rate of oxygen transfer to muscle tissues
RPA	Pulmonary arterial resistance
RPT	Pulmonary vascular resistance
RPV	Pulmonary venous resistance
RR	Renal resistance
RSM	Vascular resistance in muscle
RSN	Vascular resistance in non-muscle, non-renal tissues
RTP	Total preipheral resistance
RVG	Resistance from veins to right atrium
RVM	Depressing effect of pulmonary arterial pressure on right ventricle
RVS	Venous resistance
SR*	Intensity factor for stress relaxation
SRK*	Time constant for stress relaxation
STA*	Overriding value of overall activity of autonomic system
STH	Effect of tissue hypoxia on salt and water intake
SVO	Stroke volume output

T	Total time elapsed
THIRST	Summed appetite for water
TIMEDR	Drinking interval
TRR	Tubular reabsorption rate
TVD	Rate of drinking
TVZ	Combined effect of tissue ischemia and central nervous stimulation on thirst and drinking
T1	Total time elapsed on previous step
U*	Damping factor for QPO
VAE	Excess volume in systemic arteries that causes stretch of arterial walls
VAS	Volume in systemic arteries
VB	Blood volume
VBD	Volume correction factor added to systemic circulation to allow for updating blood volume
VEC	Extracellular fluid volume
VG	Volume of interstitial fluid gel
VGD	Rate of change of tissue gel volume
VIB	Blood viscosity, ratio to that of water
VIC	Cell volume
VID	Rate of fluid transfer between interstitial fluid and cells
VIE	Portion of blood viscosity caused by red blood cells
VIF	Volume of free interstitial fluid
VIM	Blood viscosity, ratio to normal
VLA	Volume in left atrium
VLE	Excess volume in left atrium causing stretch of left atrium and pulmonary veins
VP	Plasma volume
VPA	Volume in pulmonary arteries

VPD Rate of change of plasma volume

VPE Excess volume in right atrium causing stretching of the right atrium

VPF Pulmonary free fluid volume

VRA Right atrial volume

VRC Volume of red blood cells

VRE Excess volume in right atrium causing stretching of the right atrium

VTC Rate of fluid transfer across systemic capillary membranes

VTD Rate of volume change in total interstitial fluid

VTL Rate of systemic lymph flow

VTS Total interstitial fluid volume

VTW Total body water

VUD Rate of urinary output

VVE Excess venous vascular volume before stress relaxation correction

VVR Volume of blood in veins at zero venous pressure

VVS Venous vascular volume

VV6 Rate of change of vascular stress relaxation effect

VV7 Increased vascular volume caused by stress relaxation

VV8 Excess volume of blood in the systemic veins after stress relaxation correction

VV9* Reference venous vascular volume

V2D* Resistance factor which converts pressure drop to rate of change of tissue gel volume

X* Damping factor for QVO

Y* Damping factor for DAU

Z* Damping factor for AH, DAU, DFP, DLP, DPC, DPL, GFN, GPD, KCD, NOD, POA, POB, PPD, TVD, VID, VTC, VTL, VUD, VV6

Z1* Damping factor for VPD

Z3* Damping factor for VP

Z4* Time constant used to calculate non-muscle cell total cellular oxygen

Z5* Time constant used to calculate volume of oxygen in muscle cells

Z6* Damping factor for OVS

Z7* Damping factor for OSV

Z8* Time constant of autonomic response

Z10* Constant used to calculate effect of tissue hypoxia on salt and water intake

Z11* Constant used to calculate effect of tissue hypoxia on salt and water intake

Z12* Constant that converts exercise activity to autonomic stimulation

Z13* Constant used in calculating heart hypertrophy

APPENDIX 4

Program Listing and Input Datasets

Program Listing

```
      INTEGER UP24
      REAL LVM,I,IFP,LPD,KE,KE1,KOD,KIR,KIE,KI,KCD,KED,KN1,KN3
      REAL NAE,NED,NIC,NCC,I1,LPK,KIC,MO2,NO7,KCZ,HPL,HPR,I2,I3,MMO
      DIMENSION FUN1(14),FUN2(14),FUN3(14),FUN4(14),FUN6(14),FUN7(14)
      COMMON/ARRAY/T,I,VBC,VVS,VPA,VAS,VLA,VRA,VAE,PA,PAM,LVM,
     *             VRE,PRA,QRN,VPE,PPA,PP1,CPA,RPA,RVM,VLE,PLA,QLN,PLI,
     *             VIB,RPV,RPT,PGL,CPC,Q5  ,VVE,VVB,PVS,PGV,RVG,QVG,AVE
      COMMON/ARRAY/CN2,CN3,RVS,PGS,RTP,QAC,QRC,QLO,DVS,DPA,DAS,DLA,DRA,
     *             PA1,ALC,ALB,AUN,AL6,AU2,AU8,CAU,AUJ,AU  ,AUC,AUH,VV4,
     *             AU9,AUM,AU4,VIF,PC1,PTT,PTS,PIF,CPI,PTC,CPP,PPC,PVG
      COMMON/ARRAY/PC  ,PCD,VTC,PLD,VTL,VTS,VPD,CPL,CPI,DPC,DPI,LPD,DLP,
     *             DPP,CHY,PRM,PGR,CPG,PGP,GF1,PGX,PGC,PGH,PG2,VGD,VG  ,
     *             EPH,GP1,GP2,GPD,CAR,RK  ,RFN,APD,GLP,PFL,GFR,TRR,VUD
      COMMON/ARRAY/REK,NOD,NEC,NAE,VEC,CKE,KOD,KE1,KIR,KIE,KCD,KED,CKI,
     *             CNA,CCC,VIC,KE  ,KI  ,VIC,I1  ,VTY,Z   ,VTZ,VUZ,TVZ,PPZ,
     *             DFZ,X   ,I2  ,PK1,VTS,VP  ,PRP,IFP,GPR,KN3,KN1,AMR,AMP
      COMMON/ARRAY/AM1,AMC,AM2,AM3,AM5,AM  ,CNE,AGK,ANP,AN1,ANC,AN2,AN3,
     *             AN5,ANM,V8  ,HM1,HM  ,B1  ,VIE,VIB,VIM,FC2,PO2,RKC,RC1,
     *             RCD,VRC,RSN,OVA,RFN,OCB,ACM,P1C,OSV,PCT,POD,POB,AP1
      COMMON/ARRAY/AP2,POC,AR3,APM,CNB,GFN,AH7,AH8,AH  ,AHC,AH1,AH2,AH4,
     *             AHM,CNY,CNX,VV1,VV2,VV5,VV6,VV7,TVD,VTW,HSF,HSL,NIO,
     *             SR  ,VVR,RAR,CV  ,CN7,AUX,AUK,AUZ,Y   ,CFC,CPK,PCE,CPR
      COMMON/ARRAY/LPK,CPU,HYL,KIC,ANT,ANT,PCK,PCN,A1K,A2K,A3K,CNR,CNZ,
     *             AHK,SRK,V9  ,V2C,Z1  ,Z2  ,Z3  ,Z4  ,Z5  ,Z6  ,Z7  ,Z8  ,HMK,
     *             HKM,POV,PCZ,ROC,CO2,RBF,MO2,PCA,POY,ANU,POR,GF2,HMD
      COMMON/ARRAY/DHM,PCQ,I3  ,U   ,VP1,T1  ,GF3,GF4,AUP,AUV,RV1,AUY,OUT,
     *             DSP,AHZ,AHY,CSA,PPI,CPN,POS,PLF,PPC,PPN,PPD,PFI,DFP,
     *             VPF,PPR,PMC,PMS,PMP,HR  ,CPF,PCP,DA1,DLZ,DPY,DPZ,GPZ
      COMMON/ARRAY/NOZ,KCZ,VIZ,HPR,HPL,STH,ALC,EXC,O2M,PA2,PP2,SVU,AUL,
     *             VV9,O2A,Q1  ,EXE,ARF,QRF,RSM,RFM,RAY,OVS,PVC,RMC,COM,
     *             PMO,P2O,MMO,PDC,PCE,AMM,A4K,PCM,OMM,PM1,PM3,PM4,EX1
      COMMON/ARRAY/O2  ,O3  ,PM5,PK1,Z9  ,Z10,Z11,Z12,Z13,Z14,Z15,Z16,PK2,
     *             PK3,FIS,STA,PAR,GBL,ANY,ANZ,ANX,ANV,ANW,ANR,AUQ,AUR,
     *             AUS,A378,H1,A2,A3,TW,RH,V,TAAR,BARO,TR,EXO
      COMMON/ARRAY/DUMMY(12),TITLE(400),DUMMY(40)
      COMMON/NUMERO/K,NO(20),NTIMEC,UNITS,NZ,NTIMEP,NN,MAXNO,NTIME
     1 ,IPNEXT
      COMMON/STORE/NG1,NG2,NG3,NG4,NG5,NG6,NG7,NG8,NG9,DT,TLP,TNP,ND,
     *             TM,TMP,NFIRST,ZZ(15),OLY(9),OBY(9),YMIN(10),YMAX(10),
     *             N,PT(18),BETA(10),NGRAPH(10),GRAPH(10),HEAD(19),NOEXP
     *             ,DTMAX
      COMMON/TAPE/TOTAL
      COMMON/MCT/TERMWA,TERMK,TERMNA
      DATA FUN1(1),FUN1(2),FUN1(3),FUN1(4),FUN1(5),FUN1(6),FUN1(7),
     *FUN1(8),FUN1(9),FUN1(10),FUN1(11),FUN1(12),FUN1(13),FUN1(14)/
     *0.,1.04,60.,1.025,125.,.97,160.,.89,200.,.59,240.,0.,240.,0./
      DATA FUN2(1),FUN2(2),FUN2(3),FUN2(4),FUN2(5),FUN2(6),FUN2(7),
     *FUN2(8),FUN2(9),FUN2(10),FUN2(11),FUN2(12),FUN2(13),FUN2(14)/
     *-100.,0.0,-6.,0.0,-3.,.75,-1.,2.6,2.,9.8,8.,13.5,1000.,13.5/
      DATA FUN3(1),FUN3(2),FUN3(3),FUN3(4),FUN3(5),FUN3(6),FUN3(7),
     *FUN3(8),FUN3(9),FUN3(10),FUN3(11),FUN3(12),FUN3(13),FUN3(14)/
     *0.0,1.06,20.,.97,24.,.93,30.,.8,38.,.46,45.,0.,45.,0./
      DATA FUN4(1),FUN4(2),FUN4(3),FUN4(4),FUN4(5),FUN4(6),FUN4(7),
     *FUN4(8),FUN4(9),FUN4(10),FUN4(11),FUN4(12),FUN4(13),FUN4(14)/
     *-100.,0.,-4.,0.,-1.,3.6,3.,9.4,6.,11.6,10.,13.5,1000.,13.5/
      DATA FUN6(1),FUN6(2),FUN6(3),FUN6(4),FUN6(5),FUN6(6),FUN6(7),
     $FUN6(8),FUN6(9),FUN6(10),FUN6(11),FUN6(12),FUN6(13),FUN6(14)/
     *-100.,10000.,0.,70.,.4,9.3,.8,3.3,1.2,1.3,1.6,.43,100.,0./
      DATA FUN7(1),FUN7(2),FUN7(3),FUN7(4),FUN7(5),FUN7(6),FUN7(7),
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     *FUN7(8),FUN7(9),FUN7(10),FUN7(11),FUN7(12),FUN7(13),FUN7(14)/
     *0.,7.,30.,6.25,60.,3.,100.,1.,160.,.15,400.,.05,400.,.05/
C
      IPASS=0
      ISTOL=1
      TIME=0.
      GUYH2O=0.0
      GUYNA=0.0
      GUYK=0.0
      HOLD=0.0
      T7=0.0
      THIRST=0.0
      TERMNA=0.0
      IDRINK=0
      TERMK=0.0
      TERMWA=0.0
      QUAT=0.0
      CALL        PUTIN (IFLAG,AMOUNT,TIMEDR)
      URZ4 = 1
C
      IF(I .GT. 0.5) I=0.5
C
 100  CALL PUTOUT(URZ4,URZ5)
      IF (URZ4 .EQ. 3) GO TO 169
C
C      STABLIZER: GUYTON RUNS 30 SECS TO REACH STEADY STATE
C         BEFORE SIMULATION OF EXERCISE AND SWEATING BEGINS
C
      IF ((T.LT. 0.5).AND.(IPASS.EQ.0)) GO TO 101
      IF (IPASS.EQ.1) GO TO 102
      T7=0.0
      T=0.0
      IPASS=1
      T1=0.0
  102 CONTINUE
      T9=T
      TIM1=TIME*60.0
  104 CONTINUE
      IF (T9.LT.TIM1) GO TO 101
  103 CONTINUE
         CALL THERMO     (CKE,CNA,TERMNA,TERMK,TERMWA,ISTOL,URZ4,TW,
     *       HOLD,GUYNA,GUYK,GUYH2O,URZ5,IDRINK,TIME,TAAR,BARO,
     *        RH,V,TR,QUAT)
      HOLD=0.0
C      CONVERTS Q10 METABOLIC INCREASE FROM WATTS TO
C      UNITS OF EXC EXERCISE PARAMETER FOR GUYTON
      EXQ=0.0
      IF (QUAT.GE.32.2) EXQ=9.0+0.37175*(QUAT-32.2)
      IF ((QUAT.GE.16.6).AND.(QUAT.LT.32.2)) EXQ=4.0+0.32051*(QUAT-16.6)
      IF ((QUAT.GE.0.0).AND.(QUAT.LT.16.6)) EXQ=0.24096*QUAT
C
  101 CONTINUE
C
      T3=T
  180 CONTINUE
      T = T + I2
C
      CALL HEMO (FUN1,FUN2,FUN3,FUN4)
C     CALL HEMO         (AMM,ANM,ANU,ANY,ANZ,ARM,AUH,AUM,AUY,AVE,BFM,BFN,
C    *                   CN2,CN3,CN7,CV ,DAS,DLA,DPA,DRA,DVS,FIS,HMD,HPL,
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C    *                   HPR,HSL,HSR,I2 ,LVM,PA  ,PAM,PA2,PC  ,PGL,PGS,PLA,
C    *                   PPA,PP1,PP2,PRA,PR1,PVS,CAO,CLN,QLO,QPO,QRF,QRN,
C    *                   QRO,QVO,RAM,RAR,RBF,RPA,RPT,RPV,RSM,RSN,RVG,RVM,
C    *                   RVS,U   ,VAE,VAS,VBC,VIM,VLA,VLE,VP  ,VPA,VPE,VRA,
C    *                   VRC,VRE,VVE,VVR,VVS,VV7,VV8,X   ,FUN1,FUN2,FUN3,
C    *                   FUN4)
C
      CALL AUTO         (AU  ,AUB,AUC,AUH,AUJ,AUK,AUL,AUM,AUN,AUO,AUP,AUQ,
     *                   AUR,AUS,AUV,AUX,AUZ,AU4,AU6,AU8,A1B,DAU,EXC,EXE,
     *                   EX1,I2  ,PA  ,PA1,POC,POT,P2O,STA,VVR,VV9,Y   ,Z,
     *                  Z8,Z12,EXQ)
C
      IF ((T3+I3).LE.T) GO TO 168
  110 IF (ABS(CAO-QLO).GT..2)GO TO 180
      IF(ABS(DAL-AUJ).GT.CAL)GO TO 180
      IF (ABS(QAO-QPO).GT..2)GO TO 180
      IF (ABS(CAO-QRO).GT..4)GO TO 180
C
  168 CALL HORMON       (AM  ,AMC,AMP,AMR,AMT,AM1,ANM,CKE,PA,Z,FUN7,
     *                   AGK,ANC,ANP,ANR,ANT,ANV,ANW,AN1,CNA,CNE,GFN,
     *                   I   ,REK,A2  ,A3,Z14)
C
      CALL BLOOD        (HKM,HM  ,HMK,I   ,PCT,POY,PO1,PO2,RC1,RC2,RCD,RKC,
     *                   VB  ,VIB,VIE,VIM,VP  ,VRC)
C
      CALL MUSCLE       (ALO,AMM,AOM,AUP,A4K,BFM,EXC,HM  ,I   ,MMO,OMM,OSA,
     *                   OVA,OVS,O2A,PDC,PK1,PK2,PK3,PMO,PM1,PM3,PM4,PM5,
     *                   POE,POM,PVO,P2O,QOM,RMO,VPF,Z5,Z6,PMS,EXQ)
C
      CALL AUTORG       (AOM,ARM,AR1,AR2,AR3,A1K,A2K,A3K,BFN,DOB,HM  ,I,
     *                   MO2,OSV,OVA,O2M,POA,POB,POC,POD,POK,PON,POR,POT,
     *                   POV,POZ,P1O,QO2,RDO,Z   ,Z4  ,Z7)
C
      CALL ADH          (AH  ,AHC,AHK,AHM,AHY,AHZ,AH7,AH8,AUP,CNA,CNB,CNR,
     *                   CNZ,I   ,PRA,Z)
C
      CALL MISC1        (AHM,AU4,AU8,I   ,SR  ,SRK,STH,TVD,TVZ,VEC,VIC,VTW,
     *             VVE,VV6,VV7,Z,V9,CALC,IDRINK,AMCUNT,IFLAG,Z3)
C
      CALL HEART        (AUR,DHM,HMD,HR  ,I   ,PA  ,PMC,PMP,PMS,POT,PRA,QAO,
     *                   QLO,RTP,SVO,VAE,VLE,VPE,VRE,VVE,H1)
C
      CALL CAPMBD       (BFN,CFC,CPI,CPP,DFP,I   ,IFP,PC  ,PCD,PIF,PLD,PPC,
     *                   PRP,PTC,PTS,PTT,PVG,PVS,RVS,TVD,VG  ,VID,VIF,VP,
     *               CALC,VPD,VTC,VTD,VTL,VTS,VUD,Z   ,Z1,FUN6,Z3,IFLAG)
C
      I=I*1.2+T-T1
      I1=ABS(VP1/VPD/I)
      IF(I1.LT.I) I=I1
      IF(I3+T-T1.LT.I) I=I3+T-T1
      T=I+T1
      T1=T
      T7=T7+I
C
      CALL PULMON       (CPF,CPP,CPN,DFF,I   ,PCP,PFI,PLA,PLF,POS,PPA,PPC,
     *              IFLAG,PPD,PPI,PPN,PPO,PPR,VP  ,VPD,VPF,Z   ,Z3,CALC)
C
          CALL    MISC2 (HPL,HPR,HSL,HSR,I,PA,PPA,PCT,STH,Z10,Z11,Z13,
     *             TIMEDR,IFLAG,THIRST,T7  ,IDRINK,AMCUNT,VP,NAE,NID,KE,
     *             KID)
```

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C
      CALL PRCTEN       (CHY,CPG,CPI,CPK,CPF,CPR,CPI,DLP,DLZ,DPC,DPI,DPL,
     *                   DPO,DPY,GPD,GPR,I   ,IFP,LPK,PC  ,PCE,PGX,PRP,VG ,
     *                   VTL,Z   ,PPO)
C
      CALL KIDNEY       (AAR,AHM,AM  ,APD,ARF,AUM,CNE,CNX,CNY,GBL,GFN,GFR,
     *                   GF2,GF3,GF4,GLP,I   ,NAE,NED,NID,NOD,NOZ,PA  ,PAR,
     *                   PFL,PPC,RBF,REK,PFN,RR  ,STH,TRR,VIM,VUD,Z,GUYNA,
     *                   GUYH20,Z1,Z3,CALC)
C
      CALL IONS         (AM  ,CCD,CKE,CKI,CNA,I   ,KCD,KE  ,KED,KI  ,KID,KIE,
     *                   KIR,KCD,NAE,KEK,VEC,VIC,VID,VP  ,VPF,VTS,Z,NID,
     *                  ,CALC,GLYK,GUYH2O,Z1,Z3)
      IF (CALC.EQ.0.0) GC TO 170
      HOLD=CALC
      CALC=0.0
  170 CONTINUE
C
      CALL GELFLD       (CHY,CPG,CPI,GPR,HYL,IFP,PGC,PGH,PGP,PGR,PGX,PIF,
     *                   PRM,PTC,PTS,PTT,VG  ,VGD,VIF,VRS,VTS,V2D,FUN6)
C
      GO TO 100
  169 CONTINUE
      STOP
      END
      SUBROUTINE PUTIN (IFLAG,AMOUNT,TIMEOR)
C
      COMMON/NUMERO/K,NO(20),NTIMEC,UNITS,NZ,NTIMEP,NN,MAXNO,NTIME
     1 ,IPNEXT
      COMMON/ARRAY/A(400),TITLE(400),COL(20),ALPHA(20)
      COMMON/STORE/NG1,NG2,NG3,NG4,NG5,NG6,NG7,NG8,NG9,DT,TLP,TNP,ND,
     *              TM,TMM,NFIRST,ZZ(15),OLY(9),CHY(9),YMIN(10),YMAX(10),
     *              N,PT(18),BETA(10),NGRAPH(10),GRAPH(10),HEAD(19),NOEXP
     *              ,DTMAX
      DATA ALL/'ALL '/,BLANK/'    '/,SAME/'SAME'/
      DO 1 J=1,400
      A(J)=0.
    1 TITLE(J)=BLANK
      NZ=0
      NTIMEP=1
      NN=1
      MAXNO=1
    2 CONTINUE
      READ (5,100) VALUE,NUMBRO,SYMBOL
  100 FORMAT (E13.5,2X,I5,4X,A4)
      IF(MAXNO.LT.NUMBRO) MAXNO=NUMBRO
      IF(NUMBRO.EQ.0) GO TO 3
      A(NUMBRO)=VALUE
      TITLE(NUMBRO)=SYMBOL
      GO TO 2
    3 DSP=A(286)
      READ(5,101) NOEXP,(HEAD(J),J=1,19)
  101 FORMAT(I4,19A4)
   33 READ(5,200) (ALPHA(J),J=1,20)
  200 FORMAT       (20A4)
      READ (5,402) TIMEOR
  402 FORMAT (F8.0)
      READ (5,400) IFLAG,AMOUNT
  400 FORMAT (I2,F7.2)
  201 IF(ALPHA(1).EQ.SAME) GO TO 32
```

```
      IF(ALPHA(1).NE.ALL) GO TO 4
      READ(5,300) NTIMEC,UNITS,IPNEXT
      WRITE(6,102) NOEXP,(HEAD(J),J=1,19)
      WRITE(6,71) UNITS,(TITLE(J),A(J),J=1,MAXNC)
      GO TO 31
    4 DO 5 K=1,20
      IF(ALPHA(K).EQ.BLANK) GO TO 6
    5 CONTINUE
      K=21
    6 K=K-1
      DO 10 J=1,K
      L=1
    7 IF(ALPHA(J).EQ.TITLE(L)) GO TO 9
      L=L+1
      IF(L.LT.MAXNO+1) GO TO 7
    9 COL(J)=A(L)
      NC(J)=L
   10 CONTINUE
      GO TO 34
   32 DO 33 J=1,K
      ALPHA(J)=BETA(J)
      NO(J)=NGRAPH(J)
   33 COL(J)=GRAPH(J)
   34 READ(5,300) NTIMEC,UNITS,IPNEXT
  300 FORMAT(I6,A4,I2)
      WRITE(6,102) NOEXP,(HEAD(J),J=1,19)
  102 FORMAT(1H1///20X,'EXP ',I4,19A4///)
      IF(K.GT.10) GO TO 70
      WRITE(6,21) UNITS, (ALPHA(J),J=1,K)
   21 FORMAT('0 ',A4,10(6X,A4,1X))
      WRITE(6,22) (COL(J),J=1,K)
   22 FORMAT(' ',5X,'0',2X,F10.4,9(1X,F10.4))
      GO TO 31
   70 WRITE(6,71) UNITS,(ALPHA(J),COL(J),J=1,K)
   71 FORMAT(60X,2H0 ,A4//5(4X,A4,' = ',F10.4,4X))
   31 RETURN
      END
      SUBROUTINE PUTOUT(UR24,UR25)
      INTEGER UR24
C
      COMMON/ARRAY/A(400),TITLE(400),COL(20),ALPHA(20)
      COMMON/NUMERO/K,NC(20),
     *               NTIMEC,UNITS,NZ,NTIMEP,NN,MAXNC,NTIME
     1 ,IPNEXT
      COMMON/STORE/NG1,NG2,NG3,NG4,NG5,NG6,NG7,NG8,NG9,DT,TLP,TNP,ND,
     *            TM,TMM,NFIRST,ZZ(15),CLY(9),CBY(9),YMIN(10),YMAX(10),
     *            N,PT(13),BETA(10),NGRAPH(10),GRAPH(10),HEAD(19),NOEXP
     *            ,DTMAX
      COMMON/TAPE/TOTAL
      DATA SECS/'SECS'/,TMIN/'MINS'/,HOUR/'HOUR'/,DAYS/'DAYS'/
      DATA ALL/'ALL '/,BLANK/'    '/
C
C     WATEXC(13,2) IS RELATION BETWEEN WATTS AND PARAMETER EXC (FROM
C     DR.WHITE) TO ALLOW THE COMBINING OF GRODIN WITH GUYTON.
C
      DIMENSION WATEXC(13,2)
      DATA WATEXC/1.,5.,10.,20.,30.,40.,50.,60.,70.,80.,90.,100.,120.,
     1 0.,16.6,32.2,59.1,83.,103.,123.,140.,157.,170.,182.,193.,212./
C
      T=A(1)
```

```
C
C       ICONVT IS FLG      1=CONVERT EXC (A(319)) TO WATTS FOR GRODIN.
C                          0=DO NOT CONVERT EXC TO WATTS.
      ICONVT = 0
      IF(URZ4 .EQ. 1 ) ICONVT = 1
C
      NTIME  = T/1440.
      IF(UNITS .EQ. SECS) NTIME = T * 60.
      IF(UNITS .EQ. TMIN) NTIME  = T
      IF(UNITS .EQ. HOUR) NTIME  = T/60.
      IF(NTIME .LT. NTIMEP) GO TO 65
C
C     HERE IF TO PRINT.
      IF (URZ4.EQ.3) GO TO 900
    6 IF(URZ4 .NE. 1) URZ4 = 2
  900 CONTINUE
      IF(ALPHA(1) .NE. ALL) GO TO 7
      WRITE(6,71) NTIME,UNITS,(TITLE(J),A(J),J=1,MAXNO)
      GO TO 51
    7 DO 20 I = 1,K
      I1 = NO(I)
      COL(I) = A(I1)
   20 CONTINUE
      IF(K .GT. 10) GO TO 70
      WRITE(6,21) UNITS, (ALPHA(J),J=1,K)
   21 FORMAT('0 ',A4,10(6X,A4,1X))
      WRITE(6,31) NTIME,(COL(J),J=1,K)
   31 FORMAT(' ',I6,2X,F10.4,9(1X,F10.4))
      GO TO 51
   70 WRITE(6,71) NTIME,UNITS,(ALPHA(J),COL(J),J=1,K)
   71 FORMAT(///56X,I5,1X,A4//5(4X,A4,' = ',F10.4,4X))
   51 NTIMEP = NTIME + IPNEXT
C
C   SEE IF TIME TO STOP PRESENT TIME STEP.
   53 IF(NTIME.LT.NTIMEC) GO TO 65
   54 READ(5,400) NTIMEC,CUNITS,IPNEXT,SYMBOL,CVALUE
  400 FORMAT(I6,A4,I2,A4,E13.6)
C
C     BLANK TIME STEP CARD ENDS RUN.
      IF(SYMBOL.EQ.CUNITS) GO TO 66
      IF(CUNITS.NE.BLANK) GO TO 59
      IF(A(2).GT..5) A(2)=.5
  450 DO 55 MN=1,MAXNO
      IF(SYMBOL.EQ.TITLE(MN)) GO TO 57
   55 CONTINUE
   57 WRITE(6,58) NTIME,UNITS,SYMBOL,A(MN),CVALUE
   58 FORMAT(/15X,'AT',I5,1X,A4,' INTO THE SIMULATION, THE VALUE OF ',
     *                 A4,'WAS CHANGED FROM ',F10.3,'  TO ',F10.3/)
      A(MN)=CVALUE
C    SET FLG.INDICATION CHGED.WORK LOAD IF EXC INPUT.
      IF(MN .EQ. 319) ICONVT = 1
      GO TO 54
   59 UNITS  = CUNITS
      NTIMEP = T / 1440. + IPNEXT
      IF(UNITS .EQ. SECS) NTIMEP = T * 60. + IPNEXT
      IF(UNITS .EQ. TMIN) NTIMEP = T + IPNEXT
      IF(UNITS .EQ. HOUR) NTIMEP  = T / 60. + IPNEXT
C
      NTIMEC= NTIMEP+ NTIMEC - IPNEXT
C
```

```
C      CONVERT EXC TO WATTS FOR GRCDIN IF HAVENT ALREADY.
   65 IF(ICCNVT .EQ. 0) GO TO 650
C
       URZ5 = 0.
       IF(A(319) .LE. 1.) GO TO 650
       DO 805 JJ = 2,13
       JJ2 = JJ
       IF(A(319) .LE. WATEXC(JJ,1)) GO TO 806
  805 CONTINUE
       URZ5 = 212.
       GO TO 650
  806 URZ5 =  WATEXC(JJ2-1,2) +(((A(319)-WATEXC(JJ2-1,1))/
     1  (WATEXC(JJ2,1) - WATEXC(JJ2-1,1)))  *  (WATEXC(JJ2,2) -
     2  WATEXC(JJ2-1,2)))
C
  650 RETURN
C
C  HERE IF DETECTED END OF RUN(BLANK TIME STEP CARD).
   66 UPZ4 = 3
       RETURN
       END
       SUBROUTINE FUNCTN(TH,PCL,TAB)
       DIMENSION TAB(14)
       N=14
       DO 110 I=1,N,2
       IF(TAB(I)-TH) 110,120,110
  110 CONTINUE
       GO TO 140
  120 PCL=TAB(I+1)
  130 RETURN
  140 NN=N-2
       DO 150 I=1,NN,2
       IF(TAB(I) .LT. TH .AND. TAB(I+2) .GT. TH) GO TO 160
  150 CONTINUE
       WRITE(6,100) TH
  100 FORMAT(5X,' ***** CURVE LIMITS EXCEEDED ***** ',G12.6//)
       IF(TH .LT. TAB(1)) PCL=TAB(2)
       IF(TH .GT. TAB(N-1)) PCL=TAB(N)
       GO TO 130
  160 PCL=TAB(I+1)+(TAB(I+3)-TAB(I+1))*((TH-TAB(I))/(TAB(I+2)-TAB(I)))
       GO TO 130
       END
       SUBROUTINE HEMO (FUN1,FUN2,FUN3,FUN4)
       DIMENSION FUN1(14),FUN2(14),FUN3(14),FUN4(14)
C      SUBROUTINE HEMD (AMM,ANM,ANU,ANY,ANZ,APM,AUH,AUM,AUY,AVE,BFM,BFN,
C     *                 CN2,CN3,CN7,CV ,DAS,DLA,DPA,DRA,DVS,FIS,HMD,HPL,
C     *                 HPR,HSL,HSR,I2 ,LVM,PA ,PAM,PA2,PC ,PGL,PGS,PLA,
C     *                 PPA,PP1,PP2,PRA,PR1,PVS,QAD,QLN,QLO,QPO,QRF,QRN,
C     *                 QRO,QVC,RAM,RAR,RBF,RPA,RPT,RPV,RSM,RSN,RVG,RVM,
C     *                 RVS,U  ,VAE,VAS,VBD,VIM,VLA,VLE,VP ,VPA,VPE,VRA,
C     *                 VRC,VRE,VVE,VVR,VVS,VV7,VV8,X  ,FUN1,FUN2,FUN3,
C     *                 FUN4)
C      REAL I2,LVM
C      DIMENSION FUN1(14),FUN2(14),FUN3(14),FUN4(14)
       REAL LVM,I,IFP,LPD,KE,KE1,KCD,KIF,KIF,KI,KCD,KED,KN1,KN3
       REAL NAE,NED,NIC,NCD,I1,LPK,KID,KC2,NDZ,KCZ,HPL,HPR,I2,I3,HMD
       COMMON/ARRAY/T,I,VBD,VVS,VPA,VAS,VLA,VRA,VAE,PA,PAM,LVM,
     *           VRE,PRA,QRN,VPE,PPA,PP1,CPA,RPA,PVM,VLE,PLA,QLN,PL1,
     *           A1B,RPV,RPT,PGL,QPC,QS ,VVE,VV8,PVS,PGV,RVG,QVC,AVE
       COMMON/ARRAY/CN2,CN3,RVS,PGS,RTP,QAC,QPO,QLC,DVS,DPA,DAS,DLA,DRA,
```

```
     *               PA1,AUC,AU8,AUN,AU6,AU7,AU3,CAU,AUJ,AU  ,AUO,AUH,VV4,
     *               AU9,AUM,AU4,VIF,PO1,PTT,PTS,PIF,CPI,PTC,CPP,PPC,PVG
      COMMON/ARRAY/PC  ,PCD,VTC,PLD,VTL,VTC,VPD,CPL,CP1,DPC,DP1,LPD,DLP,
     *               DPP,CHY,PRM,PGR,CPG,PGP,GF1,PGC,PGX,PGH,PG2,VGJ,VG  ,
     *               EPH,GP1,GP2,GPC,AAP,RR  ,REN,APD,GLP,PFL,GFR,IFR,VUD
      COMMON/ARRAY/REK,NOD,NED,MAE,VEC,CKE,KOD,KE1,KIR,KIE,KCD,KED,CKI,
     *               CNA,CCC,VIC,KE  ,KI  ,VIC,I1  ,VTY,Z   ,VTZ,VUZ,TVZ,PPZ,
     *               DFZ,X   ,I2  ,PR1,VTS,VP  ,PPP,IFP,GPR,KN3,KN1,AMP,AMP
      COMMON/ARRAY/AM1,AMC,AM2,AM3,AM5,AM  ,CNE,AGK,ANP,AN1,ANC,AN2,AN3,
     *               AN5,ANM,V2  ,HM1,HM  ,R1  ,VIE,VIB,VIM,RC2,PO2,RKC,RC1,
     *               RCD,VPC,RSN,OVA,BFN,DJB,ACM,FIC,OSV,POT,POD,POB,AR1
      COMMON/ARRAY/AR2,POC,AR3,ARM,CN8,GFN,AH7,AH8,AH  ,AHC,AH1,AH2,AH4,
     *               AHM,CNY,CNX,VV1,VV2,VV5,VV6,VV7,TVD,VTW,HSR,HSL,NID,
     *               SP  ,VVR,RAR,CV  ,CN7,AUX,AUK,ALZ,Y   ,CFC,CPK,PCE,CPR
      COMMON/ARRAY/LPK,CPC,HYL,KID,AMT,ANT,POK,PCN,A1K,A2K,A3K,CNR,CN7,
     *               AHK,SRK,V9  ,V20,Z1  ,Z2  ,Z3  ,Z4  ,Z5  ,Z6  ,Z7  ,Z8  ,HMK,
     *               HKM,PGV,PCZ,RDO,QC2,RBF,MO2,POA,POY,ANU,POR,GF2,HMD
      COMMON/ARRAY/OHM,POQ,I3  ,U   ,VP1,T1  ,GF3,GF4,AUP,AUV,RV1,AUY,OUT,
     *               DSP,AHZ,AHY,OSA,PPI,CPN,PUS,PLF,PPC,PPN,PPD,PFI,DFP,
     *               VPF,PPR,PMC,PMS,PMP,HR  ,CPF,PCP,DA1,DLZ,DPY,DPZ,GPZ
      COMMON/ARRAY/NCZ,KCZ,VIZ,HPR,HPL,STH,ALO,EXC,O2M,PA2,PP2,SVO,AUL,
     *               VV9,O2A,O1  ,EXE,ARF,CRF,RSM,RFM,RAM,OVS,PVC,RMC,QCM,
     *               PMC,P2C,MMO,PDO,PCE,AMM,A4K,PCM,OM4,PM1,PM3,PM4,EX1
      COMMON/ARRAY/Q2  ,Q3  ,PM5,PK1,Z9  ,Z10,Z11,Z12,Z13,Z14,Z15,Z16,PK2,
     *               PK3,FIS,STA,PAR,GBL,ANY,ANZ,ANX,ANV,ANW,ANR,AUQ,AUR,
     *               AUS,A378,H1,A2,A3,TW,RH,V,TA4R,BARO,TR,EXQ
      COMMON/ARRAY/DUMMY(12),TITLE(400),DUMMY(40)
      COMMON/NUMERO/K,NO(20),NTIMEC,UNITS,NZ,NTIMEP,NN,MAXNO,NTIME
     1 ,IPNEXT
      COMMON/STORE/NG1,NG2,NG3,NG4,NG5,NG6,NG7,NG8,NG9,DT,TLP,TNP,ND,
     *               TM,TMP,NFIRST,ZZ(15),OLY(9),CBY(9),YMIN(10),YMAX(10),
     *               N,PT(18),BETA(10),NGRAPH(10),GRAPH(10),HEAD(19),NOEXP
     *               ,DTMAX
C
C      CIRCULATORY DYNAMICS BLOCK
C     HEMODYNAMICS
C
      VBD=VP+VRC-VVS-VAS-VLA-VPA-VRA
      VVS=VVS+DVS*I2+VBD*.3986
      VPA=VPA+DPA*I2+VBD*.155
      VAS=VAS+DAS*I2+VBD*.261
      VLA=VLA+DLA*I2+VBD*.128
      VRA=VRA+DRA*I2+VBD*.0574
      VAE=VAS-.495
      PA=VAE/.00355
      IF(PA.LT.0.) PA=.0001
      PAM=100./PA
      PA2=PA/AUH
      CALL FUNCTN(PA2,LVM,FUN1)
      VRE=VRA-.1
      PRA=VRE/.005
      CALL FUNCTN(PRA,CRN,FUN2)
      VPE=VPA-.30625
      PPA=VPE/.0048
      PP1=.026*PPA
      IF(PP1.LT.0.) PP1=10.**(-12)
      RPA=PP1**(-.5)
      PP2=PPA/AUH
      IF(PP2.LE.0.) PP2=.0001
      CALL FUNCTN(PP2,RVM,FUN3)
```

```
      VLE=VLA-.4
      PLA=VLE/.01
      CALL FUNCTN(PLA,QLN,FUN4)
      IF (QLN.LE.0.0001) QLN=0.0001
      RPV=1./(PLA+20.)/.0357
      RPT=RPV+RPA
      PGL=PPA-PLA
      QPO=PGL/RPT
      ANU=ANN
      IF (ANU.LT..8)ANU=.8
      VVE=VVS-VVR-(ANU-1.)*ANY
      VV8=VVE-VV7
      IF(VV8.LT..0001)VV8=.0001
      PVS=VV8/CV
      PR1=PRA
      IF (PRA.LT.0.)PR1=0.
      RVG=2.738/PVS
      QVO=(PVS-PR1)/RVG
      CN3=CN3+(((PC-17.)*CN7+17.)*CN2-CN3)*.1
      AVE=(AUM-1.)*AUY+1.
      PVS=AVE*(1./CN3)*VIM*((ANU-1.)*ANZ+1.)
      PGS=PA-PVS
      RSN=RAR*ARM*ANU*AUN*PAN*VIM+RVS*1.79
      BFN=PGS/RSN
      RSM=ANU*VIM*PAM*AUM*AMM*RAM
      BFM=PGS/RSM
      QAO=BFN+BFM+RBF+(PA-PRA)*FIS
      QLO=LVM*GLM*AUH*HSL*HMD*HPL
      QPO=QRN*((1.-QRF)*AUH*RVM*HSR*HMD*HFR+QRF*QLC/QLN)
      QPO=QLO+(QPO-QLO)/U
      QVO=QRO+(QVO-QRO)/X
      DVS=QAO-QVO
      DPA=QPO-QPO
      DAS=QLO-QAO
      DLA=QPO-QLO
      DRA=QVO-QRO
      RETURN
      END
      SUBROUTINE AUTC (AU  ,AUB,AUC,AUH,AUJ,AUK,AUL,AUM,AUN,AUO,AUP,AUQ,
     *                  AUR,ALS,AUV,AUX,AUZ,AU4,AU6,AU8,A18,DAU,EXC,EXE,
     *                  EX1,I2  ,PA  ,PA1,POQ,POT,P2O,STA,VVR,VV9,Y   ,Z,
     *                Z8,Z12,EXQ)
      REAL I2
C
C     AUTONOMIC CONTROL BLOCK
C
  120 EXE=(8.0-P2O)*EX1+(EXC+EXQ-1.0)*Z12
      POQ=POT
      IF (POQ.GT.8.)POQ=8.
      IF (POQ.LT.4.)POQ=4.
      PA1=PA*POQ/8.-EXE
      AUC=0.
      IF(PA1.LT.80.)AUC=.03*(80.-PA1)
      IF(PA1.LT.40.)AUC=1.2
      AUB=0.
      IF(PA1.LT.170.)AUB=.014286*(170.-PA1)
      IF(PA1.LT.40.)AUB=1.83
  123 A1B=(AUB-1.)*AUX+1.
  124 AUN=0
      IF(PA1.LT.50.)AUN=.2*(50.-PA1)
```

```
      IF(PA1.LT.20.)AUN=6.0
      AU6=A1P-AU4
      AUB=AUK*(AU6-1.)
      CAU=C/L+(AUC+AU6+AUB-DAL)/Z/Y
      AUJ=AUJ+(CAU-AUJ)*I2*6./Z8
      IF(AUJ.LT.0.)AUJ=0.
      IF(AUJ-1.)126,127,127
  126 AU=AUJ**AU7
      GO TO 128
  127 AU=(AUJ-1.)*AUZ+1.
  128 IF(STA.GT..00001)AU=STA
      AUC=AU-1.
      AUP=AUC*AUQ+1.
      AUH=AUC*AUV+1.
      AUR=AUC*AUS+1.
      VVR=VV9-ALL*AUP
      AUM=.15+.85*AUP
      RETURN
      END
      SUBROUTINE HORMON(AM ,AMC,AMP,AMR,AMT,AM1,ANM,CKE,PA,Z,FUN7,
     *                  AGK,ANC,ANP,ANR,ANT,ANV,ANW,AN1,CNA,CNE,GFN,
     *                  I   ,REK,A2 ,A3,Z14)
      DIMENSION FUN7(14)
      REAL I
C
C****************************************************************************
C
C     ALDOSTERONE CONTROL BLOCK
C
C****************************************************************************
      AMR=CKE/CNA/A3-A2
      IF (AMR.LT.0.0) AMR=0.0
      CALL FUNCTN (PA,AMP,FUN7)
      AM1=AM1+(ANM*AMP*AMR-AM1)/Z
      AMC=AMC+(AM1-AMC)*(1.-EXP(-I/AMT))
      AM=20.039-19.8*EXP(-.0391*AMC)
C****************************************************************************
C
C     ANGIOTENSIN CONTROL BLOCK
C
C****************************************************************************
      CNE=152.-CNA
      IF(CNE.LT.1.)CNE=1.
      ANR=((17.75-GFN*CNA)*AGK+1.)*REK
      ANW=ANW+((ANR-1.)*10.-ANW)*ANV*I
      IF(ANW.LT..0)ANW=0.
      ANP=ANP+ANW
      IF(ANP.GT.100.)ANP=100.
      IF(ANP.LT..01)ANP=.01
      AN1=AN1+(ANP-AN1)/Z
      ANC=ANC+(AN1-ANC)*(1.-EXP(-I/ANT))
      ANM=4.0-3.3*EXP(-.0967*ANC)
      IF(ANM.LT..7)ANM=.7
      RETURN
      END
      SUBROUTINE BLOOD (HKM,HM ,HMK,I   ,PGT,PCY,PO1,PO2,RC1,RC2,RCD,RKC,
     *                  VB ,VIB,VIE,VIM,VP ,VRC)
      REAL I
C
C     RED CELLS AND VISCOSITY BLOCK
```

```
C-----------------------------------------------------------------------
C     BLOOD VISCOSITY
C-----------------------------------------------------------------------
 170  VB=VP+VRC
      HM=100.*VRC/VB
      VIE=HM/(HMK-HM)/HKM
      VIB=VIE+1.5
      VIM=.3333*VIB
C-----------------------------------------------------------------------
C     RED BLOOD CELLS
C-----------------------------------------------------------------------
      RC2=RKC*VRC
      PO2=PC1-POT
      IF(PO2.LT..2375)PO2=.2375
      RC1=PCY*PC2
      RCD=RC1-RC2
      VRC=VRC+RCD*I
      RETURN
      END
      SUBROUTINE MUSCLE(ALO,AMM,ACM,AUP,A4K,BFM,EXC,HM ,I   ,MMO,CMM,OSA,
     *                  OVA,OVS,O2A,POO,PK1,PK2,PK3,PMO,PM1,PM3,PM4,PM5,
     *                  PCE,PCM,PVC,P2C,QOM,RMO,VPF,Z5,Z6,PMS,EXC)
      REAL I,MMO
C
C     MUSCLE BLOOD FLOW CONTROL AND PO2 BLOCK
C
 180  OSA=ALO-VPF*.5
       OVA=OSA*HM*5.0
      OVS=OVS+((BFM*OVA-RMO)/HM/5./BFM-OVS)/Z6
      PVC=57.14*OVS
      RMO=(PVO-PMO)*PM5/(PM1**PK3-PM4)
      QOM=QOM+(RMO-MMO)*(1.-EXP(-I/Z5))
      PMO=PK2/(PK1-QOM)
      PM1=PMO
      IF(PM1.LT.PM3)PM1=PM3
      P2O=PMC
      IF(P2O.GT.8.)P2O=8.
      ACM=(AUP-1.)*O2A+1.
      MMO=ACM*CMM*(EXC+EXC)*(1.0-(8.0001-P2O)**3.0/512.0)
      POC=PVC-40.
      PCE=PCM*POC+1.
      IF(PCE.LT..005)POE=.005
      AMM=AMM+(PCE-AMM)*(1.-EXP(-I/A4K))
      RETURN
      END
      SUBROUTINE AUTORG(ACM,ARM,AR1,AR2,AR3,A1K,A2K,A3K,BFN,DOB,HM ,I,
     *                  MO2,OSV,OVA,O2M,PC4,PC8,POC,POD,POK,PON,POR,POT,
     *                  POV,POZ,P10,QO2,RDO,Z   ,Z4 ,Z7)
      REAL I,MO2
C
C     NON-MUSCLE OXYGEN DELIVERY BLOCK
C     AND NON-MUSCLE LOCAL BLOOD FLOW CONTROL BLOCK
C-----------------------------------------------------------------------
C     AUTOREGULATION,RAPID
C-----------------------------------------------------------------------
      OSV=OSV+((BFN*OVA-DOB)/HM/5./BFN-OSV)/Z7
      POV=OSV*57.14
      RDO=PCT**3.
      IF(RDO.LT.50.)RDO=50.
      DOB=(POV-POT)*2896.5/RDO
```

```
      MO2=AOM*O2M*(1.-(8.0001-P10)**3./512.)
      QO2=QO2+(DOB-MO2)*(1.-EXP(-I/Z4))
      POT=QO2*.00333
      IF (POT.LE.0.0001) POT=0.0001
      P10=POT
      IF(POT.GT.8.)P10=8.
      POD=POV-POR
      POB=POB+(POK*POD+1.-POB)/Z
      IF(POB.LT..2)POB=.2
      AR1=AR1+(POB-AR1)*(1.-EXP(-I/A1K))
      ARM=AR1*AR2*AR3
C------------------------------------------------------------------------
C     AUTOREGULATION,INTERMEDIATE
C------------------------------------------------------------------------
      POA=POA+(POA*POD+1.-POA)/Z
      IF (POA.LT..5)POA=.5
      AR2=AR2+(POA-AR2)*(1.-EXP(-I/A2K))
C------------------------------------------------------------------------
C     AUTOREGULATION,LONG-TERM
C------------------------------------------------------------------------
      IF(POD)194,192,192
  192 POC=POZ*POD+1.
      GO TO 196
  194 POC=POZ*POD*.33+1.
  196 IF (POC.LT..3)POC=.3
      AR3=AR3+(POC-AR3)*I/A3K
      RETURN
      END
      SUBROUTINE ADH   (AH ,AHC,AHK,AHM,AHY,AHZ,AH7,AH8,AUP,CNA,CNB,CNR,
     *                  CNZ,I   ,PRA,Z)
      REAL I
C
C     ANTIDIURETIC HORMONE
C
      CNB=CNA-CNR
      AHZ=.2*PRA
      AHY=AHY+(AHZ-AHY)*.0007*I
      AH8=AUP-1.
      IF(AH8.LT.0.)AH8=0.
      IF(CNB.LT.0.)CNB=0.
      AH=AH+(CNZ*CNB+AH8-AHZ+AHY-AH)/Z
      IF(AH.LT.0.)AH=0.
      AHC=AHC+(.3333*AH-AHC)*(1.-EXP(-I/AHK))
      AHM=6.*(1.-EXP(-0.1808*AHC))
      IF(AHM.LT..3)AHM=.3
      RETURN
      END
      SUBROUTINE MISC1 (AHM,AU4,AU8,I ,SR ,SRK,STH,TVD,TVZ,VEC,VIC,VTW,
     *          VVE,VV6,VV7,Z,V9,CALC,IDRINK,AMOUNT,IFLAG,Z3)
      REAL I
C
C************************************************************************
C
C     VASCULAR STRESS RELAXATION BLOCK
C
C************************************************************************
      VV6=VV6+(SR*(VVE-V9   )-VV7-VV6)/Z
      VV7=VV7+VV6*(1.-EXP(-I/SRK))
C************************************************************************
C
```

```
C     THIRST AND DRINKING BLOCK
C*****************************************************************************
C
      CALC=0.0
      TVZ=(.01*AHM-.009)*STH
      TVD=TVZ
      IF(TVD.LT.0.)TVD=0.
      IF (IDRINK.NE.1) GO TO 404
      CALC=AMOUNT
      IF (IFLAG.EQ.1) CALC=TVD*I
      IDRINK=2
  404 CONTINUE
      VTW=VIC+VEC
C*****************************************************************************
C
C     AUTONOMIC CONTROL BLOCK
C     ADAPTATION OF BARORECEPTORS
C
C*****************************************************************************
      AU4=AL4+AL8*I
      RETURN
      END
      SUBROUTINE HEART (AUR,DHM,HMD,HR ,I   ,PA  ,PMC,PMP,PMS,POT,PRA,QAO,
     *                   QLC,RTP,SVO,VAE,VLE,VPE,VRE,VVE,H1)
      REAL I
C
C     HEART HYPERTROPHY OR DETERIORATION BLOCK
C
C-----------------------------------------------------------------------------
C     HEART VICIOUS CYCLE
C-----------------------------------------------------------------------------
      DHM=(POT-6.)*.0025
      HMD=HMD+DHM*I
      IF (HMD.GT.1.)HMD=1.
C-----------------------------------------------------------------------------
C     MEAN CIRCULATORY PRESSURES
C-----------------------------------------------------------------------------
      PMC=(VAE+VVE+VRE+VPE+VLE)/.11
      PMS=(VAE+VVE+VRE)/.09375
      PMP=(VPE+VLE)/.01625
C*****************************************************************************
C
C     HEART RATE AND STROKE VOLUME BLOCK AND TOTAL PERIPHERAL RESISTANCE
C
C*****************************************************************************
      HR=(32.+H1 *AUR+PRA*2.)*((HMD-1.)*.5+1.)
      RTP=(PA-PRA)/QAO
      SVO=QLC/HR
      RETURN
      END
      SUBROUTINE CAPMBD(BFN,CFC,CPI,CPP,DFP,I   ,IFP,PC  ,PCD,PIF,PLD,PPC,
     *                  PRP,PTC,PTS,PTT,PVG,PVS,RVS,TVD,VG  ,VID,VIF,VP,
     *          CALC,VPD,VTC,VTD,VTL,VTS,VUD,Z   ,Z1,FUN6,Z3,IFLAG)
      DIMENSION FUN6(14)
      COMMON/HCT/TERMWA,TERMK,TERMNA
      REAL I,IFP
C
C     CAPILLARY MEMBRANE DYNAMICS BLOCK
C
C       SWEAT
```

```
      VTS=VTS-TERMWA*I
 130  PTT=(VTS/12.)**2.
      VIF=VTS-VG
      CALL FUNCTN (VIF,PTS,FUN6)
      PIF=PTT-PTS
      CPI=IFP/VIF
      PTC=.25*CPI
      CPP=PFP/VP
      PPC=.4*CPP
      PVG=PVS*1.79*BFN
      PC=PVG+PVS
      PCD=PC+PTC-PPC-PIF
      VTC=VTC+(CFC*PCD-VTC)/Z
      PLD=7.8+PIF-PTT
      VTL=VTL+(.004*PLD-VTL)/Z
      IF(VTL.LT.0.)VTL=0.
      VTD=VTC-VTL-VID
      VTS=VTS+VTD*I
      VPD=VPD+(VTL-VTC-VUD-DFP-VPD)/Z1
C     DRINKING
      VPD=VPD+CALC*Z3/I
      VP=VP+(VPD*I)/Z3
      RETURN
      END
      SUBROUTINE PULMON(CPF,CPP,CPN,DFP,I   ,PCP,PFI,PLA,PLF,POS,PPA,PPC,
     *                IFLAG,PPC,PPI,PPN,PPO,PPR,VP  ,VPD,VPF,Z   ,Z3,CALC)
      REAL I
C
C     PULMONARY DYNAMICS AND FLUIDS BLOCK
C
C
 200  PCP=.45*PPA+.55*PLA
      PPI=2.-.150/VPF
      CPN=PPR/VPF
      POS=CPN*.4
      PLF=(PPI+11.)*.0003
      PPO=PLF*CPN
      PPN=(CPP-CPN)*.000225
      PPD=PPD+(PPN-PPO-PPD)/Z
      IF(PPR+PPD*I-.025.LT.0.)PPD=(.025-PPR)/I
      PFI=(PCP-PPI+POS-PPC)*CPF
      DFP=DFP+(PFI-PLF-DFP)/Z
      IF(VPF+DFP*I-.001.LT.0.)DFP=(.001-VPF)/I
      VPF=VPF+DFP*I
      PPR=PPR+PPD*I
      RETURN
      END
      SUBROUTINE MISC2 (HPL,HPR,HSL,HSR,I,PA,PPA,POT,STH,Z10,Z11,Z13,
     *            TIMEDR,IFLAG,THIRST,T7  ,IDRINK,AMOUNT,VP,NAE,NID,KE,
     *            KID)
      REAL I
      REAL NAE,NID,KE,KID
C
C*****************************************************************************
C
C     HEART HYPERTROPHY OR DETERIORATION BLOCK
C
C*****************************************************************************
      HPL=HPL+(((PA/100./HSL)**Z13)-HPL)*I/57600.
      HPR=HPR+(((PPA/15./HSR)**Z13)-HPR)*I/57600.
```

```
C*****************************************************************************
C
C     TISSUE EFFECT ON THIRST AND SALT INTAKE
C
C*****************************************************************************
  400 CONTINUE
      STH=(Z10-POT)*Z11
      IF(STH.LT.1.)STH=1.
      IF(STH.GT.8.)STH=8.
      THIRST=THIRST+STH
      STH=0.0
      IF (T7.LT.TIMEDR) GO TO 420
      T7=0.0
      STH=THIRST
      IDRINK=1
      THIRST=0.0
  420 CONTINUE
      RETURN
      END
      SUBROUTINE PROTEN(CHY,CPG,CPI,CPK,CPP,CPR,CP1,DLP,DLZ,DPC,DPI,DPL,
     *                  DPO,CPY,GPD,GPR,I   ,IFP,LPK,PC  ,PCE,PGX,PRP,VG ,
     *                  VTL,Z   ,PPD)
      REAL I,IFP,LPK
C
C     TISSUE FLUIDS,PRESSURES AND GEL BLOCK
C
C-----------------------------------------------------------------------------
C     PLASMA AND TISSUE FLUID PROTEIN
C-----------------------------------------------------------------------------
  135 DPL=DPL+(VTL*CPI-DPL)/Z
      IF (PC.LT.0.)PC=0.
      DPC=DPC+(CPK*(CPP-CPI)*PC**PCE-DPC)/Z
      DPI=DPC-DPL
      DLZ=LPK*(CPR-CPP)
      IF(CPP.GT.CPR)DLZ=4.*DLZ
      DLP=DLP+(DLZ-DLP)/Z
      PRP=PRP+(DLP-DPO+DPL-DPC-PPD)*I
C-----------------------------------------------------------------------------
C     GEL PROTEIN DYNAMICS
C-----------------------------------------------------------------------------
  141 PGX=CHY**2*.01332*CPG*CPG
      GPD=GPD+(.0005*(CPI-PGX)*VG-GPD)/Z
      GPR=GPR+GPD*I
      IFP=IFP+(DPI-GPD)*I
      RETURN
      END
      SUBROUTINE KIDNEY(AAR,AHM,AM  ,APD,ARF,AUM,CNE,CNX,CNY,GBL,GFN,GFR,
     *                  GF2,GF3,GF4,GLP,I   ,NAE,NED,NID,NOD,NOZ,PA  ,PAR,
     *                 PFL,PPC,RBF,REK,RFN,RR  ,STH,TRR,VIM,VUD,Z,GUYNA,
     *                 GUYH2O,Z1,Z3,CALC)
      REAL I,NAE,NED,NIC,NOD,NOZ
C
C     KIDNEY DYNAMICS AND EXCRETION BLOCK
C
 142  GF3=((GFN/.125-1.)*GF4)+1.
      IF(GF3.GT.15.)GF3=15.
      IF(GF3.LT..4)GF3=.4
      AAR=31.67*VIM*(AUM*ARF+1.-ARF)*GF3
      RR=AAR+51.66*VIM
      PAR=PA-GBL
```

```
      RFN=PAP/RR
      RBF=REK*RFN
 150  APD=AAR*RFN
      GLP=PAP-APD
      PFL=GLP-PPC-18.
      GF1=GFN
      GFN=GFN+(PFL*.00781-GFN)*GF2/Z
      IF (ABS(GFN-GF1).GT..002)GO TO 142
      GFR=GFN*REK
      TRR=.8-GFR+.025*REK-.001*REK/AM/AHM
      VUD=VUD+(GFR-TRR-VUD)/Z
      IF(VUD.LT..0002)VUD=.0002
      GUYH2O=GUYH2O+VUD*I/Z3/Z1
C-----------------------------------------------------------------------
C     KIDNEY SALT OUTPUT AND SALT INTAKE
C     (SEE ALSO ELECTROLYTES AND CELL WATER BLOCK)
C-----------------------------------------------------------------------
      NOZ=1000.*VUD/AM/(CNE/CNX+CNY)
      NOD=NOD+(NOZ-NOD)/Z
      GUYNA=GUYNA+NOD*I-CALC*NID
      NED=-1.0*NOD
      NAE=NAE+NED*I
      RETURN
      END
      SUBROUTINE IONS  (AM ,CCD,CKE,CKI,CNA,I  ,KCD,KE ,KED,KI ,KID,KIE,
     *                 KIR,KOD,NAE,REK,VEC,VIC,VID,VP ,VPF,VTS,Z,NID,
     *                 CALC,CLYK,GUYH2O,Z1,Z3)
      REAL  I,KCD,KE,KED,KI,KID,KIE,KIR,KOD,NAE
      REAL NID
      COMMON/HOT/TERMWA,TERMK,TERMNA
C
C     ELECTROLYTES AND CELL WATER BLOCK
C
 160  VEC=VTS+VP+VPF
      NAE=NAE+CALC*NID-TERMNA*I
      KE=KE+CALC*KID-TERMK*I
      CKE=KE/VEC
      KOD=(.00042*CKE+.00014*AM*CKE)*REK
      GUYK=GUYK+KOD*I-CALC*KID
      KIE=2650.+140.*CKE
      KIR=KIE-KI
      KCD=KCD+(KIR*.013-KCD)/Z
      KI=KI+KCD*I
      KED=-1.0*(KCD+KOD)
      KE=KE+KED*I
      CKI=KI/VIC
      CNA=NAE/VEC
      CCD=CKI-CNA
      VID=VID+(.01*CCD-VID)/Z
      VIC=VIC+VID*I
      RETURN
      END
      SUBROUTINE GELFLD(CHY,CPG,CPI,GPR,HYL,IFP,PGC,PGH,PGP,PGR,PGX,PIF,
     *                 PRM,PTC,PTS,PTT,VG ,VGD,VIF,VRS,VTS,V2D,FUN6)
      DIMENSION FUN6(14)
      REAL IFP
C
C     GEL FLUID DYNAMICS
 140  CHY=HYL/VG
      PRM=-5.9*CHY+24.2
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      PGR=.4*CHY
      CPG=GPP/VG
      PGP=.25*PGX
      PGC=PGP+PGR
      VIF=VTS-VG
      CALL FUNCTN (VIF,PTS,FUN6)
      PIF=PIT-PTS
      CPI=IFF/VIF
      PTC=.25*CPI
      PGH=PIF+PIS+PRM
      VGD=V20*(PIF+PGC-PTC-PGH)
      VGI=0.01*VG
      IF (VGI.LT.ABS(VGD)) GO TO 140
      VG=VG+VGD
      IF(VG.LT.0.)VG=0.
      RETURN
      END
      SUBROUTINE THERMO (CKE,CNA,TERMNA,TERMK,TERMWA,ISTOL,URZ4,TW,
     *       CALC,GLYNA,GUYK,GLYH2O,URZ5,ICRINK,TIME,TAAR,BARO,
     *        RH,V,TR,QUAT)
      DIMENSION C(25),T(25),F(25),HF(25),TC(24),TD(24),QB(24),Q(24),
     1EB(24),E(24),BFB(24),BF(24),BC(24),HC(6),S(6),HR(6),H(6),P(10),
     2EMAX(6),TSETWS(25),ERROR(25),RATE(25),COLD(25),WARM(25),SKINR(6),
     3SKINS(6),SKINV(6),SKINC(6),WORKM(6),CHILM(6),TI(25),PSKIN(6),
     4SWPCP(6),TAIR(6),PAIR(6),TSETC(25),PCT(75),VOL(24),HCSL(6),
     5RAD(24),RADNT(18),SUFA(24),DELX(18),ARX(18),COND(18),DELTAT(6)
      DIMENSION WTPCT(73),PCTN(73),WK1(6),WK2(6),WK3(6),WK4(6),
     1 TSETWA(25)
      DIMENSION SUBRAT(14),PS(6),EVG(25),FILM(25),FILMW(25),CLOWAT(25),
     1TAIRV(6,6),WTAIRV(6),PCB(24),PBCC(24)
      DIMENSION SWCG(6),EG(25),NTIME(10),WW(10),EWET(6),EVCP(6)
      DIMENSION QHOLD(24),DRIP(25),RHV(6),WRHV(6),WORKV(6),TWORKV(6),
     1VV(6),WVV(6),TC(6),FCL(6),CLO(6),FACL(6),TOTALH(6),DRY(6),TCL(6)
      INTEGER A,B,G,D
      INTEGER URZ4
       REAL ITIME1
      REAL I2
      REAL MAXBF(24),LTH(24),NWT(73),MPR(18),NST1(25),NSTM(6)
      REAL NACLMG,NACONC,NAMEQ,KCONC,KMEQ,KCLMG
      REAL KFAC
      REAL LTIME,ITIME,LR,K1,K2
      DIMENSION AREA(24),SEGWT(24),CMRAD(24),         HTSA(18),PAREA(6)
      SUBNA=0.0
      SUBK=0.0
      SUBH2C=0.0
      IF (ISTOL.EQ.0) GO TO 1895
      ISTLL=0
   10 FORMAT(1HO,4X,'S(I)= SURFACE AREA OF EACH SEGMENT',/,4X,'HR(I)= LI
     1NEAR RADIANT HEAT TRANSFER COEFFICIENT',/,4X,'HCSL(I)= CONVECTIVE
     2AND CONDUCTIVE HEAT TRANSFER COEFFICIENT - AT SEA LEVEL',/,4X,'HC(
     3I)= CONVECTIVE AND CONDUCTIVE HEAT TRANSFER COEFFICIENT',/,4X,'SKI
     4NR(I)= FRACTION OF ALL SKIN THERMAL RECEPTORS IN EACH SEGMENT',/,4
     5X,'SKINS(I)= FRACTION OF SWEATING COMMAND APPLICABLE TO EACH SKIN
     6SEGMENT',/,4X,'SKINV(I)= FRACTION OF VASODILATION COMMAND APPLICAT
     7ION TO EACH SKIN SEGMENT',/,4X,'SKINC(I)= FRACTION OF VASOCONSTRIC
     8TION COMMAND APPLICATION TO EACH SKIN SEGMENT',/,4X,'WORKM(I)= FRA
     9CTION OF TOTAL WORK DONE BY MUSCLE IN EACH SEGMENT',/,4X,'CHILM(I)
     X= FRACTION OF TOTAL SHIVERING OCCURING IN EACH SEGMENT',/,4X,'NSTM
     X(I)= PROPORTION OF NON-SHIVERING THERMOGENESIS FOR EACH SEGMENT')
   11 FORMAT(1HO,4X,'CUMULATIVE WATER LOSS,CEVG=',F9.3,' GM')
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 12 FORMAT(1H0,3X,' HEART RATE, HEARTR= ',F9.3,'  BEATS/MINUTE')
 52 FORMAT(1H0,4X,'AGE OF THE SUBJECT,AGE=',F6.2,'  YEARS')
103 FORMAT(14F5.2)
200 FORMAT(I2)
201 FORMAT(14F5.4)
504 FORMAT(1H0,4X,'SPECIFIC HEAT (THERMAL CAPACITY) OF SKIN,SHS=',1X,F
   16.3,' WATT-HR/KG-C')
505 FORMAT(1H0,4X,'WEIGHT OF THE SUBJECT,WT=',1X,F6.2,' KG')
506 FORMAT(1H0,4X,'SPECIFIC HEAT (THERMAL CAPACITY) OF FAT,SHF=',1X,F6
   1.3,' WATT-HR/KG-C')
507 FORMAT(1H0,4X,'SPECIFIC HEAT (THERMAL CAPACITY) OF BONE,SHB=',1X,F
   16.3,' WATT-HR/KG-C')
508 FORMAT(1H0,4X,'SPECIFIC HEAT (THERMAL CAPACITY) OF TISSUE,SHT=',1X
   1,F6.3,' WATT-HR/KG-C')
509 FORMAT(1H0,4X,'HEIGHT OF THE SUBJECT,HT=',1X,F6.2,' CM')
510 FORMAT(1H0,4X,'SURFACE AREA OF THE SUBJECT,SA=',1X,F6.2,' SQ M')
511 FORMAT(1H0,4X,'VOL(N),      VOLUME OF SUBJECT,CUBIC CENTIMETERS')
512 FORMAT(1H0,4X,'LTH(N),      LENGTH OF PARTS OF THE BODY,CM.')
515 FORMAT(1H0,4X,'RAD(N),      RADIUS OF PARTS OF THE BODY, CM.')
519 FORMAT(1H0,4X,'SURFACE AREA OF DRY ICE FACING SKIN,SAF=',1X,F6.2,'
   1 SQ. CM.'//)
524 FORMAT(1H0,3X,'DELX(K),      DELTA X, ABOUT RAD(I),CM.')
527 FORMAT(1H0,3X,'COND(K),      CONDUCTIVITY,W/CM C')
531 FORMAT(1H0,4X,'TC(K),  THERMAL CONDUCTANCE BETWEEN ADJACENT ELEMEN
   1TS,      WATTS/DEG C')
550 FORMAT(1H0,12X,'CORE-MUSCLE',4X,'MUSCLE-FAT',7X,'FAT-SKIN'
   1/3X,'HEAD ',3(6X,F9.3)/3X,'TRUNK',3(6X,F9.3),/3X,'ARMS ',
   23(6X,F9.3)/3X,'HANDS',3(6X,F9.3)/3X,'LEGS ',3(6X,F9.3)/3X,
   3'FEET ',3(6X,F9.3))
575 FORMAT(7F10.2)
580 FORMAT(1H0,13X,'SHAPE',9X,'CORE',9X,'MUSCLE',9X,'FAT',9X,'SKIN'
   1/3X,'HEAD        SPHERE ',4(5X,F9.3)/3X,'TRUNK     CYLINDER',4(5X,
   2F9.3)/3X,'ARMS      CYLINDER',4(5X,F9.3)/3X,'HANDS     CYLINDER',
   34(5X,F9.3)/3X,'LEGS      CYLINDER',4(5X,F9.3)/3X,'FEET      CYLINDER
   4',4(5X,F9.3))
585 FORMAT(1H0,21X,'CORE',9X,'MUSCLE',9X,'FAT',9X,'SKIN'/3X,'HEAD
   1',4(5X,F9.3)/3X,'TRUNK     ',4(5X,F9.3)/3X,'ARMS  (2)',4(5X,F9.3)/
   23X,'HANDS (2)',4(5X,F9.3)/3X,'LEGS  (2)',4(5X,F9.3)/3X,'FEET  (2)'
   3,4(5X,F9.3))
599 FORMAT(1H0,5X,'BAROMETRIC PRESSURE,BARO=',F6.1,' MM')
610 FORMAT(1H0,12X,'CORE-MUSCLE',4X,'MUSCLE-FAT',7X,'FAT-SKIN'
   1/3X,'HEAD ',3(6X,F9.5)/3X,'TRUNK',3(6X,F9.5),/3X,'ARMS ',
   23(6X,F9.5)/3X,'HANDS',3(6X,F9.5)/3X,'LEGS ',3(6X,F9.5)/3X,
   3'FEET ',3(6X,F9.5))
625 FORMAT(1H0,3X,'WTPCT(J),      KG. OF TISSUE FOR 73.4 KG. MALE -ASSU
   1MING 15% BODY FAT')
640 FORMAT(1H0,3X,'NWT(J),      KG. OF TISSUE FOR THIS MALE BF=',
   1F5.2,'%')
655 FORMAT(1H0,3X,'PCTN(J),      NEW CALCULATED WEIGHT PERCENTAGES')
679 FORMAT(1H0,4X,'TOTAL OF QBQ10(N)=',F9.3)
680 FORMAT(1H0,4X,'QBQ10(N)      Q10 METABOLIC EFFECT,W')
685 FORMAT(1H0,4X,'DRIP=EXCESS SWEAT-FILM-CLOWAT,DRIP(N)      GM/HR')
690 FORMAT(1H0,4X,'FILM ON SKIN FORMED BY OVER-SWEATING,FILM(N),      M
   1ICRONS')
695 FORMAT(1H0,4X,'SWEAT THAT SOAKS INTO CLOTHES,CLOWAT(N),      GM/HR'
   1)
715 FORMAT(1H0,4X,'TSETC(N),  SET POINT FOR RECEPTORS FOR COLD CONDITI
   1ON,  DEG C ')
730 FORMAT(1H0,4X,'WORKM(I)',6(1X,F8.3),' (WALKING)')
731 FORMAT(1H0,4X,'WORKM(I)',6(1X,F8.3),' (STANDING)')
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732 FORMAT(1H0,4X,'WORKM(I)',6(1X,F8.3),' (SITTING)')
733 FORMAT(1H0,4X,'WORKM(I)',6(1X,F8.3),' (PEDALING)')
750 FORMAT('0',4X,'TOTAL METABOLIC ACTIVITY,WORKT=',F8.2,'  WATTS')
811 FORMAT(1H0,4X,'PROPORTION OF BASAL METABOLISM,POB(N)')
812 FORMAT(1H0,17X,'CORE',9X,'MUSCLE',9X,'FAT',9X,'SKIN'/3X,'HEAD ',4(
   15X,F9.4)/3X,'TRUNK',4(5X,F9.4)/3X,'ARMS ',4(5X,F9.4)/3X,'HANDS',4(
   25X,F9.4)/3X,'LEGS ',4(5X,F9.4)/3X,'FEET ',4(5X,F9.4))
813 FORMAT(1H0,4X,'PROPORTION OF CARDIAC OUTPUT,PBCO(N)')
850 FORMAT(1H0,4X,'PAREA(I)',6(1X,F8.2),8X,'  %AGE AREA BY SECTION')
865 FORMAT(1H0,4X,'WEIGHT PER SEGMENT,SEGWT(N)       GM')
866 FORMAT(1H0,4X,'OUTSIDE SURFACE AREA,AREA(N)      SQ CM')
867 FORMAT(1H0,4X,'CENTER OF MASS RADIUS,CMRAD(N)      CM')
868 FORMAT(1H0,4X,'MIDPOINT RADIUS,MPR(K)      CM')
869 FORMAT(1H0,4X,'HEAT TRANSFER OF SURFACE AREA,HTSA(K)      SQ CM')
890 FORMAT(1H0,4X,'INITIAL INPUT TEMPERATURES, DEG C')
893 FORMAT(1H0,4X,'TIME=0.0  ************************************')
894 FORMAT(1H0,4X,'AIR VELOCITY,V=',F8.2,'  M/SEC')
896 FORMAT(1H0,4X,'RELATIVE HUMIDITY,RH=',F8.2)
898 FORMAT(1H0,4X,'OUTPUT INTERVAL,INT=',I4,' MINUTES')
900 FORMAT(1H0,4X,'METABOLIC HEAT PRODUCTION,Q(N),      WATTS')
901 FORMAT(1H0,4X,'BLOOD FLOWS,BF,(N),      LITERS/HR')
902 FORMAT(1H0,4X,'CONVECTIVE HEAT TRANSFER BETWEEN CENTRAL BLOOD AND
   XELEMENTS,BC(N),      WATTS')
903 FORMAT(1H0,4X,'CONDUCTIVE HEAT TRANSFER BETWEEN SUCCESSIVE ELEMENT
   XS,TD(N),      WATTS')
904 FORMAT(1H0,4X,'RATE OF HEAT FLOW INTO OR FROM AN ELEMENT,HF(N),
   1WATTS')
905 FORMAT(1H0,4X,'RATE OF CHANGE OF TEMPERATURE OF AN ELEMENT,F(N),
   1DEG C/HR')
906 FORMAT(1H0,4X,'EVAPORATIVE HEAT LOSS,E(N),      WATTS')
907 FORMAT(1H0,4X,'SKIN BLOOD FLOWS,SBF = ',F9.3,'  LITERS/MINUTE')
908 FORMAT(1H0,4X,'NON-SHIVERING THERMOGENESIS,NST(N),      WATTS')
911 FORMAT(1H0,4X,'CONSTANT DATA  ********************************')
931 FORMAT(1H0.4X,'TEMPERATURES,T(N),      DEG C')
940 FORMAT(F5.4)
941 FORMAT(1H0,////////'      TIME=',F8.0,'  MINUTES')
942 FORMAT('0',4X,'COOLING EFFICIENCY OF JACKET,CEFF=',F9.4)
943 FORMAT('0',4X,'SUBLIMATION RATE OF DRY-ICE FOR EACH PERIOD OF 30 M
   UINUTES,GM/HR'//4X,14(F6.2,2X))
944 FORMAT('0',4X,'BASAL METABOLISM, WORKB=',F8.2,' WATTS')
945 FORMAT('0',4X,'MECHANICAL EFFICIENCY, MEFF=',F8.3)
946 FORMAT(1H0,4X,'CLO VALUE OF CLOTHING,CLO =',6F8.3)
947 FORMAT(1H0,4X,'MEAN RADIENT TEMPERATURE,TR=',F8.3)
948 FORMAT('0','***E8(5),RESPIRATORY HEAT LOSS, IS NOT CONSTANT. SO,
   1IT HAS BEEN INITIALIZED AS ZERO AND LATER CALCULATED BY RWET')
950 FORMAT(1H0,4X,'CARDIAC OUTPUT,CO=',F9.3,'  LITERS/MINUTE')
951 FORMAT(1H0,4X,'HEAT PRODUCTION(METABOLISM+SHIVERING),HP=',F9.3,'
   1WATTS')
952 FORMAT(1H0,4X,'TOTAL EVAPORATIVE HEAT LOSS,EV=E+RWET=',F9.3,'  WAT
   1TS')
953 FORMAT(1H0,4X,'MEAN SKIN TEMPERATURE,TS=',F9.3,' DEG C')
954 FORMAT(1H0,4X,'MEAN BODY TEMPERATURE,TB=',F9.3,' DEG C')
955 FORMAT(1H0.4X,'CONVECTIVE HEAT TRANSFER COEFFICIENT(MIXED),HCMIX='
   1,1X,F6.2,' W/SQ M-C')
956 FORMAT(1H0.4X,'CONVECTIVE HEAT TRANSFER COEFFICIENT(SEATED),HCSEAT
   1=',1X,F6.2,' W/SQ M-C')
957 FORMAT(1H0,4X,'CONVECTIVE HEAT TRANSFER COEFFICIENT(WALKING),HCWAL
   1K=',1X,F6.2,' W/SQ M-C')
958 FORMAT(1H0,21X,'CORE',22X,'MUSCLE',22X,'FAT',24X,'SKIN'/13X,
   1'FAT',6X,'BONE',3X,'TISSUE',5X,'FAT',6X,'BONE',3X,'TISSUE',5X,
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   2'FAT',6X,'BONE',3X,'TISSUE',5X,'FAT',6X,'BONE',3X,'TISSUE'/T14,
   322('_'),T41,22('_'),T68,22('_'),T95,22('_')/3X,'HEAD ',12(3X,F6.2)
   4/3X,'TRUNK',12(3X,F6.2)/3X,'ARMS ',12(3X,F6.2)/3X,'HANDS',
   512(3X,F6.2)/3X,'LEGS ',12(3X,F6.2)/3X,'FEET ',12(3X,F6.2)/3X,
   6'CENTRAL BLOOD',1(3X,F6.2),1X,'TISSUE')
959 FORMAT(1H0,17X,'CORE',9X,'MUSCLE',9X,'FAT',9X,'SKIN'/3X,'HEAD ',4(
   15X,F9.3)/3X,'TRUNK',4(5X,F9.3)/3X,'ARMS ',4(5X,F9.3)/3X,'HANDS',4(
   25X,F9.3)/3X,'LEGS ',4(5X,F9.3)/3X,'FEET ',4(5X,F9.3))
960 FORMAT(1H0,17X,'CORE',9X,'MUSCLE',9X,'FAT',9X,'SKIN'/3X,'HEAD ',4(
   15X,F9.3)/3X,'TRUNK',4(5X,F9.3)/3X,'ARMS ',4(5X,F9.3)/3X,'HANDS',4(
   25X,F9.3)/3X,'LEGS ',4(5X,F9.3)/3X,'FEET ',4(5X,F9.3)/3X,'CENTRAL B
   3LOOD')
961 FORMAT(1H0,15X,'HEAD',5X,'TRUNK ',3X,'ARMS',5X,'HANDS',4X,'LEGS',6
   1X,'FEET',4X,'TOTAL',2X,'UNITS    ')
962 FORMAT(1H0,4X,'PSKIN(I)',6(1X,F8.3),9X,' MM HG  ')
963 FORMAT(1H0,4X,'EMAX(I) ',6(1X,F8.3),9X,' WATTS')
964 FORMAT(1H0,4X,'SWPCP(I)',7(1X,F8.3),' SWEAT,HEAT REMOVAL COMMAND/S
   1KIN SEGMENT,  WATTS')
965 FORMAT(1H0,4X,'H(I)     ',6(1X,F8.3),9X,' WATTS/DEG C')
966 FORMAT(1H0,4X,'S(I)     ',6(1X,F8.4),9X,' SQ. M ')
967 FORMAT(1H0,4X,'HR(I)    ',6(1X,F8.3),9X,' WATTS/SQ. M/DEG C')
968 FORMAT(1H0,4X,'HC(I)    ',7(1X,F8.3),' WATTS/SQ. M/DEG C')
969 FORMAT(1H0,4X,'EWET(I) ',6(1X,F8.3),9X,' RATIO OF WET/DRY SURFACE
   1')
970 FORMAT(1H0,4X,'SKINR(I)',6(1X,F8.3))
971 FORMAT(1H0,4X,'SKINS(I)',6(1X,F8.3))
972 FORMAT(1H0,4X,'SKINV(I)',6(1X,F8.3))
973 FORMAT(1H0,4X,'SKINC(I)',6(1X,F8.3))
974 FORMAT(1H0,4X,'NSTM(I) ',6(1X,F9.3))
975 FORMAT(1H0,4X,'CHILM(I)',6(1X,F8.3))
976 FORMAT (1H0,4X,' DRY BULB AIR TEMPERATURE, TAAP=',
   *            F8.2,'DEG C')
978 FORMAT(1H0,4X,'HCSL(I) ',7(1X,F8.3),' WATTS/SQ. M/DEG C')
979 FORMAT(1H0,4X,'PCT(J),      % DISTRIBUTION, BY WEIGHT, OF DIFFERENT
   1 TISSUE TYPES')
980 FORMAT(1H0,4X,'C(N),  HEAT CAPACITANCE,  WATT HR/DEG C')
981 FORMAT(1H0,4X,'QB(N),  BASAL METABOLIC HEAT PRODUCTION,     WATTS')
982 FORMAT(1H0,4X,'EB(N),  BASAL EVAPORATIVE HEAT LOSS (DIFFUSION),
   1  WATTS')
983 FORMAT(1H0,4X,'BFB(N),  BASAL EFFECTIVE BLOOD FLOW,  LITRES/HR ')
985 FORMAT(1H0,4X,'TSETWS(N)  SET POINT FOR RECEPTORS FOR SEDENTARY WA
   1RM CONDITION,  DEG C ')
986 FORMAT(1H0,4X,'RATE(N), DYNAMIC SENSITIVITY OF THERMORECEPTORS ')
987 FORMAT(1H0,4X,'TSETWA(N)  SET POINT FOR RECEPTORS FOR ACTIVITY WAR
   1M CONDITION,  DEG C ')
991 FORMAT(1H0,4X,'SWCG     ',7(1X,F8.3),' SWEAT,HEAT REMOVAL COMMAND/S
   1KIN SEGMENT,  GM/HR')
992 FORMAT(1H0,4X,'TOTAL EVAPORATIVE LOSS, TEVG=EV/EVCP=',F9.3,'  GM/H
   1R')
993 FORMAT(1H0,4X,'EVAPORATIVE  HEAT LOSS, EG(N),     GM/HR')
995 FORMAT(1H0,15X,'HEAD',5X,'TRUNK ',3X,'ARMS',5X,'HANDS',4X,'LEGS',6
   1X,'FEET',5X,'BODY',2X,'UNITS')
1861 FORMAT (1H0,3X,' DURING THE LAST ',I4,' MINUTES OF'
   C    ,' SIMULATION THE SUBJECT LOST:')
1862 FORMAT (1H0,5X,F10.4,' MILLIGRAMS OF SODIUM CHLORIDE')
1863 FORMAT (1H0,5X,F10.4,' MILLIGRAMS OF POTASSIUM CHLORIDE')
1864 FORMAT (1H0,5X,F10.4,' MILLILITERS OF WATER')
1865 FORMAT (1H0,3X,' THE CUMULATIVE LOSSES DURING THE SIMULATION ARE:'
   C  )
1866 FORMAT (1H0,3X,'THROUGH RESPIRATION AND SWEATING.')
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1867 FORMAT (1H0,3X,'THESE TOTALS INCLUDE RESPIRATION, URINE AND '
    C ,'SWEAT OUTPUTS AND DRINKING INPUTS.'//)
1868 FORMAT (1H0,3X,'THE NEGATIVE AMOUNTS ABOVE SHOW DRINKING INPUT '
    C    ,'EXCEEDED SYSTEM LOSS.')
1880 FORMAT (1H0,2X,' THE SUBJECT DRANK', F8.5,' LITERS DURING THIS',
    *        ' OUTPUT CYCLE')
1892 FORMAT (I4)
     CALC1=0.0
     TOTNA=0.0
     TOTK=0.0
     TOTH2O=0.0
     TIMDR=0.0
     CCW=0.0
     SIBK=0.0
     SIBNA=0.0
     SIBH2O=0.0
     ITIME1=0.
 101 CONTINUE
     DO 3000 N=1,25
     EO(N)=0
     DRIP(N)=0.
     FILM(N)=0.
     FILMW(N)=0.
     CLOWAT(N)=0.
3000 CONTINUE
     DO 815 N=1,24
     AREA(N)=0.
 815 CONTINUE
C             READ CONSTANTS FOR CONTROLLED SYSTEM
C                    READ INITIAL CONDITIONS
     READ(5,100)SEX
     READ(5,100)AGE
     READ(5,100)WT
     READ(5,100)HT
     READ(5,201)SHF
     READ(5,201)SHB
     READ(5,201)SHT
     READ(5,201)SHS
     READ(5,100)SAF
     READ(5,100)(PCT(J),J=1,73)
     READ(5,201)(POB(N),N=1,24)
     READ(5,100)(EB(N),N=1,24)
     READ(5,201)(PBCE(N),N=1,24)
     READ(5,100)(PS(I),I=1,6)
     READ(5,575) (COND(K), K=1,18)
     READ(5,100)(S(I),I=1,6)
     READ(5,100)(HR(I),I=1,6)
     READ(5,100) (HCSL(I),I=1,6)
     READ(5,100)(P(J),J=1,10)
C             READ CONSTANTS FOR THE CONTROLLER
     READ(5,100)(TSETWS(N),N=1,25)
     READ(5,100)(TSETC(N),N=1,25)
     READ(5,100)(RATE(N),N=1,25)
     READ(5,100)CSW,SSW,PSW,CDIL,SDIL,PDIL,CCON,SCON,PCON,CCHIL,SCHIL,
    XPCHIL
     READ(5,100)(SKINR(I),I=1,6)
     READ(5,100)(SKINS(I),I=1,6)
     READ(5,100)(SKINV(I),I=1,6)
     READ(5,100)(SKINC(I),I=1,6)
     READ(5,100)(WK1(I),I=1,6)
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      READ(5,100)(WK2(I),I=1,6)
      READ(5,100)(WK3(I),I=1,6)
      READ(5,100)(WK4(I),I=1,6)
      READ(5,100)(CHILM(I),I=1,6)
      READ(5,100)(WSTM(I),I=1,6)
      READ(5,100)(T(N),N=1,25)
      READ(5,100) (PAREA(I), I=1,6)
      AWT=WT
      DO 703 I=1,6
      J=4*I-3
      K=12*(I-1)+1
      C(J)=(WT*SHF*PCT(K)+WT*SHA*PCT(K+1)+WT*SHT*PCT(K+2))/100
      C(J+1)=(WT*SHF*PCT(K+3)+WT*SHA*PCT(K+4)+WT*SHT*PCT(K+5))/100
      C(J+2)=(WT*SHF*PCT(K+6)+WT*SHA*PCT(K+7)+WT*SHT*PCT(K+8))/100
      C(J+3)=(WT*SHF*PCT(K+9)+WT*SHB*PCT(K+10)+WT*SHT*PCT(K+11))/100
  703 CONTINUE
C     SLONIM, ENV. PHYSIOLOGY. P.525
      C(J+4)=(WT*SHS*PCT(73))/100
C     MITCHELL, STRYDOM, VAN GRAAN, VAN DER WALT, PFLUGERS ARCH, 325,
C     183-193, 1971.
      DUBCSA=.007184*(HT**.725)*(WT**.425)
      SA=.208+.945*DUBCSA
      DO 406 I=1,6
      S(I)=PS(I)*SA
  406 CONTINUE
      WRITE(6,911)
      WRITE(6,893)
      WRITE(6,52)AGE
      WRITE(6,505)WT
      WRITE(6,509)HT
      WRITE(6,510)SA
      WRITE(6,506)SHF
      WRITE(6,507)SHB
      WRITE(6,503)SHT
      WRITE(6,504)SHS
      WRITE(6,519)SAF
      WRITE(6,979)
      WRITE(6,558)(PCT(J),J=1,73)
C     SPECIFIC GRAVITY
      SPGRV=.162+.8*((HT**.242)/((WT*1000)**.1))
C     TOTAL BODY FAT
      TBFYM=(5.548/SPGRV)-5.044
C     ADD UP TOTAL OF FAT IN PCT(I) TABLE
      TOTF=0.
      DO 615  I=1,6
      TOTF=TOTF+PCT(12*I-5)
  615 CONTINUE
      PCTBF=TBFYM*100
      DO 621 J=1,73
      WTPCT(J)=PCT(J)*73.4/100
  621 CONTINUE
      WRITE(6,625)
      WRITE(6,598) (WTPCT(J), J=1,73)
      DO 630 I=1,6
      NWT(12*I-11)=0.0
      NWT(12*I-10)=WTPCT(12*I-10)
      NWT(12*I-9)=WTPCT(12*I-9)
      NWT(12*I-8)=0.0
      NWT(12*I-7)=0.0
      NWT(12*I-6)=WTPCT(12*I-6)
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      NWT(12*I-5)=(PCTBF/TCTF)*WTPCT(12*I-5)
      NWT(12*I-4)=0.0
      NWT(12*I-3)=0.0
      NWT(12*I-2)=0.0
      NWT(12*I-1)=0.0
      NWT(12*I)=WTPCT(12*I)
  630 CONTINUE
      NWT(73)=WTPCT(73)
      WRITE(6,640)PCTBF
      WRITE(6,558) (NWT(J), J=1,73)
      PCTLK=0.
      DO 645 J=1,73
      PCTLK=PCTLK+NWT(J)
  645 CONTINUE
      DO 650 J=1,73
      PCTN(J)=(NWT(J)/PCTLK)*100
  650 CONTINUE
C  TEXTBOOK OF PHYSIOLOGY,GUYTON,FIG47.1
C    CARDI = CARDIAC INDEX, LITERS/MIN-SQ.M
      CARDI=4.2866-0.0289*AGE+0.0003*AGE**2
      CO=CARDI*SA*60.
      IF(SEX-0.)90,90,91
C     TAYLOR AND PYE, FOUNDATIONS OF NUTRITION, TABLE 2.3
   90 BMPSMF=51.101-0.715*AGE+0.006503*(AGE**2)
      WORKB=BMPSMF*DUBCSA*1.159
      GO TO 92
   91 BMPSMM=55.3851-0.7631*AGE+0.006686*(AGE**2)
      WORKB=BMPSMM*DUBCSA*1.159
   92 DO 51 N=1,24
      OB(N)=POB(N)*WORKB
      BFB(N)=PBCC(N)*CO
   51 CONTINUE
      WORKT=WORKB
      JOB=3
      WRITE(6,655)
      WRITE(6,558) (PCTN(J), J=1,73)
      WRITE(6,980)
      WRITE(6,960)(C(N),N=1,25)
      WRITE(6,811)
      WRITE(6,812)(POB(N),N=1,24)
      WRITE(6,991)
      WRITE(6,559)(OB(N),N=1,24)
      WRITE(6,982)
      WRITE(6,559)(EB(N),N=1,24)
      WRITE(6,948)
      WRITE(6,813)
      WRITE(6,812)(PBCC(N),N=1,24)
      WRITE(6,983)
      WRITE(6,559)(BFB(N),N=1,24)
      DO 820 I=1,6
      SEGWT(4*I-3)=((PCTN(12*I-10)*WT/100)+(PCTN(12*I-9)*WT/100))*1000
      SEGWT(4*I-2)=(PCTN(12*I-6)*WT/100)*1000
      SEGWT(4*I-1)=(PCTN(12*I-5)*WT/100)*1000
      SEGWT(4*I)=PCTN(12*I)*WT*10
  820 CONTINUE
      DO 581 I=1,6
      VOL(4*I-3)=SEGWT(4*I-3)
      VOL(4*I-2)=SEGWT(4*I-3)+SEGWT(4*I-2)
      VOL(4*I-1)=SEGWT(4*I-3)+SEGWT(4*I-2)+SEGWT(4*I-1)
      VOL(4*I  )=SEGWT(4*I-3)+SEGWT(4*I-2)+SEGWT(4*I-1)+SEGWT(4*I)
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```
581 CONTINUE
    DO 810 I=1,6
    AREA(4*I)=SA*PAREA(I)*100
810 CONTINUE
    PIE=3.1416
    DO 845 I=1,6
    IF(I.EQ.1) GO TO 752
    LTH(4*I)=(((AREA(4*I))**2))/(4*PIE*VOL(4*I))
    LTH(4*I-3)=LTH(4*I)
    LTH(4*I-2)=LTH(4*I)
    LTH(4*I-1)=LTH(4*I)
    GO TO 845
752 LTH(4*I-3)=0.
    LTH(4*I-2)=0.
    LTH(4*I-1)=0.
    LTH(4*I)=0.
845 CONTINUE
    WRITE(6,865)
    WRITE(6,559) (SEGWT(N), N=1,24)
    WRITE(6,511)
    WRITE(6,580) (VOL(N),N=1,24)
    WRITE(6,866)
    WRITE(6,559) (AREA(N), N=1,24)
    WRITE(6,512)
    WRITE(6,585) (LTH(N),N=1,24)
    DO 514  I=1,6
    IF(I.LE.1) GO TO 513
    RAD(4*I)=2*VOL(4*I)/(AREA(4*I))
    RAD(4*I-1)=((RAD(4*I)**2)-(VOL(4*I)-VOL(4*I-1))/(PIE*LTH(4*I-1)))
   1**(.5)
    RAD(4*I-2)=((RAD(4*I-1)**2)-(VOL(4*I-1)-VOL(4*I-2))/(PIE*LTH(4*I-2
   1)))**(.5)
    RAD(4*I-3)=((RAD(4*I-2)**2)-(VOL(4*I-2)-VOL(4*I-3))/(PIE*LTH(4*I-3
   1)))**(.5)
    GO TO 514
513 RAD(4*I)=3*VOL(4*I)/(AREA(4*I))
    RAD(4*I-1)=((RAD(4*I)**3)-(3*(VOL(4*I)-VOL(4*I-1)))/(4*PIE))
   1**(.333333)
    RAD(4*I-2)=((RAD(4*I-1)**3)-(3*(VOL(4*I-1)-VOL(4*I-2)))/(4*PIE))
   1**(.333333)
    RAD(4*I-3)=((RAD(4*I-2)**3)-(3*(VOL(4*I-2)-VOL(4*I-3)))/(4*PIE))
   1**(.333333)
514 CONTINUE
    DO 516  I=1,6
    CMRAD(4*I-3)=((RAD(4*I-3)**3)/2)**(.333333)
    CMRAD(4*I-2)=((RAD(4*I-3)**3+RAD(4*I-2) ** 3)/2)**( .333333)
    CMRAD(4*I-1)=((RAD(4*I-2)**3+RAD(4*I-1) ** 3)/2)**( .333333)
    CMRAD(4*I)=((RAD(4*I-1)**3+RAD(4*I)**3)/2)**(.333333)
516 CONTINUE
    DO 523  I=1,6
    DELX(3*I-2)=(CMRAD(4*I-2)-CMRAD(4*I-3))
    DELX(3*I-1)=(CMRAD(4*I-1)-CMRAD(4*I-2))
    DELX(3*I)=(CMRAD(4*I)-CMRAD(4*I-1))
523 CONTINUE
    DO 825 I=1,6
    MPR(3*I-2)=CMRAD(4*I-3)+(DELX(3*I-2)/2)
    MPR(3*I-1)=CMRAD(4*I-2)+(DELX(3*I-1)/2)
    MPR(3*I)=CMRAD(4*I-1)+(DELX(3*I)/2)
825 CONTINUE
    DO 855 I=1,6
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      IF(I.EQ.1) GO TO 860
      HTSA(3*I-2)=2*PIE*LTH(4*I)*MPR(3*I-2)
      HTSA(3*I-1)=2*PIE*LTH(4*I)*MPR(3*I-1)
      HTSA(3*I)=2*PIE*LTH(4*I)*MPR(3*I)
      GO TO 855
  860 HTSA(3*I-2)=4*PIE*(MPR(3*I-2)**2)
      HTSA(3*I-1)=4*PIE*(MPR(3*I-1)**2)
      HTSA(3*I)=4*PIE*(MPR(3*I)**2)
  855 CONTINUE
      DO 530  K=1,18
      TC(K)=CCND(K)*HTSA(K)/DELX(K)
  530 CONTINUE
      WRITE(6,515)
      WRITE(6,959) (RAD(N),N=1,24)
      WRITE(6,867)
      WRITE(6,959) (CMRAD(N), N=1,24)
      WRITE(6,524)
      WRITE(6,550) (DELX(K), K=1,18)
      WRITE(6,868)
      WRITE(6,550) (MPR(K), K=1,18)
      WRITE(6,869)
      WRITE(6,550) (HTSA(K), K=1,18)
      WRITE(6,527)
      WRITE(6,610) (CCND(K), K=1,18)
      WRITE(6,531)
      WRITE(6,550) (TC(K), K=1,18)
      WRITE(6,985)
      WRITE(6,960)(TSETWS(N),N=1,25)
      WRITE(6,715)
      WRITE(6,960)(TSETC(N),N=1,25)
      WRITE(6,996)
      WRITE(6,960)(RATE(N),N=1,25)
      WRITE(6,995)
      WRITE(6,850) (PAREA(I), I=1,6)
      WRITE(6,966)(S(I),I=1,6)
      WRITE(6,967)(HR(I),I=1,6)
      DO 579   I=1,6
      HC(I)=HCSL(I)*(BARO/760)**(.55)
  579 CONTINUE
C     HCSLTB = CONVECTIVE HEAT TRANSFER COEFFICIENT AT SEA LEVEL, TOTAL BODY
C     WATTS/SQ. M-C
C     HCTB = CONVECTIVE HEAT TRANSFER COEFFICIENT AT LOCAL BARO PRESSURE, TOTAL
C     BODY  WATTS/SQ. M-C
      HCSLTB=0.0
      DO 407 I=1,6
  407 HCSLTB=HCSLTB+HCSL(I)*S(I)
      HCSLTB=HCSLTB/SA
      HCTB=0.0
      DO 408 I=1,6
  408 HCTB=HCTB+HC(I)*S(I)
      HCTB=HCTB/SA
      WRITE(6,978) (HCSL(I), I=1,6),HCSLTB
      WRITE(6,968)(HC(I),I=1,6),HCTB
      WRITE(6,970)(SKINF(I),I=1,6)
      WRITE(6,971)(SKINS(I),I=1,6)
      WRITE(6,972)(SKINV(I),I=1,6)
      WRITE(6,973)(SKINC(I),I=1,6)
  734 WRITE(6,975)(CHILM(I),I=1,6)
      WRITE(6,974)(NSTM(I),I=1,6)
      WRITE(6,10)
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      WRITE(6,890)
      WRITE(6,560)(T(N),N=1,25)
      DO 102 N=1,25
      F(N)=0
  102 CONTINUE
C                   READ EXPERIMENTAL CONDITIONS
  103 CONTINUE
      READ(5,100)(SUBRAT(J),J=1,14)
      READ(5,543)CEFF
      READ(5,100)(CLO(I),I=1,6)
      READ(5,100)VWALK
      READ (5,1892) INT
      WRITE(6,544)WORKB
      WRITE(6,858)INT
      WRITE(6,943)(SUBRAT(J),J=1,14)
      WRITE(6,942)CEFF
      WRITE(6,546)(CLO(I),I=1,6)
      WRITE (6,576) TAAR
      WRITE(6,854)V
      WRITE(6,599)BARC
      WRITE(6,896)PH
      WRITE(6,547)TR
      WRATE=0.
      CALC=0.0
      HEATIM=10.
      ITIME=0.
      CEVG=0.0
      LTIME=0.0
      CWW=0.
      DTM=0.
      DT=0.0
      L=1
 1855 CONTINUE
      BWT=BWT-GLYNA*58.4428/1000000.0
      BWT=BWT-GUYK*74.555/1000000.0
      BWT=BWT-GLYH2O
      UP24 = 0
  301 CONTINUE
C  ******    LR= LEWIS RELATION
C  **       BARO= BAROMETRIC PRESSURE,   MM. HG
      LR=2.2*(760./BARC)
C                  ESTABLISH THERMORECEPTOR OUTPUT
      DO 81 I=1,6
   81 TAIR(I)=TAAR
      AVDELT=0.0
      DO 60 I=1,6
      DELTAT(I)=ABS(T(4*I)-TAIR(I))
      AVDELT=AVDELT+DELTAT(I)*S(I)
   60 CONTINUE
      AVDELT=AVDELT/SA
      HCMIX=1.26*(AVDELT**0.25)*(1+3.17*(((V**2)/AVDELT)**0.2))
      HCSEAT=11.6*(V**0.5)
      RELV=V+VWALK
      HCWALK=8.6*(RELV**0.53)
      DO 30 I=1,6
      TOTALH(I)=HR(I)+HC(I)
      FCL(I)=1./(1.+0.155*TOTALH(I)*CLO(I))
      TO(I)=(HR(I)*TR+HC(I)*TAIR(I))/TOTALH(I)
   30 CONTINUE
      TEST=WORKT-WORKB
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      IF (TIME.EQ.0.0) GO TO 1890
      IF (ABS(URZ5-TEST).LT.0.1) GO TO 1871
 1890 CONTINUE
      WORKT=URZ5+WORKB
      WRITE(6,750)WORKT
      READ(5,200)JOB
C     JOB=1 WALK,2 STAND,3 SIT,4 PEDAL
      GO TO(560,562,564,566),JOB
  560 DO 561 I=1,6
      WORKM(I)=WK1(I)
  561 CONTINUE
      WEFF=.05
      GO TO 568
  562 DO 563 I=1,6
      WORKM(I)=WK2(I)
  563 CONTINUE
      WEFF=.00
      GO TO 568
  564 DO 565 I=1,6
      WORKM(I)=WK3(I)
  565 CONTINUE
      WEFF=.00
      GO TO 568
  566 DO 567 I=1,6
      WORKM(I)=WK4(I)
  567 CONTINUE
      WEFF=.21
  568 CONTINUE
      IF(JOB.EQ.1) GO TO 735
      IF(JOB.EQ.2) GO TO 736
      IF(JOB.EQ.3) GO TO 737
      IF(JOB.EQ.4) GO TO 738
  735 WRITE(6,730)(WORKM(I),I=1,6)
      GO TO 1870
  736 WRITE(6,731)(WORKM(I),I=1,6)
      GO TO 1870
  737 WRITE(6,732)(WORKM(I),I=1,6)
      GO TO 1870
  738 WRITE(6,733)(WORKM(I),I=1,6)
 1870 CONTINUE
      WRITE(6,945)WEFF
 1871 CONTINUE
      TB=0.
      DO 689 N=1,25
      TSETWA(N)=TSETWS(N)
  689 CONTINUE
      DO 202 I=1,6
      H(I)=(HR(I)+3.16*HC(I)*V**0.5)*S(I)
      J=TAIR(I)/5
      PAIR(I)=RH*(P(J)+(P(J+1)-P(J))*(TAIR(I)-5*J)/5.)
  202 CONTINUE
C     CALCULATION OF RESPIRATORY HEAT LOSS.
      RDRY=0.0014*WORKT*(34.-TAIR(1))
      RWET=0.0023*WORKT*(44.-PAIR(1))
C     PAIR(1) AND TAIR(1) HAS BEEN USED FOR AMBIENT ATMOS. CONDITIONS
      ER(5)=RWET
      IF(WORKT-WORKB)104,104,105
  104 WORKAH=0.
      GO TO 106
  105 WORKAH=(WORKT-WORKB)*(1.-WEFF)
```

```
  106 CONTINUE
      AEWET=0.0
      DO 451 I=1,6
      N=4*I-3
      K=T(N+3)/5
      PSKIN(I)=P(K)+(P(K+1)-P(K))*(T(N+3)-5*K)/5.
      EMAX(I)=(PSKIN(I)-PAIR(I))*LR*(HC(I)*S(I))
      EWET(I)=EB(N+3)/EMAX(I)
      AEWET=AEWET+EWET(I)*(S(I)/SA)
      PPHG=PSKIN(I)
      SVP=EMAX(I)
      PWET=EWET(I)
      TEMP=T(N+3)
      CALL SWVP(PWET,PPHG,SVP,TEMP,HVAPS)
      EVCP(I)=HVAPS
      EG(N+3)=EB(N+3)/EVCP(I)
  451 CONTINUE
C     FOR EVAPORATION DUE TO RESPIRATION,WE CONSIDER THE RESPIRATORY
C     TRACT AS 100 PERCENT WET AND CALCULATE HVP=EVCP(TRUNK CORE) AS:
      HVP=(2433.95-2.2549*(T(5)-30.))*0.0002778
      EG(5)=EB(5)/HVP
      DO 302 N=1,25
      ERROR(N)=0.
      WARM(N)=0.
      COLD(N)=0.
      IF(T(N).GT.TSETWA(N))ERROR(N)=T(N)-TSETWA(N)+RATE(N)*F(N)
      IF(T(N).LT.TSETC(N))ERROR(N)=T(N)-TSETC(N)+RATE(N)*F(N)
C     TSETWA(N)=SET TEMPERATURE ABOVE WHICH SWEATING AND VASODILATION
C     TAKE PLACE
C     TSETC(N)=SET TEMPERATURE BELOW WHICH SHIVERING AND
C     VASOCONSTRICTION TAKE PLACE
      IF(ERROR(N))303,302,304
  303 COLD(N)=-ERROR(N)
      GO TO 302
  304 WARM(N)=ERROR(N)
  302 CONTINUE
C                   INTEGRATE PERIPHERAL AFFERENTS
      WARMS=0.0
      COLDS=0.0
      DO 305 I=1,6
      K=4*I
      WARMS=WARMS+WARM(K)*SKINR(I)
      COLDS=COLDS+COLD(K)*SKINR(I)
  305 CONTINUE
C                  DETERMINE EFFERENT OUTFLOW
      SWEAT=CSW*ERROR(1)+SSW*(WARMS-COLDS)+PSW*ERROR(1)*(WARMS-COLDS)
      DILAT=CDIL*ERROR(1)+SDIL*(WARMS-COLDS)+PDIL*WARM(1)*WARMS
      STRIC=-CCON*ERROR(1)-SCON*(WARMS-COLDS)+PCON*COLD(1)*COLDS
      CHILL=-CCHIL*ERROR(1)-SCHIL*(WARMS-COLDS)+PCHIL*ERROR(1)*(WARMS-CO
     XLDS)
      IF(SWEAT)1500,1500,1501
 1500 SWEAT=0.0
 1501 CONTINUE
      IF(DILAT)1502,1502,1503
 1502 DILAT=0.0
 1503 CONTINUE
      IF(STRIC)1504,1504,1505
 1504 STRIC=0.0
 1505 CONTINUE
      IF(CHILL)1506,1506,1507
```

```
 1506 CHILL=0.0
 1507 CONTINUE
C                     ASSIGN EFFECTOR OUTPUT
  400 CONTINUE
      DO 665 N=1,24
      QBQ10(N)=(0.126*(T(N)-TSETWA(N))*QB(N))
  665 CONTINUE
      QUAT=0.
      DO 660 N=1,24
      QUAT=QBQ10(N)+QUAT
  660 CONTINUE
C     NST=NON-SHIVERING THERMOGENESIS, WATTS
      NST=.067*(SAF)
      DO 150 N=1,25
      IF(N-6)40,41,40
   40 NST1(N)=0.
      GO TO 150
   41 NST1(N)=NST
  150 CONTINUE
      DO 401 I=1,6
      N=4*I-3
      BF(N)=BFB(N)
      Q(N)=QB(N)+QBQ10(N)
      E(N)=EB(N)
      Q(N+1)=QB(N+1)+WORKM(I)*WORKAH+CHILM(I)*CHILL+QBQ10(N+1)+NSTM(I)*N
     1ST
      E(N+1)=0
      BF(N+1)=BFB(N+1)+Q(N+1)-QB(N+1)
      Q(N+2)=QB(N+2)+QBQ10(N+2)
      E(N+2)=0
      BF(N+2)=BFB(N+2)
      Q(N+3)=QB(N+3)+QBQ10(N+3)
      E(N+3)=EB(N+3)+SKINS(I)*SWEAT*2.**((T(N+3)-TSETWA(N+3))/4.)
      BF(N+3)=(BFB(N+3)+SKINV(I)*DILAT)/(1.+SKINC(I)*STRIC)
      K=T(N+3)/5.
      PSKIN(I)=P(K)+(P(K+1)-P(K))*(T(N+3)-5*K)/5.
      EMAX(I)=(PSKIN(I)-PAIR(I))*LR*(H(I)-HR(I)*S(I))
      IF(EMAX(I)-E(N+3))402,403,403
C *** SWEAT DRIVE-EVAPORATION=EXTRA WATER(FILM(I)+DRIP(I)+CLOWAT(I))
C *** ROE=DENSITY OF SWEAT (GM/CC.)
  402 ROE=1.0
      FILM(N+3)=((E(N+3)-EMAX(I))/EVCP(I))/((S(I)*ROE))
C *** THICKNESS OF FILM ON SKIN TO START DRIPPING=35 MICRONS (L. BERGLAND
C *** DOCTORATE THESIS 1971)
      IF(SWET(I).EQ.1.0.AND.FILM(N+3).GT.35) GO TO 45
      GO TO 399
   45 FILM(N+3)=35.
      FILMW(N+3)=S(I)*(35.)*ROE
      DRIP(N+3)=((E(N+3)-EMAX(I))/EVCP(I))-FILMW(N+3)
  399 E(N+3)=EMAX(I)
  403 CONTINUE
  401 CONTINUE
      SWEAG=0.0
      AEWET=0.0
      DO 405 I=1,6
      N=4*I-3
      SWPCP(I)=SKINS(I)*SWEAT
      EWET(I)=E(N+3)/EMAX(I)
      AEWET=AEWET+EWET(I)*(S(I)/SA)
      PPHG=PSKIN(I)
```

```
      SVP=EMAX(I)
      PWET=EWET(I)
      TEMP=T(N+3)
      CALL SWVP(PWET,PPHG,SVP,TEMP,HVAPS)
C     EVCP=EVAPORATIVE SPECIFIC HEAT, W*HR/GM
 5100 EVCP(I)=HVAPS
      EG(N+3)=E(N+3)/EVCP(I)+FILMW(N+3)+DRIP(N+3)
      SWCG(I)=SWPCP(I)/EVCP(I)
      SWEAG=SWEAG+SWCG(I)
  405 CONTINUE
      HVP=(2433.95-2.2549*(T(5)-30.))*0.0002778
      EG(5)=E(5)/HVP
      EG(25)=0.0
C ** THESE CARDS ARE PLACED HERE TO LIMIT MAXIMUM BLOOD FLOW  *****
      DO 704 I=1,6
      MAXBF(4*I-3)=BFB(4*I-3)
      MAXBF(4*I-2)=BFB(4*I-2)*18.
      MAXBF(4*I-1)=BFB(4*I-1)
      IF(I.EQ.1) GO TO 751
      MAXBF(4*I)=BFB(4*I)*7.
      GO TO 704
C *** FROESE AND BURTON, J. APP PHYSIOLOGY,10,2, 235-241, 1957
  751 MAXBF(4*I)=BFB(4*I)
  704 CONTINUE
      DO 706 N=1,24
      IF(BF(N).GT.MAXBF(N))BF(N)=MAXBF(N)
  706 CONTINUE
C ** THESE CARDS WERE PLACED HERE TO LIMIT MAX BLOOD FLOW **
C                   CALCULATE HEAT FLOWS
      DO 499 I=1,6
      TD(4*I-3)=TC(3*I-2)*(T(4*I-3)-T(4*I-2))
      TD(4*I-2)=TC(3*I-1)*(T(4*I-2)-T(4*I-2))
      TD(4*I-1)=TC(3*I)   *(T(4*I-1)-T(4*I))
      TD(4*I)=0.
  499 CONTINUE
      DO 500 N=1,24
      BC(N)=BF(N)*(T(N)-T(25))
  500 CONTINUE
      DO 501 I=1,6
      K=4*I-3
      HF(K)=Q(K)-E(K)-BC(K)-TD(K)
      HF(K+1)=Q(K+1)-BC(K+1)+TD(K)-TD(K+1)
      HF(K+2)=Q(K+2)-BC(K+2)+TD(K+1)-TD(K+2)
      DRY(I)=TOTALH(I)*FCL(I)*(T(4*I)-TO(I))*S(I)
      HF(K+3)=Q(K+3)-BC(K+3)-E(K+3)+TD(K+2)-DRY(I)
  501 CONTINUE
      HF(5)=HF(5)-RDRY
      DO 31 I=1,6
      FACL(I)=1.+0.15*CLO(I)
      TCL(I)=TO(I)+FCL(I)*(T(4*I)-TO(I))
      HR(I)=4*.0000000597*((TCL(I)+TC(I))/2.+273.)*3.*FACL(I)*0.72
      TOTALH(I)=HR(I)+HC(I)
      FCL(I)=1./(1.+0.155*TOTALH(I)*CLO(I))
      TO(I)=(HR(I)*TR+HC(I)*TAIR(I))/TOTALH(I)
   31 CONTINUE
C *** NEXT FOUR CARDS ARE PLACED TO ACCOUNT FOR VARIABLE SUBLIMATION
C     RATE AND COOLING EFFECT IO DRY-ICE.IF MORE THAN 14 PERIODS,CHANGE
C     DIMENSION AND READ STATEMENTS FOR SUBRAT      **********
      PER=ABS((ITIME-0.0001)/30.)
      JPER=PER
```

```
      K=JPER+1
      HF(8)=HF(8)-(SUBRAT(K)*.159*CEFF)
C *****  NEXT CARD IS PLACED TO TAKE CARE OF DRINKING WATER
C  ****   TW = TEMPERATURE OF DRINKING WATER , DEGREE C
C ***   HEATIM= HEAT TRANFER PERIOD
      IF (CALC.EQ.0.0) GO TO 1893
      CALC=CALC*1000.0
      TIMDR=LTIME+0.5
      BWT=BWT+CALC
      TOTH2O=TOTH2O-CALC*1000.0
      CALC1=CALC1+CALC
      CALC=0.0
      IDRINK=0
 1893 CONTINUE
      IF(LTIME.GT.TIMDR) GO TO 50
      WRATE=0.06*CALC/HEATIM
      HF(5)=HF(5)-WRATE*(T(5)-TW)
   50 HF(25)=0.0
C   ****  BWT =BODY WEIGHT , KG
C   ***  WT = INITIAL BODY WEIGHT ,WT
C    ***  CWW = CUMMULATIVE DRINKING WATER
      CWW=CWW+CALC*1000.0
      IF (BWT .LT. 0.95*WT) GO TO 20
      GO TO 25
   20 WRITE(6,22)
   22 FORMAT (1H0,4X,'FLUID LOSS EXCEEDS MAXIMUM LIMIT')
      UPZ4=2
      GO TO 903
   25 CONTINUE
      DO 502 N=1,24
      HF(25)=HF(25)+BC(N)
  502 CONTINUE
C                DETERMINE OPTIMUM INTEGRATION STEP
      DT=1./60.
      DO 600 N=1,25
      F(N)=HF(N)/C(N)
      U=ABS(F(N))
      IF(U*DT-0.1)600,600,601
  601 DT=0.1/U
  600 CONTINUE
C                   CALCULATE NEW TEMPERATURES
      DO 700 N=1,25
      T(N)=T(N)+F(N)*DT
      EVG(N)=EG(N)*DT
      CEVG=CEVG+EVG(N)
  700 CONTINUE
      SR=0.0
      WATER=0.0
      DO 1660 J=4,24,4
      SR=SR+EG(J)/60.0/SA
      WATER=WATER+EG(J)*DT/1000.0
 1660 CONTINUE
      IF (SR.LE.0.0) SR=0.0
      IF (WATER.LE.0.0) WATER=0.0
      NACCNC=10.8+2.565*SR
C    *** EQUATION ADAPTED FROM CAGE AND DOBSON,J. OF CLIN INVES
C           VOL 44, NO 7, 1965    PAGES 1270-1274
      IF (NACCNC .GE. CNA) NACCNC=CNA
      KFAC=1.0-0.05327*SR
      KCONC=10.0**KFAC
```

```
C    *** EQUATION ADAPTED FROM ELINZONDO, BANERJEE, AND BULLARD,
C          J. OF APP. PHYSIOL.  VOL 32, NO 1, 1972   PAGES 1-6
      CK1=CKE*1.2
      IF (KCONC.GT.CK1) KCONC=CK1
C     ***MAXIMUM CONCENTRATION OF 1.2 TIMES PLASMA CONCENTRATION OF K+
C            FROM GUYTON'S TEXTBOOK OF MEDICAL PHYSIOLOGY, 1971,PAGE 835
      NAMEQ=NACONC*WATER
      KMEQ=KCONC*WATER
      NACLMG=58.4428*NAMEQ
      KCLMG=74.555*KMEQ
      EG5=EG(5)
      IF (EG5.LT.0.0) EG5=0.0
      WATER1=WATER+EG5*DT/1000.0
      BWT=BWT-((NACLMG+KCLMG)/1000.0+WATER1)/1000.0
      SUBNA=SUBNA+NACLMG
      SUBK=SUBK+KCLMG
      SUBH2O=SUBH2O+1000.0*WATER1
      FLO=INT
      IF (FLO.GT.5.0) FLO=5.0
      TERMWA=SUBH2O/FLO/1000.0
      TERMNA=SUBNA/FLO/58.4428
      TERMK=SUBK/FLO/74.555
      TIME=TIME+DT
      LTIME=60.*TIME
      DTM=60.*DT
      IF (LTIME-INT-ITIME) 306,701,701
  306 CONTINUE
      IF (LTIME-5.0-ITIME1) 301,307,307
  307 CONTINUE
      ITIME1=ITIME1+5.0
      SIBH2O=SUBH2O+SIBH2O
      SIBNA=SUBNA+SIBNA
      SIBK=SUBK+SIBK
      GO TO 603
  701 CONTINUE
      SUBH2O=SUBH2O+SIBH2O
      SUBNA=SUBNA+SIBNA
      SUBK=SUBK+SIBK
      TOTNA=TOTNA+SUBNA+GUYNA*58.4428
      TOTK=TOTK+SUBK+GUYK*74.555
      TOTH2O=TOTH2O+SUBH2O+GUYH2O*1000.0
      GUYNA=0.0
      GUYK=0.0
      GUYH2O=0.0
      SIBK=0.0
      SIBNA=0.0
      SIBH2O=0.0
      ITIME=ITIME+INT
      ITIME1=ITIME
      WRITE(6,941)ITIME
      WRITE (6,975) TAAR
      WRITE(6,750)WCRKT
      WRITE(6,894)V
      WRITE(6,599)BARC
      WRITE(6,896)RH
      WRITE(6,947)TR
      WRITE (6,1961) INT
      WRITE (6,1862) SUBNA
      WRITE (6,1863) SUBK
      WRITE (6,1864) SUBH2O
```

```
      WRITE (6,1866)
      WRITE (6,1365)
      WRITE (6,1862) TCTNA
      WRITE (6,1863) TCTK
      WRITE (6,1864) TCTH2C
      IF ((TOTNA.GE.0.0).AND.(TOTK.GE.0.0).AND.(TOTH2O.GE.0.0))
     C   GO TO 1869
      WRITE (6,1868)
 1869 CONTINUE
      IF (CALC1.LE.0.0) GO TO 1881
      WRITE (6,1880) CALC1
      CALC1=0.0
 1881 CONTINUE
      WRITE (6,1867)
      WRITE(6,961)
      WRITE(6,955)HCMIX
      WRITE(6,956)HCSEAT
      WRITE(6,957)HCWALK
      WRITE(6,962)(PSKIN(I),I=1,6)
      WRITE(6,963)(EMAX(I),I=1,6)
      WRITE(6,964) (SWPCP(I),I=1,6),SWEAT
      WRITE(6,991) (SWCG(I),I=1,6),SWEAG
      WRITE(6,969) (EWET(I), I=1,6)
      WRITE(6,965)(H(I),I=1,6)
      WRITE(6,931)
      WRITE(6,960)(T(N),N=1,25)
      WRITE(6,901)
      WRITE(6,959)(BF(N),N=1,24)
      WRITE(6,580)
      WRITE(6,959) (OBC10(N), N=1,24)
      WRITE(6,579)QUAT
      WRITE(6,900)
      WRITE(6,959)(Q(N),N=1,24)
      WRITE(6,908)
      WRITE(6,959)(NST1(N),N=1,24)
      WRITE(6,906)
      WRITE(6,959)(E(N),N=1,24)
      WRITE(6,993)
      WRITE(6,959)(EG(N),N=1,24)
      WRITE(6,690)
      WRITE(6,959) (FILM(N), N=1,24)
      WRITE(6,685)
      WRITE(6,959) (DRIP(N), N=1,24)
      WRITE(6,695)
      WRITE(6,959) (CLCWAT(N), N=1,24)
      WRITE(6,902)
      WRITE(6,959)(BC(N),N=1,24)
      WRITE(6,903)
      WRITE(6,959)(TD(N),N=1,24)
      WRITE(6,904)
      WRITE(6,960)(HF(N),N=1,25)
      WRITE(6,905)
      WRITE(6,960)(F(N),N=1,25)
C                     PREPARE FOR OUTPUT
      CO=0.
      HP=0.
      EV=0.
      TEVG=0.0
      TS=0.
      HFLOW=0.
```

```
      SBF=0.
      DO 800 N=1,24
      CO=CO+BF(N)/60.
  762 HP=HP+Q(N)
      EV=EV+E(N)
      TEVG=TEVG+EG(N)
  800 CONTINUE
C   *******    CALCULATION HEART RATE,HEARTR, BEAT/MIN
C   ***      STROV = STROKE VOLUME, LITER/STROKE
      STMLKG=1.15+.0017*(WORKT-WORKB)
      IF(STMLKG.GT.1.71)STMLKG=1.71
      STROV=STMLKG*WT/1000.
      HEARTR=CO/STROV
      EV=EV+EWET
      CT=0
      DO 804 I=1,6
      CT=CT+C(4*I)
  804 CONTINUE
      DO 802 I=1,6
  766 TS=TS+T(4*I)*C(4*I)/CT
      SBF=SBF+BF(4*I)/60.
  802 CONTINUE
      CN=0
      DO 805 N=1,25
      CN=CN+C(N)
  805 CONTINUE
      DO 801 N=1,25
      TB=TB+T(N)*C(N)/CN
      HFLOW=HFLOW+HF(N)
  801 CONTINUE
      WRITE(6,987)
      WRITE(6,963) (TSETWA(N), N=1,25)
      WRITE(6,55)CO
      WRITE(6,12)HEARTR
      WRITE(6,907)SBF
      WRITE(6,951)HP
      WRITE(6,952)EV
      WRITE(6,952)TEVG
      WRITE(6,11)CEVG
      WRITE(6,953)TS
      WRITE(6,954)TB
  803 CONTINUE
      IF (TB.GT.41.0) URZ4=3
      RETURN
      END
      SUBROUTINE SWVP(PWET,PPHG,SVP,TSK,HVAPS)
      REAL K1,K2
C     SUBROUTINE TO CALCULATE THE HEAT OF VAPORIZATION OF SWEAT
 2000 PHIS=PWET+((1.-PWET)*PPHG)/SVP
      K1=2806.55-762.8*PHIS+390.2*(PHIS**2)
      K2=1.1435+1.75*PHIS-0.6386*(PHIS**2)
      HVAPS=(K1-K2*(TSK-30.))*0.0002778
      RETURN
      END
```

Input Dataset - Basal Conditions

0.000000E 00	1	T
0.530000E 00	2	I
0.000000E 00	3	VBC
0.300000E 01	4	VVS
0.380000E 00	5	VPA
0.850000E 00	6	VAS
0.400000E 00	7	VLA
0.100000E 00	8	VRA
0.354000E 00	9	VAE
0.100000E 03	10	PA
0.100000E 01	11	PAM
0.100000E 01	12	LVM
0.000000E 00	13	VRE
0.000000E 00	14	PRA
0.500000E 01	15	QRN
0.700000E-01	16	VPE
0.154000E 02	17	PPA
0.400000E 00	18	PPI
0.000000E 00	19	CPA
0.160000E 01	20	PPA
0.100000E 01	21	RVM
0.000000E 00	22	VLE
0.000000E 00	23	PLA
0.500000E 01	24	QLN
0.200000E 02	25	PLI
0.000000E 00	26	VIB
0.140000E 01	27	RPV
0.300000E 01	28	RPT
0.152000E 02	29	PGL
0.500000E 01	30	QPC
0.000000E 00	31	G5
0.330000E 00	32	VVE
0.310000E 00	33	VVB
0.380000E 01	34	PVS
0.370000E 01	35	PGV
0.720000E 00	36	RVG
0.500000E 01	37	QVC
0.100000E 01	38	AVE
0.212000E-01	39	CN2
0.356000E 00	40	CN3
0.280000E 01	41	RVS
0.960000E 02	42	PGS
0.194000E 02	43	RTP
0.500000E 01	44	QAC
0.500000E 01	45	QRC
0.500000E 01	46	QLC
0.000000E 00	47	CVS
0.000000E 00	48	DPA
0.000000E 00	49	DAS
0.000000E 00	50	DLA
0.000000E 00	51	DRA
0.100000E 03	52	PA1
0.000000E 00	53	AUC
0.100000E 01	54	AUB
0.000000E 00	55	AUN
0.100000E 01	56	AU6
0.000000E 00	57	AU2
0.000000E 00	58	AUE
0.100000E 01	59	DAU
0.100000E 01	60	AUJ

0.100000E 01	61	AU
0.000000E 00	62	AUC
0.100000E 01	63	AUH
0.000000E 00	64	VV4
0.850000E 00	65	AU9
0.100000E 01	66	AUM
0.000000E 00	67	AU4
0.550000E 00	68	VIF
0.825000E 01	69	PO1
0.100000E 01	70	PTT
0.700000E 01	71	PTS
-0.600000E 01	72	PIF
0.165000E 02	73	CPI
0.410000E 01	74	PTC
0.700000E 02	75	CPP
0.280000E 02	76	PPC
0.146000E 02	77	PVG
0.184000E 02	78	PC
0.450000E 00	79	PCD
0.000000E 00	80	VTC
0.300000E 00	81	PLD
0.300000E-02	82	VTL
0.000000E 00	83	VTD
0.000000E 00	84	VPD
0.500000E-01	85	DPL
0.535000E 02	86	CP1
0.500000E-01	87	CPC
0.000000E 00	88	CPI
0.000000E 00	89	LPD
0.700000E-02	90	DLP
0.000000E 00	91	DPP
0.500000E 01	92	CHY
-0.500000E 01	93	PRM
0.230000E 01	94	PGR
0.125000E 02	95	CPG
0.413000E 01	96	PGP
0.125000E 00	97	GF1
0.165000E 02	98	PGX
0.610000E 01	99	PGC
-0.400000E 01	100	PGH
0.000000E 00	101	PG2
0.000000E 00	102	VGD
0.115000E 02	103	VG
0.000000E 00	104	EPH
0.000000E 00	105	GP1
0.000000E 00	106	GP2
0.000000E 00	107	GPD
0.317000E 02	108	AAR
0.840000E 02	109	RR
0.120000E 01	110	RFN
0.380000E 02	111	APC
0.620000E 02	112	GLP
0.160000E 02	113	PFL
0.125000E 00	114	GFR
0.124000E 00	115	TRR
0.100000E-02	116	VUD
0.100000E 01	117	REK
0.100000E 00	118	NCD
0.000000E 00	119	NED
0.213600E 04	120	NAE

0.150000E 02	121	VEC
0.500000E 01	122	CKE
0.280000E-02	123	KCD
0.700000E 03	124	KE1
0.355000E 04	125	KIR
0.000000E 00	126	KIE
0.000000E 00	127	KCD
0.000000E 00	128	KED
0.142000E 03	129	CKI
0.142000E 03	130	CNA
0.000000E 00	131	CCD
0.000000E 00	132	VID
0.750000E 02	133	KE
0.355000E 04	134	KI
0.250000E 02	135	VIC
0.000000E 00	136	I1
0.000000E 00	137	VTY
0.100000E 01	138	Z
0.000000E 00	139	VTZ
0.000000E 00	140	VUZ
0.100000E-02	141	TVZ
0.000000E 00	142	PPZ
0.000000E 00	143	DFZ
0.100000E 02	144	X
0.300000E-02	145	I2
0.000000E 00	146	PR1
0.120000E 02	147	VTS
0.300000E 01	148	VP
0.208000E 03	149	PRP
0.910000E 01	150	IFP
0.143000E 03	151	GPR
0.000000E 00	152	KN3
0.100000E 02	153	KN1
0.100000E 01	154	AMR
0.100000E 01	155	AMF
0.100000E 01	156	AM1
0.100000E 01	157	AMC
0.000000E 00	158	AM2
0.000000E 00	159	AM3
0.000000E 00	160	AM5
0.100000E 01	161	AM
0.100000E 02	162	CNE
0.200000E 00	163	AGK
0.100000E 01	164	ANP
0.100000E 01	165	AN1
0.100000E 01	166	ANC
0.420000E-01	167	AN2
0.110150E 01	168	AN3
0.300000E 01	169	AN5
0.100000E 01	170	ANM
0.500000E 01	171	VB
0.000000E 00	172	HM1
0.410000E 02	173	HM
0.000000E 00	174	B1
0.150000E 01	175	VIE
0.300000E 01	176	VIB
0.100000E 01	177	VIM
0.110000E-04	178	RC2
0.250000E 00	179	PC2
0.580000E-05	180	RKC

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0.200000E 01	183	VRC
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0.203000E 03	185	CVA
0.300000E 01	186	BFN
0.190000E 03	187	DOR
0.100000E 01	188	AOM
0.800000E 01	189	P1C
0.700000E 00	190	CSV
0.820000E 01	191	POT
0.000000E 00	192	PCD
0.100000E 01	193	POB
0.100000E 01	194	AR1
0.100000E 01	195	AR2
0.100000E 01	196	POC
0.100000E 01	197	AR3
0.100000E 01	198	ARM
0.300000E 01	199	CNR
0.125000E 00	200	GFN
0.000000E 00	201	AH7
0.000000E 00	202	AH8
0.300000E 01	203	AH
0.100000E 01	204	AHC
0.735000E-01	205	AH1
0.125000E 01	206	AH2
0.500000E 01	207	AH4
0.100000E 01	208	AHM
0.600000E 01	209	CNY
0.250000E 01	210	CNX
0.150000E 00	211	VV1
0.150000E 00	212	VV2
0.000000E 00	213	VV5
0.000000E 00	214	VV6
0.000000E 00	215	VV7
0.000000E 00	216	TVC
0.400000E 02	217	VTW
0.100000E 01	218	FSR
0.100000E 01	219	HSL
0.240000E 02	220	NID
0.500000E 00	221	SR
0.295000E 01	222	VVR
0.305200E 02	223	RAR
0.925000E-01	224	CV
0.200000E 00	225	CN7
0.300000E 01	226	AUX
0.500000E-03	227	AUK
0.100000E 01	228	AUZ
0.100000E 01	229	Y
0.700000E-02	230	CFC
0.160000E-06	231	CPK
0.300000E 01	232	PCE
0.850000E 02	233	CPR
0.470000E-03	234	LPK
0.700000E-02	235	DPC
0.570000E 02	236	HYL
0.400000E 01	237	KIC
0.600000E 02	238	AMT
0.150000E 02	239	ANT
0.600000E-01	240	PGK

0.300000E 00	241	PCN
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0.200000E 02	243	A2K
0.115200E 05	244	A3K
0.139000E 03	245	CNR
0.100000E 01	246	CNZ
0.700000E 01	247	AHK
0.330000E 02	248	SRK
0.330000E 00	249	V9
0.200000E-01	250	V20
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0.000000E 00	252	Z2
0.400000E 01	253	Z3
0.100000E 02	254	Z4
0.100000E 02	255	Z5
0.500000E 01	256	Z6
0.500000E 01	257	Z7
0.100000E 01	258	Z8
0.900000E 02	259	HMK
0.530000E 00	260	HKM
0.400000E 02	261	PCV
0.300000E 00	262	POZ
0.535000E 03	263	RDC
0.240000E 04	264	GC2
0.120000E 01	265	RBF
0.180000E 03	266	MC2
0.100000E 01	267	PDA
0.464000E-04	268	PDY
0.100000E 01	269	ANU
0.400000E 02	270	PCR
0.500000E-01	271	GF2
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0.000000E 00	273	DHM
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0.200000E 02	275	I3
0.400000E 01	276	U
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0.000000E 00	278	T1
0.100000E 01	279	GF3
0.500000E 01	280	GF4
0.100000E 01	281	AUP
0.300000E 00	282	AUV
0.000000E 00	283	RV1
0.250000E 00	284	AUY
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0.300000E 01	286	DSP
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0.000000E 00	288	AHY
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0.000000E 00	295	PPN
0.000000E 00	296	PPD
0.000000E 00	297	PFI
0.000000E 00	298	DFP
0.120000E-01	299	VPF
0.330000E 00	300	PPR

0.690000E 01	301	PMC
0.725000E 01	302	PMS
0.460000E 01	303	PMP
0.720000E 02	304	HR
0.300000E-03	305	CPF
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0.700000E-02	308	DLZ
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0.000000E 00	311	GPZ
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0.000000E 00	313	KCZ
0.000000E 00	314	VIZ
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0.100000E 01	316	HPL
0.000000E 00	317	STH
0.100000E 01	318	ALC
0.100000E 01	319	EXC
0.180000E 03	320	C2M
0.100000E 03	321	PA2
0.155000E 02	322	PP2
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0.210000E 00	324	AUL
0.315900E 01	325	VV9
0.150000E 01	326	O2A
0.000000E 00	327	Q1
0.000000E 00	328	EXE
0.150000E 01	329	ARF
0.600000E 00	330	CRF
0.965000E 02	331	RSM
0.100000E 01	332	BFM
0.963000E 02	333	RAM
0.700000E 00	334	CVS
0.400000E 02	335	PVC
0.600000E 02	336	PMC
0.240000E 04	337	QOM
0.800000E 01	338	PMC
0.800000E 01	339	P2C
0.600000E 02	340	MMC
0.000000E 00	341	PDC
0.100000E 01	342	POE
0.100000E 01	343	AMM
0.100000E 01	344	A4K
0.800000E-01	345	POM
0.600000E 02	346	CMM
0.800000E 01	347	PM1
0.100000E-02	348	PM3
-0.100000E 01	349	PM4
0.300000E 01	350	EX1
0.000000E 00	351	C2
0.000000E 00	352	Q3
0.122000E 03	353	PMS
0.250000E 04	354	PK1
0.000000E 00	355	Z9
0.825000E 01	356	Z10
0.100000E 00	357	Z11
0.124000E 01	358	Z12
0.625000E 00	359	Z13
0.400000E 01	360	Z14

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 0.000000E 00     361     Z15
 0.000000E 00     362     Z16
 0.800000E 03     363     PK2
 0.200000E 01     364     PK3
 0.000000E 00     365     FIS
 0.000000E 00     366     STA
 0.100000E 03     367     PAR
 0.000000E 00     368     GBL
-0.200000E 00     369     ANY
 0.400000E 00     370     ANZ
 0.000000E 00     371     ANX
 0.300000E-03     372     ANV
 0.000000E 00     373     ANW
 0.100000E 01     374     ANR
 0.100000E 01     375     AUC
 0.100000E 01     376     AUR
 0.100000E 01     377     AUS
 0.000000E 00     378     A378
 0.400000E 02     379     H1
 0.910000E 01     380     A2
 0.352000E-02     381     A3
 0.110000E 02     382     TW
 0.400000E 00     383     RH
 0.450000E 00     384     V
 0.240000E 02     385     TAAR
 0.730000E 03     386     BARO
 0.240000E 02     387     TR
 0.000000E 00     388     EXQ
                   0
   1  COMBINED THERMOREGULATORY-CIRCULATORY SIMULATION- BASAL CONDITIONS
ULC AU  AM  AHP ANM VF  VUC NAE KE  KI  VEC VIC CNA CKE CKI EXQ RMO
      15                                                              TIMEDR
 1     0.0
    30SECS10
     2MINS 1
1.                                                                    SEX=MALE
25.                                                                   AGE001
70.
173.
0.64                                                                  SHF
0.582                                                                 SHB
1.058                                                                 SHT
0.856                                                                 SHS
0.0                                                                   SAF
0.   2.14 2.13 0.   0.   0.51 0.50 0.   0.   0.   0.   0.36 0.   3.30  PCT    35
12.980.   0.   24.359.60 0.   0.   0.   0.   1.82 0.   2.02 1.0  0.    PCT    35
0.   4.58 1.30 0.   0.   0.   0.   0.65 0.   0.31 0.04 0.   0.   0.10  PCT    35
0.19 0.   0.   0.   0.   0.26 0.   6.73 2.64 0.   0.   13.823.23 0.    PCT    35
0.   0.   0.   1.62 0.   0.50 0.07 0.   0.    .11 0.29 0.   0.   0.    PCT    35
0.   0.34 3.37                                                        PCT    35
 1729   14   15    1  6086  672  288   54   95  128   23   17   1   27 PQB 01
    3    7  3    384   58   43   17    2    6    9                    PQB 02
0.00 0.00 0.00 .81   0.0 0.00 0.00 3.78 0.00 0.00 0.00 1.40 0.00 0.00  EB  005
0.00 0.32 0.00 0.00 0.00 3.32 0.00 0.00 0.00 0.72                     EB  006
 1076   59   18   87 5021 1397  348  127    2  267   48    3    2    6 PBCO 01
    7  121   64  811  117  172    4    6   11  182                    PBCO 02
.08  .37  .13  .05  .29  .06                                          PS
0.00419   0.00278   0.00205   0.00419   0.00335   0.00205   0.00419     C/ND  43
0.00335   0.00205   0.00419   0.00278   0.00205   0.00419   0.00335     COND  43
0.00205   0.00419   0.00278   0.00205                                   COND  43
```

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.1731.7638.2684.1002.6012.1299                                               S    011
4.80 4.80 4.20 3.60 4.20 4.0                                                 HR   012
3.0  2.10 2.1  4.0  2.1  4.0                                                 HCSL013
6.54 9.20512.7817.5123.6931.7142.0255.1371.6692.30                           P    014
36.6634.3634.0433.7636.5935.8133.5632.3935.2432.9432.0831.5236.1234.85      TSETW 22
34.1233.3935.5234.8732.3532.0834.8534.6633.1132.9936.41                     TSETW 23
36.6634.3634.0433.7636.5935.8133.5632.3935.2432.9432.0831.5236.1234.85      TSETC 24
34.1233.3935.5234.8732.3532.0834.8534.6633.1132.9936.41                     TSETC 25
0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.         RATE017
0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.                        RATE018
372. 33.7 0.00 136. 17.0 0.00 10.8 10.8 0.00 13.0 0.40 0.00                  CONT019
0.21 0.42 0.10 0.04 0.20 0.03                                                SKINR20
0.0810.4810.1540.0310.2180.035                                               SKINS21
0.1320.3220.0950.1210.2300.100                                               SKINV22
0.01 0.05 0.19 0.20 0.20 0.35                                                SKINC23
   0.  .30  .08  .01  .60  .01                                               WK1   50
   0.  .15  .02  .0   .78  .05                                               WK2   51
  .01  .88  .10  .01  .00  .00                                               WK3   52
  .01  .20  .02  .00  .67  .10                                               WK4   53
0.02 0.85 0.05 0.00 0.07 0.00                                                CHILM25
0.00 1.00 0.00 0.00 0.00 0.00                                                NSTM
36.6634.3634.0433.7636.5935.8133.5632.3935.2432.9432.0831.5236.1234.85      INIT  38
34.1233.3935.5234.8732.3532.0834.8534.6633.1132.9936.41                     INIT  39
 7.0036.0213.41 5.0031.74 6.86                                               PAREA 60
0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.         SUB   33
0.55                                                                         CEFF  34
0.0  0.3  0.05 0.0  0.3  0.1                                                CLO
2.0                                                                          VWALK
0005                                                                         INT MIN
 2                                                                           JOB STAN
    17MINS 1
    10MINS 1
    20MINS 1
 3                                                                           JOB SIT
```

Input Dataset - Heat and Exercise Forcing

0.000000E 00	1	T
0.500000E 00	2	I
0.000000E 00	3	VBC
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0.850000E 00	6	VAS
0.400000E 00	7	VLA
0.100000E 00	8	VRA
0.354000E 00	9	VAE
0.100000E 03	10	PA
0.100000E 01	11	PAM
0.100000E 01	12	LVM
0.000000E 00	13	VRE
0.000000E 00	14	PRA
0.500000E 01	15	QRN
0.700000E-01	16	VPE
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0.400000E 00	18	PPI
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0.160000E 01	20	RPA
0.100000E 01	21	RVM
0.000000E 00	22	VLE
0.000000E 00	23	PLA
0.500000E 01	24	QLN
0.200000E 02	25	PLI
0.000000E 00	26	VIB
0.140000E 01	27	RPV
0.300000E 01	28	RPT
0.152000E 02	29	PGL
0.500000E 01	30	CPC
0.000000E 00	31	C5
0.230000E 00	32	VVE
0.310000E 00	33	VVB
0.380000E 01	34	PVS
0.370000E 01	35	PGV
0.720000E 00	36	RVG
0.500000E 01	37	QVC
0.100000E 01	38	AVE
0.212000E-01	39	CN2
0.356000E 00	40	CN3
0.280000E 01	41	RVS
0.960000E 02	42	PGS
0.194000E 02	43	RTP
0.500000E 01	44	QAC
0.500000E 01	45	CRC
0.500000E 01	46	CLC
0.000000E 00	47	CVS
0.000000E 00	48	DPA
0.000000E 00	49	DAS
0.000000E 00	50	DLA
0.000000E 00	51	DRA
0.100000E 03	52	PAI
0.000000E 00	53	AUC
0.100000E 01	54	AUB
0.000000E 00	55	AUN
0.100000E 01	56	AU6
0.000000E 00	57	AU2
0.600000E 00	58	AU8
0.100000E 01	59	DAU
0.100000E 01	60	AUJ

0.100000E 01	61	AU
0.000000E 00	62	AUC
0.100000E 01	63	AUH
0.000000E 00	64	VV4
0.850000E 00	65	AU9
0.100000E 01	66	AUM
0.000000E 00	67	AU4
0.550000E 00	68	VIF
0.825000E 01	69	PD1
0.100000E 01	70	PTT
0.700000E 01	71	PTS
-0.600000E 01	72	PIF
0.165000E 02	73	CPI
0.410000E 01	74	PTC
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0.280000E 02	76	PPC
0.146000E 02	77	PVG
0.134000E 02	78	PC
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0.830000E 00	81	PLD
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0.500000E-01	87	DPC
0.000000E 00	88	CPI
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0.700000E-02	90	DLP
0.000000E 00	91	CPP
0.500000E 01	92	CHY
-0.500000E 01	93	PRM
0.200000E 01	94	PGR
0.125000E 02	95	CPG
0.413000E 01	96	PGP
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0.165000E 02	98	PGX
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0.120000E 01	110	RFN
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0.100000E 00	118	NCD
0.000000E 00	119	NEC
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0.700000E 03	124	KEL
0.355000E 04	125	KIR
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0.000000E 00	128	KEC
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0.000000E 00	131	CCD
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0.750000E 02	133	KE
0.355000E 04	134	KI
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0.000000E 00	136	I1
0.000000E 00	137	VTY
0.100000E 01	138	Z
0.000000E 00	139	VTZ
0.000000E 00	140	VUZ
0.100000E-02	141	TVZ
0.000000E 00	142	PPZ
0.000000E 00	143	DFZ
0.100000E 02	144	X
0.300000E-02	145	I2
0.000000E 00	146	PRI
0.120000E 02	147	VTS
0.300000E 01	148	VP
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0.510000E 01	150	IFP
0.143000E 03	151	GPR
0.000000E 00	152	KN3
0.100000E 02	153	KN1
0.100000E 01	154	AMR
0.100000E 01	155	AMP
0.100000E 01	156	AM1
0.100000E 01	157	AMC
0.000000E 00	158	AM2
0.000000E 00	159	AM3
0.000000E 00	160	AM5
0.100000E 01	161	AM
0.100000E 02	162	CNE
0.200000E 00	163	AGK
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0.100000E 01	165	AN1
0.100000E 01	166	ANC
0.420000E-01	167	AN2
0.110150E 01	168	AN3
0.300000E 01	169	AN5
0.100000E 01	170	ANM
0.500000E 01	171	VB
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0.410000E 02	173	HM
0.000000E 00	174	B1
0.150000E 01	175	VIE
0.300000E 01	176	VIB
0.100000E 01	177	VIM
0.110000E-04	178	RC2
0.250000E 00	179	PC2
0.580000E-05	180	RKC

0.110000E-04	181	RC1
0.000000E 00	182	RCC
0.200000E 01	183	VRC
0.325000E 02	184	RSN
0.203000E 03	185	CVA
0.300000E 01	186	BFN
0.130000E 03	187	DOB
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0.700000E 00	190	CSV
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0.100000E 01	195	AR2
0.100000E 01	196	PCC
0.100000E 01	197	AR3
0.100000E 01	198	ARM
0.300000E 01	199	CN6
0.125000E 00	200	GFN
0.000000E 00	201	AH7
0.000000E 00	202	AH6
0.330000E 01	203	AH
0.100000E 01	204	AHC
0.785000E-01	205	AH1
0.120000E 01	206	AH2
0.500000E 01	207	AH4
0.100000E 01	208	AHM
0.600000E 01	209	CNY
0.250000E 01	210	CNX
0.150000E 00	211	VV1
0.150000E 00	212	VV2
0.000000E 00	213	VV5
0.000000E 00	214	VV6
0.000000E 00	215	VV7
0.000000E 00	216	TVC
0.400000E 02	217	VTW
0.100000E 01	218	HSR
0.100000E 01	219	HSL
0.240000E 02	220	NIC
0.500000E 00	221	SR
0.295000E 01	222	VVR
0.305200E 02	223	RAP
0.925000E-01	224	CV
0.200000E 00	225	CN7
0.300000E 01	226	AUX
0.500000E-03	227	AUK
0.100000E 01	228	AUZ
0.100000E 01	229	Y
0.700000E-02	230	CFC
0.160000E-06	231	CPK
0.300000E 01	232	PCE
0.850000E 02	233	CPR
0.470000E-03	234	LPK
0.700000E-02	235	DPD
0.570000E 02	236	HYL
0.400000E 01	237	KID
0.600000E 02	238	AMT
0.150000E 02	239	ANT
0.600000E-01	240	PCK

0.300000E 00	241	PCN
0.100000E 01	242	A1K
0.200000E 02	243	A2K
0.115200E 05	244	A3K
0.139000E 03	245	CNR
0.100000E 01	246	CNZ
0.700000E 01	247	AHK
0.330000E 02	248	SRK
0.330000E 00	249	V9
0.200000E-01	250	V2D
0.100000E 01	251	Z1
0.000000E 00	252	Z2
0.400000E 01	253	Z3
0.100000E 02	254	Z4
0.100000E 02	255	Z5
0.500000E 01	256	Z6
0.500000E 01	257	Z7
0.100000E 01	258	Z8
0.900000E 02	259	HMK
0.530000E 00	260	HKM
0.410000E 02	261	POV
0.300000E 00	262	PCZ
0.555000E 03	263	ROC
0.240000E 04	264	QO2
0.120000E 01	265	RBF
0.180000E 03	266	MO2
0.100000E 01	267	POA
0.464000E-04	268	PCY
0.100000E 01	269	ANL
0.400000E 02	270	PCR
0.530000E-01	271	GF2
0.100000E 01	272	HMD
0.000000E 00	273	CHM
0.800000E 01	274	POC
0.200000E 02	275	I3
0.400000E 01	276	U
0.100000E-01	277	VP1
0.000000E 00	278	T1
0.100000E 01	279	GF3
0.530000E 01	280	GF4
0.100000E 01	281	AUP
0.300000E 00	282	AUV
0.000000E 00	283	RV1
0.250000E 00	284	AUY
0.300000E 01	285	CUT
0.300000E 01	286	DSP
0.000000E 00	287	AHZ
0.000000E 00	288	AHY
0.100000E 01	289	CSA
-0.130000E 02	290	PPI
0.300000E 02	291	CPN
0.120000E 02	292	PCS
0.300000E-03	293	PLF
0.900000E-02	294	PPC
0.000000E 00	295	PPN
0.000000E 00	296	PPD
0.000000E 00	297	PFI
0.000000E 00	298	DFP
0.120000E-01	299	VPF
0.380000E 00	300	PPR

0.590000E 01	01	301	PMC
0.725000E 01	01	302	PMS
0.460000E 01	01	303	PMP
0.720000E 02	02	304	HR
0.300000E-03	-03	305	CPF
0.700000E 01	01	306	PCP
0.100000E 01	01	307	CA1
0.700000E-02	-02	308	CLZ
0.000000E 00	00	309	DPY
0.000000E 00	00	310	DPZ
0.000000E 00	00	311	GPZ
0.100000E 00	00	312	NCZ
0.000000E 00	00	313	KCZ
0.000000E 00	00	314	VIZ
0.100000E 01	01	315	HPR
0.100000E 01	01	316	HPL
0.000000E 00	00	317	STH
0.100000E 01	01	318	ALC
0.100000E 01	01	319	EXC
0.130000E 03	03	320	C2M
0.100000E 03	03	321	PA2
0.155000E 02	02	322	PP2
0.700000E-01	-01	323	SVC
0.210000E 00	00	324	AUL
0.315500E 01	01	325	VVS
0.150000E 01	01	326	C2A
0.000000E 00	00	327	Q1
0.000000E 00	00	328	EXE
0.150000E 01	01	329	ARF
0.530000E 00	00	330	GRF
0.965000E 02	02	331	RSM
0.100000E 01	01	332	BFM
0.963000E 02	02	333	RAM
0.700000E 00	00	334	CVS
0.400000E 02	02	335	PVO
0.600000E 02	02	336	RMO
0.240000E 04	04	337	CCM
0.400000E 01	01	338	FMC
0.900000E 01	01	339	F2C
0.600000E 02	02	340	MMC
0.000000E 00	00	341	PDC
0.100000E 01	01	342	FCE
0.100000E 01	01	343	AMM
0.100000E 01	01	344	A4K
0.800000E-01	-01	345	PCM
0.500000E 02	02	346	CMM
0.300000E 01	01	347	PM1
0.100000E-02	-02	348	PM3
-0.100000E 01	01	349	PM4
0.300000E 01	01	350	EX1
0.000000E 00	00	351	Q2
0.000000E 00	00	352	Q3
0.122000E 03	03	353	PM5
0.250000E 04	04	354	PK1
0.000000E 00	00	355	Z9
0.825000E 01	01	356	Z10
0.100000E 00	00	357	Z11
0.124000E 01	01	358	Z12
0.625000E 00	00	359	Z13
0.400000E 01	01	360	Z14

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 0.000000E 00     361     Z15
 0.000000E 00     362     Z16
 0.800000E 03     363     PK2
 0.200000E 01     364     PK3
 0.000000E 00     365     FIS
 0.000000E 00     366     STA
 0.100000E 03     367     PAR
 0.000000E 00     368     GBL
-0.200000E 00     369     ANY
 0.400000E 00     370     ANZ
 0.000000E 00     371     ANX
 0.300000E-03     372     ANV
 0.000000E 00     373     ANW
 0.100000E 01     374     ANR
 0.100000E 01     375     AUC
 0.100000E 01     376     AUR
 0.100000E 01     377     ALS
 0.000000E 00     378     A378
 0.400000E 02     379     H1
 0.900000E 01     380     A2
 0.352000E-02     381     A3
 0.110000E 02     382     TW
 0.400000E 00     383     RH
 0.450000E 00     384     V
 0.240000E 02     385     TAAR
 0.736000E 03     386     BARO
 0.240000E 02     387     TR
 0.000000E 00     388     EXQ
                C
   2  COMBINED THERMOREGULATORY-CIRCULATORY SIMULATION- HEAT AND EXERCISE
QLO AU  AM  AHM ANM VP  VUC NAE KE  KI  VEC VIC CNA CKE CKI EXQ RMO
     15                                                                  TIMEDR
 1   0.0
    30SECS10
     2MINS 1
1.                                                                       SEX=MALE
25.                                                                      AGE001
70.
173.
0.64                                                                     SHF
0.582                                                                    SHB
1.058                                                                    SHT
0.896                                                                    SHS
0.0                                                                      SAF
0.   2.14 2.13 0.   0.   0.51 0.50 0.   0.   0.   0.   0.36 0.   3.30   PCT   35
12.980.   0.   24.359.60 0.   0.   0.   0.   1.82 0.   2.02 1.0  0.     PCT   35
0.   4.58 1.30 0.   0.   0.   0.   0.65 0.   0.31 0.04 0.   0.   0.10   PCT   35
0.19 0.   0.   0.   0.   0.26 0.   6.73 2.64 0.   0.   13.823.23 0.     PCT   35
0.   0.   0.   1.62 0.   0.50 0.07 0.   0.   .11 0.29 0.   0.   0.     PCT   35
0.   0.34 3.37                                                          PCT   35
 1729   14   15    1  6086  672  288   54   95  128   23   17   1    27 PQB 01
    3    7  3    384   53   43   17    2    6    9                       PQB 02
0.00 0.00 0.00 .81   0.0 0.00 0.00 3.78 0.00 0.00 0.00 1.40 0.00 0.00   EB  005
0.00 0.52 0.00 0.00 0.00 3.32 0.00 0.00 0.00 0.72                       EB  006
 1076   59   18   87 5021 1397  348  127    2  267   48    3    2    6 PBCO 01
    7  121   64  811  117  172    4    6   11  182                       PBCO 02
.08  .37  .13  .05  .29  .06                                            PS
0.00419   0.00278   0.00205   0.00419   0.00335   0.00205   0.00419     C/ND  43
0.00335   0.00205   0.00419   0.00278   0.00205   0.00419   0.00335     COND  43
0.00205   0.00419   0.00278   0.00205                                   COND  43
```

```
.1731.7638.2684.1002.6012.1299                                                S    011
4.80 4.60 4.20 3.60 4.20 4.0                                                  HR   012
3.0  2.10 2.1  4.0  2.1  4.0                                                  HCSL013
6.54 9.20512.7817.5123.6931.7142.0255.1371.6692.30                            P    014
36.6634.3634.0433.7636.5935.8133.5632.3935.2432.9432.0831.5236.1234.85       TSETW 22
34.1233.3935.5234.8732.3532.0834.8534.6633.1132.9936.41                       TSETW 23
36.6634.3634.0433.7636.5935.8133.5632.3935.2432.9432.0831.5236.1234.85       TSETC 24
34.1233.3935.5234.8732.3532.0834.8534.6633.1132.9936.41                       TSETC 25
0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.          RATE017
0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.                          RATE018
372. 33.7 0.00 136. 17.0 0.00 10.8 10.8 0.00 13.0 0.40 0.00                   CONT019
0.21 0.42 0.10 0.04 0.20 0.03                                                 SKINR20
0.0810.4810.1540.0310.2180.035                                                SKINS21
0.1320.3220.0950.1210.2300.100                                                SKINV22
0.01 0.05 0.19 0.20 0.20 0.35                                                 SKINC23
   0.  .30  .08  .01  .60  .01                                                WK1   50
   0.  .15  .02  .0   .78  .05                                                WK2   51
  .01  .88  .10  .01  .00  .00                                                WK3   52
  .01  .20  .02  .00  .67  .10                                                WK4   53
0.02 0.85 0.05 0.00 0.07 0.00                                                 CHILM25
0.00 1.00 0.00 0.00 0.00 0.00                                                 NSTM
36.6634.3634.0433.7636.5935.8133.5632.3935.2432.9432.0831.5236.1234.85       INIT  38
34.1233.3935.5234.8732.3532.0834.8534.6633.1132.9936.41                       INIT  39
 7.0036.0213.41 5.0031.74 6.66                                                PAREA 60
0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.          SUB   33
0.55                                                                          CEFF  34
0.0  0.3  0.05 0.0  0.3  0.1                                                 CLG
2.0                                                                           VWALK
0005                                                                          INT MIN
 2                                                                            JOB STAN
            TP   0.433000E 02
            TAAR 0.433000E 02
            RH   0.550000E 00
            AUQ  0.150000E 00
            AUV  0.300000E-01
            ALS  0.100000E 00
            Z6   0.100000E 02
            Z8   0.300000E 01
            EXC  0.100000E 03
            Z    0.500000E 01
            A4K  0.250000E-01
    17MINS 1
 4                                                                            JOB PECA
    10MINS 1
    20MINS 1
 3                                                                            JOB SIT
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COMPUTER SIMULATION AND INTERFACE OF HUMAN THERMOREGULATORY AND CIRCULATORY SYSTEMS WITH EXERCISE FORCING

by

WILLIAM HENRY HEARN

B. S., Carnegie-Mellon University, 1973

AN ABSTRACT OF A MASTER'S REPORT

submitted in partial fulfillment of the

requirements for the degree

MASTER OF SCIENCE

Department of Electrical Engineering

KANSAS STATE UNIVERSITY
Manhattan, Kansas

1977

ABSTRACT

A sweat centered interface is developed between the KSU-Stolwi Thermoregulatory System Simulation and the Guyton Long Term Circula System Simulation. Implementation of the interface is demonstrated the rationale for computational techniques is discussed. Complete tions of sweat electrolyte loss formulations and their derivation a vided. Appendices include a Fortran computer program listing, a li of input data sets, a list of variables, and sample outputs. A sepa chapter is included to support independent researchers using the co computer simulation.

Results of the simulations indicate that the calculated sweati drinking amounts compare favorably with published water loss data f similar forcing conditions. Cardiac output is not adequately force heat inputs. Simulation results and areas for further study are di