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# "OPERATION WORKLOAD" A STUDY OF PASSENGER ENERGY EXPENDITURE DURING AN EMERGENCY EVACUATION

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16. Abstract
In an earlier study at the Civil Aeromedical Institute, workloads were determined for passengers during an emergency evacuation. The evacuation tests were conducted in an orderly manner and were suggested as representative of a moderate workload. The current study is a continuation and amplification of that study and utilizes similar techniques for determining workload. In this study, passengers were required to avoid the aircraft aisles and to traverse over seat backs to the exit in order to simulate a maximum effort which might be anticipated in an emergency. Thus, maximum workload could be estimated more realistically. This information is necessary to formulate qualification requirements for passenger protective breathing equipment. Recommended values proposed in the first study should be modified. Original recommendations are listed below and are crossed out when change is indicated, then followed by the recommended new value.

1) A 20-min work profile consisting of:
   15-min at 0.7 W/Kg body weight; 2 min at 1.2 W/Kg body weight;
   1 min at ~~1.5~~ (2.0) W/Kg body weight; 2 min at 1.2 W/Kg body weight.
2) The volume of the smoke hood - type PPBE should exceed the volume that encloses the head and neck by 3.0 Liters.
3) The device should provide 3.0 L/min oxygen for 20 minutes.
4) The device should probably be capable of absorbing ~~45~~ (30) L of $CO_2$.

The subject population should include one or two individuals who meet or exceed the weight of the 95th percentile male.

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Passenger Protective Breathing Equipment, Emergency Evacuation, Smoke/Fume Environment

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# ABSTRACT

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## ACKNOWLEDGMENT

This study is one of two concerned with ways in which workload might be assessed for Passenger Protective Breathing Equipment. These two workload studies formed a portion of four aviation-related projects devised and organized under the auspices of Linacre College, Oxford University. Financial support for all these events came from worldwide donations and grants made by many organizations and individuals.

Volunteers to take part in the workload tests were recruited through local radio phone-in programs and facilities provided by the personnel departments of Land Rover Limited and the local authority offices at Solihul. These tests were conducted at Birmingham Airport which furnished the aircraft, power supplies, security services, fire tender and an ambulance. The Airport Fire Service undertook on-site preparations and provided staff in support of the test program.

Drs. J.A.S. Ross and S.J. Watt, carrying out the other workload study undertaken under the auspices of Linacre College, conducted the medical screening process and monitoring of participants. First Aid support on site was drawn from the St. John's Ambulance Brigade. Pretest calibration of specific participants and the required physiological parameter measurements were carried out by the Department of Physical Education, Birmingham University.

The Air Accident Investigation Branch of the Department of Transport and the Civil Aviation Authority furnished comment and recommendations during the development of the test protocol; the latter extended their insurance coverage to include the tests. British Airways provided the Cabin Attendants who served to conduct the emergency evacuations for the four trials in this study. British Airways also fitted the escape slide, and set up the seats to the proper tension in the rear cabin of the Trident Aircraft.

Three members of the team established by Linacre College, Mr. J. McNab, Mr. M. Ellery, and Mr. J. Boath of the Offshore Fire Training Center at Montrose, took part in the event fulfilling the roles of "Controller," "Safety Officer," and "External Marshall." A further member, Mr. D.D. Dempster handled public relations matters. Mrs. H. Brunton and Mr. P. Reynolds, seconded by the C.S.V. Newcastle, handled the Mercia Radio phone-in programs and the organization of volunteers. Mrs. E.A. Higgins, with help from Mrs. J. Boath, assisted Dr. Higgins to prepare participants for the heart rate monitoring during the tests and the coding of records.

Following the data collection phase, Mrs. P. Lyne and Mr. J.T. Saldivar, Jr., were responsible for much of the data reduction and analysis.

The authors wish to express their sincere thanks to the Principal and Fellows of Linacre College for their agreement and support for these tests. In turn, gratitude is expressed to Mr. R. Taylor, M.B.E., Managing Director, Birmingham International Airport and Mr. B. Wood, his Assistant Director - Operations; all those who so generously denoted funds in support of the program, and to more than 400 people who gave their time and efforts in many ways to help to identify means by which passenger safety in aviation can be improved.

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## INTRODUCTION

In an earlier study at the Civil Aeromedical Institute in Oklahoma City (1), workloads were determined by correlation with heart rate for passengers during an emergency evacuation. The evacuation tests were conducted in an orderly manner and were suggested as representative of a moderate workload. Values for a maximum effort were not measured, only estimated. The current study is a continuation and amplification of that study and utilizes similar techniques for determining workload. In this study passengers were required to avoid the aircraft aisles and to traverse over seat backs to the exit to simulate a maximum effort which might be anticipated in an emergency. Thus, maximum workload could be estimated more realistically. This information is necessary to formulate qualification requirements for passenger protective breathing equipment.

## METHODS

Calibration tests were conducted on 56 volunteer subjects at the University of Birmingham Department of Physical Education using a Monarch bicycle ergometer and an Oxycon respiratory gas analyzer. After a preselection physical examination, subjects were tested while exercising on the ergometer beginning at 30 watts, with the workload increased by 20 W every 2 min until either the 150-W workload was complete or heart rate (HR) exceeded 80 percent of the individual's predicted maximum HR (calculated as 220 minus age[2]).

Subjects were fitted with adhesive chest electrodes for HR measurement during the exercise test. Prior to each test, subjects were fitted with a noseclip to assure that all air exchange was via the mouth. Expired air was measured for volume, $O_2$ and $CO_2$ content, as well as respiratory rate. This computer-assisted system reported on-line data for each 30-s period of the test. Parameters reported were:

i) time in 0.5 min intervals:

ii) VE (expiratory volume), BTPS, in liters/min to nearest 0.1 liter;

iii) respiratory frequency, in breaths/min to nearest whole number;

iv) VT (tidal volume), BTPS, to nearest hundreth of a liter;

v) percent of $O_2$ in the expired air to nearest tenth of a percent;

vi) percent of $CO_2$ in the expired air to nearest tenth of a percent;

vii) $\dot{V}O_2$, STPD (volume of $O_2$ used), in liters/min to nearest hundredth;

viii) $\dot{V}O_2$/Kg, STPD to nearest tenth in mL/Kg;
ix) $\dot{V}CO_2$, STPD (volume of $CO_2$ expired) in liters/min to nearest hundredth;
x) $\dot{V}CO_2$/Kg, STPD, to nearest tenth in mL/Kg; xi) RQ (respiratory quotient), a ratio of $CO_2$ produced to $O_2$ consumed, to nearest hundredth; and,
xii) heart rate in beats/min in whole numbers.

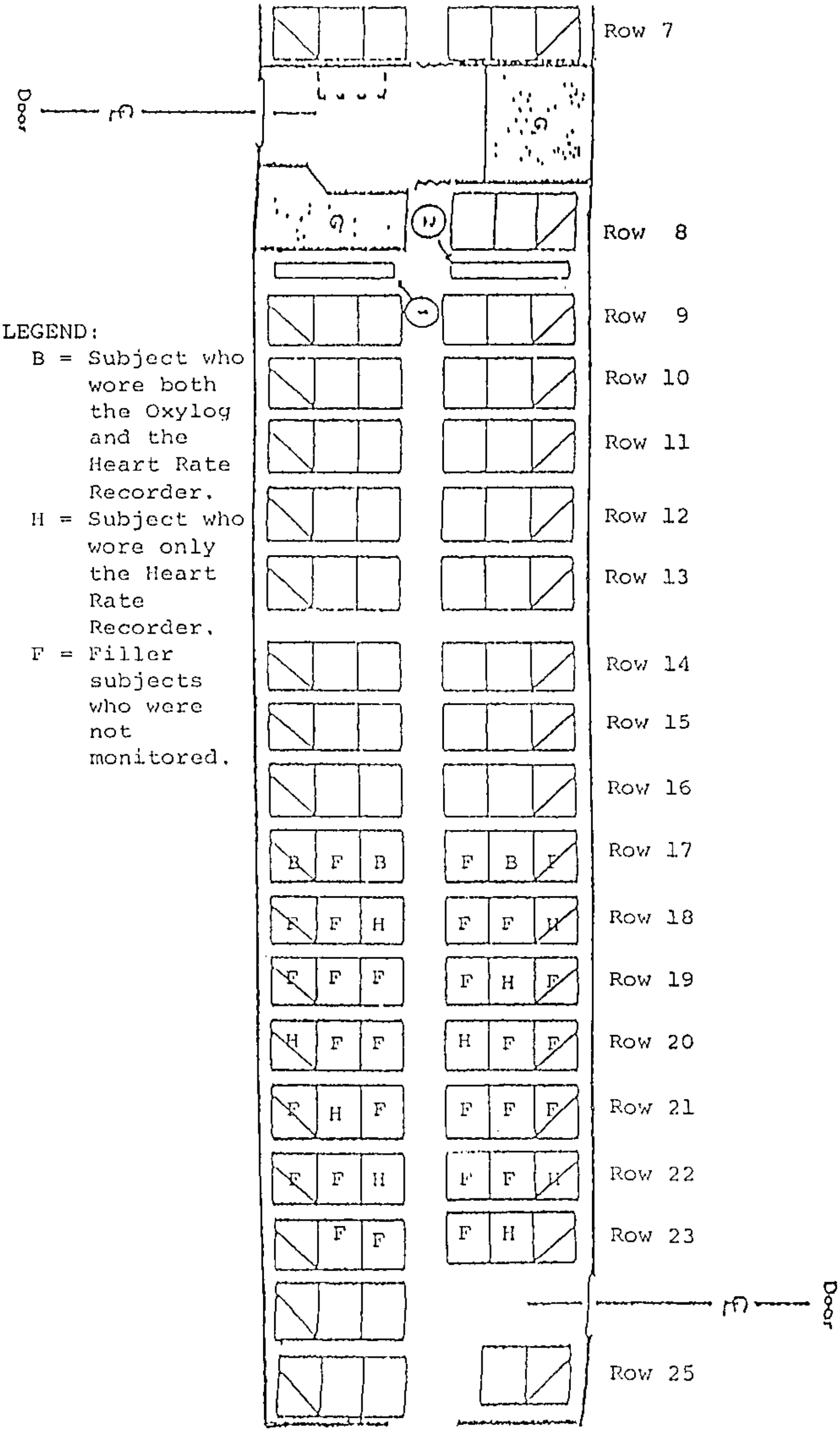
In analyzing these data, the values for the low 30-W exercise level were not used. The 30-W 2-min period was considered a warm-up period for stabilization of the subject. In most instances, data collected during the last 30-s period of each 2-min workload segment were used for the statistical treatment. If data for the final 30-s period for any one workload segment appeared to be out-of-line with other data, primarily due to rounding-off error with low respiratory rates, then data for the entire last minute were used as more representative. The full-minute values were retained only if they yielded a higher correlation coefficient for the line-of-best-fit than did the final 30-s data.

Subsequently, four evacuation trials were conducted from a Trident III aircraft, with 40 subjects seated to the rear of the rear compartment.

Of the 56 participants who were calibrated, 48 were monitored for HR, in groups of twelve during the four evacuation trials. For each evacuation trial, 28 non-instrumented subjects were included to fill the 40-passenger total. For each test, three of the 12 subjects who were monitored for heart rate were also measured for oxygen consumption via an "Oxylog" analyzer system by Dr. Ross and Dr. Watt for inclusion in separate studies (3,4).

Figure 1 shows a typical seating arrangement for the rear cabin of the Trident III aircraft during the evacuation trials. Rows 8 through 16 were left vacant, with seated subjects starting in row 17. Those subjects who were not monitored are indicated with the letter "F" (fillers); those monitored for both heart rate and the Oxylog are indicated with the letter "B"; those monitored for heart rate only are indicated with the letter "H."

Heart rate monitoring was accomplished by use of portable Marquette, Series 8500, Holter HR recorders. The first 12 calibrated subjects who reported for the evacuation tests were instrumented. Heart rate electrode skin sites were cleaned with alcohol and mild abrasion; NaCl-pumice type electrode paste was applied to the skin sites, then disposable AG/AgCl electrodes were applied. Two Electrocardiogram (EKG) electrode placements, CM-5 and a modified V-1, were monitored. The CM-5 (5) is manubrium to the 5th intercostal space, anterior axillary line. The electrode sites for the modified V-1 are below left clavicle, just lateral to the




LEGEND:

B = Subject who wore both the Oxylog and the Heart Rate Recorder.

H = Subject who wore only the Heart Rate Recorder.

F = Filler subjects who were not monitored.

Figure 1
Typical Seating Arrangement for the Rear Cabin of the Trident III Used During the Four Trials

mid-clavicular line to V-1. V-1 is below the left clavicle, just lateral to the mid-clavicular line to the 4th intercostal space, right sternal edge.

At the conclusion of the evacuation tests, the Holter monitor tapes were returned to the CAMI laboratory where the tapes were played on a Marquette Series 8000 T Playback Analysis System and HR values were determined for the evacuation test period.

## RESULTS

Of the 48 subjects monitored for HR during the evacuation trials (12 per trial), usable data were obtained for 45 subjects. Of the three subjects for whom data were not used, two appeared to have experienced a disconnect from the recorder between the time of the hookup and evacuation trial and no data were on the tape. For the other subject, data were obtained, but were totally inconsistent with the calibration data (high HR's were recorded during calibration, very low HR's were recorded during evacuation trial). The reason for this inconsistency is not readily apparent. The subjects not included are nos. 1-12, 3-04, and 3-08.

Tables I through VII present the determinations made from the workload calibration tests for the 45 subjects for whom valid data were obtained during the evacuation trials. Table VIII contains the heart rates recorded during the evacuation trials in 0.5-min increments from the time the emergency was declared with the order to evacuate. Because all participants evacuated the craft in less than 1 minute, the heart rate assessment was made only for 2 minutes. Table IX lists the workloads calculated from heart rate based on the calibration data. The data in Tables X and XI present oxygen consumption and oxygen consumption per Kg, and expired carbon dioxide and carbon dioxide per Kg values calculated for the evacuation trials workload data using the relationships determined in the calibration tests. The blanks in Tables VIII through XI during the final 30-s period are not due to lost data, but are due to the HR upon which they are based being below calibration values. Because all subjects were evacuated and away from the aircraft in the first minute, and because none registered a peak heart rate during either 30-s segment of the second minute, the first minute of data will be used to represent the maximum workload experienced during these evacuation tests.

In Table XII data are presented from the first minute of the evacuation trials. When all subjects are considered, the mean workload per kg body weight is 2.029 watts per kilogram

## DISCUSSION

To better determine any differences between categories of test subjects, data were divided by the four test trials for all subjects in the group, by those wearing the Oxylog equipment and those without the Oxylogs. Because data appear to be different for the fourth trial, and the subjects from the first three trials appeared similar, the subjects from these first three trials were grouped as being representative of one population. Group IV appeared to be a very intense group determined to "be the best group, with the most rapid evacuation time." Tables XIII through XV list the mean, standard error and sample sizes for each subject population and the P values for statistical differences between these groups for age, and weight (Table XIII), for the first-minute evacuation test heart rate (Table XIV), and for the first-minute workload, and workload per unit weight (Table XV). Table XVI lists the oxygen consumption (mL/min) and oxygen consumption per kg body weight based on the calibration regression equations for workloads at 0.7 W/Kg (low work-load), 1.2 W/Kg (intermediate workload), and workload of the first minute of the evacuation test (high workload). Table XVII lists the carbon dioxide production (mL/min) and carbon dioxide production per kg body weight based on the calibration regression equations for workloads at 0.7 W/Kg (low workload), 1.2 W/Kg (intermediate workload) and workload of the first minute of the evacuation test (high workload). Table XVIII gives the oxygen consumption (in liters) and the carbon dioxide production (in liters) based on the proposed 20-min workload profile. Table XIX gives the means, standard errors, and sample size for the various populations of subjects, as well as the tests for significant differences between these groups for the values listed in Table XVIII.

For seven of 19 comparisons, the statistical difference when comparing group IV to the other three groups proved to be significant (Tables XIII, XIV, XV, and XIX). Their total evacuation time was much faster than those of the other three groups (33 s compared to 46 s, 41 s, and 43 s, respectively). Their exertion was probably higher, and thus workload, $CO_2$ production, and $O_2$ consumption were greater. In 10 of 19 comparisons, those wearing oxylogs showed statistically significant difference when compared to those who were not wearing oxylogs. One possible explanation for this difference is found in Table XIII. The subjects wearing oxylogs were significantly lighter in weight than those without oxylogs (a mean of 66.5 kg vs. 79.2 kg). It is also possible that those wearing oxylogs proved different from the other subjects because they were placed on the front row of those evacuating the aircraft and had to make the effort required to fold down eight rows of seats on their way to the exit. None of the other subjects wearing heart rate recorders had to accomplish this task.

Data from eight of the twelve subjects wearing the Oxylogs in this study, have been reported by Drs. John Ross and Stephen Watt (3). Their report also includes data from several subjects not covered in this report.

For those eight subjects which the two reports have in common, we were able to make the following determinations: During the brief (14 to 24 s) periods of the subjects' evacuation, they report an average $O_2$ uptake of about 39.6% (range = 23.7 to 53.5%) of the predicted average $O_2$ utilization based on heart rate. This, in itself, is not surprising for several reasons. First, during a brief rapid increase in work, the $O_2$ utilization is partially accounted for by utilization of stored $O_2$ and not just the $O_2$ uptake. Another possible explanation for the differences is that the higher heart rate could be psychogenically induced and not due solely to physical exertion, which would result in a higher predicted workload than is actually the case.

Then, by extending the time for both sets of data to 2 min, their reported total $O_2$ uptake rose to 59.8% (range = 46.5 to 75.2%) of the predicted $O_2$ utilization. This probably indicates that the $O_2$ uptake still does not equal the $O_2$ used within that time frame. There is also the fact that, with an abrupt increase in workload, it is not unusual to see an initial drop in $O_2$ uptake. This is not indicative of a decrease in workload, nor in $O_2$ utilization. This decrease is temporary. As evidence, a table of data (Table XX) taken from the calibration tests at the University of Birmingham has been included. This table presents the change in $O_2$ uptake from the final 30 s of a 2-min workload segment to the first 30 s of the next higher workload. Frequently there is a decrease, even though these are for changes of only 20 watts. This is also supported in Åstrand's Textbook of Work Physiology (6), where it states: "The kinetics of the increase in oxygen uptake during the first minutes of an exercise, which lead to a steady state situation, have a time constant of about 30 s, or about 20 s when a given moderate exercise is preceded by a warming-up period." Thus, one must be cautious in interpreting a drop in $O_2$ uptake as indicating a decline in workload, or a lessening of $O_2$ utilization, especially when it occurs during the first 30 s after an abrupt increase in activity level.

A direct measurement of $O_2$ uptake, assuming reliable equipment and techniques, should provide a better estimate of $O_2$ requirements for a specific test condition than an indirect method such as the one used for this study. If, however, it is intended to include the brief maximum exertion as a part of a longer-term profile, then there is justification to utilize an indirect measurement, especially when employing a large subject population. For a brief isolated exertion, $O_2$ uptake would better reflect total $O_2$ requirements. For a more complex workload profile with a longer time frame, in which $O_2$ debt could be repaid, then $O_2$ utilization would be needed to reflect the total $O_2$ requirements imposed by that brief maximum exertion.

By employing the regression equations developed for the calibration workload tests, values can be determined for each test subject for predicted $O_2$ consumption and $CO_2$ production at the low workload of 0.7 W/Kg, for the intermediate workload of 1.2 W/Kg, and for each individual`s estimated 1-min workload during the evacuation trial (Tables XVI and XVII). These values can then be used to determine $O_2$ flow requirements and $CO_2$ absorption requirements for a 20-min work profile of 15 min at 0.7 W/Kg, 4 min at 1.2 W/Kg, and 1 min at a maximum workload. Of course, other scenarios can be described and other determinations made for varying times at each of the three workload levels. Results for all 45 subjects are given in Table XVIII.

If it is assumed that the total group is representative of a desired population (see Table II for description of subject population), then by applying the mean values for overall $O_2$ consumption and $CO_2$ production the requirements for the 20-min work profile described above for a 95th percentile male (100.1 Kg) would be 28.38 L of $O_2$ consumed and 23.36 L of $CO_2$ produced for the 20-min period.

In this study there were four subjects who exceeded 100 Kg in weight (No. 2-11 [106 Kg], No. 3-07 [103 Kg], No. 4-10 [103 Kg], and No. 4-11 [102 Kg]). In considering the data from these four, the 20-min profile for exercise would yield $O_2$ requirements of 28.43, 28.87, 28.82, and 29.41 L respectively. The average of the four is 28.88 L of $O_2$ required (compared to the 28.38 L predicted for the 95th percentile male). The one subject in the prior study (1) representative of the 95th percentile male had an $O_2$ requirement of 29.0 L. The mean $CO_2$ production for these four subjects in the current study was 24.63 L (with 23.36 L predicted for 95th percentile male). The prior study reported 24.7 L. These values are very comparable.

In the original study, allowances were made for the possibility of greater $CO_2$ production. However, the data of this study indicate that significantly higher production will not occur. The highest calculated value was for subject 4-11 and was 26.11 L. Thirty L of $CO_2$ absorption capacity should be adequate. Carbon dioxide absorption can be described in terms of the total amount required for the 20-min period, but for required $O_2$ supply, peak flow requirements must be considered. Although only two subjects exceeded 3.0 L/min $O_2$ consumption during peak workload (Subjects 3-01 and 4-10, Table XVI), the device should probably be capable of providing that 3.0 L at any time during its functional life.

Table VII indicates that although eight individuals exceeded a maximum tidal volume of 3.0 L, the greatest value was only 3.15 L. Therefore, the earlier estimate of 3.0 L for the volume that the hood-type PPBE should exceed the enclosed head and neck for devices with a breathable air supply is supported by these data, particularly when those devices have an inboard flow of 3L $O_2$ per minute. However, these values are for subjects with normal inspired $CO_2$ levels. If the $CO_2$ levels are increased for significant periods of time, this maximum tidal volume could be higher.

## CONCLUSIONS

Under the conditions of this study, and with the techniques used for determining $O_2$ consumption and $CO_2$ production, certain recommendations might be made concerning the respiratory requirements for passenger protective breathing devices. In considering the recommended values proposed in the earlier study (1), some modifications should be made. Original recommendations will be crossed out when a change is indicated, then this will be followed by the new value based on data from this study:

1) A 20-min work profile consisting of:
   15 min at 0.7 W/Kg body weight
   2 min at 1.2 W/Kg body weight
   1 min at ~~1.5~~ 2.0 W/Kg body weight
   2 min at 1.2 W/Kg body weight.

2) The volume of a hood-type PPBE should exceed the volume that encloses the head and neck by 3.0 Liters.

3) For a breathable-air type, the device should provide 3.0 L/min oxygen for 20 minutes.

4) The device should probably be capable of absorbing ~~40~~ 30 L of carbon dioxide.

The subject population studied should include one or two individuals who meet or exceed the weight of the 95th percentile male.

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TABLE I
Calibration Data: Workload vs Heart Rate

| Workload = | 50W | 70W | 90W | 110W | 130W | 150W |
|---|---|---|---|---|---|---|
| Subject Number | Heart Rate (BPM) | | | | | |
| 1-01 | 76 | 90 | 100 | 108 | 120 | 132 |
| 1-02 | 116 | 116 | 122 | 130 | 142 | - |
| 1-03 | 94 | 104 | 116 | 128 | 144 | - |
| 1-04* | 104 | 114 | 126 | 142 | 156 | - |
| 1-05* | 102 | 108 | 118 | 130 | 140 | - |
| 1-06 | 76 | 82 | 92 | 92 | 100 | 110 |
| 1-07 | 108 | 122 | 144 | - | - | - |
| 1-08* | 96 | 102 | 114 | 126 | 146 | 154 |
| 1-09 | 78 | 84 | 88 | 100 | 104 | 110 |
| 1-10 | 100 | 108 | 120 | 130 | 138 | 148 |
| 1-11 | 90 | 98 | 108 | 114 | 122 | 132 |
| 2-01* | 110 | 120 | 138 | - | - | - |
| 2-02* | 110 | 114 | 126 | 144 | 152 | 162 |
| 2-03 | 90 | 98 | 108 | 116 | 132 | 140 |
| 2-04 | 110 | 118 | 128 | 138 | 152 | - |
| 2-05 | 112 | 112 | 126 | 136 | - | - |
| 2-06 | 86 | 90 | 102 | 112 | 128 | 142 |
| 2-07* | 118 | 127 | 134 | 148 | - | - |
| 2-08 | 88 | 94 | 106 | 110 | 116 | 124 |
| 2-09 | 102 | 116 | 126 | 142 | 160 | - |
| 2-10 | 86 | 94 | 100 | 110 | 124 | 134 |
| 2-11 | 90 | 96 | 104 | 118 | 134 | 146 |
| 2-12 | 84 | 92 | 102 | 112 | 124 | 132 |
| 3-01* | 72 | 78 | 86 | 90 | 98 | 102 |
| 3-02* | 94 | 96 | 114 | 122 | 140 | 154 |
| 3-03 | 98 | 106 | 112 | 118 | 129 | 136 |
| 3-05 | 110 | 124 | 138 | 152 | - | - |
| 3-06 | 82 | 86 | 96 | 104 | 114 | 124 |
| 3-07 | 98 | 104 | 116 | 124 | 134 | 146 |
| 3-09 | 98 | 104 | 116 | 124 | 144 | - |
| 3-10* | 102 | 112 | 120 | 130 | 144 | 158 |
| 3-11 | 92 | 100 | 112 | 118 | 132 | 144 |
| 3-12 | 102 | 110 | 114 | 126 | 134 | 144 |
| 4-01 | 112 | 120 | 124 | 136 | 158 | - |
| 4-02 | 100 | 104 | 116 | 126 | 138 | 148 |
| 4-03 | 106 | 118 | 124 | 134 | 150 | 164 |
| 4-04 | 100 | 112 | 116 | 130 | 138 | 146 |
| 4-05* | 96 | 102 | 118 | 128 | 144 | 160 |
| 4-06 | 86 | 94 | 96 | 112 | 124 | 140 |
| 4-07* | 92 | 108 | 116 | 116 | 128 | 124 |
| 4-08* | 98 | 112 | 128 | 138 | - | - |
| 4-09 | 92 | 102 | 114 | 128 | 144 | - |
| 4-10 | 115 | 112 | 118 | 120 | 130 | 140 |
| 4-11 | 112 | 118 | 122 | 130 | 144 | - |
| 4-12 | 92 | 102 | 108 | 120 | 124 | 130 |

*Subjects also monitored with the Oxylog.

TABLE II
Subject Population Data

| Subject Number | Age (Yrs) | Weight (Kgs) | Height (Cm) |
|---|---|---|---|
| 1-01 | 39 | 66 | 179 |
| 1-02 | 41 | 86 | 178 |
| 1-03 | 37 | 63 | 168 |
| 1-04* | 27 | 71 | 175 |
| 1-05* | 22 | 70 | 175 |
| 1-06 | 26 | 79 | 178 |
| 1-07 | 33 | 65 | 178 |
| 1-08* | 22 | 73 | 182 |
| 1-09 | 32 | 93 | 190 |
| 1-10 | 35 | 86 | 186 |
| 1-11 | 32 | 71 | 163 |
| 2-01* | 38 | 70 | 166 |
| 2-02* | 20 | 58 | 171 |
| 2-03 | 32 | 80 | 181 |
| 2-04 | 27 | 75 | 180 |
| 2-05 | 40 | 70 | 168 |
| 2-06 | 26 | 72 | 168 |
| 2-07* | 35 | 73 | 175 |
| 2-08 | 29 | 71 | 173 |
| 2-09 | 20 | 66 | 185 |
| 2-10 | 35 | 81 | 183 |
| 2-11 | 32 | 106 | 177 |
| 2-12 | 24 | 89 | 180 |
| 3-01* | 38 | 67 | 177 |
| 3-02* | 24 | 68 | 177 |
| 3-03 | 29 | 73 | 180 |
| 3-05 | 33 | 56 | 167 |
| 3-06 | 34 | 76 | 181 |
| 3-07 | 38 | 103 | 171 |
| 3-09 | 31 | 86 | 171 |
| 3-10* | 18 | 56 | 168 |
| 3-11 | 23 | 71 | 179 |
| 3-12 | 23 | 85 | 180 |
| 4-01 | 23 | 81 | 176 |
| 4-02 | 32 | 94 | 172 |
| 4-03 | 20 | 69 | 174 |
| 4-04 | 26 | 72 | 170 |
| 4-05* | 20 | 62 | 165 |
| 4-06 | 33 | 86 | 182 |
| 4-07* | 24 | 64 | 183 |
| 4-08* | 29 | 66 | 174 |
| 4-09 | 29 | 66 | 173 |
| 4-10 | 27 | 103 | 192 |
| 4-11 | 42 | 102 | 171 |
| 4-12 | 21 | 70 | 175 |

*Subjects also monitored with the Oxylog.

TABLE III
Calibration Data: Oxygen Consumption (mL/min, STPD)

| Workload = Subject Number | 50W | 70W | 90W | 110W | 130W | 150W |
|---|---|---|---|---|---|---|
| 1-01 | 740 | 1000 | 1330 | 1580 | 1670 | 1890 |
| 1-02 | 890 | 940 | 1190 | 1640 | 1730 | - |
| 1-03 | 690 | 900 | 1160 | 1350 | 1670 | - |
| 1-04* | 800 | 1040 | 1180 | 1380 | 1690 | - |
| 1-05* | 890 | 1070 | 1440 | 1650 | 1750 | - |
| 1-06 | 1240 | 1340 | 1470 | 1780 | 1880 | 2340 |
| 1-07 | 870 | 990 | 1290 | - | - | - |
| 1-08* | 700 | 1230 | 1370 | 1670 | 1930 | 2060 |
| 1-09 | 1050 | 1230 | 1470 | 1600 | 1600 | 1970 |
| 1-10 | 960 | 1120 | 1390 | 1460 | 1700 | 1980 |
| 1-11 | 1050 | 1120 | 1360 | 1690 | 1780 | 1990 |
| 2-01* | 830 | 1110 | 1230 | - | - | - |
| 2-02* | 740 | 1130 | 1230 | 1520 | 1750 | 2060 |
| 2-03 | 930 | 1060 | 1440 | 1440 | 1850 | 1880 |
| 2-04 | 890 | 1180 | 1300 | 1510 | 1600 | - |
| 2-05 | 830 | 1120 | 1280 | 1380 | - | - |
| 2-06 | 1030 | 1080 | 1360 | 1390 | 1590 | 2030 |
| 2-07* | 1120 | 1170 | 1350 | 1530 | - | - |
| 2-08 | 730 | 1130 | 1190 | 1370 | 1520 | 1820 |
| 2-09 | 790 | 890 | 1120 | 1340 | 1530 | - |
| 2-10 | 910 | 1100 | 1330 | 1450 | 1740 | 1970 |
| 2-11 | 1030 | 1200 | 1420 | 1560 | 1980 | 2040 |
| 2-12 | 930 | 1450 | 1390 | 1680 | 1880 | 2310 |
| 3-01* | 1080 | 1130 | 1320 | 1600 | 1810 | 2120 |
| 3-02* | 1040 | 1130 | 1270 | 1640 | 1600 | 2070 |
| 3-03 | 1030 | 1250 | 1250 | 1450 | 1860 | 2000 |
| 3-05 | 890 | 970 | 1300 | 1460 | - | - |
| 3-06 | 790 | 950 | 1160 | 1310 | 1610 | 1870 |
| 3-07 | 1000 | 1230 | 1400 | 1740 | 1940 | 2220 |
| 3-09 | 1090 | 1220 | 1310 | 1450 | 1710 | - |
| 3-10* | 860 | 990 | 1130 | 1530 | 1510 | 2050 |
| 3-11 | 1130 | 1200 | 1390 | 1400 | 1600 | 2040 |
| 3-12 | 1140 | 1170 | 1260 | 1740 | 1870 | 2000 |
| 4-01 | 1140 | 1270 | 1390 | 1680 | 2320 | - |
| 4-02 | 1010 | 1260 | 1350 | 1770 | 1790 | 2120 |
| 4-03 | 985 | 1090 | 1500 | 1560 | 1920 | 2060 |
| 4-04 | 1000 | 1160 | 1500 | 1560 | 1920 | 2060 |
| 4-05* | 930 | 880 | 1310 | 1420 | 1600 | 2220 |
| 4-06 | 790 | 1220 | 1070 | 1490 | 1640 | 1900 |
| 4-07* | 890 | 1140 | 1420 | 1530 | 1600 | 1830 |
| 4-08* | 740 | 1100 | 1350 | 1940 | - | - |
| 4-09 | 880 | 870 | 1280 | 1340 | 1770 | - |
| 4-10 | 950 | 1080 | 1350 | 1940 | 2080 | 2240 |
| 4-11 | 1150 | 1340 | 1460 | 1710 | 1850 | - |
| 4-12 | 860 | 1110 | 1300 | 1280 | 1770 | 1730 |

*Subjects also monitored with the Oxylog.

TABLE IV
Calibration Data: Oxygen Consumption (mL/min, STPD) per Kg Body Weight

| Workload = / Subject Number | 50W | 70W | 90W | 110W | 130W | 150W |
|---|---|---|---|---|---|---|
| 1-01 | 11.2 | 15.2 | 20.2 | 23.9 | 25.4 | 28.7 |
| 1-02 | 10.3 | 11.0 | 13.8 | 19.0 | 20.1 | - |
| 1-03 | 10.9 | 14.3 | 18.4 | 21.5 | 26.4 | - |
| 1-04* | 11.3 | 14.6 | 16.7 | 19.5 | 23.8 | - |
| 1-05* | 12.7 | 15.3 | 20.5 | 23.6 | 25.0 | - |
| 1-06 | 15.7 | 16.9 | 18.7 | 22.6 | 23.8 | 29.6 |
| 1-07 | 13.4 | 15.3 | 19.8 | - | - | - |
| 1-08* | 9.6 | 16.9 | 18.8 | 22.9 | 26.5 | 28.3 |
| 1-09 | 11.3 | 13.3 | 15.8 | 17.2 | 17.2 | 21.2 |
| 1-10 | 11.2 | 13.0 | 16.2 | 17.0 | 19.8 | 23.0 |
| 1-11 | 14.8 | 15.8 | 19.2 | 23.8 | 25.1 | 28.0 |
| 2-01* | 11.9 | 15.8 | 17.5 | - | - | - |
| 2-02* | 12.8 | 19.5 | 21.1 | 26.2 | 30.1 | 35.6 |
| 2-03 | 11.6 | 13.2 | 18.0 | 18.0 | 23.1 | 23.6 |
| 2-04 | 11.9 | 15.8 | 17.3 | 20.1 | 21.3 | - |
| 2-05 | 11.9 | 16.0 | 18.2 | 19.6 | - | - |
| 2-06 | 14.3 | 15.0 | 18.9 | 19.3 | 22.1 | 28.2 |
| 2-07* | 15.3 | 16.0 | 18.4 | 21.0 | - | - |
| 2-08 | 10.3 | 15.9 | 16.8 | 19.3 | 21.4 | 25.6 |
| 2-09 | 11.9 | 13.5 | 16.9 | 20.3 | 23.2 | - |
| 2-10 | 9.9 | 12.0 | 14.4 | 15.7 | 18.9 | 21.4 |
| 2-11 | 9.7 | 11.3 | 13.4 | 14.7 | 18.7 | 19.3 |
| 2-12 | 10.5 | 16.3 | 15.6 | 18.9 | 21.1 | 25.9 |
| 3-01* | 16.1 | 16.8 | 19.7 | 23.9 | 27.0 | 31.7 |
| 3-02* | 15.3 | 16.5 | 18.7 | 24.0 | 23.5 | 30.4 |
| 3-03 | 14.1 | 17.1 | 17.1 | 19.8 | 25.4 | 27.4 |
| 3-05 | 15.8 | 17.4 | 23.3 | 26.0 | - | - |
| 3-06 | 10.3 | 12.5 | 15.3 | 17.2 | 21.1 | 24.5 |
| 3-07 | 9.7 | 12.0 | 13.6 | 16.9 | 18.8 | 21.5 |
| 3-09 | 12.7 | 14.1 | 15.2 | 16.8 | 19.8 | - |
| 3-10* | 15.4 | 17.7 | 20.2 | 27.3 | 27.0 | 36.6 |
| 3-11 | 16.0 | 16.9 | 19.5 | 19.7 | 22.5 | 28.8 |
| 3-12 | 13.4 | 13.7 | 14.9 | 20.4 | 22.0 | 23.5 |
| 4-01 | 14.1 | 15.7 | 17.2 | 20.7 | 28.6 | - |
| 4-02 | 10.8 | 13.4 | 14.4 | 18.8 | 19.1 | 22.6 |
| 4-03 | 14.2 | 15.8 | 21.7 | 21.0 | 25.8 | 29.5 |
| 4-04 | 13.9 | 16.2 | 20.8 | 21.6 | 26.7 | 28.6 |
| 4-05* | 15.0 | 14.2 | 21.1 | 22.8 | 25.9 | 32.6 |
| 4-06 | 9.2 | 14.2 | 12.5 | 17.4 | 19.0 | 22.1 |
| 4-07* | 14.0 | 17.9 | 22.2 | 23.9 | 25.0 | 28.6 |
| 4-08* | 11.2 | 16.7 | 20.4 | 29.4 | - | - |
| 4-09 | 13.3 | 13.1 | 19.3 | 20.2 | 26.8 | - |
| 4-10 | 9.2 | 10.5 | 13.1 | 18.9 | 20.2 | 21.8 |
| 4-11 | 11.3 | 13.2 | 14.3 | 16.8 | 18.1 | - |
| 4-12 | 12.3 | 15.8 | 18.6 | 18.3 | 25.2 | 24.8 |

*Subjects also monitored with the Oxylog.

TABLE V

Calibration Data: Expired Carbon Dioxide (mL/min, STPD)

| Workload = Subject Number | 50W | 70W | 90W | 110W | 130W | 150W |
|---|---|---|---|---|---|---|
| 1-01 | 560 | 750 | 1050 | 1320 | 1440 | 1670 |
| 1-02 | 830 | 720 | 1010 | 1440 | 1640 | - |
| 1-03 | 560 | 690 | 1040 | 1200 | 1570 | - |
| 1-04* | 650 | 860 | 1120 | 1370 | 1720 | - |
| 1-05* | 720 | 920 | 1380 | 1690 | 1900 | - |
| 1-06 | 860 | 980 | 1120 | 1360 | 1520 | 1830 |
| 1-07 | 780 | 970 | 1370 | - | - | - |
| 1-08* | 580 | 960 | 1190 | 1460 | 1850 | 2100 |
| 1-09 | 770 | 980 | 1230 | 1290 | 1370 | 1670 |
| 1-10 | 690 | 870 | 1130 | 1260 | 1510 | 1830 |
| 1-11 | 800 | 890 | 1160 | 1520 | 1570 | 1840 |
| 2-01* | 660 | 990 | 1190 | - | - | - |
| 2-02* | 580 | 900 | 1150 | 1510 | 1820 | 2120 |
| 2-03 | 770 | 940 | 1290 | 1350 | 1750 | 1840 |
| 2-04 | 830 | 1030 | 1190 | 1420 | 1560 | - |
| 2-05 | 720 | 940 | 1240 | 1200 | - | - |
| 2-06 | 730 | 850 | 1050 | 1200 | 1440 | 1850 |
| 2-07* | 760 | 900 | 1100 | 1200 | - | - |
| 2-08 | 660 | 1070 | 1160 | 1390 | 1660 | 1890 |
| 2-09 | 680 | 780 | 950 | 1220 | 1520 | - |
| 2-10 | 820 | 990 | 1240 | 1340 | 1720 | 2070 |
| 2-11 | 840 | 1030 | 1250 | 1440 | 1940 | 2180 |
| 2-12 | 710 | 1140 | 1180 | 1440 | 1650 | 2110 |
| 3-01* | 730 | 850 | 970 | 1200 | 1450 | 1740 |
| 3-02* | 830 | 950 | 1220 | 1530 | 1650 | 2070 |
| 3-03 | 830 | 1110 | 1130 | 1400 | 1790 | 2020 |
| 3-05 | 730 | 910 | 1250 | 1490 | - | - |
| 3-06 | 710 | 740 | 890 | 1100 | 1410 | 1590 |
| 3-07 | 780 | 1060 | 1230 | 1590 | 1870 | 2090 |
| 3-09 | 970 | 1110 | 1340 | 1500 | 1830 | - |
| 3-10* | 710 | 820 | 1080 | 1490 | 1600 | 2100 |
| 3-11 | 820 | 910 | 1140 | 1200 | 1420 | 1820 |
| 3-12 | 960 | 890 | 1070 | 1410 | 1700 | 1780 |
| 4-01 | 880 | 1100 | 1220 | 1560 | 1910 | - |
| 4-02 | 780 | 1050 | 1160 | 1620 | 1770 | 2210 |
| 4-03 | 830 | 880 | 1390 | 1340 | 1660 | 1990 |
| 4-04 | 750 | 970 | 1280 | 1360 | 1680 | 1920 |
| 4-05* | 890 | 690 | 1080 | 1260 | 1600 | 2060 |
| 4-06 | 710 | 1030 | 910 | 1380 | 1620 | 2000 |
| 4-07* | 710 | 900 | 1350 | 1440 | 1630 | 1800 |
| 4-08* | 570 | 740 | 1040 | 1530 | - | - |
| 4-09 | 700 | 740 | 1170 | 1190 | 1700 | - |
| 4-10 | 890 | 800 | 870 | 1440 | 1680 | 1900 |
| 4-11 | 1000 | 1100 | 1290 | 1570 | 1820 | - |
| 4-12 | 700 | 950 | 1070 | 1170 | 1580 | 1660 |

*Subjects also monitored with the Oxylog.

TABLE VI
Calibration Data: Expired Carbon Dioxide (mL/min, STPD) per Kg Body Weight

| Workload = <br> Subject Number | 50W | 70W | 90W | 110W | 130W | 150W |
|---|---|---|---|---|---|---|
| 1-01 | 8.5 | 11.4 | 15.9 | 20.0 | 21.8 | 25.3 |
| 1-02 | 9.7 | 8.4 | 11.7 | 16.7 | 19.1 | - |
| 1-03 | 8.9 | 11.0 | 16.5 | 19.0 | 24.9 | - |
| 1-04* | 9.2 | 12.1 | 15.8 | 19.3 | 24.2 | - |
| 1-05* | 10.3 | 13.1 | 19.7 | 24.1 | 27.1 | - |
| 1-06 | 10.9 | 12.4 | 14.2 | 17.2 | 19.2 | 23.2 |
| 1-07 | 12.0 | 14.9 | 21.1 | - | - | - |
| 1-08* | 7.9 | 13.2 | 16.3 | 20.0 | 25.3 | 28.8 |
| 1-09 | 8.3 | 10.5 | 13.2 | 13.9 | 14.7 | 18.0 |
| 1-10 | 8.0 | 10.1 | 13.1 | 14.7 | 17.6 | 21.3 |
| 1-11 | 11.3 | 12.5 | 16.3 | 21.4 | 22.1 | 25.9 |
| 2-01* | 9.4 | 14.1 | 17.0 | - | - | - |
| 2-02* | 10.0 | 15.5 | 19.8 | 26.0 | 31.4 | 36.6 |
| 2-03 | 9.6 | 11.8 | 16.1 | 16.9 | 21.9 | 23.0 |
| 2-04 | 11.1 | 13.7 | 15.9 | 18.9 | 20.8 | - |
| 2-05 | 10.3 | 13.4 | 17.7 | 17.1 | - | - |
| 2-06 | 10.1 | 11.8 | 14.6 | 16.7 | 20.0 | 25.7 |
| 2-07* | 10.4 | 12.3 | 15.1 | 16.4 | - | - |
| 2-08 | 9.3 | 15.1 | 16.3 | 19.6 | 23.4 | 26.6 |
| 2-09 | 10.3 | 11.8 | 14.4 | 18.5 | 23.0 | - |
| 2-10 | 10.1 | 12.2 | 15.3 | 16.5 | 21.3 | 25.6 |
| 2-11 | 7.9 | 9.7 | 11.8 | 13.6 | 18.3 | 20.6 |
| 2-12 | 8.0 | 12.8 | 13.3 | 16.2 | 18.5 | 23.7 |
| 3-01* | 10.9 | 12.7 | 14.5 | 17.9 | 21.6 | 26.0 |
| 3-02* | 12.2 | 14.0 | 17.9 | 22.5 | 24.3 | 30.4 |
| 3-03 | 11.4 | 15.2 | 15.5 | 19.2 | 24.5 | 27.7 |
| 3-05 | 13.0 | 16.3 | 22.3 | 26.6 | - | - |
| 3-06 | 9.3 | 9.7 | 11.7 | 14.5 | 18.6 | 20.9 |
| 3-07 | 7.6 | 10.3 | 11.9 | 15.4 | 18.2 | 20.3 |
| 3-09 | 11.3 | 12.9 | 15.6 | 17.4 | 21.3 | - |
| 3-10* | 12.7 | 14.6 | 19.3 | 26.6 | 28.6 | 37.5 |
| 3-11 | 11.5 | 12.8 | 16.1 | 16.9 | 20.0 | 25.6 |
| 3-12 | 11.3 | 10.5 | 12.6 | 16.6 | 20.0 | 20.9 |
| 4-01 | 10.9 | 13.6 | 15.1 | 19.3 | 23.6 | - |
| 4-02 | 8.3 | 11.2 | 12.3 | 17.2 | 18.8 | 23.5 |
| 4-03 | 12.0 | 12.8 | 20.1 | 19.4 | 24.1 | 28.8 |
| 4-04 | 10.4 | 13.5 | 17.8 | 18.9 | 23.3 | 26.7 |
| 4-05* | 14.4 | 11.1 | 17.4 | 20.3 | 25.8 | 33.2 |
| 4-06 | 8.3 | 12.0 | 10.6 | 16.0 | 18.3 | 23.3 |
| 4-07* | 11.1 | 14.1 | 21.1 | 22.5 | 25.5 | 28.1 |
| 4-08* | 8.6 | 11.2 | 15.8 | 23.2 | - | - |
| 4-09 | 10.6 | 11.2 | 17.7 | 18.0 | 25.8 | - |
| 4-10 | 8.6 | 7.8 | 8.4 | 14.0 | 16.3 | 18.4 |
| 4-11 | 9.7 | 10.7 | 12.5 | 15.2 | 17.7 | - |
| 4-12 | 10.0 | 13.6 | 15.3 | 16.7 | 22.6 | 23.7 |

*Subjects also monitored with the Oxylog.

TABLE VII
Maximum Minute Volumes and Tidal Volumes Measured During Workload Calibration Tests

| Subject Number | Maximum Minute Volume (Liters/min) | Maximum Tidal Volume (Liters) |
|---|---|---|
| 1-01 | 44.3 | 2.63 |
| 1-02 | 41.9 | 2.41 |
| 1-03 | 40.4 | 2.02 |
| 1-04* | 44.2 | 2.10 |
| 1-05* | 57.7 | 2.06 |
| 1-06 | 40.9 | 2.16 |
| 1-07 | 44.0 | 3.14 |
| 1-08* | 50.1 | 1.73 |
| 1-09 | 45.8 | 3.04 |
| 1-10 | 43.2 | 2.16 |
| 1-11 | 50.9 | 1.83 |
| 2-01* | 35.1 | 1.86 |
| 2-02* | 58.2 | 1.75 |
| 2-03 | 51.5 | 2.22 |
| 2-04 | 50.4 | 1.80 |
| 2-05 | 47.7 | 3.15 |
| 2-06 | 43.5 | 2.15 |
| 2-07* | 36.0 | 1.56 |
| 2-08 | 59.1 | 3.12 |
| 2-09 | 47.7 | 2.51 |
| 2-10 | 54.8 | 2.61 |
| 2-11 | 59.1 | 3.12 |
| 2-12 | 53.9 | 2.45 |
| 3-01* | 45.3 | 1.97 |
| 3-02* | 57.4 | 2.10 |
| 3-03 | 55.6 | 2.57 |
| 3-05 | 40.5 | 2.03 |
| 3-06 | 38.0 | 2.86 |
| 3-07 | 54.3 | 2.69 |
| 3-09 | 46.5 | 1.94 |
| 3-10* | 55.9 | 1.46 |
| 3-11 | 48.3 | 1.58 |
| 3-12 | 44.2 | 2.71 |
| 4-01 | 44.8 | 2.24 |
| 4-02 | 58.3 | 3.07 |
| 4-03 | 53.8 | 2.00 |
| 4-04 | 47.5 | 2.18 |
| 4-05* | 53.3 | 1.84 |
| 4-06 | 55.2 | 3.10 |
| 4-07* | 51.4 | 1.79 |
| 4-08* | 32.0 | 3.01 |
| 4-09 | 45.6 | 2.29 |
| 4-10 | 48.1 | 2.88 |
| 4-11 | 47.6 | 1.96 |
| 4-12 | 45.3 | 2.16 |

*Subjects also monitored with the Oxylog.

TABLE VIII
Heart Rate Data Recorded During Tests

| Subject Number | Heart Rate (BPM) in 0.5-min Intervals from Start of Test | | | |
|---|---|---|---|---|
| | 0.0-0.5 | 0.5-1.0 | 1.0-1.5 | 1.5-2.0 |
| 1-01 | 144 | 162 | 112 | 80 |
| 1-02 | 150 | 156 | 134 | 118 |
| 1-03 | 148 | 132 | 92 | 82 |
| 1-04* | 138 | 128 | 108 | 88 |
| 1-05* | 150 | 128 | 100 | 80 |
| 1-06 | 124 | 110 | 62 | - |
| 1-07 | 162 | 160 | 130 | 100 |
| 1-08* | 142 | 134 | 102 | 80 |
| 1-09 | 128 | 118 | 86 | 72 |
| 1-10 | 132 | 146 | 132 | 82 |
| 1-11 | 120 | 138 | 112 | 80 |
| 2-01* | 160 | 159 | 144 | 126 |
| 2-02* | 164 | 154 | 132 | 122 |
| 2-03 | 122 | 134 | 92 | 68 |
| 2-04 | 140 | 152 | 128 | 112 |
| 2-05 | 130 | 122 | 102 | - |
| 2-06 | 140 | 110 | 82 | 74 |
| 2-07* | 164 | 158 | 122 | 118 |
| 2-08 | 146 | 134 | 110 | 90 |
| 2-09 | 144 | 146 | 98 | 72 |
| 2-10 | 146 | 138 | 112 | 94 |
| 2-11 | 150 | 158 | 110 | 62 |
| 2-12 | 150 | 158 | 110 | 64 |
| 3-01* | 134 | 130 | 94 | 66 |
| 3-02* | 146 | 132 | 100 | 86 |
| 3-03 | 110 | 116 | 100 | - |
| 3-05 | 128 | 130 | 100 | 82 |
| 3-06 | 146 | 110 | 80 | - |
| 3-07 | 160 | 166 | 148 | 128 |
| 3-09 | 154 | 174 | 148 | 132 |
| 3-10* | 138 | 148 | 112 | 96 |
| 3-11 | 134 | 114 | 84 | 80 |
| 3-12 | 146 | 140 | 130 | - |
| 4-01 | 170 | 168 | 120 | 88 |
| 4-02 | 170 | 178 | 154 | 136 |
| 4-03 | 162 | 158 | 110 | 86 |
| 4-04 | 160 | 158 | 120 | 98 |
| 4-05* | 142 | 148 | 130 | 100 |
| 4-06 | 148 | 158 | 128 | 118 |
| 4-07* | 166 | 162 | 154 | 138 |
| 4-08* | 170 | 154 | 122 | 110 |
| 4-09 | 166 | 152 | 138 | 124 |
| 4-10 | 162 | 156 | 150 | 120 |
| 4-11 | 156 | 156 | 142 | 130 |
| 4-12 | 152 | 140 | 114 | 110 |

*Subjects also monitored with the Oxylog.

TABLE IX
Workloads Calculated from Evacuation Test Heart Rate Data

| Subject Number | Calculated Workload (Watts) in 0.5 min Intervals from Start of Test | | | |
|---|---|---|---|---|
| | 0.0-0.5 | 0.5-1.0 | 1.0-1.5 | 1.5-2.0 |
| 1-01 | 173 | 207 | 114 | 55 |
| 1-02 | 165 | 183 | 117 | 68 |
| 1-03 | 140 | 114 | 49 | 33 |
| 1-04* | 105 | 89 | 59 | 29 |
| 1-05* | 152 | 107 | 50 | 9 |
| 1-06 | 200 | 156 | 6 | - |
| 1-07 | 111 | 109 | 76 | 43 |
| 1-08* | 131 | 118 | 66 | 31 |
| 1-09 | 203 | 173 | 76 | 34 |
| 1-10 | 116 | 145 | 116 | 14 |
| 1-11 | 123 | 167 | 103 | 25 |
| 2-01* | 123 | 122 | 100 | 75 |
| 2-02* | 152 | 135 | 95 | 77 |
| 2-03 | 116 | 139 | 57 | 11 |
| 2-04 | 111 | 134 | 88 | 57 |
| 2-05 | 100 | 81 | 35 | - |
| 2-06 | 152 | 100 | 51 | 38 |
| 2-07* | 147 | 134 | 60 | 52 |
| 2-08 | 211 | 178 | 110 | 54 |
| 2-09 | 111 | 114 | 46 | 9 |
| 2-10 | 178 | 162 | 108 | 71 |
| 2-11 | 161 | 174 | 92 | 10 |
| 2-12 | 186 | 202 | 105 | 12 |
| 3-01* | 251 | 238 | 121 | 29 |
| 3-02* | 141 | 119 | 68 | 46 |
| 3-03 | 83 | 99 | 56 | - |
| 3-05 | 76 | 79 | 36 | 10 |
| 3-06 | 205 | 121 | 51 | - |
| 3-07 | 182 | 195 | 157 | 116 |
| 3-09 | 156 | 191 | 145 | 116 |
| 3-10* | 119 | 137 | 72 | 43 |
| 3-11 | 134 | 96 | 37 | 30 |
| 3-12 | 158 | 144 | 120 | - |
| 4-01 | 164 | 160 | 71 | 12 |
| 4-02 | 195 | 211 | 164 | 128 |
| 4-03 | 152 | 145 | 60 | 18 |
| 4-04 | 179 | 175 | 92 | 44 |
| 4-05* | 127 | 136 | 108 | 62 |
| 4-06 | 173 | 192 | 136 | 117 |
| 4-07* | 213 | 204 | 185 | 148 |
| 4-08* | 155 | 131 | 84 | 67 |
| 4-09 | 167 | 145 | 124 | 102 |
| 4-10 | 222 | 204 | 187 | 98 |
| 4-11 | 171 | 171 | 134 | 103 |
| 4-12 | 203 | 171 | 103 | 93 |

*Subjects also monitored with the Oxylog.

TABLE X
Evacuation Test Calculated Oxygen Consumption Expressed as mL/min, STPD, and as mL/min, STPD, per Kg Body Weight (in parentheses) in 0.5-min Intervals from Start of Test

| Subject Number | 0.0-0.5 | 0.5-1.0 | 1.0-1.5 | 1.5-2.0 |
|---|---|---|---|---|
| 1-01 | 2204 (33.5) | 2593 (39.4) | 1529 (23.2) | 853 (12.9) |
| 1-02 | 2171 (25.2) | 2385 (27.7) | 1599 (18.6) | 1016 (11.8) |
| 1-03 | 1757 (27.9) | 1443 (22.9) | 660 (10.5) | 467 (7.4) |
| 1-04* | 1377 (19.5) | 1207 (17.1) | 889 (12.6) | 571 (8.1) |
| 1-05* | 2073 (29.7) | 1556 (22.3) | 900 (12.9) | 429 (6.1) |
| 1-06 | 2736 (34.6) | 2269 (28.7) | 677 (8.6) | - - |
| 1-07 | 1481 (22.7) | 1460 (22.4) | 1113 (17.1) | 767 (11.8) |
| 1-08* | 1901 (26.2) | 1730 (23.8) | 1046 (14.4) | 586 (8.1) |
| 1-09 | 2346 (25.1) | 2096 (22.5) | 1286 (13.8) | 936 (10.1) |
| 1-10 | 1587 (18.6) | 1871 (21.9) | 1587 (18.6) | 585 (6.9) |
| 1-11 | 1729 (24.4) | 2169 (30.6) | 1528 (21.6) | 747 (10.6) |
| 2-01* | 1587 (22.5) | 1577 (22.3) | 1357 (19.3) | 1107 (15.8) |
| 2-02* | 2055 (35.5) | 1843 (31.8) | 1343 (23.2) | 1118 (19.3) |
| 2-03 | 1596 (20.0) | 1830 (22.9) | 996 (12.4) | 528 (6.5) |
| 2-04 | 1480 (19.8) | 1681 (22.4) | 1279 (17.1) | 1007 (13.5) |
| 2-05 | 1334 (19.0) | 1162 (16.6) | 745 (10.8) | - - |
| 2-06 | 1901 (26.4) | 1413 (19.6) | 954 (13.2) | 832 (11.5) |
| 2-07* | 1765 (24.3) | 1673 (23.0) | 1152 (15.8) | 1095 (15.0) |
| 2-08 | 2372 (33.3) | 2051 (28.8) | 1390 (19.5) | 846 (11.9) |
| 2-09 | 1337 (20.2) | 1366 (20.7) | 709 (10.7) | 352 (5.3) |
| 2-10 | 2235 (24.3) | 2067 (22.5) | 1501 (16.3) | 1113 (12.1) |
| 2-11 | 2194 (20.7) | 2334 (22.1) | 1452 (13.7) | 570 (5.3) |
| 2-12 | 2648 (29.6) | 2842 (31.8) | 1667 (18.7) | 541 (6.1) |
| 3-01* | 3132 (46.8) | 2993 (44.7) | 1736 (25.9) | 747 (11.1) |
| 3-02* | 1864 (27.3) | 1646 (24.1) | 1142 (16.7) | 924 (13.5) |
| 3-03 | 1306 (17.8) | 1464 (20.0) | 1041 (14.2) | - - |
| 3-05 | 1114 (19.9) | 1145 (20.5) | 706 (12.6) | 441 (7.9) |
| 3-06 | 2411 (31.6) | 1508 (19.8) | 755 (9.9) | - - |
| 3-07 | 2592 (25.1) | 2751 (26.6) | 2286 (22.1) | 1784 (17.3) |
| 3-09 | 1841 (21.4) | 2098 (24.4) | 1760 (20.4) | 1547 (18.0) |
| 3-10* | 1560 (27.8) | 1763 (31.4) | 912 (18.4) | 701 (12.5) |
| 3-11 | 1740 (24.5) | 1427 (20.1) | 942 (13.3) | 884 (12.5) |
| 3-12 | 2100 (24.8) | 1963 (23.1) | 1727 (20.3) | - - |
| 4-01 | 2585 (31.8) | 2530 (31.2) | 1297 (16.0) | 480 (6.0) |
| 4-02 | 2576 (27.4) | 2749 (29.3) | 2241 (23.9) | 1852 (19.7) |
| 4-03 | 2009 (29.1) | 1935 (28.1) | 1039 (15.1) | 597 (8.6) |
| 4-04 | 2396 (33.2) | 2352 (32.6) | 1446 (20.1) | 922 (12.8) |
| 4-05* | 1658 (26.7) | 1757 (28.3) | 1448 (23.3) | 941 (15.1) |
| 4-06 | 2106 (24.5) | 2302 (26.8) | 1724 (20.1) | 1527 (17.8) |
| 4-07* | 2429 (37.8) | 2348 (36.6) | 2176 (33.9) | 1841 (28.7) |
| 4-08* | 2726 (49.2) | 2264 (42.1) | 1360 (28.4) | 1032 (23.5) |
| 4-09 | 2094 (31.8) | 1847 (28.0) | 1611 (24.4) | 1363 (20.6) |
| 4-10 | 3446 (33.6) | 3172 (31.0) | 2912 (28.4) | 1555 (15.2) |
| 4-11 | 2219 (21.7) | 2219 (21.7) | 1891 (18.5) | 1617 (15.9) |
| 4-12 | 2270 (32.4) | 1982 (28.3) | 1369 (19.5) | 1279 (18.2) |

*Subjects also monitored with the Oxylog.

TABLE XI

Evacuation Test Calculated Expired Carbon Dioxide Expressed as mL/min, STPD, and as mL/min, STPD, per Kg Body Weight (in parentheses) in 0.5-min Intervals from Start of Test

| Subject Number | 0.0-0.5 | 0.5-1.0 | 1.0-1.5 | 1.5-2.0 |
|---|---|---|---|---|
| 1-01 | 1954 (29.5) | 2338 (35.3) | 1289 (19.5) | 624 (9.5) |
| 1-02 | 2006 (23.4) | 2216 (25.8) | 1444 (16.8) | 871 (10.2) |
| 1-03 | 1645 (26.1) | 1316 (20.9) | 493 (7.9) | 291 (4.7) |
| 1-04* | 1343 (18.9) | 1131 (15.9) | 733 (10.4) | 336 (4.8) |
| 1-05* | 2292 (32.7) | 1588 (22.7) | 696 (9.9) | 54 (0.8) |
| 1-06 | 2237 (28.3) | 1815 (22.9) | 377 (4.8) | - - |
| 1-07 | 1645 (25.4) | 1615 (24.9) | 1129 (17.4) | 642 (9.9) |
| 1-08* | 1823 (24.9) | 1628 (22.2) | 845 (11.5) | 318 (4.3) |
| 1-09 | 2062 (22.1) | 1816 (19.5) | 1022 (11.0) | 678 (7.3) |
| 1-10 | 1392 (16.2) | 1713 (19.9) | 1392 (16.2) | 263 (3.0) |
| 1-11 | 1546 (21.8) | 2024 (28.5) | 1329 (18.7) | 482 (6.8) |
| 2-01* | 1649 (23.6) | 1636 (23.4) | 1344 (19.2) | 1013 (4.5) |
| 2-02* | 2150 (37.1) | 1888 (32.6) | 1269 (21.9) | 991 (17.1) |
| 2-03 | 1503 (18.8) | 1760 (22.0) | 842 (10.5) | 327 (4.1) |
| 2-04 | 1400 (18.7) | 1613 (21.5) | 1188 (15.8) | 901 (12.0) |
| 2-05 | 1199 (17.1) | 1034 (14.8) | 634 (9.1) | - - |
| 2-06 | 1745 (24.3) | 1187 (16.5) | 660 (9.2) | 521 (7.2) |
| 2-07* | 1499 (20.5) | 1400 (19.2) | 838 (11.5) | 777 (10.6) |
| 2-08 | 2597 (36.6) | 2213 (31.2) | 1421 (20.0) | 769 (10.9) |
| 2-09 | 1253 (35.1) | 1284 (29.8) | 564 (18.8) | 171 (9.8) |
| 2-10 | 2315 (18.5) | 2120 (18.9) | 1461 (8.6) | 1010 (3.0) |
| 2-11 | 2285 (21.6) | 2464 (23.3) | 1337 (12.6) | 210 (1.9) |
| 2-12 | 2452 (27.6) | 2652 (29.8) | 1434 (16.2) | 267 (3.0) |
| 3-01* | 2684 (40.1) | 2552 (38.1) | 1369 (20.5) | 439 (6.6) |
| 3-02* | 1879 (27.7) | 1609 (23.7) | 981 (14.5) | 711 (10.5) |
| 3-03 | 1179 (16.1) | 1368 (18.7) | 861 (11.7) | - - |
| 3-05 | 1043 (18.6) | 1082 (19.3) | 519 (9.3) | 178 (3.2) |
| 3-06 | 2066 (27.2) | 1272 (16.7) | 610 (8.0) | - - |
| 3-07 | 2531 (24.7) | 2704 (26.3) | 2197 (21.4) | 1650 (16.1) |
| 3-09 | 2046 (23.9) | 2416 (28.2) | 1930 (22.5) | 1624 (18.9) |
| 3-10* | 1563 (28.0) | 1813 (32.4) | 912 (16.3) | 510 (9.1) |
| 3-11 | 1538 (21.7) | 1181 (16.6) | 625 (8.8) | 559 (7.9) |
| 3-12 | 1871 (22.0) | 1733 (20.4) | 1498 (17.6) | - - |
| 4-01 | 2266 (28.1) | 2216 (27.5) | 1095 (13.6) | 351 (4.4) |
| 4-02 | 2758 (29.3) | 2981 (31.6) | 2325 (24.7) | 1822 (19.3) |
| 4-03 | 1940 (28.0) | 1858 (26.9) | 864 (12.5) | 372 (5.4) |
| 4-04 | 2236 (31.1) | 2190 (30.4) | 1235 (17.2) | 682 (9.5) |
| 4-05* | 1601 (25.9) | 1714 (27.7) | 1363 (22.0) | 788 (12.7) |
| 4-06 | 2181 (25.1) | 2417 (27.8) | 1722 (19.9) | 1486 (17.2) |
| 4-07* | 2670 (41.7) | 2563 (40.1) | 2337 (36.5) | 1896 (29.6) |
| 4-08* | 2767 (32.9) | 2385 (27.0) | 1638 (15.7) | 1367 (11.6) |
| 4-09 | 2043 (28.0) | 1774 (24.3) | 1517 (20.8) | 1247 (17.1) |
| 4-10 | 3024 (29.4) | 2753 (26.8) | 2497 (24.3) | 1157 (11.3) |
| 4-11 | 2211 (21.5) | 2211 (21.5) | 1820 (17.7) | 1493 (14.5) |
| 4-12 | 2187 (31.2) | 1877 (26.7) | 1217 (17.4) | 1120 (16.0) |

*Subjects also monitored with the Oxylog.

TABLE XII

Calculated Workload (CWL) and Workload per Body Weight (CWL/Kg), Measured Heart Rate (HR), and Percent of Predicted Maximum Heart Rate (PPMHR) for First Minute of Test

| Subject Number | CWL (Watts) | CWL/Kg (W/Kg) | HR (BPM) | PPMHR |
|---|---|---|---|---|
| 1-01 | 190 | 2.879 | 153 | 84.5 |
| 1-02 | 174 | 2.023 | 153 | 85.5 |
| 1-03 | 127 | 2.016 | 140 | 76.5 |
| 1-04* | 97 | 1.366 | 133 | 68.9 |
| 1-05* | 130 | 1.850 | 139 | 70.2 |
| 1-06 | 178 | 2.253 | 117 | 60.3 |
| 1-07 | 110 | 1.692 | 161 | 86.1 |
| 1-08* | 125 | 1.705 | 138 | 69.7 |
| 1-09 | 188 | 2.022 | 123 | 65.4 |
| 1-10 | 131 | 1.517 | 139 | 75.1 |
| 1-11 | 145 | 2.042 | 129 | 68.6 |
| 2-01* | 123 | 1.750 | 160 | 87.6 |
| 2-02* | 144 | 2.474 | 159 | 79.5 |
| 2-03 | 128 | 1.594 | 128 | 68.1 |
| 2-04 | 123 | 1.633 | 146 | 75.6 |
| 2-05 | 91 | 1.293 | 126 | 70.0 |
| 2-06 | 126 | 1.750 | 125 | 64.4 |
| 2-07* | 141 | 1.925 | 161 | 87.0 |
| 2-08 | 195 | 2.739 | 140 | 73.3 |
| 2-09 | 113 | 1.705 | 145 | 72.5 |
| 2-10 | 170 | 2.099 | 142 | 76.8 |
| 2-11 | 168 | 1.580 | 154 | 81.9 |
| 2-12 | 194 | 2.180 | 154 | 78.6 |
| 3-01 | 245 | 3.649 | 132 | 72.5 |
| 3-02* | 130 | 1.912 | 139 | 70.9 |
| 3-03 | 91 | 1.247 | 113 | 59.2 |
| 3-05 | 78 | 1.348 | 129 | 69.0 |
| 3-06 | 163 | 2.145 | 128 | 69.4 |
| 3-07 | 189 | 1.830 | 163 | 89.6 |
| 3-09 | 174 | 2.017 | 164 | 86.8 |
| 3-10* | 128 | 2.286 | 143 | 70.8 |
| 3-11 | 115 | 1.620 | 124 | 62.9 |
| 3-12 | 151 | 1.776 | 143 | 72.6 |
| 4-01 | 162 | 2.000 | 169 | 85.8 |
| 4-02 | 203 | 2.160 | 174 | 92.6 |
| 4-03 | 149 | 2.152 | 160 | 80.0 |
| 4-04 | 177 | 2.458 | 159 | 82.0 |
| 4-05* | 132 | 2.121 | 145 | 72.5 |
| 4-06 | 183 | 2.122 | 153 | 81.8 |
| 4-07* | 209 | 3.258 | 164 | 83.7 |
| 4-08* | 143 | 2.167 | 162 | 84.8 |
| 4-09 | 156 | 2.364 | 159 | 83.2 |
| 4-10 | 226 | 2.189 | 159 | 82.4 |
| 4-11 | 171 | 1.676 | 156 | 87.6 |
| 4-12 | 187 | 2.671 | 146 | 73.4 |
| Mean | 153 | 2.029 | 146 | 76.4 |
| S.E. | 5.6 | 0.072 | 2.3 | 1.26 |

*Subjects also monitored with the Oxylog.

TABLE XIII
Mean, Standard Error, and Population Size for
Subjects' Ages in Years and
Weight in Kilograms (in Parentheses)

| | | All Subjects | Without Oxylogs | With Oxylogs |
|---|---|---|---|---|
| Trial 1 | Mean | 31.5 (74.8) | 34.4 (76.1) | 23.7 (71.3) |
| | S.E. | 1.96 (2.97) | 1.67 (4.04) | 1.67 (0.88) |
| | N | 11 | 8 | 3 |
| Trial 2 | Mean | 29.8 (75.9) | 29.4 (78.9) | 31.0 (67.0) |
| | S.E. | 1.91 (3.54) | 2.02 (4.10) | 5.57 (4.58) |
| | N | 12 | 9 | 3 |
| Trial 3 | Mean | 29.1 (74.1) | 30.1 (78.6) | 26.7 (63.7) |
| | S.E. | 2.17 (4.54) | 2.12 (5.56) | 5.93 (3.84) |
| | N | 10 | 7 | 3 |
| Trial 4 | Mean | 27.2 (77.9) | 28.1 (82.6) | 24.3 (64.0) |
| | S.E. | 1.85 (4.31) | 2.30 (4.81) | 2.60 (1.16) |
| | N | 12 | 9 | 3 |
| Trials 1+2+3 | Mean | 30.2 (75.0) | 31.3 (77.9) | 27.1 (67.3) |
| | S.E. | 1.14 (2.06) | 1.17 (2.50) | 2.62 (2.07) |
| | N | 33 | 24 | 9 |
| All | Mean | 29.4 (75.8) | 30.4 (79.2) | 26.4 (66.5) |
| | S.E. | 0.98 (1.88) | 1.07 (2.23) | 2.05 (1.61) |
| | N | 45 | 33 | 12 |

Test for Determination of Statistical Differences Between
Categories of Test Subjects Expressed as P Values.

| | All Subjects | | Subjects Without Oxylogs | | Subjects With Oxylogs | |
|---|---|---|---|---|---|---|
| Across Runs | | | | | | |
| Trial 1 vs Trial 2 | 56.2 | (81.3) | 7.8* | (63.8) | 27.7 | (40.6) |
| Trial 1 vs Trial 3 | 43.4 | (89.8) | 14.1 | (72.5) | 65.0 | (11.1) |
| Trial 1 vs Trial 4 | 12.7 | (56.2) | 4.3# | (32.0) | 84.4 | (0.7)# |
| Trial 2 vs Trial 3 | 80.5 | (75.2) | 73.9 | (96.1) | 62.5 | (60.6) |
| Trial 2 vs Trial 4 | 33.3 | (72.3) | 67.3 | (57.0) | 33.7 | (56.3) |
| Trial 3 vs Trail 4 | 50.5 | (54.9) | 52.7 | (59.8) | 73.7 | (94.0) |
| Within Runs (With vs. Without Oxylogs) | | | | | | |
| Trial 1 | | | 0.1# | (27.6) | | |
| Trial 2 | | | 87.6 | (8.3)* | | |
| Trial 3 | | | 59.8 | (5.9)* | | |
| Trial 4 | | | 30.6 | (0.4)# | | |
| Trials 1+2+3 | | | 15.5 | (0.3)# | | |
| All Runs | | | 8.4* | (0.0)# | | |

* 0.05 < P <0.10
\# P < 0.05

TABLE XIV
Mean, Standard Error, and Population Size for Heart Rate (BPM) for the First Minute of the Test

| | | All Subjects | Without Oxylogs | With Oxylogs |
|---|---|---|---|---|
| Trial 1 | Mean | 138.6 | 139.4 | 136.7 |
| | S.E. | 3.99 | 5.54 | 1.86 |
| | N | 11 | 8 | 3 |
| Trial 2 | Mean | 145.0 | 140.0 | 160.0 |
| | S.E. | 3.82 | 3.77 | 0.58 |
| | N | 12 | 9 | 3 |
| Trial 3 | Mean | 137.8 | 137.7 | 138.0 |
| | S.E. | 5.15 | 7.44 | 3.22 |
| | N | 10 | 7 | 3 |
| Trial 4 | Mean | 158.8 | 159.4 | 157.0 |
| | S.E. | 2.42 | 2.73 | 6.03 |
| | N | 12 | 9 | 3 |
| Trials 1+2+3 | Mean | 140.7 | 139.1 | 144.93 |
| | S.E. | 2.47 | 3.04 | 3.92 |
| | N | 33 | 24 | 9 |
| All | Mean | 145.5 | 144.7 | 147.9 |
| | S.E. | 2.36 | 2.81 | 3.54 |
| | N | 45 | 33 | 12 |

Test for Determination of Statistical Differences Between Categories of Test Subjects Expressed as P Values.

| | All Subjects | Subjects Without Oxylogs | Subjects With Oxylogs |
|---|---|---|---|
| Across Runs | | | |
| Trial 1 vs. Trial 2 | 26.0 | 92.9 | 0.0# |
| Trial 1 vs. Trial 3 | 90.6 | 86.0 | 74.1 |
| Trial 1 vs. Trial 4 | 0.0# | 0.6# | 3.2# |
| Trial 2 vs. Trial 3 | 27.6 | 78.4 | 0.0# |
| Trial 2 vs. Trial 4 | 0.6# | 0.1# | 64.3 |
| Trial 3 vs. Trail 4 | 0.1# | 1.2# | 5.0# |

| Within Runs (With vs. Without Oxylogs) | |
|---|---|
| Trial 1 | 65.7 |
| Trial 2 | 0.0# |
| Trial 3 | 95.9 |
| Trial 4 | 72.7 |
| Trials 1+2+3 | 25.1 |
| All Runs | 47.8 |

* 0.05 < P <0.10
\# P < 0.05

## TABLE XV

### Mean, Standard Error, and Population Size for First Minute of Test, Workload in Watts and Workload per Unit Weight in W/Kg (in Parentheses)

| | | All Subjects | | Without Oxylogs | | With Oxylogs | |
|---|---|---|---|---|---|---|---|
| Trial 1 | Mean | 145.0 | (1.94) | 155.4 | (2.06) | 117.3 | (1.64) |
| | S.E. | 9.76 | (0.12) | 10.93 | (0.14) | 10.27 | (0.14) |
| | N | 11 | | 8 | | 3 | |
| Trial 2 | Mean | 143.0 | (1.89) | 145.3 | (1.84) | 136.0 | (2.05) |
| | S.E. | 9.37 | (0.12) | 12.43 | (0.14) | 6.56 | (0.22) |
| | N | 12 | | 9 | | 3 | |
| Trial 3 | Mean | 146.4 | (1.99) | 137.3 | (1.72) | 167.7 | (2.62) |
| | S.E. | 15.61 | (0.21) | 16.20 | (0.12) | 38.67 | (0.53) |
| | N | 10 | | 7 | | 3 | |
| Trial 4 | Mean | 174.8 | (2.28) | 179.3 | (2.20) | 161.3 | (2.52) |
| | S.E. | 8.19 | (0.11) | 8.04 | (0.09) | 24.04 | (0.37) |
| | N | 12 | | 9 | | 3 | |
| Trials 1+2+3 | Mean | 144.7 | (1.94) | 146.3 | (1.88) | 140.3 | (2.10) |
| | S.E. | 6.46 | (0.09) | 7.38 | (0.08) | 13.82 | (0.22) |
| | N | 33 | | 24 | | 9 | |
| All | Mean | 152.7 | (2.03) | 155.3 | (1.96) | 145.6 | (2.21) |
| | S.E. | 5.55 | (0.07) | 6.30 | (0.07) | 11.75 | (0.19) |
| | N | 45 | | 33 | | 12 | |

### Test for Determination of Statistical Differences Between Categories of Test Subjects Expressed as P Values.

| Across Runs | All Subjects | | Subjects Without Oxylogs | | Subjects With Oxylogs | |
|---|---|---|---|---|---|---|
| Trial 1 vs Trial 2 | 88.2 | (78.2) | 61.8 | (30.2) | 20.1 | (13.2) |
| Trial 1 vs Trial 3 | 94.5 | (85.9) | 37.0 | (8.8)* | 27.7 | (9.1)* |
| Trial 1 vs Trial 4 | 3.0# | (5.6)* | 9.9* | (41.1) | 16.8 | (3.9)# |
| Trial 2 vs Trial 3 | 85.1 | (70.8) | 70.3 | (52.4) | 46.3 | (33.4) |
| Trial 2 vs Trial 4 | 1.8# | (2.9)# | 3.5# | (5.0)# | 37.0 | (29.2) |
| Trial 3 vs Trail 4 | 12.3 | (23.7) | 3.6# | (0.5)# | 89.6 | (87.5) |

| Within Runs (With vs. Without Oxylogs) | | |
|---|---|---|
| Trial 1 | 3.2# | (7.0)* |
| Trial 2 | 52.5 | (44.2) |
| Trial 3 | 48.7 | (12.6) |
| Trial 4 | 49.4 | (43.2) |
| Trials 1+2+3 | 70.7 | (34.5) |
| All Runs | 46.6 | (23.8) |

* $0.05 < P < 0.10$

\# $P < 0.05$

TABLE XVI
Oxygen Consumption in mL/min and Oxygen Consumption per Kg Body Weight in mL/min/Kg (in Parentheses) Based on Calibration Regression Equations for Workloads at 0.7 W/Kg, 1.2 W/Kg, and First Minute of Evacuation Trials

| Subject Number | Values at 0.7 W/Kg | | Values at 1.2 W/Kg | | Values at 1-Min Evac Test | |
|---|---|---|---|---|---|---|
| 1-01 | 750 | (11.36) | 1129 | (17.11) | 2404 | (36.42) |
| 1-02 | 920 | (10.70) | 1431 | (16.64) | 2273 | (26.43) |
| 1-03 | 599 | (9.51) | 984 | (15.62) | 1598 | (25.37) |
| 1-04* | 797 | (11.23) | 1170 | (16.48) | 1298 | (18.28) |
| 1-05* | 889 | (12.70) | 1293 | (18.47) | 1825 | (26.07) |
| 1-06 | 1196 | (15.14) | 1620 | (20.51) | 2498 | (31.62) |
| 1-07 | 801 | (12.32) | 1134 | (17.45) | 1467 | (22.57) |
| 1-08* | 852 | (11.67) | 1341 | (18.37) | 1830 | (25.07) |
| 1-09 | 1194 | (12.84) | 1583 | (17.02) | 2212 | (23.78) |
| 1-10 | 1044 | (12.14) | 1470 | (17.09) | 1746 | (20.30) |
| 1-11 | 1001 | (14.10) | 1351 | (19.03) | 1952 | (27.49) |
| 2-01* | 849 | (12.13) | 1192 | (17.03) | 1574 | (22.49) |
| 2-02* | 668 | (11.52) | 1031 | (17.78) | 1958 | (33.76) |
| 2-03 | 982 | (12.28) | 1391 | (17.39) | 1719 | (21.49) |
| 2-04 | 977 | (13.03) | 1299 | (17.32) | 1586 | (21.15) |
| 2-05 | 877 | (12.53) | 1188 | (16.97) | 1250 | (17.86) |
| 2-06 | 944 | (13.11) | 1281 | (17.79) | 1655 | (22.99) |
| 2-07* | 1086 | (14.88) | 1350 | (18.49) | 1730 | (23.70) |
| 2-08 | 808 | (11.38) | 1146 | (16.14) | 2208 | (31.10) |
| 2-09 | 706 | (10.70) | 1026 | (15.55) | 1356 | (20.53) |
| 2-10 | 852 | (10.52) | 1222 | (15.09) | 1896 | (23.41) |
| 2-11 | 1256 | (11.85) | 1829 | (17.25) | 2272 | (21.43) |
| 2-12 | 1147 | (12.89) | 1688 | (18.97) | 2733 | (30.71) |
| 3-01* | 937 | (13.99) | 1293 | (19.30) | 3073 | (45.87) |
| 3-02* | 940 | (13.82) | 1275 | (18.75) | 1748 | (25.71) |
| 3-03 | 988 | (13.53) | 1350 | (18.49) | 1380 | (18.90) |
| 3-05 | 737 | (13.16) | 1024 | (18.29) | 1137 | (20.30) |
| 3-06 | 774 | (10.18) | 1182 | (15.55) | 1953 | (25.70) |
| 3-07 | 1246 | (12.10) | 1878 | (18.23) | 2668 | (25.90) |
| 3-09 | 1136 | (13.21) | 1451 | (16.87) | 1970 | (22.91) |
| 3-10* | 657 | (11.73) | 972 | (17.36) | 1659 | (29.63) |
| 3-11 | 1050 | (14.79) | 1339 | (18.86) | 1586 | (22.34) |
| 3-12 | 1138 | (13.39) | 1552 | (18.26) | 2035 | (23.94) |
| 4-01 | 1106 | (13.65) | 1656 | (20.44) | 2552 | (31.51) |
| 4-02 | 1185 | (12.61) | 1693 | (18.01) | 2666 | (28.36) |
| 4-03 | 912 | (13.22) | 1282 | (18.58) | 1979 | (28.68) |
| 4-04 | 989 | (13.74) | 1380 | (19.17) | 2370 | (32.92) |
| 4-05* | 729 | (11.76) | 1071 | (17.27) | 1711 | (27.60) |
| 4-06 | 943 | (10.97) | 1386 | (16.12) | 2212 | (25.72) |
| 4-07* | 915 | (14.30) | 1202 | (18.78) | 2385 | (37.27) |
| 4-08* | 629 | (9.53) | 1265 | (19.17) | 2499 | (37.86) |
| 4-09 | 730 | (11.06) | 1102 | (16.70) | 1971 | (29.86) |
| 4-10 | 1163 | (11.29) | 1961 | (19.04) | 3527 | (34.24) |
| 4-11 | 1337 | (13.11) | 1784 | (17.49) | 2214 | (21.71) |
| 4-12 | 880 | (12.57) | 1196 | (17.09) | 2126 | (30.37) |

*Subjects also monitored with Oxylogs.

TABLE XVII

Carbon Dioxide in mL/min and Carbon Dioxide per Kg Body Weight in mL/min/Kg (in Parentheses) Based on Calibration Regression Equations for Workloads at 0.7 W/Kg, 1.2 W/Kg, and First Minute of Evacuation Trials

| Subject Number | Value at 0.7 W/Kg | | Values at 1.2 W/Kg | | Values at 1-min Evac Test | |
|---|---|---|---|---|---|---|
| 1-01 | 523 | (7.92) | 893 | (13.53) | 2129 | (32.26) |
| 1-02 | 781 | (9.08) | 1284 | (14.93) | 2115 | (24.59) |
| 1-03 | 432 | (6.86) | 835 | (13.25) | 1478 | (23.46) |
| 1-04* | 616 | (8.68) | 1078 | (15.18) | 1237 | (17.42) |
| 1-05* | 680 | (9.71) | 1227 | (17.53) | 1945 | (27.83) |
| 1-06 | 846 | (10.71) | 1228 | (15.54) | 2002 | (25.34) |
| 1-07 | 687 | (10.57) | 1161 | (17.86) | 1635 | (25.15) |
| 1-08* | 617 | (8.45) | 1173 | (16.07) | 1729 | (23.68) |
| 1-09 | 929 | (9.99) | 1314 | (14.13) | 1936 | (20.82) |
| 1-10 | 768 | (8.93) | 1245 | (14.48) | 1556 | (18.09) |
| 1-11 | 755 | (10.63) | 1135 | (15.99) | 1787 | (25.17) |
| 2-01* | 666 | (9.51) | 1131 | (16.16) | 1650 | (23.57) |
| 2-02* | 433 | (7.47) | 882 | (15.21) | 2028 | (34.97) |
| 2-03 | 830 | (10.38) | 1278 | (15.98) | 1636 | (20.45) |
| 2-04 | 865 | (11.53) | 1206 | (16.08) | 1510 | (20.13) |
| 2-05 | 757 | (10.81) | 1061 | (15.16) | 1122 | (16.03) |
| 2-06 | 650 | (9.03) | 1039 | (14.43) | 1471 | (20.43) |
| 2-07* | 769 | (10.53) | 1050 | (14.38) | 1452 | (19.89) |
| 2-08 | 724 | (10.20) | 1132 | (15.94) | 2412 | (33.97) |
| 2-09 | 562 | (8.52) | 913 | (13.83) | 1274 | (19.30) |
| 2-10 | 834 | (10.30) | 1322 | (16.32) | 2216 | (27.36) |
| 2-11 | 1087 | (10.25) | 1817 | (17.14) | 2382 | (22.47) |
| 2-12 | 898 | (10.09) | 1462 | (16.43) | 2554 | (28.70) |
| 3-01* | 622 | (9.28) | 955 | (14.25) | 2625 | (39.18) |
| 3-02* | 737 | (10.84) | 1155 | (16.99) | 1746 | (25.68) |
| 3-03 | 798 | (10.93) | 1235 | (16.92) | 1271 | (17.41) |
| 3-05 | 558 | (9.96) | 924 | (16.50) | 1069 | (19.09) |
| 3-06 | 626 | (8.24) | 987 | (12.99) | 1671 | (21.99) |
| 3-07 | 1066 | (10.35) | 1763 | (17.12) | 2633 | (25.56) |
| 3-09 | 1037 | (12.06) | 1492 | (17.35) | 2243 | (26.08) |
| 3-10* | 455 | (8.13) | 844 | (15.07) | 1691 | (30.20) |
| 3-11 | 748 | (10.54) | 1078 | (15.18) | 1361 | (19.17) |
| 3-12 | 911 | (10.72) | 1321 | (15.54) | 1800 | (21.18) |
| 4-01 | 923 | (11.40) | 1429 | (17.64) | 2250 | (27.78) |
| 4-02 | 956 | (10.17) | 1610 | (17.13) | 2862 | (30.45) |
| 4-03 | 722 | (10.46) | 1130 | (16.38) | 1900 | (27.54) |
| 4-04 | 751 | (10.43) | 1166 | (16.19) | 2214 | (30.75) |
| 4-05* | 550 | (8.87) | 936 | (15.10) | 1659 | (26.76) |
| 4-06 | 781 | (9.08) | 1306 | (15.19) | 2283 | (26.55) |
| 4-07* | 671 | (10.48) | 1052 | (16.44) | 2624 | (41.00) |
| 4-08* | 427 | (6.47) | 954 | (14.45) | 1976 | (29.94) |
| 4-09 | 559 | (8.47) | 965 | (14.62) | 1910 | (28.94) |
| 4-10 | 771 | (7.49) | 1553 | (15.08) | 3087 | (29.97) |
| 4-11 | 1147 | (11.25) | 1683 | (16.50) | 2198 | (21.55) |
| 4-12 | 693 | (9.90) | 1031 | (14.73) | 2026 | (28.94) |

*Subjects also monitored with Oxylog.

TABLE XVIII
Oxygen Consumption (in Liters) and Carbon Dioxide Production (in Liters) Based on Proposed 20-Min Workload Profile

| Subject Number | Oxygen Consumption | Carbon Dioxide Production |
|---|---|---|
| 1-01 | 18.17 | 13.55 |
| 1-02 | 21.80 | 18.97 |
| 1-03 | 14.52 | 11.30 |
| 1-04* | 17.93 | 14.79 |
| 1-05* | 20.33 | 17.05 |
| 1-06 | 26.92 | 19.60 |
| 1-07 | 18.02 | 16.58 |
| 1-08* | 19.97 | 15.68 |
| 1-09 | 26.45 | 21.13 |
| 1-10 | 23.29 | 18.06 |
| 1-11 | 22.37 | 17.65 |
| 2-01* | 19.08 | 16.16 |
| 2-02* | 16.10 | 12.05 |
| 2-03 | 22.01 | 19.20 |
| 2-04 | 21.44 | 19.31 |
| 2-05 | 19.16 | 16.72 |
| 2-06 | 20.94 | 15.38 |
| 2-07* | 23.42 | 17.19 |
| 2-08 | 18.91 | 17.80 |
| 2-09 | 16.05 | 13.36 |
| 2-10 | 19.56 | 20.01 |
| 2-11 | 28.43 | 25.96 |
| 2-12 | 26.69 | 21.87 |
| 3-01* | 22.30 | 15.78 |
| 3-02* | 20.95 | 17.42 |
| 3-03 | 21.60 | 18.18 |
| 3-05 | 16.29 | 13.14 |
| 3-06 | 18.29 | 15.01 |
| 3-07 | 28.87 | 25.68 |
| 3-09 | 24.81 | 23.77 |
| 3-10* | 15.40 | 11.89 |
| 3-11 | 22.69 | 16.89 |
| 3-12 | 25.31 | 20.75 |
| 4-01 | 25.77 | 21.81 |
| 4-02 | 27.21 | 23.46 |
| 4-03 | 20.79 | 17.25 |
| 4-04 | 22.73 | 18.14 |
| 4-05* | 16.93 | 13.65 |
| 4-06 | 21.90 | 19.22 |
| 4-07* | 20.92 | 16.90 |
| 4-08* | 16.99 | 12.20 |
| 4-09 | 17.33 | 14.16 |
| 4-10 | 28.82 | 20.86 |
| 4-11 | 29.41 | 26.14 |
| 4-12 | 20.11 | 16.55 |

* Subjects also monitored with Oxylogs.

TABLE XIX
Mean, Standard Error, and Population Size for Oxygen Consumption and Carbon Dioxide Production (in Parentheses) Based on Proposed 20-Min Workload Profile

| | | All Subjects | | Without Oxylogs | | With Oxylogs | |
|---|---|---|---|---|---|---|---|
| Trial 1 | Mean | 20.89 | (16.76) | 21.44 | (17.11) | 19.41 | (15.84) |
| | S.E. | 1.14 | (0.85) | 1.52 | (1.15) | 0.75 | (0.66) |
| | N | 11 | | 8 | | 3 | |
| Trial 2 | Mean | 20.98 | (17.92) | 21.47 | (18.85) | 19.53 | (15.13) |
| | S.E. | 1.09 | (1.08) | 1.30 | (1.23) | 2.13 | (1.57) |
| | N | 12 | | 9 | | 3 | |
| Trial 3 | Mean | 21.65 | (17.85) | 22.55 | (19.06) | 19.55 | (15.03) |
| | S.E. | 1.32 | (1.40) | 1.63 | (1.73 | 2.11 | (1.64) |
| | N | 10 | | 7 | | 3 | |
| Trial 4 | Mean | 22.41 | (18.38) | 23.79 | (19.75) | 18.28 | (14.25) |
| | S.E. | 1.29 | (1.21) | 1.40 | (1.25) | 1.32 | (1.39) |
| | N | 12 | | 9 | | 3 | |
| Trials 1+2+3 | Mean | 21.15 | (17.51) | 21.78 | (18.33) | 19.50 | (15.33) |
| | S.E. | 0.66 | (0.63) | 0.82 | (0.77) | 0.89 | (0.69) |
| | N | 33 | | 24 | | 9 | |
| All | Mean | 21.49 | (17.74) | 22.32 | (18.72) | 19.19 | (15.06) |
| | S.E. | 0.59 | (0.56) | 0.71 | (0.65) | 0.73 | (0.61) |
| | N | 45 | | 33 | | 12 | |

Test for Determination of Statistical Differences Between Categories of Test Subjects Expressed as P Values.

| | All Subjects | | Subjects Without Oxylogs | | Subjects With Oxylogs | |
|---|---|---|---|---|---|---|
| **Across Runs** | | | | | | |
| Trial 1 vs Trial 2 | 95.3 | (41.1) | 99.2 | (32.0) | 96.3 | (69.6) |
| Trial 1 vs Trial 3 | 66.5 | (51.1) | 62.5 | (36.5) | 95.5 | (67.0) |
| Trial 1 vs Trial 4 | 38.9 | (28.4) | 27.3 | (14.0) | 49.6 | (36.2) |
| Trial 2 vs Trial 3 | 70.1 | (96.9) | 61.1 | (92.2) | 99.3 | (97.0) |
| Trial 2 vs Trial 4 | 40.5 | (83.6) | 24.4 | (61.7) | 64.3 | (69.6) |
| Trial 3 vs Trail 4 | 68.6 | (77.5) | 57.1 | (75.4) | 63.7 | (73.7) |
| **Within Runs (With vs. Without Oxylogs)** | | | | | | |
| Trial 1 | | | 26.1 | (36.3) | | |
| Trial 2 | | | 45.4 | (9.3)* | | |
| Trial 3 | | | 29.2 | (13.0) | | |
| Trial 4 | | | 1.7# | (1.5)# | | |
| Trials 1+2+3 | | | 6.8* | (0.7)# | | |
| All Runs | | | 0.0# | (0.0)# | | |

* 0.05 < P <0.10
# P < 0.05

TABLE XX
Change in Oxygen Uptake (L/Min) from Final 30-s of a Workload to the First 30-s of the Next Higher Workload

| Subject Number | 30W - 50W | 50W - 70W | 70W - 90W | 90W -110W | 110W-130W | 130W-150W |
|---|---|---|---|---|---|---|
| 1-01 | -.15 | -.05 | -.05 | -.11 | -.21 | -.08 |
| 1-02 | 0.00 | -.28 | +.26 | +.22 | -.19 | - |
| 1-03 | +.12 | +.08 | +.22 | +.05 | +.11 | - |
| 1-04 | 0.00 | -.04 | +.15 | +.24 | +.12 | - |
| 1-05 | +.14 | +.03 | +.21 | -.12 | -.14 | -.07 |
| 1-06 | -.11 | -.22 | +.33 | -.22 | -.03 | +.09 |
| 1-07 | -.10 | +.17 | +.26 | +.11 | - | - |
| 1-08 | -.02 | +.17 | -.09 | -.09 | +.07 | -.10 |
| 1-09 | +.27 | -.02 | 0.00 | -.21 | -.02 | +.34 |
| 1-10 | -.09 | -.08 | +.15 | +.15 | +.11 | +.19 |
| 1-11 | +.18 | -.18 | -.02 | +.01 | -.31 | -.02 |
| 2-01 | +.09 | -.03 | -.13 | -.04 | - | - |
| 2-02 | +.02 | +.21 | 0.00 | +.34 | +.18 | -.01 |
| 2-03 | +.14 | -.03 | +.12 | -.22 | +.20 | -.15 |
| 2-04 | -.06 | -.01 | -.16 | +.13 | +.04 | - |
| 2-05 | -.03 | +.23 | -.01 | -.01 | +.10 | - |
| 2-06 | +.10 | +.01 | +.15 | -.08 | +.37 | +.42 |
| 2-07 | +.06 | -.22 | +.03 | -.24 | - | - |
| 2-08 | +.03 | +.26 | -.12 | +.07 | +.24 | +.45 |
| 2-09 | 0.00 | -.10 | +.17 | +.06 | +.01 | - |
| 2-10 | -.15 | -.08 | -.01 | -.02 | +.10 | +.01 |
| 2-11 | -.23 | -.09 | -.01 | +.09 | +.15 | -.06 |
| 2-12 | -.09 | +.36 | -.21 | +.04 | +.04 | +.30 |
| 3-01 | +.08 | -.14 | 0.00 | +.05 | +.10 | -.13 |
| 3-02 | -.17 | -.19 | +.01 | +.04 | +.09 | +.38 |
| 3-03 | +.13 | +.15 | -.04 | +.46 | +.31 | +.17 |
| 3-05 | +.04 | -.07 | +.10 | -.04 | - | - |
| 3-06 | +.04 | -.19 | +.05 | +.18 | +.13 | +.12 |
| 3-07 | +.39 | +.05 | -.01 | +.12 | +.02 | +.10 |
| 3-09 | -.35 | -.17 | -.06 | +.17 | +.11 | +.17 |
| 3-10 | +.20 | +.01 | +.09 | +.22 | -.07 | +.31 |
| 3-11 | +.02 | -.11 | -.08 | +.04 | +.35 | +.37 |
| 3-12 | -.11 | -.09 | +.27 | +.38 | -.04 | +.03 |
| 4-01 | +.06 | -.17 | -.02 | +.02 | -.02 | - |
| 4-02 | -.04 | +.08 | -.07 | +.22 | -.11 | -.09 |
| 4-03 | -.04 | -.15 | -.06 | -.27 | +.18 | +.13 |
| 4-04 | 0.00 | +.08 | +.08 | -.09 | 0.00 | -.01 |
| 4-05 | +.05 | -.16 | +.29 | +.08 | +.32 | +.23 |
| 4-06 | +.05 | +.02 | -.24 | +.26 | -.01 | +.03 |
| 4-07 | -.11 | +.06 | +.22 | -.02 | +.01 | +.12 |
| 4-08 | +.23 | +.15 | +.30 | -.02 | -.21 | - |
| 4-09 | -.47 | +.18 | +.21 | +.01 | +.35 | +.04 |
| 4-10 | -.02 | -.16 | +.18 | -.05 | -.27 | - |
| 4-11 | +.05 | -.01 | -.06 | +.03 | +.08 | - |
| 4-12 | +.03 | +.09 | -.10 | +.05 | +.39 | -.03 |
| N (Total) | 45 | 45 | 45 | 45 | 41 | 31 |
| N (+) | 24 | 19 | 23 | 29 | 27 | 20 |
| N (-) | 17 | 26 | 19 | 16 | 13 | 11 |
| N (No Change) | 4 | 0 | 3 | 0 | 1 | 0 |
| Mean | +.008 | -.014 | +.053 | +.045 | +0.65 | +.105 |