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GLARE RECOVERY OF A TWO DIMENSIONAL TRACKING TASK WITH RESPECT TO VARIOUS COLORS

DARCOM INTERN TRAINING CENTER

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GLARE RECOVERY OF A TWO DIMENSIONAL TRACKING TASK WITH RESPECT TO VARIOUS COLORS

Dennis A. Boyer Maintainability Engineering Program Intern Training Center Red River Army Depot Texarkana, Texas 75501

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April 1976

Final Report

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FOREWORD

The research discussed in this report was accomplished as part of the Maintainability Engineering Program conducted jointly by DARCOM Intern Training Center and Texas A&M University. As such, the ideas, concepts and results herein presented are those of the author and do not necessarily reflect approval or acceptance by the Army.

This report has been reviewed and is approved for release. For further information on this project contact Dr. Ronald C. Higgins, Chief of Maintenance Effectiveness, Red River Army Depot, Texarkana, Texas.

Approved:

Higgins,

Maintenance Effectiveness Engineering

For the Commander

Arnett, Director Latern Training Center

ABSTRACT

Research Performed by <u>Dennis A. Boyer</u> Under the Supervision of <u>Dr. R. S. Morris</u>

This report describes the results of research intended to determine the effect of variation in color on a two dimensional tracking task with superimposed glare flashes. The EAI 680 Analog Computer was the primary function generator with the EAI 600 Pacer digital computer performing control functions and data analysis. Tests on five subjects under four colors indicates that the blue filtered light was significantly better than white, red, or orange-red filtered light when a glare was imposed.

ACKNOWLEDGEMENTS

For serving as the chairman of my committee and offering many helpful suggestions, I extend my appreciation to Dr. R. S. Morris. For serving as members of my committee, I wish to thank Dr. J. M. Covan and Dr. W. L. Johnston. Gratitude is extended to Dr. R. W. Ferguson for his assistance in the experimental portion of this project. I would especially like to thank my fiance Kathy for the typing and editing of this work.

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C H A P T E R I

STATEMENT OF PROBLEM

Since man first began to fly at night for any great distances, the incandescent red filtered lamp has been used to light the aircraft instruments. Until only recently has the method of aircraft instrument lighting changed any appreciable amount. Most aircraft now use an electroluminescent lamp for the various secondary information displays, while the incandescent red filtered lamp is used for the primary instrument lighting system.

The electroluminescent sheets are excellent for use in various displays, however, they have the primary disadvantages of being susceptible to moisture and ineffective at high levels of ambient light. This was found by H. N. Renolds (17) in his study of electroluminescent lighting. The incandescent lamps, however, are still used as the primary instrument lighting system. These systems provide no redundancy; when an incandescent lamp fails completely. Whereas an electroluminescent lamp fails with gradually diminishing intensity. Also, the incandescent lamp will only provide a non-uniform lighting distribution across the face of the instrument, thus leaving dark areas in which a

portion of the information vital to the pilot may be displayed.

An example of both incandescent lighting and of electroluminescent lighting systems can be seen in display shown in figure 1. The panel shown is a standard aircraft instrument panel used on a current U.S. Army aircraft." In some cases, a combination of both incandescent and electroluminescent systems are used. An example of the combined system is illustrated by the camera pulse control (see figure 1, number 24), in which the background lettering is illuminated by an electroluminescent lamp, and the pulse control button contains an incandescent lamp. As an example of a pure electroluminescent display see item number 19 on figure 1. The lighting of the primary instrumentation is by the red filtered lamps which are housed inside the lens caps of the light receptacles. These lens caps only allow light to be emitted in a small arc across the instrument face. An example of this type of illumination can be seen at the top two corners of the airspeed indicator (figure 1, number 26).

Though these two methods of lighting aircraft instruments have been in use for a period of time, little work 2

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This figure was taken from the Gruman OV-1C Mohawk operators manual.



has been done on glare recovery with respect to the electroluminescent panels, or with either electroluminescent or incandescent lighting colors.

OBJECTIVES OF RESEARCH

The object of this research is to determine if the color of the instrument lighting system will affect the ability of a human to recover from a short duration glare and perform a two dimensional tracking task. The effect of the lighting color on the ability of a human to perform the tracking task can be divided into two separate areas of interest. These two areas are to determine if the effect of the instrument color 1) will correlate in some manner with the level or error produced between the reactions of the subject and the applied signal stimulus, and 2) the time required for the subject to return to his preglare level of accuracy.

It is with this basic, underlying idea that the equipment was developed and the experiment designed and conducted. The remainder of this paper will discuss the literature that was reviewed, the experimental design, the equipment that was developed, and the results of the experiment.

CHAPTER TI

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REVIEW OF PERTINENT LITERATURE

The Eye

The human eye is a small spherical body capable of transforming visual images, which have passed through the lens (shown in figure 2, number 19) and are projected on the rear of the retina, into impulses of energy. The impulses of energy are then passed along the nerves to the brain. The human eye itself is only about 24 mm in diameter and can be divided into seven separate areas. These seven areas are the cornea, the anterior chamber, the lens, the vitreous chamber, the retina, the optic nerve, and the fovia.

The cornea is the small portion of the eye which is transparent and which focuses the light image on the lens. The light image must then pass through the anterior chamber in order to reach the lens system. Contained in the anterior chamber is a transparent liquid fluid called the Aqueous Humor. The Aqueous Humor is thought by several persons to supply a portion of the oxygen to the cornea (13). The remainder of the oxygen to the cornea is supplied by the contact of the surrounding air. The Aqueous Humor is produced in the vitreous chamber, and is circulated to the



Figure 2. The human Eye. (NASA, 1964).

anterior chamber through the lens supportive structure. The excess fluid in the anterior chamber is drained through a canal into the vascular system of the outside case of the eye. The exterior case of the eye is called the sclera.

The lens system of the eye is composed of a small, transparent, yellowish tinged crystalline material of complex bio-chemical structure. Yellowing of the lens will continue with age, and thus increase the light absorbtion and scattering by the lens. This yellowing causes a loss of visual acuity with age (12,18). Over the front of the lens is a heavily pigmented membrane which can contract or dilate to allow various amounts of light to enter the vitreous chamber. The lens is focused by slight variations in its shape accomplished by contractions of the ligaments which suspend the lens in the eye.

The retina, or the inner lining of the rear wall of the eye (as shown in figure 3, number 19), contains the rods and cones which are connected to the nerves. This allows the light images to be changed to neurological impulses. The retina is covered with a brown pigment, which reduces the internal optical scattering of the light and acts as a support for the rod and cone receptors in the eye. Figure 4 illustrates the variation in the horizontal distribution of the rods and cones across the eye. Table 1 gives the numerical population of the rods and cones in



Figure 3. Plan of the Retina. (NASA, 1964).



Figure 4. Centeral and Peripheral Vision. (NASA, 1964).

Angular	Population	
Eccentricity	Rods/sq min	Cones/ sq mm
degrees	thousands	
. 0.00	0	136.
0.25	0 ·	84.4
0.50	7.22	57.5
1.00	34.2	41.3
5.00	88.	19.4
6.00	105.	12.1
10.00	118.	· 9.13
12.00	125.	7.64
12.50	126.	7,63
20.00	158.	7.08
30.00	140.	6.52
40.00	132.	5.95
50.00	108.	5.79
70.00	80.4	5.47
90.00	57.7	6.84

•

Table 1. Rod and Cone Populations. (NASA, 1964).

terms of angular eccentricity across the eye.

The basic, and most important, differences of the rods and cones are their susceptibility to variations in light wavelength and intensity. Hardesty and Projector (7), in their studies of cone to rod ratios, and Lazo (10), in his studies, found results which were quite similar. Figure 5 shows that the relative spectral luminous efficiency curves for scotopic (dark adapted) rod vision, and photopic cone vision vary only slightly. It should, however, be noted that these curves have the peaks normalized, and they show the relative sensitivity to radiant energy of different wavelengths. They do not give a value of the absolute difference in the sensitivity between the rods and the cones. This graph demonstrates the situation that Hardesty and Projector (7) studied, which is called the Purkinje Effect. The Purkinje Effect states that the spectral sensitivity of the dark adapted rods is greater for lower wavelengths of illumination that are the cones.

The actual composition of the chemical action which takes place in the rods and cones is quite complex. Basically as stated by Guyton (6), light enters the eye and strikes the receptors. At this time a photochemical change takes place. In this chemical change the rhodopsin changes to what is called lumi-rhodopsin, which then decomposes to a state called meta-rhodopsin. The meta-rhodopsin then



Figure 5. Night and Day Vision Efficiency. (Naval Ship Laboratory, 1969).

decomposes to sctopsin, and then to retinene. When the retinene seperates from the scotopsin it is partially ionized, thus causing an electrical charge to be transmitted along the nerves to the brain. The time required for the complete chemical reaction to take place is called the flicker fusion and will only last about 0.1 second. An approach using a method similar to the flicker fusion was used for various experiments involving optimum flash rates by Markowitz (11), and by Goodwin and Smith (4).

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Webb (19) states that in the optic nerve region there are no rods or cones present. This is the area of the eye in which the nerve endings go from the rear nasal side of the eye to the brain. More commonly, this region is called the blind spot. Its actual position is about 15 degrees to the nasal side of the center of the eye, and about 1.5 degrees below the horizontal meridian of the eye. The region is sometimes called the forea.

The final and last portion of the eye that will be discussed is the macula lutea. In this region the largest number of cones are grouped together forming the major portion of the day light sensitivity of the eye. As seen from the distribution of the rods and cones in figure 4, page 9, this region is devoid of rods, which supply the scotopic vision when the luminescence level drops below .001 milli-lamberts (m1). When the luminescence level drops below the .001 ml level, this region becomes non reactive. Therefore, in order to see an object at night, it is necessary to look to the side of the object. This is stated by the U.S. Air Force (15) in several of their military courses. The night vision, as shown by figure 4, page 9, is greatly enhanced by looking approximately 20 degrees to the side of the object.

Interior Lighting Systems

Although aircraft instruments today are primarily lighted by red incandescent filtered lamps there is now a large group of people who believe that white instrument lighting should be used. This belief is due in general to the commercial and military high performance aircraft in which most of the flying that is done is solely under instruments. The only exception, it seems, to this rule is that of the slow flying fixed wing aircraft and the helicopter. In these cases the visual detection of other aircraft, ground obstructions, and of unlighted airfield night landings makes it necessary for the pilot to use his maximum scotopic or night vision.

In reports by Grether (5) and in a report by Jolly and Planet (9), it was pointed out that some U.S. Air Force aircraft during World War II were equiped with an ultraviolet lighting system. In this system the markings of the instruments were in a florescent coloring.

This allowed the aircraft cockpit to be continuously dark. The ultraviolet method however had several drawbacks 1) the instruments which were not treated with the florescence seemed to disappear, 2) pilots often reported the phenomenon of the instruments appearing to float in a black void, 3) pilot eye strain and headaches and 4) fogging of the pilots vision due to the ultraviolet light being reflected into the eyes. This method of instrument lighting was changed after World War II to that of primarly red light. However, as stated earlier in this report, red lighting usually results in an uneven distribution of lighting across the instrument face.

A point in favor of the white lighting system over the red system is discussed in reports by Greather and Renolds (5), by Lazo (10), and by Mercier and Whiteside (16) that visual acuity is greater with white lighted system, and will produce a more comfortable environment than will a red light system. Greather and Renolds found that by using a much lower filament temperature than was normally used that a white light system could be safely employed with only a slight increase in the dark adaption index for non-glare situations. In their report the dark adaption index was defined as the time required to adapt to a specified value of 90% of total dark adaption.

Another point which was discussed by Mercer and

Whiteside (16) was that in both civilian and in military aircraft the use of maximum dark adaption is less important at present due to the use of radar which can locate other aircraft long before the human eye is able to receive any image.

Color Temperatures

A consideration of the dark adaption index is also that of the color temperature. Figure 6 is taken from a report by Muick (14) and is a copy of the chromaticity diagram. This diagram shows the coordinates of the U.S. information color limits. In this diagram the color of the U.S. Air Force white light, which operates at approximately 2900° K, lies between the coordinates of (.420,.385) and (.460,.425). These two coordinates are that of the unfiltered white light and that of the blue filtered white light which Muick used in his study of aircraft instrument lighting systems.

In Greather and Renolds (5) report it was found that by testing the luminance levels in the mesopic range the red lighting increased the dark adaption threshold 48%, while the white lighting system increased the threshold 82%. It should also be noted that luminance levels are displayed on a log scale. The white lighting system used in this experiment used a military 28 volt system which was operated at a much lower voltage level than normal. The use of the





lower voltage produced a color temperature which was below 1000° K. Similarly in the report by Lazo (10), it was found that the pure red light was better for the dark adaption index of the rods. Lazo also stated in his report that white light, which is produced by radiant energy from a tungsten filament includes all colors; while red light that is specified for aircraft use is in the range of light wavelengths above 600 nonometers, as shown in figure 7 (1). This would tend to explain the reason that an older instrument in which colors were fading seemed to produce a less uniform distribution of light across the instrument face. Under the narrow band red lighting system these variations in luminance are difficult for the rod receptors to discern due to the fact that the rod receptors are fairly insensitive to small variations in color. Similarly as the wavelength of the light increases to approximately 450 nonometer (7) the rods function is decreased and the cones become the primary visual receptors.

Glare and Glare Recovery

Glare is generally defined as a strong veiling light within the subjects field of vision. The actual amount of veiling produced depends basically on 1) the location of the light in the field of vision, 2) the intensity of the light observed at the eys, and 3) the ambient lighting conditions. As the glare illumination enters the eye the



Figure 7. Light Energy Distribution. (Armstrong, 1961). light will scatter according to a Raleigh distribution. The light focused on the retina will then cause the bleaching of the rods and cones and will begin the process described previously in this report on pages 14 and 15. The variations in glare recovery time when the ambient lighting conditions are high is easily explained due to the fact that under photopic or mesopic conditions there is less time required to allow the cones to regain their sensitivity to the variations in light. However in the case of the dark adapted subject, the amount of time to recover can vary.

There are basically two types of glare (or in the case of this study flash blindness) these being discomfort glare and disability glare. Disability glare can be defined as an excess amount of unwanted light entering the eye causing a partial loss of vision. Similarly discomfort glare can be defined as a larger amount of the unwanted light that enters the eye making adaption to any specific level difficult.

At present there are various methods of evaluating glare and glare recovery time. In the case of discomfort glare studies were done by Fry (3) and by Hopkinson(8) relating a glare index to various parameters of the glare. In the study by Hopkinson a modification was made of the Guth formula:

$$G = \frac{F(B_s) F(Q)}{F(B_b) F(B_i) F(\Theta)}$$
(2.1)

where

 B_s is the source luminance Q is the apparent size of the source B_b is the adaption luminance B_i is the luminance of the immediate surrondings of the source

 Θ is the angle between the direction of the source and the direction of viewing

G is the glare constant

These values of the different parameters of equation 2.1 are functions relating to the glare constant G. It should be noted that in this case the higher the value of G indicates a greater discomfort is encountered. Hopkinson found that the general population in his experiment was less sensitive to the glare than was an experienced team of observers.

In the study by Fry a modification of the Guth formula was also used. In this case the equation became:

$$\underset{1}{\overset{n}{=}} \frac{L^{2}W}{p^{3}} C_{(S)}^{1/C}$$
 (2.2)

where

M is the total glare,

S is a constant,

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)

- C is .283,
- H is 6.38,
- n is the number of luminances used in the room,
- p is the position index,
- W is the solid angle subtended by each glare source, and

L is the luminance of each glare source.

By the use of this formula Fry included to the Guth formula such things as the number and spacings of luminances, the lumen output of each lamp, the size and shape or the rooms, and the relative candlepower distribution of the lamps. In equation 2.2 the M can be correlated to the glare in the same way as that of the G of Hopkinsons relationship in equation 2.1.

A relation between the glare duration, intensity, and the glare recovery time was developed by Brown and reported in a dissertation by Morris (13) as

$$T = .2 + B \frac{2.7 - \log L}{(2.7 - \log L_0) \log L/L_0}$$
(2.3)

where

L is the minimum illuminance need to detect the target by the dark adapted eye,

- L is the illuminance of the target to be detected, B is equal to $.022A^{.68}$, and
- A is the energy of the flash in foot lambert seconds.

This emperical formula was developed from short duration

and high intensity flashes. However it can be seen that as the value of $\frac{L}{L}$ (the target illuminance divided by the minimum illuminance needed to detect the target) approaches zero the value for the recovery time approaches .2.

In Frys (2) study of positive afterimage and measurements of light and dark adaption a conclusion is made that positive afterimages act like a small patch of veiling glare luminance and will affect the absolute threshold of the subjects vision. In his report Fry described the relationship of the primary and secondary reactions basically as shown in figure 8.

When light enters the eye a photosensitive element (S) is decomposed and becomes opsin (O) and retinene (R). The decomposition of the S will also form the substance M which then decomposes into substance N. The decomposition of the element S, Fry theorizes, will also become an element W. The element W is formed into another substance Z by part of the energy produced by the decomposition of S. This process of dwindling away gives off energy which decomposes M and generates nerve impulses. The rate of dwindling of Z in the dark adapted eye is, according to Fry,

$$\frac{\mathrm{d}Z}{\mathrm{d}T} = -\mathrm{K}_5 Z \qquad (2.4)$$

where

 X_5 is a constant





Z is the rate of dwindling of substance M In Fry's report, however, he states that in his experiments the positive afterimage has dwindled down to the measurement of about .01 troulands it will tend to disappear and then reappears as a negative afterimage. The negative afterimage will last at the most about eight minutes.
CHAPTER III

DESIGN OF THE EXPERIMENT

During the course of the experiment five subjects tested using five different color systems. Each of the subjects were tested using a Cathode Ray Oscilloscope having a green luminescence dot, with the color of the grid being varied by placing various filters over the screen. The test consisted of an unfiltered non dark-adapted control run, and the various filter colors of blue, white, red, orange-red, having a dark adaption period and a glare included. The subjects were run in accordance with the chart shown in figure 8. The subjects number is shown at the right and the run number along the top, with the color for that subject-run given inside the block.

Subject

Run

	I	II	III	IV	V
001	U. S.	CR	В	Ŗ	W
002	R	B	U	W	OR
003	OR	W	R	В	U
00 <u>L</u>	W	R .	62 -	ប	В
005	В	U	W	OR	R

where

- B is the blue filtered light
- OR is the orange-red filtered light
- W is the unfiltered light with a glare and dark adaption
- U is the unfiltered light without a glare with no dark adaption
- R is the red filtered light

Figure 9. Layout for the Run Colors.

The Experimental Apparatus

The subjects station includes the Cathode Ray Oscilloscope, control stick, buzzer, and the glare source. The subject is seated approximately 20 inches in front of the glare source, which is shown on top of the oscilloscope in figure 10. At the subjects right hand is the control stick which the subject can move to control the position of the dot on the oscilloscope screen. The ouzzer which is controlled by the Analog computer will be set off when the dot is one unit of deviation off from the center of the grid. This is essentially a difference of potential of approximately 1.5 volts between the dots position and the zeroed position of the dot.

The oscilloscope which is essentially controlled by the Analog computer, displays a cross plot of two random varying voltages. The display of these two varying lines



Figure 10. Subject's Position Oscilloscope and Glare Source.

results in a dot which will more randomly in both the vertical and the horizontal planes.

The glare source is an external circuit which is controlled only by the operator. When the operator places comparator button 104 high a timer will be energized allowing the headlamps to remain on for approximately five seconds. After the end of the five seconds the timer will turn off the headlamps and recycle for the next glare signal to be initiated by the operator.

The Analog Computer

The EAI 680 Analog Computer used in this study supplied the random number generators, integrators, the summers, and the time ramp generators. The Analog computer patching diagram shown in figure 11 provided most of the necessary trunk lines and hardware needed to perform the test runs. Two random varying number generators were used to form two random varying lines which when cross plotted formed the moving dot which the subject was to control. This dot was then displayed on the master control screen and on the subjects screen, as shown in figure 12. The moving dot can be seen in this figure just slightly above the center of the screen. The cross plotting of lines is controlled by the panel to the right and below the master control screen. The mode controls are located below the master control panel, as shown in figure 13. This provides the initial condition and operate modes for the Analog computer allowing the computer to run at the desired speed, to hold, or to perform the initial setup of the system. The push buttons and comparator control button are on the master control panel. To the right of the master control panel in figure 13 is the patch board in which the circuit of figure 11 is patched into the computer. This part of the





Figure 12. Master Control Screen and Crossplot Controls.



Figure 13. Master Control Fanel and Patch Board.

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master control panel also contains the logic circuits and the inputs for the trunk lines to the subjects station, as well as, the control and sense lines which go to the digital portion of the hybrid computer system. The EAI 600 Pacer Computer

Included in Appendix III is the EAI Pacer program which controls the Analog computer through a special set of hybrid linkage routines. The program when called from disk will first read in all values to be set into the potentiometers of the Analog computer. At this point a block of instructions is printed on the cathode ray tube shown in figure 14. The Pacer shown in figure 15 will then set all the potentiometers used in the experiment to the values entered through the data statement. The Facer program then will initialize the data arrays and set the initial conditions of the integrators to zero. At this point the experimental apparatus is ready to be placed into operate and the test runs are ready to start. After the operator starts the test run the Pacer will wait for a pulse to come from comparator 99 of the Analog computer. When this comparator sends a high pulse to the Pacer the values of the time ramp generator, and the values of the galvanic skin response are read into a storage array. The Pacer will then reset all the initial conditions of the integrators to zero and place the integrators back into the



Figure 14. EAI 600 Pacer, Cathode Ray Tube and Keyboard.



Figure 15. The EAI 600 Facer Console. ./

operate mode. The Pacer will then wait until Comparator 99 sends a high pulse to the Pacer. At this point the Pacer will then take the required readings and reset the integrators. This will continue throughout the experiment. Comparator 99 essentially measure the cumulative amount of error and checks this error against a preset level of error. At the end of the experimental run the Pacer will calculate the mean and standard deviation of both the time ramp generator values and the galvanic skin response in blocks of ten and for the entire run. At this point the Pacer will plot the time ramp values on the Cathode Ray Tube of the Pacer keyboard.

The Experimental Procedure

At the beginning of the experimental run each subject received a short briefing on the system and what to expect during the course of the experiment. At this time the subject was given a copy of the instructions contained in Appendix I to read, the test room was closed, and the subject began the required dark adaption time of approximately thirty minutes. The comparitor button 74 which will ring the buzzer and signal to the subject to begin was rang. At this time the Analog system is placed into the operate mode and the subject begins his two minute practice period. After two minutes of operation the Analog computer is put into the initial condition mode for fifteen seconds. This

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operate mode. The Pacer will then wait until Comparator 99 sends a high pulse to the Pacer. At this point the Pacer will then take the required readings and reset the integrators. This will continue throughout the experiment. Comparator 99 essentially measure the cumulative amount of error and checks this error against a preset level of error. At the end of the experimental run the Pacer will calculate the mean and standard deviation of both the time ramp generator values and the galvanic skin response in blocks of ten and for the entire run. At this point the Pacer will plot the time ramp values on the Cathode Ray Tube of the Pacer keyboard.

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At the beginning of the experimental run each subject received a short briefing on the system and what to expect during the course of the experiment. At this time the subject was given a copy of the instructions contained in Appendix I to read, the test room was closed, and the subject began the required dark adaption time of approximately thirty minutes. The comparitor button 74 which will ring the buzzer and signal to the subject to begin was rang. At this time the Analog system is placed into the operate mode and the subject begins his two minute practice period. After two minutes of operation the Analog computer is put into the initial condition mode for fifteen seconds. This

signals the subject that the practice is over and the test run is ready to begin. At this time, push button number 1 is set low and the Analog computer is placed into the optic mode and the test run is started. At periodic intervals into the run a glare is initiated by pressing push button 2 high, which resets the time ramp generator to zero and starts the counter going again. The Comparator button 104 is then pressed high which activates the glare source which consists of two automotive type headlights. The glare source is coupled to a timer which allows the headlamps to remain on for five seconds and then the headlamps are turned off. During this time the Pacer will automatically take a reading when the level of error reaches a preset value on the Comparator 99. Whenever this Comparator is tripped the Pacer records the data point number, the value of the time ramp, and galvanic skin response value.

This process of glare, recovery, and data taking is repeated at specified times into the run, with the times between flashes remaining constant for each subject's run.

At the end of the complete testing series the subject was asked to fill out the post run questions on the data sheet contained in Appendi II.

C H A P T E R IV

ANALYSIS OF EXPERIMENTAL DATA

In addition to the recording of data on a printout the data of the experiment may also be recorded on paper tape for later compilation or a brush chart recorder as shown in figure 16. The four channels of the brush chart recorder, depicted in figure 16, contain in channel five the vertical error signal, in channel six the horizontal error, in channel seven the values of Comparator 99 and in channel eight the values of the time ramp generator. The tick marks at the bottom of the figure are graduated in increments of one second per tick mark. In this portion of the strip chart the line at point A indicates the point at which a glare is introduced. It is interesting to note that at this point the subject lost control of the dot and, as a result, the values of the time in channel eight were extremely small. The responses shown in figure 16 are typical of all the subjects that were tested.

The data was ranked, then plotted on probability paper. This plot closely approximates a straight line. This indicates that the data is essentially from a normal population. The same procedure was repeated for the control



runs of each of the subjects.

The data shown in Table 2 is a condensed version of the total data of all of the runs for each subject. The values inside the blocks are the summation of the time values of the first four data points for each flash of the run.

When the means of the data are found as shown in Table 3 and plotted as in Figure 17, it can be seen that the blue filtered light system was one of the better colors for the time to reach the level of error which was checked by Comparitor 99. The subjects also stated that the blue lighting system produced less cyestrain and fatigue as the run progressed.

The AMDAL 470 computer utilizing the Statistical Analysis System was used for data analyzations and output was set in the form of an Analysis of Variance (ANOVA) shown in Table 4. The model that was employed was

 $Y_{ijk} = A^{c} + S_{i} + C_{j} + S_{i}^{*C}_{j} + \varepsilon_{ijk}^{o}$

where

^Y ijk	is the data point taken at the flash
ju	is the mean of the data
Si	is the error due to the subject
сj	is the error due to the colors
s _i *c _j	is the error due to the subject color interaction

	1	2	3	4	5	_
с. •₩.	38.164 51.952 56.488 53.656	65.296 77.014 74.759 78.674	54.962 64.654 54.865 48.663	46.271 55.597 37.152 56.897	26.546 38.556 35.254 35.100	
R Color (cj)	39.630 48.108 35.605 50.248	76.410 64.512 71.74 1 58.069	58.301 58.538 62.933 61.974	42.737 56.797 56.994 54.883	24.981 36.566 39.416 47.735	_
В	35.962 49.359 56.133 56.622	77.289 67.212 85.803 78.479	81.916 74.093 79.652 89.789	55.237 58.850 76.954 64.221	49.830 54.047 27.527 39.710	
OR	40.277 41.251 28.714 42.982	72.912 68.204 62.946 62.640	77.209 66.271 61.682 60.590	49.066 32.697 6.507 59.161	40.711 57.190 79.105 45.276	
		•				

Subject (S_i)

 $\mathbb{E}[\mathbb{E}_{i}^{(n)}] = \mathbb{E}[\mathbb{E}_{i}^{(n)}] = \mathbb{E}[\mathbb{E}_{i}^{(n)}] = \mathbb{E}[\mathbb{E}_{i}^{(n)}]$

Table 2. Reduced table of data.

		Sub je	ct (S _i)		
	<u> </u>	· 2	3	4	5
¥	12.516	18.484	13.946	12.244	8.466
R	10.849	16.920	13.109	13.984	9.293
В	12.379	16.975	20.340	15.953	10.694
OR	10.208	16.737	16.609	9.214	11.117

Table ?. Means of reduced table of data.

1

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ANALYSIS OF VARIANCY FOR THE VARIABLE F

SOURCE	DF	SS	MS	F VALUE
SI	4	12558.5202	006-6-9 ود 1 د	30.13581
CJ	3	1166.6981	7569.885	286 و. و.
SI#CJ	12	2691.6375	224. 70729	2.15.02
RESIDUAL	60	6250.9624	104.15271	
CORRECTED TOTAL	79	22667.8682	286.97504	· .

Table L. Glare Recovery ANOVA.

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Fijk is the error due to the residual. The use of this model indicated that the effect of the colors of the experiment should be included in the model. The F statistic which resulted due to the color error term was found to fall between alpha values of .025 and the .010 levels. The next object was to determine if one color overall was found to be significantly different from the rest with respect to the time to recovery after the four flashes.

The analysis of the individual colors was conducted first through the use of the Scheffe Test, and then through the use of the Newman-Keuls Range Test.

In order to conduct the Scheffe Test the totals over the subjects and the individual data points was found. The values of these totals are 1050.520, 1046.176, 1258.679, and 1022.205 for white, red, blue, and the orange-red filtered light respectively. At this point a contrast between the blue and red filtered light systems was found. By the use of these contrasts it was found that the times for the blue filtered light was significantly longer than the red filtered light, and significantly larger than the combination of the red, white, and the orange-red.

The Newman-Keuls Range Test similarly indicated at the 95% confidence level that the blue filtered light was significantly better than the red, white, and the orange-red

light. The test however indicated that the white light was not significantly different from that of the red light, and that both the red and the white light systems were better than the orange-red filtered light.

CHAPTER IV

CONCLUSIONS AND RECOMMENDATIONS

Through out the testing of the subjects it was noted that while the subjects were all of the normal population one of the subjects, who held a current pilot's license, did considerably better than the other subjects. This would tend to explain part of the large variation in the mean square error of the ANOVA for the subjects given in Table 4. It is possible that should future tests be run the subjects have equivalent pilot experience.

Another problem that was encountered was that several times a subject would tend to look below the glare source and more to the bottom of the display screen. In this experiment the location of the glare source with respect to the display screen of the oscilloscope was approximately 22° above the display screen. The results of the experiment could also have been affected by this equipment location problem in which the subjects were forced to look below the glare source instead of directly into the area of the glare. In the original configuration of the experiment a meater was to have been built which would have been composed of two millivolt meaters. This would

have been smaller and would have allowed the glare source to be moved closer to the display screen.

Under the assumptions made in the experiment it was shown that the blue filtered light tended to have a significantly greater time before the reset error level was reached. The level of error, although kept at a constant throughout the experiment, could have been varied by changing the value of a potentiometer in the Pacer program. This would yield a higher sensitivity of the Comparitor. The selection of the blue filtered light also tended to point out the fact that all the subjects preferred the blue filtering system over the three other colors used in the experiment. The red filtered light, which is similar to the lighting systems that are used today, was reported several times to be fatiguing and cause eyestrain during . the glare periods.

Based on the results of this study it would appear that because the greatest portion of today's aviation activities are using the instrument flying techniques, the best color selection for the instrument lighting system would be that of a blue nature. However, appropriate further tests of how the blue lighting would effect the pilots dark adaption and his ability to go from the instrument flying conditions to that of a visual controlled flight would be necessary in order to select the best color

17-

system for the flight.

As found in Chapter 3 there was no signifance between the red and the white lighting system. In the case of a mixture of an instrument flight and a visual flight one of these could be selected. One possibility would be that the pilot could select between the colors which would be appropriate for his expected flight condition.

APPENDIX I

INSTRUCTIONS

At the beginning of the experiment you will be given thirty minutes in which to become accustomed to the control of the equipment.

The control stick at your right hand controls the movement of the dot on the screen. If you move the stick back the dot moves up, if you move the stick forward the dot will move down, moving the stick to the right and left will cause the dot to move in that direction. Your objective is to hold the dot on the cross hairs of the screen, or as close as you can.

At the end of your practice run you will be placed in a darkened room for about thirty minutes in order to allow your eyes to become dark adapted. After this time the buzzer will sound and you will be given two minutes of practice time, and then the operators will place the Analog computer into the initial condition mode for fifteen seconds. This will move the dot to the center of the screen and hold it there. At this time the machine will be placed into the operate mode and will begin taking data.

During the run there will be from two to five flashes, with each run lasting approximately thirty minutes. At the end of the run an operator will change the filters on the screen. You will then be given a short rest period to

readjust your eyes to the room and the next run will begin.

If you have any questions ask the operator at this time.

APPENDIX II

I. EN. 685 DATA SHEET

Subject Number	Sex
Name	Age
Date Tested	Does the Subject:
Time of Test	Wear Glasses
Amount of Practice Time	Wear Contact Lens
Practice Sample Mean	Smoke
Practice Standard Deviation	Drink
	if yes, when was last time
***************************************	***************************************
POST RUN QUESTI	ONS
Did you feel fatigued during a run	
If so, when	
What effect did the glare have	
What effect did the buzzer have	
Did you lose sight of the grid	
Did you lose sight of the dot	
If so, when	
Was any color better than the other _	
Best	
Worst	
************************************	********
COMMENTS :	

APPENDIX III

<u>____</u>

_____54__

JOB GLAREOUD EX.RTFOR GLAREOUD DIMENSIUN A1200,21 GLAREOUD UMENSIUN VALI01,PT101,VALUE(200),GSR(200) GLAREOUD LAREOUD GLAREOUD DATA PT(1),PT101,VALUE(200),GSR(200) GLAREOUD DATA PT(1),PT(2),PT(3),PT(4),PT(5),PT(6/4HP042, GLAREOUD DATA PT(1),PT(2),PT(3),PT(4),PT(5),PT(6/4HP042, GLAREOUD DATA PT(1),PT(2),PT(3),VAL(4),VAL(5),VAL(6)/.99995 GLAREOUD DATA VAL(1),VAL(7),VAL(3),VAL(4),VAL(5),VAL(6)/.99995 GLAREOUD DATA VAL(1),VAL(3),F5,.75/ GLAREOUD DATA VAL(1),VAL(3),F5,.75/ GLAREOUD DATA VAL(1),VAL(3),F6,.55/ GLAREOUD DATA VAL(1),VAL(3),F5,.75/ GLAREOUD CALL GSUTX(2,I EXR) GLAREOUD CALL GSUTX(2,I EXR) GLAREOUD CALL GSUTX(2,I EXR) GLAREOUD CALL GSUTX(2,I EXR)		55
EX.RTOR CLARE001 DIMENSIUN A(200,2) GLARE003 UNENSIUN VALIO,PTIIO,VALUE(200),GSR(200) (CLARE003 INTEGER.HPT GLARE004 GLARE005 GLARE005 DATA DT(1),PT(2),PT(3),PT(4),PT(5),PT(6)/4HP042, GLARE006 DATA PT(1),PT(3),PT(4),PT(5),PT(6)/4HP042, GLARE006 DATA PT(1),PT(3),PT(4),PT(5),PT(6)/4HP042, GLARE006 DATA PT(1),PT(2),PT(3),PT(4),VAL(4),VAL(5),VAL(6)/.9999.5, GLARE007 DATA PL(1),VAL(1)/,VAL(3),VAL(4),VAL(5),VAL(6)/.9999.5, GLARE013 DATA VAL(1)/,VAL(3)/.75,.75/ GLARE014 DATA VAL(1)/,VAL(3)/.75,.75/ GLARE016 DATA VAL(1)/,VAL(3)/.75,.75/ GLARE017 DATA VAL(1)/.70010/ GLARE018 CALL QSUTX(2,.FERR) GLARE016 DATA VAL(1)/.VAL(10)/.75,.75/ GLARE017 DATA VAL(1)/.75,.75/ GLARE018 CALL QSUTX(2,.FERR) GLARE017 CALL QSUTX(2,.FERR) GLARE018 CALL QSUTX(2,.FERR) GLARE017 GLARE018 GLARE0207 TYPE15 GLARE021 TYPE15 GLARE022 TYPE15 GLARE023 TYPE35		
EX.RTOR CLARE001 DIMENSIUN A(200,2) GLARE003 UNENSIUN VALIO,PTIIO,VALUE(200),GSR(200) (CLARE003 INTEGER.HPT GLARE004 GLARE005 GLARE005 DATA DT(1),PT(2),PT(3),PT(4),PT(5),PT(6)/4HP042, GLARE006 DATA PT(1),PT(3),PT(4),PT(5),PT(6)/4HP042, GLARE006 DATA PT(1),PT(3),PT(4),PT(5),PT(6)/4HP042, GLARE006 DATA PT(1),PT(2),PT(3),PT(4),VAL(4),VAL(5),VAL(6)/.9999.5, GLARE007 DATA PL(1),VAL(1)/,VAL(3),VAL(4),VAL(5),VAL(6)/.9999.5, GLARE013 DATA VAL(1)/,VAL(3)/.75,.75/ GLARE014 DATA VAL(1)/,VAL(3)/.75,.75/ GLARE016 DATA VAL(1)/,VAL(3)/.75,.75/ GLARE017 DATA VAL(1)/.70010/ GLARE018 CALL QSUTX(2,.FERR) GLARE016 DATA VAL(1)/.VAL(10)/.75,.75/ GLARE017 DATA VAL(1)/.75,.75/ GLARE018 CALL QSUTX(2,.FERR) GLARE017 CALL QSUTX(2,.FERR) GLARE018 CALL QSUTX(2,.FERR) GLARE017 GLARE018 GLARE0207 TYPE15 GLARE021 TYPE15 GLARE022 TYPE15 GLARE023 TYPE35	.JOR	GLAREODO
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DIMENSION VALID:,PTID:,VALUE(201,GSR(200) CLARE003 INTEGER.HPT GLARE004 LOGICAL LUGVAL,SFT,RESET GLARE005 DATA PTID:,PTID:,PTID:,PTID:,PTID:/HD0/HP042, GLARE006 DATA PTID:,PTID:,PTID:,PTID:/HD0/HP042, GLARE007 CLARE008 CLARE008 DATA PTID:/APD03.HP003.HP003.HP02/ GLARE009 DATA VAL(1).VAL(2).VAL(3).VAL(4).VAL(5).VAL(6)/.9999.S. GLARE010 1.S.:01999925/ GLARE014 DATA VAL(1).VAL(2).VAL(3).VAL(4).VAL(5).VAL(6)/.9999.S. GLARE013 DATA VAL(1).VAL(2).VAL(3).VAL(4).VAL(5).VAL(6)/.9999.S. GLARE016 DATA VAL(1).VAL(2).VAL(3).VAL(4).VAL(5).VAL(6)/.9999.S. GLARE017 DATA VAL(1).VAL(2).VAL(3).VAL(4).VAL(5).VAL(6)/.9999.S. GLARE018 DATA VAL(1).VAL(2).VAL(3).VAL(4).VAL(5).VAL(6)/.9999.S. GLARE017 DATA VAL(1).VAL(2).VAL(3).VAL(4).VAL(5).VAL(6)/.9999.S. GLARE018 DATA VAL(1).VAL(1).VAL(3).VAL(4).VAL(5).VAL(6)/.9999.S. GLARE017 CLARE017 GLARE018 GLARE018 DATA VAL(1).VAL(1).VAL(1).VAL(5).VAL(4).VAL(5).VAL(6)/.9999.S. GLARE018 DATA VAL(1).VAL(1).VAL(1).VAL(5).VAL(4).VAL(5).VAL(6)/.9999.S. GLARE018 CAL CSUN		GLARE002
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DATA ICARO, IPRINT, ITV-IK8076-16-1.27 DATA PT(1), PT(2), PT(3), PT(4), PT(6)/PT(6)/4HP042, GLAREOOT DATA PT(1), PT(B)/4HP06, 4HP107/ GLAREOOT DATA PT(1), PT(B)/4HP06, 4HP107/ GLAREOOT DATA VAL(1), VAL(2), VAL(4), VAL(5), VAL(6)/, 9999, 5, GLAREOID DATA VAL(1), VAL(3), 75, 75/ GLAREOIT DATA VAL(1), VAL(3), 75, 75/ GLAREOIT DATA VAL(1), VAL(3), 75, 75/ GLAREOIT GLAREOIT DATA VAL(1), VAL(3), VAL(4), VAL(5), VAL(6)/, 9999, 5, GLAREOIT GLAREOIT DATA VAL(1), VAL(3), VAL(4), VAL(5), VAL(6)/, 9999, 5, GLAREOIT GLAREOIT DATA VAL(1), VAL(3), VAL(4), VAL(5), VAL(6)/, 9999, 5, GLAREOIT DATA VAL(1), VAL(1), 75, 75/ GLAREOIT GLAREO		
DATA PT(12), PT(2), PT(3), PT(6), PT(6), PH(6), PH(9042, GLAREOOB 14HP043, 4HP063, 4HP063, 4HP064, HP100, 4HP102/ GLAREOOB DATA PT(7), PT(8), PANDOA, 4HP069/ GLAREOOB DATA PT(7), PT(8), PANDOA, 4HP069/ GLAREOOB DATA PT(7), PT(8), PANDOA, 4HP069/ GLAREOOB DATA PT(12), PT(8), PANDOA, 4HP069/ GLAREOOB DATA PT(12), PAL(7), VAL(7), VAL(4), VAL(5), VAL(6)/, 9999, .5, GLAREOOB DATA VAL(1), VAL(7), VAL(7), VAL(4), VAL(5), VAL(6)/, 9999, .5, GLAREOOB DATA VAL(1), VAL(3), VAL(3), VAL(4), VAL(5), VAL(6)/, 9999, .5, GLAREOIB DATA VAL(1), VAL(3), VAL(3), VAL(4), VAL(5), VAL(6)/, 9999, .5, GLAREOIB DATA VAL(1), VAL(3), VAL(3), VAL(4), VAL(5), VAL(6)/, 9999, .5, GLAREOIB DATA VAL(1), VAL(3), VAL(3), VAL(4), VAL(5), VAL(6)/, 9999, .5, GLAREOIB DATA VAL(1), VAL(3), VAL(3), VAL(4), VAL(5), VAL(6)/, 9999, .5, GLAREOIB DATA VAL(10), VAL(3), VAL(3), VAL(4), VAL(5), VAL(6)/, 9999, .5, GLAREOIB DATA VAL(10), VAL(3), VAL(3), VAL(4), VAL(5), VAL(6)/, 9999, .5, GLAREOIB DATA VAL(10), VAL(3), VAL(3), VAL(3), VAL(5), VAL(6)/, 9999, .5, GLAREOIB DATA VAL(10), VAL(1), TS, .75, GLAREOIB GLAREOIB DATA VAL(10), CANDS <td></td> <td></td>		
16HPD633.4HPD033.4HPD02, AHPD02, GLARE009DATA PT(7),PT(8)/4HPD04, AHPD09, GLARE009DATA VAL(1),VAL(2),VAL(3),VAL(4),VAL(5),VAL(6)/.9999,5, GLARE001DATA VAL(1),VAL(3),VAL(3),VAL(4),VAL(5),VAL(6)/.9999,5, GLARE011L1.5,01.9999,257DATA VAL(7),VAL(3),C30,VAL(4),VAL(5),VAL(6)/.9999,5, GLARE014DATA VAL(7),VAL(3),C30,VAL(4),VAL(5),VAL(6)/.9999,5, GLARE016DATA VAL(1),VAL(3),C30,VAL(4),VAL(5),VAL(6)/.9999,5, GLARE016DATA VAL(1),VAL(3),C30,VAL(4),VAL(5),VAL(6)/.9999,5, GLARE016DATA VAL(1),VAL(3),C30,VAL(4),VAL(5),VAL(6)/.9999,5, GLARE016DATA VAL(1),VAL(3),C30,VAL(4),VAL(4),VAL(5),VAL(6)/.9999,5, GLARE016DATA VAL(1),VAL(3),C30,VAL(4),VAL(4),VAL(5),VAL(6)/.9999,5, GLARE016DATA VAL(1),VAL(3),C30,VAL(4),VAL(4),VAL(5),VAL(6)/.9999,5, GLARE016DATA VAL(1),VAL(3),C30,VAL(4),VAL(4),VAL(5),VAL(6)/.9999,5, GLARE016DATA VAL(1),VAL(7),VAL(1),C30,VAL(4),VAL(5),VAL(6)/.9999,5, GLARE016DATA VAL(1),VAL(7),VAL(3),C30,VAL(4),VAL(5),VAL(6)/.9999,5, GLARE016DATA VAL(1),VAL(7),VAL(3),C30,VAL(4),VAL(5),VAL(6)/.9999,5, GLARE016DATA VAL(1),VAL(1),C30,VAL(4),VAL(5),VAL(6)/.9999,5, GLARE016DATA VAL(1),VAL(1),C30,VAL(4),VAL(5),VAL(6)/.9999,5, GLARE016CARE016CARE016CARE017GLARE017GLARE018CAL GSUTK(1), GARGATYPE 515GLARE019GLARE019GLARE019GLARE019GLARE014GLARE035GLARE036TYPE 515GLARE036GLARE037GLARE038GLARE038GLARE039GLARE039GLARE		+
DATA PT137, PT181/44P004, 44P009/ DATA PT191/44P040/ DATA PT191/44P040/ DATA VAL(1)/VAL(3), VAL(4), VAL(5), VAL(6)/.9999.5, GLAREO10 DATA VAL(1)/VAL(3), VAL(4), VAL(5), VAL(6)/.9999.5, GLAREO11 GLAREO13 DATA VAL(1)/VAL(3), VAL(4), VAL(5), VAL(6)/.9999.5, GLAREO13 DATA VAL(1)/VAL(1)/VAL(4), VAL(4), VAL(5), VAL(6)/.9999.5, GLAREO13 DATA VAL(1)/VAL(3), VAL(4), VAL(4), VAL(6)/.9999.5, GLAREO13 DATA VAL(1)/VAL(1)/VAL(4), VAL(4), VAL(5), VAL(6)/.9999.5, GLAREO13 GLAREO13 GLAREO13 GLAREO14 GLAREO14 GLAREO15 GLAREO26 TYPE15 GLAREO26 TYPE15 GLAREO27 TYPE15 GLAREO27 TYPE 315 FORMAT(30H PLACE IN 10N, FJSH BUTTON 4 OFF) GLAREO23 GLAREO23 GLAREO23 GLAREO23 GLAREO23 GLAREO24 TYPE 415 GLAREO30 GLAREO31 GLAREO31 GLAREO32 GLAREO31 GLAREO32 GLAREO31 GLAREO33 GLAREO34 GLAREO32 GLAREO33 GLAREO34 GLAREO34 GLAREO34 GLAREO34 GLAREO34 GLAREO34 GLAREO34 GLAREO34 GLAREO34 GLAREO35 GLAREO35 GLAREO36 GLAREO36 GLAREO36 GLAREO36 GLAREO37 GLAREO36 GLAREO37 GLAREO37 GLAREO37 GLAREO37 GLAREO38 GLAREO38 GLAREO38 GLAREO39		
LDATA PILOJ/AHPOAO/ DATA VAL (1),VAL(2),VAL(3),VAL(4),VAL(5),VAL(6)/.9999,.5, GLAREO11 LJ.5.01.9999,.25/ GLAREO13 DATA VAL(7),VAL(3).75,.75/ GLAREO14 DATA VAL(7),VAL(3).75,.75/ GLAREO14 DATA VAL(1).2.0300/ GLAREO14 DATA PILOJ/AHPIO8/ GLAREO16 GLAREO16 GLAREO17 GLAREO16 GLAREO17 GLAREO18 GLAREO18 GLAREO18 GLAREO19 GLAREO19 GLAREO19 GLAREO19 GLAREO19 GLAREO19 GLAREO19 GLAREO19 GLAREO19 GLAREO19 GLAREO21 GLAREO21 GLAREO22 TYPE15 SFORMAT(3)H INSTRUCTIONS TYPE 215 SFORMAT(4)H SET PUSH BUTTON 1 UN, FUSH RUTTON 4 OFF } GLAREO22 TYPE 315 SFORMAT(4)H PLACE IN 10**6, AND RUN MODE) TYPE 315 SFORMAT(3)H PLACE IN 10**6, AND RUN MODE) TYPE 315 SFORMAT(3)H PLACE IN 10**6, AND RUN MODE) TYPE 315 SFORMAT(3)H PLACE IN 10**6, AND RUN MODE) TYPE 325 GLAREO22 GLAREO23 GLAREO33 CS.FORMAT(3)H FUACE IN 10**6, AND RUN PLACE PUSH BUTTON 4 OFF } GLAREO30 GLAREO32 GLAREO33 CS.FORMAT(3)H PLACE IN 10**6, AND RUN PLACE PUSH BUTTON 4 ON) GLAREO33 CS.FORMAT(3)H FUACE INTO NORMAL AND SECONDS.) SFORMAT(3)H FUACE INTO NORMAL AND SECONS.) SFORMAT(3)H FUACE INTO NO		
DATA VAL(1),VAL(2),VAL(3),VAL(4),VAL(5),VAL(6)/.9999,.5, GLAREOI 1.5.*.01,*.9999,.5/ GLAREOI DATA VAL(1),VAL(3)/.75,.75/ GLAREOI DATA VAL(1),VAL(3)/.75,.75/ GLAREOI DATA VAL(1),VAL(3)/.75,.75/ GLAREOI DATA VAL(1)/.0010/ GLAREOI CALL GSUTKI2FALSE./ GLAREOI CALL GSUTKI2FALSE./ GLAREOI CALL GSUTKI2FALSE./ GLAREOI CALL GSUTKI2FALSE./ GLAREOI CAL GSUTKI2FALSE./ GLAREOI CAL GSUTKI2FALSE./ GLAREOI GLAREOI GLAREOI CAL GSUTKI2FALSE./ GLAREOI CAL GSUTKI2FALSE./ GLAREOI TYPE 215 GLAREOI<		-
1.5.,01,.9999,.25/ GLAR-012 DATA VAL(1)/.010/.000/ GLAR-013 DATA VAL(1)/.0010/ GLAR-014 DATA VAL(1)/.0010/ GLAR-015 DATA SET,RESET/.TRUE,FALSE./ GLAR-017 HPT=40 GLAR-017 CALL GSULYK(2., IERR) GLAR-017 CALL GSULYK(2., IERR) GLAR-021 CALL GSULYK(2., IERR) GLAR-021 CALK GSULYK(2., IERR) GLAR-022 TYPE115 GLAR-022 TYPE115 GLAR-022 TYPE 215 GLAR-022 TYPE 315 GLAR-022 TYPE 315 GLAR-022 TYPE 315 GLAR-022 S.FORMAT(3H) PLACE IN 10**6, AND RUN MODE J GLAR-022 TYPE 315 GLAR-023 S.FORMAT(3HURN (M) SCOPE AND SELECT CROSSPLOT) GLAR-023 S.FORMAT(4H SHPLACE COUNTERS AND MUNOSTABLES AT DESTRED VALUE) GLAR-032 TYPE 315 GLAR-032 GLAR-033 S.FORMAT(5AHURN (M) SCOPE AND SELECT CROSSPLOT) GLAR-032 TYPE 525 GLAR-032 GLAR-033 S.FORMAT(5AHURA (COUNTERS AND MUNOSTABLES AT DESTRED VALUE) GLARE033 TYPE 525		
DATA VAL(3) //6300/ DATA PTILOJ/4HP108/ CLAREO14 CLAREO15 CLAREO15 CLAREO17 CLAREO17 CLAREO17 CLAREO19 CALL GSUYIN(IEKR,68D) CALL GSUYIN(IEKR,68D) CALL GSUYIN(IEKR,68D) CALL GSUYIN(IEKR,68D) CALL GSUYIN(IEKR,68D) CALL GSUYIN(IEKR,68D) CALL GSUYIN(IEKR,68D) CLAREO21 TYPE115 IS FORMAT(33H INSTRUCTIONS) CLAREO22 TYPE115 IS FORMAT(33H INSTRUCTIONS) CLAREO23 IS FORMAT(33H INSTRUCTIONS) CLAREO24 TYPE 315 IS FORMAT(41H SET PUSH BUTTON 1 ON, PJSH BUTTON 4 OFF) CLAREO23 TYPE 415 IS FORMAT(35H PLACE IN 10**6, AND RUN MODE) CLAREO23 TYPE 415 IS FORMAT(35H PLACE IN 10**6, AND RUN MODE) CLAREO23 TYPE 415 IS FORMAT(35HTURN (N SCOPE AND SELECT CROSSPLOT) CLAREO23 CLAREO23 CLAREO23 CLAREO23 CLAREO31 CLAREO31 CLAREO31 CLAREO33 CLAREO34 CLAREO34 CLAREO34 CLAREO35 CLAREO35 CLAREO35 CLAREO36 CLAREO36 CLAREO36 CLAREO37 CLAREO36 CLAREO37 CLAREO37 CLAREO37 CLAREO37 CLAREO37 CLAREO37 CLAREO38 CLAREO38 CLAREO39 CLAREO40 CLARE		
DATA PTILO//4PID0/ DATA_VALLO//0010/ DATA_VALLO//0010/ GLARE018 GLARE016 GLARE017 HPT=40 GLAL GST/.TRUE.,.FALSE./ HPT=40 GLARE019 GLARE019 GLARE019 GLARE019 GLARE019 GLARE020 INSTRUCTION CARDS GLARE020 INSTRUCTION CARDS GLARE022 TYPE115 GLARE022 SFORMAT(33H INSTRUCTIONS } GLARE022 SFORMAT(33H INSTRUCTIONS } GLARE023 SFORMAT(33H PLACE IN 10**6, AND RUN MODE.) FORMAT(30H PLACE COUNTERS AND MONOSIABLES AT DESIRED VALUE) GLARE023 SFORMAT(32H TURN ON SCOPE AND SELECT CROSSPLOT) GLARE031 SFORMAT(32H TURN ON SCOPE AND SELECT CROSSPLOT) GLARE032 SFORMAT(32H TURN ON SCOPE AND SELECT CROSSPLOT) GLARE033 SFORMAT(32H TURN ON SCOPE AND SELECT CROSSPLOT) GLARE034 SFORMAT(32H TURN ON SCOPE AND SELECT CROSSPLOT) GLARE035 SFORMAT(32H TURN ON SCOPE AND SELECT CROSSPLOT) GLARE036 SFORMAT(32H TURN ON SCOPE AND SECONDS.) SFORMAT(32H TURN ON SCOPE AND SELECT CROSSPLOT) GLARE037 SFORMAT(32H TURN ON SCOPE AND SELECT CROSSPLOT) GLARE038 SFORMAT(32H TURN ON SCOPE AND SELECT CROSSPLOT) GLARE039 SFORMAT(32H TURN ON SCOPE AND SELECT CROSSPLOT) GLARE040 SCALL GSULYA(33, 1F YUU HAVE DURE THIS TYPE A 1) GLARE040 SCALL GSULYA(3, 1, 1FRA) GLARE040 SCALL GSULYA(2, 1, 1, 1FRA) SCALECACE SCALLARDA SCALL GSULYA(2, 1, 1, 1FRA) SCALECACE SCALLARDA SCALL GSULYA(2,		
DATA.VAL1017.00107GLARE016DATA SET,RESET,TRUE.,FALSE./GLARE018CALL SET,RESET,TRUE.,FALSE./GLARE018CALL GSDLYK(2., IERR)GLARE020INSTRUCTION CARDSGLARE02116CONTINUEGLARE02315. FORMAT(33H INSTRUCTIONS)GLARE024TYPE 115GLARE02515. FORMAT(33H INSTRUCTIONS)GLARE02615. FORMAT(30H PLACE IN 10**6, AND RUN MODE)GLARE02715. FORMAT(3)H PLACE IN 10**6, AND RUN MODE)GLARE02815. FORMAT(3)H PLACE COUNTERS AND MONOSIARLES AT DESIRED VALUE)GLARE03115. FORMAT(3)H PLACE COUNTERS AND MONOSIARLES AT DESIRED VALUE)GLARE03325. FORMAT(3)H PLACE INTO NORMAL AND. SECGNDS)GLARE03417 WFE 515GLARE03626. FORMAT(2)H FYOU HISH TO STOP RUN PLACE PUSH BUTTON 4 ON)GLARE03715. FORMAT(2)H FYOU HISH TO STOP RUN PLACE PUSH BUTTON 4 ON)GLARE03816. FORMAT(2)H IF YOU HAVE DONE THIS TYPE A 1)GLARE03917 FUE 715GLARE034GLARE03416. GUNTINUEGLARE044GLARE03417 FUE AT 1116-216+116GLARE03416. GUNTINUEGLARE04417 GUNRIF(1),VAL(1),IERR)GLARE04417 GUNRIF(1),VAL(1),IERR)GLARE04417 GLARE045GLARE04417 GUNRIF(2), IERR)GLARE04518 GUNRIF(1),VAL(1),IERR)GLARE04419 GUNRIF(1),VAL(1),IERR)GLARE04519 GUNRIF(1),VAL(1),IERR)GLARE04519 GUNRIF(1),VAL(1),IERR)GLARE04519 GUNRIF(1),VAL(1),IERR)GLARE04519 GUNRIF(1),VA		
DATA SET, RESET/.TRUE., FALSE./GLAREOITHPT=40GLAREOITGALL GSHVIN(IERK, 680)GLAREOIDGALL GSULYR(2., IERR)GLAREO20INSTRUCTION CAROSGLAREO20INSTRUCTION CAROSGLAREO22TYPE115GLAREO2315FORMAT(33H INSTRUCTIONS)15FORMAT(41H SET PUSH BUTION 1 ON, FUSH BUTION 4 OFF)17/PE 215GLAREO2515FORMAT(30H PLACE IN 10**6, AND RUN MODE.)17/PE 315GLAREO2715FORMAT(30H PLACE IN 10**6, AND RUN MODE.)15FORMAT(30H PLACE COUNTERS AND MONOSTARLES AT DESIRED VALUE)16GLAREO3017/PE 515GLAREO3215FORMAT(48HPLACE COUNTERS AND MONOSTARLES AT DESIRED VALUE)16GLAREO3317/PE 525GLAREO3315FORMAT(52H WHEN YOU WISH TO STOP RUN PLACE PUSH BUTTON 4 ON)17/PE 715GLAREO3316FORMAT(52H WHEN YOU WISH TO STOP RUN PLACE PUSH BUTTON 4 ON)17/PE 715GLAREO3316GUAREO3417/PE 715GLAREO3517FORMAT(52H IF YUU HAVE DUNE THIS TYPE A 1)18GLAREO3419GLAREO3419GLAREO3119GLAREO3119GLAREO3119GLAREO3119GLAREO3119GLAREO3119GLAREO3219GLAREO3119GLAREO3219GLAREO3119GLAREO3119GLAREO3219GLAREO32 <td></td> <td></td>		
HPT=40GLAREO19CALL GSHYIN(TERK,680)GLAREO20CALL GSUYIN(T2.,TERR)GLAREO20INSTRUCTION CARDSGLAREO22TYPE115GLAREO22TYPE115GLAREO22TYPE 215GLAREO22TYPE 315GLAREO22TYPE 415GLAREO22TYPE 415GLAREO22TYPE 415GLAREO23S FORMAT(3)H PLACE IN 10**6, AND RUN MODE)GLAREO23TYPE 415GLAREO23TYPE 415GLAREO23S FORMAT(3)H PLACE IN 10**6, AND RUN MODE)GLAREO23TYPE 415GLAREO23S FORMAT(3)H PLACE COUNTERS AND MONOSTABLES AT DESTRED VALUE)GLAREO33S FORMAT(3)H PLACE_INTO NORMAL AND SECONDS.)GLAREO33TYPE 525GLAREO25GLAREO33S FORMAT(3)H PLACE_INTO NORMAL AND SECONDS.)GLAREO33TYPE 525GLAREO33GLAREO33S FORMAT(3)H PLACE_INTO NORMAL AND SECONDS.)GLAREO33TYPE 715GLAREO33GLAREO33S FORMAT(3)H F YOU HISH TO STUP RUN PLACE PUSH BUTTON 4 ON)GLAREO33TYPE 715GLAREO34GLAREO34C15 FORMAT(3)H F YOU HAVE DUNE THIS TYPE A 1)GLAREO34C16 CONTINUEGLAREO34GLAREO34C17 FORMAT(3)H F YOU HAVE DUNE THIS TYPE A 1)GLAREO34C16 CONTINUEGLAREO34GLAREO34C17 FORMAT(3)H F YOU HAVE DUNE THIS TYPE A 1)GLAREO34C16 CONTINUEGLAREO34GLAREO34C17 FORMAT(3)H F YOU HAVE DUNE THIS TYPE A 1)GLAREO34C18 CONTINUEGLAREO34GLAREO34		
CALL GSHYIN(IERK,680)GLARE01CALL GSUYK(2.,1ERR)GLARE020INSTRUCTION CARDSGLARE02116CONTINUEGLARE02116CONTINUEGLARE02116CONTINUEGLARE02116CONTINUEGLARE022TYPE115GLARE02515FORMAT(33H INSTRUCTIONS)GLARE026TYPE 215GLARE02715FORMAT(30H PLACE IN 10**6, AND RUN MODE)GLARE02715FORMAT(35HTURN (N SCOPE AND SELECT GROSSPLOT)GLARE02315FORMAT(45HPLACE COUNTERS AND MONOSTARLES AT DESTRED VALUE)GLARE03215FORMAT(45HPLACE COUNTERS AND MONOSTARLES AT DESTRED VALUE)GLARE03216FORMAT(55H WHEN YOU WISH TO STOP RUN PLACE PUSH BUTTON 4 ON)GLARE03515FORMAT(52H WHEN YOU WISH TO STOP RUN PLACE PUSH BUTTON 4 ON)GLARE03716FORMAT(52H WHEN YOU WISH TO STOP RUN PLACE PUSH BUTTON 4 ON)GLARE03717FORMAT(52H WHEN YOU WISH TO STOP RUN PLACE PUSH BUTTON 4 ON)GLARE03716FORMAT(52H IF YOU HAVE DUNE THIS TYPE A 1)GLARE03717FORMAT(52H WHEN YOU WISH TO STOP RUN PLACE PUSH BUTTON 4 ON)GLARE03717FORMAT(52H IF YOU HAVE DUNE THIS TYPE A 1)GLARE03717FORMAT(52H IF YOU HAVE DUNE THIS TYPE A 1)GLARE03817FORMAT(52H IF YOU HAVE DUNE THIS TYPE A 1)GLARE03417FORMAT(52H IF YOU HAVE DUNE THIS TYPE A 1)GLARE03418FORMAT(50H, COLL CURPTION C		
CALL GSDLYR(2., IERR) INSTRUCTION CARDS GLAREO22 TYPE15 GLAREO23 GLAREO23 GLAREO23 GLAREO23 GLAREO23 GLAREO23 GLAREO24 TYPE 215 FORMAT(31H INSTRUCTIONS) GLAREO25 IS FORMAT(31H SET PUSH BUTION 1 UN, FUSH BUTION 4 OFF) GLAREO25 IS FORMAT(31H PLACE IN 10**6, AND RUN MODE.) TYPE 315 FORMAT(35HTURN UN SCOPE AND SELECT CROSSPLOT) GLAREO27 IS FORMAT(35HTURN UN SCOPE AND SELECT CROSSPLOT) GLAREO30 TYPE 515 GLAREO32 GLAREO32 GLAREO33 CALL 05UPK 12.5 IS FORMAT(32H PLACE.INTO NORMAL AND SECUNDS.) TYPE 525 IS FORMAT(32H FLACE.INTO NORMAL AND SECUNDS.) TYPE 515 GLAREO35 GLAREO35 GLAREO35 GLAREO36 GLAREO37 GLAREO37 GLAREO38 GLAREO38 GLAREO38 GLAREO39 GLAREO39 GLAREO39 GLAREO39 GLAREO39 GLAREO39 GLAREO39 GLAREO39 GLAREO39 GLAREO39 GLAREO39 GLAREO39 GLAREO41 GLAREO41 GLAREO41 GLAREO45 GLAREO45 GLAREO46 GLAREO46 GLAREO47 GLAREO47 GLAREO47 GLAREO47 GLAREO48 GLAREO49 GLAREO41 GLAREO49 GLAREO4		
INSTRUCTION CAROS GLAREO21 16CONTINUE. GLAREO23 TYPE115 GLAREO23 15 FORMAT(33H INSTRUCTIONS) GLAREO25 15 FORMAT(3H SET PUSH BUTION 1 ON, FUSH RUTTON 4 OFF) GLAREO25 15 FORMAT(30H PLACE IN 10**6, AND RUN MODE) GLAREO27 15FORMAT(30H PLACE IN 10**6, AND RUN MODE) GLAREO23 15FORMAT(35HTURN ON SCOPE AND SELECT CROSSPLOT) GLAREO23 15FORMAT(45HPLACE COUNTERS AND MONOSTABLES AT DESTRED VALUE) GLAREO30 15FORMAT(45HPLACE COUNTERS AND MONOSTABLES AT DESTRED VALUE) GLAREO32 15FORMAT(50H WHEN YOU WISH TO STOP RUN PLACE PUSH BUTTON 4 ON) 17.YPE 615 GLAREO35 15FORMAT(50H WHEN YOU WISH TO STOP RUN PLACE PUSH BUTTON 4 ON) 17.YPE 715 GLAREO36 15FORMAT(52H IF YOU HAVE DUNE THIS TYPE A 1) GLAREO37 15FORMAT(52H IF YOU HAVE DUNE THIS TYPE A 1) GLAREO37 16GONTINUE GLAREO36 16GONTINUE GLAREO37 16GONTINUE GLAREO37 16GONTINUE GLAREO36 16GONTINUE GLAREO37 17GLAREO46 16GONTINUE GLAREO3 16GONTINUE GLAREO37 17GLAREO47 18GLAREO47 19GLAREO47 10GLAREO47 10GLAREO47 11GLAREO47 11GLAREO47 11GLAREO411EAF FHL MUMBER UF SURDECTS PREVIPUSLY TESTED 11GLAREO43 11GLAREO43 11GLAREO43 11GLAREO43 11GLAREO43 11GLAREO43 11GLAREO43 11GLAREO43 11		
16CONTINUEGLARE022TYPE115GLARE02315 FORMAT(33H INSTRUCTIONS)GLARE024TYPE 215GLARE02515 FORMAT(41H SET PUSH BUTION 1 UN, FUSH RUTION 4 OFF)GLARE02715FORMAT(30H PLACE IN 10**6, AND RUN MODE)GLARE028TYPE 415GLARE02915FORMAT(48HPLACE COUNTERS AND MONOSTABLES AT DESIRED VALUE)GLARE03015FORMAT(48HPLACE COUNTERS AND MONOSTABLES AT DESIRED VALUE)GLARE03325FORMAT(31H PLACE INTO NORMAL AND SECGNDS.)GLARE03325FORMAT(32H HEN YOU WISH TO STOP RUN PLACE PUSH BUTTON 4 ON)GLARE03315FORMAT(32H IF YOU HAVE DONE THIS TYPE A 1)GLARE037715FORMAT(32H IF YOU HAVE DONE THIS TYPE A 1)GLARE037715FORMAT(32H IF YOU HAVE DONE THIS TYPE A 1)GLARE037715FORMAT(32H IF YOU HAVE DONE THIS TYPE A 1)GLARE037716GUTINUEGLARE048717GLARE048GLARE049718GUTINUEGLARE049719GLU GSUTY(13, IERR)GLARE04972GLU GSUTY(13, IERR)GLARE04973GLU GSUTY(11, SERR)GLARE04974GUTINUEGLARE04975GLU GSUTY(12, ILRP)GLARE04976GLU GSUTY(12, ILRP)GLARE04977GLU GSUTY(14, ILR)GLARE04977GLU GSUTY(14, ILR)GLARE04977GLU GSUTY(14, ILR)GLARE049		
<pre>15 FORMAT(33H INSTRUCTIONS } GLAREO24 TYPE 215 GLAREO25 15 FORMAT(41H SET PUSH BUTION 1 DN, FUSH BUTION 4 OFF) GLAREO25 17 FORMAT(30H PLACE IN 10**6, AND RUN MODE) GLAREO27 15. FORMAT(30H PLACE IN 10**6, AND RUN MODE) GLAREO27 15 FORMAT(30H PLACE IN 10**6, AND RUN MODE) GLAREO23 15 FORMAT(30H PLACE COUNTERS AND MONOSIABLES AT DESIRED VALUE) GLAREO30 TYPE 515 GLAREO32 15 FORMAT(48HPLACE COUNTERS AND MONOSIABLES AT DESIRED VALUE) GLAREO33 25 FORMAT(131H PLACE INTO NORMAL AND SECONDS) GLAREO33 25 FORMAT(131H PLACE INTO NORMAL AND SECONDS) GLAREO35 15 FORMAT(131H PLACE INTO NORMAL AND SECONDS) GLAREO35 15 FORMAT(132H IF YOU WISH TO STOP RUN PLACE PUSH BUTTON 4 ON) GLAREO35 15 FORMAT(32H IF YOU HAVE DUNE THIS TYPE A 1) GLAREO35 16 CONTINUE GLAREO35 17 FORMAT(300, 40)JAA GLAREO35 18 FORMAT(300, 116, 216, 116 GLAREO35 19 CALL GSLYR(300, 116RR) GLAREO35 19 CALL GSLYR(13, 116RR) GLAREO41 10 CONTINUE GLAREO3 10 CALL GSLYR(13, 116RR) GLAREO45 11 CONTINUE GLAREO45 12 CALL GSLYR(13, 116RR) GLAREO45 13 CALL GSLYR(13, 116RR) GLAREO45 14 CALL GSLYR(13, 116RR) GLAREO45 15 CALL GSLYR(13, 116RR) GLAREO55 15 CALL GSLYR(13, 116RR) GLAREO55 15 CALL G</pre>		GLARE022
TYPE 215GLARE02515FORMAT(41H SET PUSH BUTTON 1 UN, FJSH BUTTON 4 DFF)GLARE026TYPE 315GLARE02715.FORMAT(30H PLACE IN 10**6, AND RUN MODE)GLARE028TYPE 415GLARE02915FORMAT(35HTURN ON SCOPE AND SELECT CROSSPLOT)GLARE03016FURMAT(48HPLACE COUNTERS AND MONOSTABLES AT DESTRED VALUE)GLARE03217FURMAT(48HPLACE COUNTERS AND MONOSTABLES AT DESTRED VALUE)GLARE03215FORMAT(48HPLACE COUNTERS AND MONOSTABLES AT DESTRED VALUE)GLARE03325FORMAT(131H PLACE INTO NORMAL AND SECONDS.)GLARE03326FORMAT(132H TP YOU WISH TO STOP RUN PLACE PUSH BUTTON 4 ON)GLARE03727FORMAT(52H WHEN YOU WISH TO STOP RUN PLACE PUSH BUTTON 4 ON)GLARE03728FORMAT(52H IF YOU HAVE DONE THIS TYPE A 1)GLARE03729FORMAT(12H IF YOU HAVE DONE THIS TYPE A 1)GLARE03720101=1,10GLARE04640201111.16,216,116GLARE04720121=1,10GLARE04420121=1,10GLARE04420131=1,10GLARE044201414,11,116,216,116GLARE04421GLARE044GLARE044GLARE04421GLARE045GLARE045GLARE04521GLARE04GLARE044GLARE04422GLARE04GLARE045GLARE04523GLARE04GLARE045GLARE04524GLARE04GLARE045GLARE04525<		
15FORMAT(4)H SET PUSH BUTION 1 ON, PUSH BUTION 4 OFF) TYPE 315GLARE026 GLARE02715FORMAT(30H PLACE IN 10**6, AND RUN MODE) TYPE 415GLARE02715FORMAT(30H PLACE IN 10**6, AND RUN MODE) TYPE 415GLARE02315FORMAT(35HTURN ON SCOPE AND SELECT CROSSPLOT) TYPE 515GLARE030 GLARE03115FORMAT(48HPLACE COUNTERS AND MONOSTABLES AT DESTRED VALUE) TYPE 525GLARE032 GLARE03325FORMAT(48HPLACE INTO NORMAL AND SECONDS.) TYPE 615GLARE03515FORMAT(50H WHEN YOU WISH TO STOP RUN PLACE PUSH BUTTON 4 ON) GLARE035GLARE036 GLARE037715FORMAT(52H IF YOU HAVE DUNE THIS TYPE A 1) REAU(1KBD, 40)JAA IF(JAA-1)116,216,116GLARE04 GLARE03716CONTINUE CALL OSELYR(300,1ERR)GLARE04 GLARE044GLARE042 GLARE045 GLARE04516CONTINUE CALL OSELYR(11,1ERR) CALL OSELYR(13,1ERR) GLARE045GLARE0466 GLARE0466 GLARE046665 GLAL QSULYR(13,1ERR) GLARE047GLARE047 GLARE048 GLARE048 GLARE049 GLARE049 GLARE049 GLARE049 GLARE049 GLARE04665 GLAL QSULYR(13,1ERR) GLARE047GLARE048 GLARE048 GLARE049 GLARE049 GLARE049 GLARE049 GLARE049 GLARE047GLARE049 		
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TYPE 525GLARE03325. FORMAT.(31H PLACE_INTO NORMAL AND SECONDS_)GLARE034TYPE 615GLARE035315 FORMAT.(52H WHEN YOU WISH TO STUP RUN PLACE PUSH BUTTON 4 ON)GLARE036715 FORMAT.(32H IF YOU HAVE DONE THIS TYPE A 1)GLARE037715 FORMAT.(32H IF YOU HAVE DONE THIS TYPE A 1)GLARE037715 FORMAT.(32H IF YOU HAVE DONE THIS TYPE A 1)GLARE037716 FORMAT.(32H IF YOU HAVE DONE THIS TYPE A 1)GLARE037717 FORMAT.(32H IF YOU HAVE DONE THIS TYPE A 1)GLARE037718 FORMAT.(32H IF YOU HAVE DONE THIS TYPE A 1)GLARE037719 FORMAT.(32H IF YOU HAVE DONE THIS TYPE A 1)GLARE037710 CONTINUEGLARE040711 GONTINUEGLARE041712 CALL OSDLYR(300., IERR)GLARE043713 CALL OSDLYR(13., IERR)GLARE043714 CALL OSDLYR(13., IERR)GLARE046715 CALL OSDLYR(2., ILRR)GLARE046716 INPUT THE NUMBER OF SUBJECTS 'PREVIOUSLY TESTEDGLARE049717 CALL OSDLYR(13., IERR)GLARE049718 CALL OSDLYR(13., IERR)GLARE049719 CALL OSDLYR(13., IERR)GLARE046710 INPUT THE NUMBER OF SUBJECTS 'PREVIOUSLY TESTEDGLARE050711 FORMAT (40HENTER THE NUMBER UF SUBJECTS PREVIOUSLY TESTED)GLARE053719 CALL OSDLYR(13., IERR)GLARE052719 CALL OSDLYR(13., IERR)GLARE052719 CALL OSDLYR(15., IERR)GLARE052719 CALL OSDLYR(15., IERR)GLARE052719 CALL OSDLYR(15., IERR)GLARE053719 CALL OSDLYR(15., IERR)GLARE053719 CALL OSDLYR(15., IER		
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15FORMAT(50H WHEN YOU WISH TO STUP RUN PLACE PUSH BUTTON 4 ON)GLARE036TYPE 715GLARE037715FURMAT(32H IF YOU HAVE DUNE THIS TYPE A 1)GLARE039REAU(IKB0, 40)JAAGLARE039IF(JAA-1)116.216.116GLARE040716CONFINUEGLARE041DG 10I=1,10GLARE042CALL GSDLYR(JOO., IERR)GLARE044ICCONTINUEGLARE044ICCONTINUEGLARE044GALL QSULYR(13., IERR)GLARE044CALL QSULYR(13., IERR)GLARE044CALL QSULYR(2., IEAR)GLARE046GLAL QSULYR(2., IEAR)GLARE046GALL QSULYR(13., IERR)GLARE046GLARE049TO INPUT THE NUMPER OF SUBJECTS PREVIOUSLY TESTEDGLARE050GLARE051GLARE051GLARE051WRITE(1TV,11)IIFURMAT (40HE TER FHE NUMBER OF SUBJECTS PREVIOUSLY TESTED)GLARE054		
TYPE 715GLARE037/15FURMAT(32H IF YOU HAVE DUNE THIS TYPE A 1)GLARE039READ(1KBD, 40)JAAGLARE039		
IF(JAA-1)116.216.116GLARE040'16CONTINUEGLARE041DG 10I=1,10GLARE042CALL WWPR(PT(I),VAL(I),IERR)GLARE043CALL OSDLYR(300.,IERR)GLARE04410CONTINUEGLARE045CALL QSIC(IERR)GLARE046CALL QSULYR(13.,IERR)GLARE046CALL QSULYR(13.,IERR)GLARE047CALL QSULYR(2.,IERR)GLARE048CALL QSULYR(2.,IERR)GLARE048CALL QSULYR(2.,IERR)GLARE049TOINPUT THE NUMBER OF SUBJECTS 'PREVIOUSLY TESTEDGLARE050CALL QSUP(1ERR)GLARE051CALL QSUP(1ERR)GLARE051CALL QSUP(1ERR)GLARE053I1FURMAT (40HENTER THE HUMBER OF SUBJECTS PREVIOUSLY TESTED)GLARE054		
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716 CONFINUE GLARE041 DG 10 I=1,10 GLARE042 CALL GWPR(PT(I),VAL(I),IERR) GLARE043 CALL QSULYR(300.,IERR) GLARE044 10 CONTINUE GLARE045 CALL QSIC(IERR) GLARE045 CALL QSIC(IERR) GLARE046 CALL QSULYR(13.,IERR) GLARE046 CALL QSULYR(13.,IERR) GLARE047 CALL QSULYR(2.,IERR) GLARE048 CALL QSULYR(2.,IERR) GLARE050 CALL QSULYR(13.,IERR) GLARE050 CALL QSULYR(13.,IERR) GLARE051 CALL QSULYR(13.,IERR) GLARE052 WRITE(ITV,11) GLARE052 GLARE053 I1 FURMAT GUMBER UF SUDJECTS PREVIDUSLY TESTLD) GLARE054	REAU(IKBD, 40)JAA	GLARE039
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CALL GWPR(PT(1),VAL(1),IERR)GLARE043CALL GSGLYR(300,IERR)GLARE04410 CONTINUEGLARE045CALL QSIC(IERR)GLARE046CALL GSGLYR(13,IERR)GLARE047CALL GWCLL(1,SET,IERR)GLARE048CALL GSGLYR(2,IERR)GLARE048CALL GSGLYR(2,IERR)GLARE049TO INPUT THE NUMPER OF SUBJECTS PREVIOUSLY TESTEDGLARE050CALL GSGLYR(13,IERR)GLARE050CALL GSGLYR(13,IERR)GLARE050CALL GSGLYR(13,IERR)GLARE050CALL GSGLYR(13,IERR)GLARE050CALL GSGLYR(13,IERR)GLARE050CALL GSGLYR(13,IERR)GLARE050CALL GSGLYR(13,IERR)GLARE050GLARE051GLARE051GLARE052GLARE05311 FORMAT (40HENTER THE NUMBER OF SUBJECTS PREVIDUSLY TESTED)GLARE054		
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10CONTINUEGLARE045CALL QSIC(IERR)GLARE046CALL QSULYR(13., 1ERR)GLARE047CALL QWCLL(1,SET, 1ERR)GLARE048CALL QSULYR(2., 1ERP)GLARE049TO INPUT THE NUMBER OF SUBJECTS 'PREVIOUSLY TESTEDGLARE050CALL QSUP(1ERR)GLARE050CALL QSUP(1ERR)GLARE051GALL QSUP(1ERR)GLARE052WRITE(ITV,11)GLARE05211FURMAT (40HENTER THE NUMBER OF SUBJECTS PREVIOUSLY TESTED)GLARE054		
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CALL GWCLL(1,SET+IERR)GLARE048CALL GSDLYK(2+,IERP)GLARE049TO INPUT THE NUMBER OF SUBJECTS PREVIOUSLY TESTEDGLARE050CALL GSDLYR(12+,IERR)GLARE051CALL GSDLYR(13+,IERR)GLARE052WRITE(ITV,II)GLARE05311 FORMAT (40HENTER THE NUMBER OF SUBJECTS PREVIOUSLY TESTED)GLARE054	CALL OSIC(IERR)	GLAREO46
CALL GWCLL(1,SET+IERR)GLARE048CALL GSDLYK(2+,IERP)GLARE049TO INPUT THE NUMBER OF SUBJECTS PREVIOUSLY TESTEDGLARE050CALL GSDLYR(12+,IERR)GLARE051CALL GSDLYR(13+,IERR)GLARE052WRITE(ITV,II)GLARE05311 FORMAT (40HENTER THE NUMBER OF SUBJECTS PREVIOUSLY TESTED)GLARE054	CALL USULYR(13., IERR)	GLAREU47
TO INPUT THE NUMBER OF SUBJECTS PREVIOUSLY TESTED GLAREOSO GALL OSUP(1ERR) GLAREOS1 GLAREOS1 GLAREOS2 WRITE(1TV,11) GLAREOS3 11 FURMAT (40HENTER THE NUMBER OF SUBJECTS PREVIOUSLY TESTED) GLAREOS4	CALL GWCLL(1,SET,IERR)	GLARE048
CALL OSUP(1ERR) CALL OSULYR(13.,1ERR) WRITE(ITV,11) GLAREOS3 11 FORMAT (40HENTER THE NUMBER OF SUBJECTS PREVIPUSLY TESTED) GLAREOS4	CALL OSULYK(2., 1ERP)	
CALL OSDLYR(13.,1ERR) GLAREOS2 WRITE(ITV,11) GLAREOS3 11 FORMAT (40HENTER THE NUMBER OF SUBJECTS PREVIPUSLY TESTED) GLAREOS4		
WRITE(ITV,11) GLAREOS3 11 FORMAT (40HENTER THE NUMBER OF SUBJECTS PREVIPUSLY TESTED) GLAREOS4		
11 FORMAT (40HENTER THE HUMBER OF SUBJECTS PREVIPUSLY TESTED) GLARLOSA		
	11 FORMAT (40HENTER THE NUMBER OF SUBJECTS PREVIOUSLY TESTED)	

56 GLARE057 WRI-TE(-I-TV+13) 13 FORMAT (38HSET PUSH BUTTONS IN ZERO THEN TYPE 1) GLARE058 GLARE059 14 READ(IKBD,40)IA GLARE060 10 FORMAI(11) GLAREU61 1F (1A-1)12,50,50 GLARE062 50 CALL QWCLL(1, RESET, LERR) GLARE063 CALL-USULYRIA. + IERRI GLARE064 CALL QWCLL(1,SET,TERR) GLARE065 CALL OSULYR(2., IERR) GLARE066 C=0 GLARE067 J=0 GLARE068 1SPT=ISPT+1 GLARE069 CALL CRCPL (99, LUGVAL, IERR) 15 GLARE070 CALL GSULYR(2., IERR) GLARE071 JF(NOT LOGVAL) GG TU 15 GLARE072 CALL URBAUR (VALUE, 6, 1, IERR) GLARE073 CALL GRUADR (GSRE, 7, 1, IERR) GLARE074 TYPE 1.J.VALOC.GSRE GLARE075 FURMAT(13,G12.6,618.6) GLARE076 CALL GSULYR(2., IERR) G! ARE077 CALL QNCLL(1,RESET, IERR) GLARE078 CALL OSDLYR(4., IERR) GLARE079 CALL ONCLUIT, SET, LERR) GLARE080 CALL QSULYR(2., IERR) GLARE381 C=C+1. CLARE082 1=1+1 GLARE083 VALUE(J)=VALGC/VAL(4) GLARE084 GSR(J)=GSRE GLARE055 IF(J-200)911,911,912 GLAREU86 **TYPE 913**) GLAREU87 FORMATIGON EXCELUED J VALUE LIMIT GLAREU88 TO STUP AFTER 30 MINUTES. SLARE037 CALL URSLL(U, LUGVAL, TERR) GLARE090 CALL GSDLYR(2., LERR) GLARE091 CALL URSLLID, LUGVAL, TERR) GLAREU72 CALL USDLYK(2., TEPR) GLARE093 IF(.NOT.LOGVAL)66 TO 15 GLARE094 CALL QSH(IERR) GLAREUJS CALL GRBADR (B1, 3, 1, IERR) GLARE096 CALL OSULYR (13. + FERR) GLAKE097 WRITE(IIV.9) 9 FORMAT (99HIF YOU WISH A PRINTOUT OF THE VALUES OF THE GLARE098 GLAREU99 LARRAY THEN TYPE 1 1) GLARE100 READ(IKBD.4()) IC GLARE101 IF(1C-1)123,6,123 GLARE102 BEGIN CUMPILATION OF DATA GLARE103 WRITE(ITV.10) 15 FORMAT (42HCOMPTLATION OF DATA AND PRINTOUT BEGINNING) GLAPE104 GLARE105 WRITE(IPRIAL, 26) ISPL 15 FORMAT (1111, 2018, 4 3HPRINTOUT OF ARRAY VALUES FOR SUBJECT NUMBER, GLARE106 GLARE107 115) GLARE109 WRITE(HPT,51) J GLARE109 FORMAT(13) 1 GLARELLO 0 17 1=1+J GLAREIII TB=BT/VAL(10) GLARE112 WRITE(HPT, 52) I.VALUELIJ.GS4(1) GLARE113 FURMAT(13.110.3.110.3) 61341114 WRITELIPRINT, 1311, VALUE (1), GSP(1), TS

Paul Bank Mar (1997) - Canada part and a contract of the second state of the

GLARE116 CUNTINUE. GLARE117 10=1 GLARE118 MMMa-9 GLARE119 1=0 GLARE120 00 1000 JJJ=1,20 GLARE121 MMM=MMM+10 GLARE122 and a second GLARE123 1F (1-J)1222,1222,1111 GLARE124 CONTINUE GLARE125 CALL SQPG(1, USR, JQ, 10., MMM) GLARE126 CALL SOPMII.VALUE, JO, 10., MMM) GLARE127 1 . GLARE128 CALL_SUPG(1.USR.JU.C.L) GLARE129 CALL SOPP(1,VALUE,JU,C.1) GLARE130 3 CONTINUE GLARE131 TO PLOT ON CRT GLARE132 WRITE(ITV.19) - FORMAT(SUNDU YOU WISH THE VALUES OR THE ARRAY TO BE PLOTTED . GLARE133 GLARE134 11.20HIE YES THEN TYPE 2 1 GLARE135 READ(INBD,40)18 GLARE136 1F(1B-2)122,24,122 GLARE137 CONTINUE GLARE138 PLOT PROGRAM GLARE139 00 6: I=1+J GLARE140 A(I.,)=1 GLARE141 $\Lambda(1,2)=V\Lambda LUE(1)$ GLARE142 - CONTINUE GLARL143 CALL APLIT(A, 200, 1, J) GLARE144 CONTINUE GLARE145 TO STOP OR HOLD AT THE END OF A RUN GLARE146 WRITE(ITV.101) GLARE147 IF YOU WISP TO STOP THE EXPERIMENT, 1 E FORMATE 45HTYPE GLARE148 1 / .37HZ IF YOU WISH TO START A NEW SUBJECT. GLARE149 / 45H 3 IF YOU WISH TO HULD WAITING A NEW SUBJECT) L GLARE150 READLIKED, LOZIJA GLARE151 FORMAT([1]) GLARE152 GO [O(100.10.10).JA GLARE153 SHUT DUWN SERVERCE GLARE154 · CONTINUE GLARE155 END GLARE156 SUBROUFINE APEOI(A, N, NPLOT, NPNT) GLARE157 DIMENSION A(1) GLARE158 CALL 5EGIN(9600.1) GLARE159 CALL ERASE GLARE160 CALL VECTUR GLARE101 XMAX=4(1) GLARE162 XMIN=A(1) GLARE 163 00 31 1=L+NP1H GLARE164 IF(A(I).LF.XMIN)XHIN=A(I) GLAREL65 1F(A(1).GT.XMAX)XMAx=A(1) GLARE 166 CONFINE GLARE167 NDX=约+1 GLARE168 YMIN= A(NUX) GLARE169 VMAX=VM[N] ULARE170 60 90 11+1.NPLGT GLARE171 Dr. 85 12=1+5P37 GLARE172 108=11+0+12 GLARE173 IFEAENDX).LT.YNENDYMTHEAENDKS 66746174 FFEALUDX J. GT. YMAX JYMAX = ACHEX J

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CUNTINUE	GLARE175
CONTINUE	GLARE176
CONTINUE XFACT=800./(XMAX-XMIN) YFACT=500./(YMAX-YMIN) XORG=(1023800.)/2. LF(XMIN.LT.U.)XURG=223800.*XMIN/(XMAX-XM1N)	GLARE177
YFACT=500./(YMAX-YMIN)	GLARE178
XORG=(1023800.)/2.	GLARE179
IF(XMIN.LT.U.)XURG=223800.*XM[N/(XMAX-XM1N)	GLARE180
	GLARE181
IF(YMIN.LT.O.)YURG=140500.*YMIN/(YMAX-YMIN)	GLARE182
CALL SCALE(XFACT, YFACT, XORG, YURG)	GLARE183
XLUW=XMIN	GLARE184
IF(XMIN.GE.O.)XLUW=0.	GLARE185
YLOW=YMIN	GLARE186
IF (YMIN.GE. D.)YLOW=0.	GLARE187
XLNG=(XMAX-XMIN)	GLARF188
YLNG=(YMAX-YMIN)	GLARE189
XTIC=XLNG/10.	GLARE190
YTIC=YLNG/10.	GLARE191
MARKX=1	GLARE192
MARKY=1	GLARE193
GALL AXIS(XLOW, YLOW, XLNG, YLNG, XTIC, YTIC, MARKX, MARKY)	GLARE194
00 1000 IZ=I, APLOI	GLARE195
CALL VECTOR	GLARE196
00 2000 II=1,NPNT	GLARE197
IF(11-1)10,20,10	GLARE198
IPEN=0	GLARE199
MARK=0.	GLARE200
GO TO 40	GLARE201
IPEN=1	GLARE202
CONTINUE	GLARE203
NDX=I2*N+I1	GLARE204
X = A(11)	GLARE205
IF(XMI4.GE.O.)X=A(II)-XHIN	GLARE205
	GLARE207
IF(YMIN,GE,O,)Y=A(NDX)-YMIN	GLARE208
CALL TPLUT(X,Y,IPEN,MARK) CONTINUE	GLARE209
CALL TPAUSE	GLARE210 GLARE211
CUNTINUE	GLARE212
RETURN	GLARE213
- FAD	GLARE214
SUBROUTINE SUPM(I,VALUE, JQ,C,MMM)	GLARE215
DIMENSION VALUE(1).JO(1).S(100).AMEAN(100).R(100)	GLARE216
UIMENSIUN FFF(100).	GLARE217
ASUM=0.0	GLARE218
SUM=D.J	GLARE219
60 9122 K=MPN,1	GLARE 220
8(K)=VALUE(K)++2	GLARE221
SUM=SUM+B(K)	GLARE222
ASUM#ASUM+VALUE(K)	GLARE223
2 CONTINUE	GLARE224
S(JQ)=SQRT(SUM-(ASUM++2)+(1./C))+(1./(C-1.))	GLARE225
AMEAN(JJ)=ASUM/L	GL ARE226
FFF(JU)=(S(JU)==2/AMEAN(JU))=100.	GLARE227
WRITE(16,015)C,S(JQ),AMEAN(JQ),FFR(JQ)	GLARE228
> FORMATIF20.2.2)HSAMPLE STANLARD DEVIATION IS .G18.6.	GLARE227
114453MPLE M-AV 13 +518+5+114+14FAGT 15 +F8+4)	GLARE230
RETURN	GLARE 231
	GLARE232
SUBREUTINE SWERT, VALUE, JURC, MEM)	GLARE233
	GL ARE 234

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DINENSION FFF(100)	
ASUM=0.0	GLARE23
SUM=0.0	
DU 9122 K=MMN, I	GLARE23
B(K)=VALUE(K) ** 2 SUM=SUM+B(K)	GLARE24
ASUM=SUM+B(K)	
CONTINUE	GLARE24
S(JQ)=SQRT(SUM-(ASUM**2)*(1./C))*(1./(C-1.))	
AMEAN(JQ)=ASUM/C	GLARE24
FFE(JQ) = (S(JC) * * 2/AMEAN(JQ)) * 100.	GLARE24
WRITE(16,815)C,S(JQ),AMEAN(JC),FFF(JQ)	GLARE24
FORMATIFIS.0.5HGSR	
14HSAMPLE MEAN IS ,G18.6,11HWINFACT IS ,F8.4)	GLARE24
RETURN	GLARE24
END ·	GLARE25
CIG	GLARE25
	GLARE25 GLARE25
LUT, DK3	GLARE25
RTL	
TLDK3	GLARE25
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