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# Investigation to establish acceptability tolerance limits in various regions of the cielab color space

Barry Yuhas Lehigh University

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INVESTIGATION TO ESTABLISH ACCEPTABILITY TOLERANCE LIMITS IN VARIOUS REGIONS OF THE CIELAB COLOR SPACE

Ву

Barry Yuhas

This research report is respectfully submitted to the Department of Chemical Engineering of Lehigh University in partial fulfillment of the requirement for the degree of Master of Science.

Barry G. Yuhas

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equirements for the degree of Master	of Science,
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ccepted	Acting Chairman
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# General Introduction

In recent years it has been of great concern to the United States Army to find nother way of accepting shipments of textiles, other than the visual method previously sed. This visual method has led to problems due to disagreements between inspectors r the Army and the textile manufacturers.

The objective of this investigation was to develop a new method of finding acceptance limits by use of a numerical method involving instrumental measurements in submitted samples. The part of this investigation presented here includes the instrumental measurements on submitted samples, picking of sample pairs for blue and the visual test used on the inspectors. The results of the visual test will be used find the acceptance limits.

# Determination of CIELAB Coordinates

# A. Introduction and Equipment

The CIELAB color space was used in this investigation. This color space a Cartesian coordinate system, consisting of three mutually perpendicular axes. The axis is the lightness (L\*) axis and extends from black (minus) to white (plus). The two remaining axes are the yellow-blue axis (b\* axis) and the red-green axis axis) which are perpendicular to the lightness axis (L\* axis) and perpendicular each other.

Measurements on all submitted samples, 200 to 300 samples for each color tudied, were obtained on a Diano-Hardy II spectrophotometer. These measurements ere the reflectances of each submitted sample between 400 and 700 nanometers, taken in 20 nanometer intervals. These reflectance values were obtained with use of a 10 egree-diffuse geometry. A tungsten lamp was used to obtain the reflectances. hese reflectances were used to calculate the L\*, a\* and b\* values for each sample. hese values were calculated by use of an ACS 2000 color computer with programs in storage discs. The L\*, a\* and b\* values were obtained for illuminant D75, 1931 tandard Observer.

After the CIELAB values for each sample had been obtained a data file was created, which contained the L\*, a\* and b\* values along with the corresponding sample number. A separate file was created for each color studied. Appendix A gives a typical page from a data file listing.

#### B. Procedure

The first step was to calibrate the equipment using a white standard, Barium Sulfate (Ba SO<sub>4</sub>). After correct reflectances were obtained from a standard and sample, both of Barium Sulfate, the next step was to obtain the reflectance factor for the color standard of interest. The next step was to use the color standard as the standard in the beam marked for standards (reference beam) and test each submitted sample in the beam marked for samples (sample beam). Two sets of reflectances were obtained for each sample and their average was used in the calculations. The programs stored on the discs were used to calculate the tristimulus values, chromaticity coordinates, color differences and CIELAB coordinates for each sample. This procedure was repeated for each color studied.

#### III. Use of Sample Pairs for Finding Tolerances

#### A. Introduction

The standard and limit samples, of the color studied, should form a three-dimensional figure in the CIELAB color space. This figure will be set up such that all the points in the interior represent an acceptance and all that lie outside represent a rejection. This figure is an ellipsoid with its axis oriented in the lightness, hue and chroma directions. The acceptability tolerances that correspond to this ellipsoid shall be determined from the pass or fail responses, of inspectors, to various sample pairs which differ in only lightness, hue and chroma.

It can be recognized that six tolerances will be found for each color studied, one tolerance in each of the plus and minus directions of the three axes. To find each tolerance a series of four sample pairs were used.

#### B. Visual Test Method

In each of the six directions studied, four color differences in increasing amounts were studied. Thus 24 color differences were used for each color. Each color difference is represented by a sample pair in which one sample is designated as the standard and the other is designated as the sample to be judged against the standard. These color differences were set up such that the largest difference would be deemed unacceptable and the smallest difference would be deemed acceptable as a match. The desired tolerance limit will lie somewhere in the range of the four differences.

Each of the color differences, sample pairs, will be shown to an inspector ten times in random order. This was done so that the inspector did not realize that the same difference is shown repeatedly. Each time a sample pair was shown, the inspector was asked if he or she would accept or reject the sample against the standard. Thus 240 judgements were made by each inspector for every color studied. A special sample holder, lazy susan, was used during the judging so that the inspector could not recognize which sample pair was presented for judgment.

## C. Procedure

## 1. Finding Sample Pairs

To find the sample pairs needed for use in the visual test a set of several hundred sample submissions was used for each color. These samples lie closely all around the standard and should make it possible to find the needed sample pairs amoungst the set of samples.

It would be very difficult to find a single standard to be used in all the sample pairs. It is easier to use a series of standards in the pairs with which corresponding samples can be used to represent the required color difference.

The following procedure was used to determine the sample pairs:

The data file was rearranged such that the listing was in increasing numerical order of sample identification. This rearrangement was performed by the computer program presented in Appendix B supplied by Dr. Eugene Allen. The next step was to enter the rearranged data file into a program supplied by Dr. Eugene Allen

see Appendix C), to find all the possible sample pairs obtainable from the entire et of sample submissions.

The program in Appendix C considers each sample as a standard for which a subset of samples are found. These samples all lie on one of the six lines, previously mentioned, extending outward from that standard. The program prints out, for each sample submission considered individually as a standard, the subset along with the corresponding color difference between each sample in the subset and the standard. From the output it was easy to find pairs of samples in which the sample differs from the standard in each of the six directions, with four color differences in each direction. It must be remembered that the standard varies with each pair and that each pair represents a specific color difference in either hue, chroma, or lightness. This procedure was carried out by myself for one of the colors studied, blue, and Dr. Allen performed the sample selection on all the other colors studied. Table I shows the sample pair selection for blue. A full description of how the program, in Appendix C, works can be found in the first reference.

## 2. Using Sample Pairs

The number of sample pairs actually used for each shade was less than 24, needed to represent the six directions with four color differences in each direction. This is due to the fact that in many cases the same pair was used for a minus difference and also for a plus difference. To further explain this refer to page 19 of the first reference.

A computer program, supplied by Dr. Eugene Allen, was used to randomize the order of sample pair presentation for each shade. The program randomized the presentation of 24 sample pairs, with each pair being presented ten times; thus the listing was composed of 240 total presentations. After the listing was obtained the visual test was performed on the shade and the results were recorded. The randomizing program used is given in Appendix D.

This procedure was used on six inspectors, three from civil service (Bill, Moe and Carol) and three from textile manufacturers (Jim, Charlie and Robie).

After the CIELAB values for each sample had been obtained a data file was created, which contained the L\*, a\* and b\* values along with the corresponding sample number. A separate file was created for each color studied. Appendix A gives a typical page from a data file listing.

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This procedure was used on six inspectors, three from civil service (Bill, Moe and Carol) and three from textile manufacturers (Jim, Charlie and Robie).

Table I
Sample Pair Selection Results For Blue

Plus Lightness	Delta E	Standard	Sample
	0.50	681	984
	1.00	714	644
	1.50	5000	5327
	2.01	1000	5310
Minus Lightness	0.50	984	681
	1.00	644	714
	1.50	5327	5000
	2.01	5310	1000
Plus Chroma	0.36	1001	8444
	0.69	7294	7426
	1.07	7291	8443
	1.42	7052	7000
Minus Chroma	0.36	8444	1001
	0.69	7426	7294
	1.07	8443	7291
	1.42	7000	7052
Plus Hue	0.18	709	7023
	0.38	847	979
	0.57	866	650
	0.75	006	837
Minus Hue	0.18	7023	709
	0.38	979	847
	0.57	650	866
	0.75	837	006

These six inspected all three shades while a seventh inspector (Linda), recently entered into civil service and previously from textile manufacturing, only inspected the pairs from the blue shade.

For this visual test procedure, illuminant D75 was used by all inspectors except Jim and Robie. Jim and Robie used a cool white fluorescent illuminant due to the fact that a D75 illuminant was unavailable. During this procedure a neutral gray background was used by all inspectors, except for inspector Robie. Inspector Robie used a very light tan background due to the unavailability of neutral gray. All inspectors made judgements looking at the face of the material and overlaped the sample over the standard.

#### D. Results

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The results of the visual test were recorded and tabulated. These results can be seen in Tables II, III, and IV. In these tables the leftmost column shows the total CIELAB color difference (Delta E) given for each pair. In the columns to the right the percentage of acceptance judgements are shown for each inspector.

It can be seen that in most cases the expected outcome, the percentage of pass judgements decreasing with increasing color difference, occured. Occassionally the opposite of the expected outcome occured. Despite this the results of the tests agreed with what was expected.

#### IV. Use of the Visual Test Results

From the data in Tables II, III, and IV the color difference corresponding to a 50% acceptance rate must be calculated. This is done by use of a logistic function, see reference two. The 50% acceptance rates were found for each color by using a computer program written by Dr. Eugene Allen. This was then considered the accepted tolerances. This final tolerance evaluation was done by Dr. Allen.

Table II

Visual Results For Olive Green

	Delta E	% Pass (Bill)	% Pass (Moe)	% Pass (Carol)	% Pass (Jim)	% Pass (Charlie)	% Pass (Robie)
Plus Lightness	0.60	100	90	100	100	100	100
	1.17	70	100	100	100	90	100
	1.82	30	10	70	. 0	30	40
	2.29	50	40	90	0	0	90
Minus Lightness	0.60	100	100	100	100	100	100
	1.17	100	100	100	100	90	100
	1.82	100	10	100	0	20	60
	2.29	90	40	50	10	0	90
Plus Chroma	0.40	100	100	100	100	100	100
	0.80	40	50	70	90	90	100
	1.13	20	80	90	50	40	100
	1.52	20	40	70	50	30	30
Minus Chroma	0.40	100	100	100	100	100	100
	0.80	100	50	80	40	60	100
	1.13	100	70	80	100	20	70
	1.52	100	20	40	20	10	10
Plus Hue	0.40	100	70	100	80	100	100
	0.77	70	0	40	0	0	70
·	1.17	10	0	0	0	0	10
	1.32	0	0	0	0	0	0
Minus Hue	0.40	40	90	90	100	100	100
	0.77	20	0	0	0	0	10
	1.17	0	0	0	0	0	0
•	1.45	0	0	0	0	0	0

Table III

Visual Results for Tan

	Delta E	% Pass (Bill)	% Pass (Moe)	% Pass (Carol)	% Pass (Jim)	% Pass (Charlie)	% Pass (Robie)
Plus Lightness	0.66	60	100	100	100	100	100
·	1.32	30	50	20	20	100	100
	1.95	20	0	10	0	100	100
	2.65	0	0	0	0	40	30
Minus Lightness	0.66	100	100	100	100	100	100
	1.32	50	20	30	0	90	100
	1.95	30	70	10	0	100	100
	2.65	10	0	0	0	40	90
Plus Chroma	0.50	80	100	80	100	100	100
	0.92	80	40	80	0	90	100
	1.33	10	0	20	100	100	80
	1.92	10	0	10	0	100	100
Minus Chroma	0.50	90	100	100	100	100	100
	0.92	20	20	30	0	100	100
	1.33	0	<b>10</b>	0	70	100	100
	1.92	0	0	0	0	50	90
Plus Hue	0.25	40	70	60	100	100	100
	0.47	40	60	30	90	90	100
	0.69	0	0	0	0	20	100
	1.01	0	0	0	0	0	100
Minus Hue	0.25	50	70	. 60	100	100	10
	0.48	10	0	70	100	90	100
	0.69	0	0	10	10	10	20
	1.01	0	0	0	0	0	100

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Table IV

Visual Results For Dark Blue

	Delta A	% Pass (Bill)	% Pass (Moe)	% Pass (Carol)	% Pass (Jim)	% Pass (Charlie)	% Pass (Robie)	% Pass (Linda)
Plus Lightness	0.50	50	100	. 60	100	100	100	90
	1.00	30	100	10	10	100	100	90
	1.50	0	10	0	10	0	100	20
	2.01	0	0	0	0	0	10	10
Minus Lightness	0.50	90	100	70	100	90	100	100
	1.00	70	80	10	10	90	100	100
	1.50	10	20	0	0	0	100	60
	2.01	0	0	0	0	0	0	10
Plus Chroma	0.36	70	90	80	10	100	100	80
	0.69	20	80	80	100	100	100	100
	1.07	0	0	10	0	0	100	10
	1.42	20	70	40	0	60	100	40
Minus Chroma	0.36	80	100	40	50	100	100	100
	0.69	30	90	80	100	100	100	90
	1.07	10	100	10	10	0	100	0
	1.42	30	80	10	0	50	100	100
Plus Hue	0.18	70	100	100	90	100	100	100
	0.38	80	100	90	100	100	100	100
	0.57	60	100	80	100	100	100	90
	0.75	50	90	0	0	0	100	100
Minus Hue	0.18	70	100	80	100	100	90	100
	0.38	50	90	90	100	100	100	90
	0.57	100	100	100	100	100	100	100
	0.75	60	10	0	. 10	10	80	30

# IV. Conclusions

The methods of selecting samples for inspection and presenting samples to inspectors seem to be dependable and worthy of future use. Some of the unexpected results can be attributed to the use of a different illuminant, other than D75, and the use of a non-gray background by inspector Robie.

It is suggested that the same procedure be used for sample selection in the future. It is strongly suggested that inspectors be required to use a neutral gray background and the same illuminant, D75, as that from which the CIELAB coordinates were calculated.

### VI. References

- Dr. E. M. Allen and Barry Yuhas, "Performing Laboratory Investigations to Define Acceptability Tolerance Ranges in Various Regions of Color Space", Technical Report to United States Army, Agreement #DAAK60-78-C-0084.
- J. Berkson, "Application of the Logistic Function to Bio-Assay", Am. Stat. Assn. J. 39, pp. 357-305 (\frac{1}{2}944).

Appendix A

Typical Page of a Data File

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120 0003						22.18			•		
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130 0004   22,70   -0.25   -11.25     160 0007   22,33   -0.16   -10.81     170 0001   22,83   -0.16   -10.81     180 0000   23,83   -0.16   -10.81     180 0000   23,83   -0.16   -10.81     180 0000   23,83   -0.16   -10.81     180 0000   23,83   -0.16   -10.81     180 0000   23,83   -0.16   -10.81     180 0000   23,83   -0.16   -10.81     180 0000   23,83   -0.16   -11.84     190 0001   22,15   -0.76   -11.16     230 7442   22,17   -0.44   -11.18     240 7442   21,17   -0.44   -11.18     240 7442   21,27   -0.48   -11.17     250 7442   21,75   -0.30   -11.17     250 7442   21,75   -0.30   -11.17     260 5327   22,43   -0.27   -10.91     270 7426   22,75   -0.13   -10.91     280 5310   23,64   -0.13   -10.93     300 8568   23,07   -0.13   -10.93     301 742   21,94   -0.13   -10.83     301 742   21,94   -0.13   -10.83     302 742   21,94   -0.13   -10.83     303 7410   21,65   -0.21   -11.15     304 5000   21,24   -0.44   -1.15     305 2000   21,24   -0.44   -1.15     307 407   21,94   -0.13   -10.83     308 2000   21,24   -0.43   -1.18     309 2000   21,24   -0.43   -1.19     300 8000   21,24   -0.43   -1.19     300 8000   21,46   -0.51   -10.83     301 710   21,17   -0.14   -1.19     302 4000   21,66   -0.51   -1.19     303 4000   21,66   -0.51   -1.19     304 7000   21,66   -0.51   -1.19     305 2000   21,64   -0.13   -1.19     307 712   -1.19   -1.19     308 2000   21,64   -0.13   -1.19     309 2000   21,66   -0.51   -1.19     309 2000   21,66   -0.51   -1.19     309 2000   21,66   -0.51   -1.19     300 2000   21,66   -0.51   -1.19     300 2000   21,66   -0.51   -1.19     300 2000   21,66   -0.51   -1.19     300 2000   21,66   -0.51   -1.19     300 2000   21,66   -0.51   -1.19     300 2000   21,66   -0.51   -1.19     300 2000   21,66   -0.51   -1.19     300 2000   21,66   -0.51   -1.19     300 2000   21,66   -0.51   -1.19     300 2000   21,60   -0.30   -1.19     300 2000   21,60   -0.30   -1.19     300 2000   21,60   -0.30   -1.19     300 2000   31,60   -0.30   -1.19     300 2000   31,60   -0.30   -1.19									<u></u>		· ·
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170   0001   20.93   0.16   -10.83   180   0007   22.85   0.13   -15.12   190   7.613   22.17   22.17   -11.64   20.07   -11.65   20.07   -12.65   20.07   -12.65   20.07   -12.65   20.07   -12.65   20.07   -12.65   20.07   -12.65   20.07   -12.65   20.07   -12.65   20.07   -12.65   20.07   -12.65   20.07   -11.65   20.07   -12.65   -12.65   20.07   -12.65   20.07   -12.65   20.07   -12.65   -12.65   20.07   -12.65   -12.65   20.07   -12.65	-										
180				/							
190   7413   22-17   -0.69   -11.47   -11.48							0.13				
210 75418   22.43   -0.71   -11.54     220 7407   22.51   -0.72   -11.61     230 7442   21.71   -0.44   -11.48     240 7442   21.75   -0.45   -11.18     280 4108   23.02   -0.62   -10.02     270 7428   21.75   -0.22   -11.25     270 7428   21.75   -0.22   -11.25     270 7420   21.75   -0.30   -11.17     281 31317   23.44   -0.22   -10.90     330 8345   23.07   -0.13   -10.90     330 8345   23.07   -0.13   -10.90     330 7408   21.48   -0.39   -11.35     330 742   21.84   -0.39   -11.35     330 742   21.84   -0.39   -11.15     340 7410   21.65   -0.21   -11.17     350 2000   21.24   -0.41   -11.51     360 3000   21.81   -4.50   -11.70     370 4000   21.81   -4.50   -11.70     380 5000   21.23   -0.42   -11.70     380 5000   21.24   -0.42   -11.70     380 5000   21.66   -0.59   -11.70     380 5000   21.66   -0.59   -11.70     400 7000   22.06   -0.59   -11.70     401 8000   21.66   -0.51   -11.69     430 1000   21.69   -0.30   -11.70     430 1000   21.69   -0.30   -11.70     530 7207   21.50   -0.40   -11.60     540 7207   21.50   -0.40   -11.60     540 7207   21.50   -0.40   -11.60     540 7208   21.70   -0.40   -11.60     540 7208   21.70   -0.40   -11.60     540 7209   21.70   -0.40   -11.60     540 7209   21.70   -0.60   -11											
200   7407   22.51   -0.76   -11.61   -1.61						22.36					
220 7.442   21.71			•						•		
240										urken Falkan	<del></del>
1.55									•		
240   7428   21.75   -0.22   -11.25		٠									
270 7426											•
1990   53127   23.43   -0.27   -10.91     300   8365   23.07   -0.13   -10.90     310   7402   21.58   -0.40   -11.30     320   7408   21.44   -0.39   -11.35     330   7432   21.84   -0.33   -10.63     340   7410   21.65   -0.21   -11.15     350   2000   21.24   -0.61   -11.51     350   2000   21.24   -0.61   -11.52     360   3000   21.81   -0.50   -10.59     370   4006   21.34   -0.42   -11.52     380   5000   22.04   -0.59   -11.70     400   7000   22.15   -0.46   -10.43     410   8000   22.03   -0.35   -10.87     420   9000   21.64   -0.51   -11.69     430   1000   21.64   -0.51   -11.69     440   4297   23.37   -0.35   -10.87     420   7000   21.44   -0.44   -11.39     450   1001   21.64   -0.44   -11.39     450   1001   21.64   -0.44   -11.39     470   7189   21.88   -0.47   -10.88     480   7277   21.50   -0.81   -11.69     500   7197   22.08   -0.39   -11.69     500   7197   22.08   -0.41   -11.44     500   7217   22.08   -0.41   -11.47     550   7226   21.85   -0.54   -11.67     550   7227   21.55   -0.45   -11.68     550   7223   21.75   -0.45   -11.68     550   7223   21.75   -0.45   -11.68     560   7227   21.55   -0.45   -11.68     560   7227   21.55   -0.45   -11.68     560   7227   21.55   -0.45   -11.68     560   7227   21.55   -0.45   -11.68     560   7227   21.55   -0.45   -11.68     560   7227   21.55   -0.45   -11.68     560   7227   21.55   -0.45   -11.68     560   7227   21.55   -0.45   -11.68     560   7227   21.55   -0.45   -11.68     560   7227   21.55   -0.45   -11.68     560   7227   21.55   -0.45   -11.68     560   7227   21.55   -0.45   -11.68     560   7227   21.55   -0.45   -11.68     560   7227   21.55   -0.65   -11.66     570   7235   21.55   -0.65   -11.66     570   7235   21.55   -0.65   -11.66     570   7236   21.57   -0.65   -11.66     570   7236   21.57   -0.65   -11.66     570   7236   21.59   -0.66   -11.72     570   7236   21.59   -0.66   -11.72     570   7236   21.50   -0.66   -11.72					7426	21.75	-0.30	-11.19			
100   100   113   100   100   113   100   100   113   113			<b>.</b>								•
310									•		
320 7408				and the second s	7 /G - 1						
130 7432   21.84   -0.53   -10.63   -10.63   -10.741   -11.19   -10.741   -11.19   -10.741   -11.19   -10.741   -11.19   -10.741   -11.19   -10.741   -11.19   -10.741   -11.19   -10.741   -11.19   -10.741   -11.19   -10.741   -11.19   -10.741										-	
7410 7410 21.45						21.84					14
							-0.21	-11.19	<del></del>		
356 3000   21.81   -0.50   -10.98     370 4000   21.34   -0.62   -11.52     380 5000   21.93   -0.32   -10.92     390 6000   22.06   -0.59   -11.70     400 7000   22.15   -0.46   -10.43     410 8000   22.03   -0.35   -10.87     420 9000   21.66   -0.51   -11.69     430 1000   21.66   -0.51   -11.69     430 1000   21.66   -0.51   -11.01     440 4297   23.34   -0.64   -11.39     450 1001   21.64   -0.64   -11.39     450 1001   21.64   -0.64   -11.39     470 7189   21.88   -0.47   -10.84     480 277   21.50   -0.50   -11.68     490 7193   21.91   -0.41   -11.44     510 7206   21.69   -0.38   -11.59     530 7281   21.75   -0.141   -11.57     530 7281   21.75   -0.41   -11.57     540 7207   21.95   -0.45   -11.48     550 7203   22.04   -0.35   -11.48     550 7203   22.04   -0.35   -11.48     550 7203   22.04   -0.45   -11.48     550 7203   22.04   -0.45   -11.48     540 7207   21.95   -0.45   -11.48     550 7223   21.95   -0.41   -11.74     560 7223   21.95   -0.41   -11.74     570 7250   21.75   -0.42   -11.71     570 7250   21.75   -0.42   -11.71     570 7250   21.75   -0.43   -11.68     580 7252   21.95   -0.40   -11.68     580 7252   21.95   -0.40   -11.68     580 7257   -171   -0.33   -11.64     580 7257   -171   -0.33   -11.64     580 7257   -171   -0.33   -11.74     580 7257   -171   -0.33   -11.74     580 7257   -1.75   -0.41   -11.75     580 7270   -1.75   -0.43   -11.75     580 7270   -1.75   -0.43   -11.75     580 7270   -1.75   -0.43   -11.75     580 7270   -1.75   -0.43   -11.68     580 7195   21.70   -0.65   -11.78     580 7275   21.75   -0.63   -11.66     580 7195   21.70   -0.66   -11.75     580 7208   21.90   -0.61   -11.56     580 7208   21.90   -0.66   -11.75     580 7208   21.90   -0.66   -11.75			No.		2000	21.24					
380 5000   21.93   -0.32   -10.92   390 6000   22.06   -0.59   -11.70   400 7000   22.15   -0.46   -10.43   410 8000   22.03   -0.35   -10.87   420 9000   21.66   -0.51   -11.67   430 1000   21.66   -0.21   -11.01   440 4297   23.37   -0.35   -11.02   450 1001   21.64   -0.64   -11.39   450 1001   21.64   -0.64   -11.39   480 1000   22.31   -0.76   -11.39   480 1000   21.66   -0.21   -10.04   480 4297   23.37   -0.35   -11.02   450 1001   21.64   -0.64   -11.39   -11.68   480 727   21.50   -0.50   -11.68   480 727   21.50   -0.50   -11.68   -11.44   -11				360	3000	21.81					
390 6000   22.06									·.·		
A00 7000											
410 8000   22.03   -0.35   -10.87   -							· ·			The second secon	
100   11.66   -0.51   -11.67     11.61   12.66   -0.21   -11.01     12.66   -0.21   -11.01     12.66   -0.21   -11.01     12.66   -0.21   -11.02     12.67   -0.35   -11.02     12.68   -0.64   -11.29     12.68   -0.64   -11.29     12.68   -0.72   -11.29     12.68   -0.72   -11.29     12.68   -0.72   -11.29     12.68   -0.72   -11.68     12.69   -0.11   -11.68     12.69   -0.11   -11.68     12.69   -0.11   -11.44     12.69   -0.11   -11.44     12.69   -0.11   -11.44     12.69   -0.11   -11.57     12.60   -0.11   -11.57     12.60   -0.11   -11.57     12.60   -0.11   -11.57     12.60   -0.11   -11.57     12.60   -0.11   -11.57     12.60   -0.11   -11.57     12.60   -0.11   -11.57     12.60   -0.11   -11.57     12.60   -0.11   -11.64     12.60   -0.11   -0.11     12.60   -0.11   -0.11     12.60   -0.11   -0.11     12.60   -0.11   -0.11     12.60   -0.11   -0.11     12.60   -0.11   -0.11     12.60   -0.11   -0.11     12.60   -0.11   -0.11     12.60   -0.11   -0.11     12.60   -0.11   -0.11     12.60   -0.11   -0.11     12.60   -0.11   -0.11     12.60   -0.11   -0.11     12.60   -0.11   -0											
A30 1000										•	
140   4297   23.37   -0.35   -11.02     450   1001   21.31   -0.76   -11.39     460   1100   22.31   -0.76   -11.39     470   7189   21.88   -0.47   -10.84     480   7277   21.50   -0.50   -11.68     480   7277   21.50   -0.51   -11.44     510   7206   21.69   -0.38   -11.58     520   7279   21.58   -0.54   -11.57     540   7207   21.95   -0.45   -11.48     550   7203   22.04   -0.35   -11.63     550   7203   22.04   -0.35   -11.63     550   7250   21.50   -0.41   -11.71     570   7250   21.50   -0.41   -11.74     570   7250   21.50   -0.41   -11.68     600   7255   21.85   -0.64   -11.68     640   7257   21.71   -0.38   -11.68     640   7257   21.71   -0.38   -11.63     640   7257   21.71   -0.38   -11.61     640   7283   22.06   -0.61   -11.68     640   7283   22.06   -0.61   -11.68     640   7283   22.06   -0.61   -11.68     640   7283   22.06   -0.61   -11.68     640   7283   22.06   -0.61   -11.68     640   7283   22.06   -0.61   -11.68     640   7283   22.06   -0.61   -11.68     640   7283   22.06   -0.61   -11.68     640   7283   22.06   -0.61   -11.68     640   7283   22.06   -0.61   -11.68     640   7298   21.50   -0.47   -1.80     640   7298   21.50   -0.47   -1.80     640   7298   21.50   -0.47   -1.80     640   7298   21.50   -0.66   -11.72     700   7400   21.86   -0.66   -11.72					•		•	-11.01			
1001							-0.35				
A40       1100       22,31       -0.24       -11,39         470       7189       21,88       -0.47       -10,84         490       7277       21,50       -0.50       -11,68         490       7198       21,91       -0.41       -11,40         500       7197       22.06       -0.81       -11,44         510       7206       21,69       -0.38       -11,58         520       7227       21,58       -0.54       -11,66         530       7281       21,76       -0.41       -11,57         540       7207       21,95       -0.45       -11,68         550       7203       22,104       -0.35       -11,63         360       7262       21,72       -0.42       -11,71         570       7250       21,50       -0.41       -11,74         580       7252       21,99       -0.27       -11,52         590       7253       22,05       -0.61       -11,68         410       7257       21,71       -0.38       -11,62         420       7200       21,74       -0.33       -11,74         40       7283       22,06       -0.			9			21.64				,	•
## A # 80			_	440	1100		THE RESERVE OF A SECTION OF THE SECTION OF THE PROPERTY OF THE PARTY O	2. 2. 7. 2. 2. 3. 6. 6. 6. 6. 6. 6. 6. 6. 6. 6. 6. 6. 6.			
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10				** ** ** ** * * * * * * * * * * * * *	Committee of the Commit			Commence of the second			
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S20 7279   21.58								-11.58		•	
530 7281							-0.54	-11,66			
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$						21.76	-0.41				
560       7262       21.72       -0.42       -11.71         570       7250       21.50       -0.41       -11.74         580       7252       21.99       -0.27       -11.52         590       7253       22.05       -0.61       -11.60         600       7255       21.85       -0.40       -11.68         610       7257       21.71       -0.38       -11.62         620       7200       21.74       -0.33       -11.94         630       7259       21.59       -0.39       -11.71         640       7283       22.06       -0.61       -11.63         650       7190       21.70       -0.50       -11.55         660       7275       21.75       -0.63       -11.66         670       7191       21.46       -0.56       -11.78         680       7195       21.50       -0.47       -11.80         690       7208       21.90       -0.61       -11.72         700       7400       21.86       -0.66       -11.79         710       7377       21.79       -0.66       -11.72				540	7207						
570       7250       21.50       -0.41       -11.74         580       7252       21.99       -0.27       -11.52         590       7253       22.05       -0.61       -11.60         600       7255       21.85       -0.40       -11.68         610       7257       21.71       -0.33       -11.94         620       7200       21.74       -0.33       -11.94         630       7259       21.59       -0.39       -11.71         640       7283       22.06       -0.61       -11.63         650       7190       21.70       -0.50       -11.55         670       7191       21.75       -0.63       -11.66         670       7191       21.46       -0.47       -11.80         690       7208       21.90       -0.47       -11.80         690       7208       21.90       -0.61       -11.56         700       7400       21.86       -0.66       -11.72         710       7377       21.79       -0.66       -11.72										<u> </u>	· · · · · · · · · · · · · · · · · · ·
580     7252     21,99     -0.27     -11,52       590     7253     22.05     -0.61     -11,60       400     7255     21.85     -0.40     -11,68       410     7257     21.71     -0.38     -11,62       420     7200     21.74     -0.33     -11,74       430     7259     21.59     -0.39     -11,71       440     7283     22.06     -0.61     -11,63       450     7190     21.70     -0.50     -11,55       460     7275     21.75     -0.63     -11,66       470     7191     21.46     -0.56     -11.78       480     7195     21.50     -0.47     -11.80       490     7208     21.90     -0.61     -11.56       700     7400     21.86     -0.66     -11.72       710     7377     21.79     -0.66     -11.72							•			·	
\$\frac{590}{600} \frac{7253}{7253}  \frac{22.05}{21.85}  \text{-0.40}{-0.40}  \text{-11.68}{-11.68}\$\$\$\$\$\frac{620}{640}  \frac{7257}{21.71}  \text{-0.38}{-0.38}  \text{-11.62}\$\$\$\$\$\$\frac{620}{620}  \frac{7200}{7200}  \frac{21.74}{21.74}  \text{-0.33}{-0.39}  \text{-11.71}{-11.71}\$\$\$\$\$\$\frac{630}{630}  \frac{7259}{7283}  \frac{22.06}{21.59}  \text{-0.61}{-0.61}  \text{-11.63}\$\$\$\$\$\$\$\$\$\frac{650}{7190}  \frac{21.70}{21.70}  \text{-0.50}{-0.63}  \text{-11.66}\$\$\$\$\$\$\$\frac{660}{640}  \frac{7275}{21.75}  \frac{21.46}{0.056}  \text{-0.56}{-11.78}\$\$\$\$\$\$\$\frac{680}{7195}  \frac{7191}{21.46}  \frac{-0.56}{0.47}  \text{-11.80}\$\$\$\$\$\$\$\$\frac{690}{7208}  \frac{21.90}{21.86}  \text{-0.66}{0.66}  \frac{-11.72}{11.79}\$\$\$\$\$\$\frac{710}{7377}  \frac{71.79}{21.79}  \frac{-0.66}{0.66}  \frac{-11.72}{11.72}\$											
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$			F				THE TOTAL NAME OF THE PARTY OF				
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$								-11.68			
620 7200 21.74 -0.33 -11.94 630 7259 21.59 -0.39 -11.71 640 7283 22.06 -0.61 -11.63 650 7190 21.70 -0.50 -11.55 640 7275 21.75 -0.63 -11.66 670 7191 21.46 -0.56 -11.78 680 7195 21.50 -0.47 -11.80 690 7208 21.90 -0.61 -11.56 700 7400 21.86 -0.66 -11.79 710 7377 21.79 -0.66 -11.72						21.71	-0.38	-11.62			
630 7259 21.59 -0.39 -11.71 640 7283 22.06 -0.61 -11.63 650 7190 21.70 -0.50 -11.55 640 7275 21.75 -0.63 -11.66 640 7275 21.46 -0.56 -11.78 670 7191 21.46 -0.47 -11.80 680 7195 21.50 -0.47 -11.80 690 7208 21.90 -0.61 -11.56 690 7208 21.90 -0.66 -11.79 710 7377 21.79 -0.66 -11.72	·		•		7200						
650 7190 21.70 -0.50 -11.55 650 7190 21.75 -0.63 -11.66 660 7275 21.75 -0.56 -11.78 670 7191 21.46 -0.56 -11.78 680 7195 21.50 -0.47 -11.80 690 7208 21.90 -0.61 -11.56 690 7208 21.90 -0.66 -11.79 700 7400 21.86 -0.66 -11.79				630	7259						
660 7275 21.75 -0.63 -11.66 670 7191 21.46 -0.56 -11.78 680 7195 21.50 -0.47 -11.80 690 7208 21.90 -0.61 -11.56 690 7400 21.86 -0.66 -11.79 710 7377 21.79 -0.66 -11.72							1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1				
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$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	•		h				-0.61				
710 7377 21.79 -0.66 -11.72 720 7391 21.70 -0.62 -11.93 730 7393 21.64 -0.49 -11.83	e .				7400	21.86	-0.66			. Carrier We	
720 7391 21.70 -0.49 -11.83				710	7377			-11./2			
730 7393 6 21 64 2			5	720	7391	21.70		-11 Da			14.
				730	7393	21.64				Service Control	174, 34, 35, 35, 35, 35, 35, 35, 35, 35, 35, 35

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Appendix B

Program to Rearrange the Data File
(supplied by Dr. Eugene M. Allen)

```
001000
      PROGRAM REARRAN (INPUT, OUTPUT, TAPE1, TAPE3)
                                                                     001010
      DIHENSION I(200), A(200), B(200)
      REAL L(200)
                                                                     001020
                                                                      001030
     LOGICAL OK
REHIND 3
J = 1
                                                                     001040
                                                                    001050
                                                                      001060
  100 READ (3, 1001) I1, I2, L(J), A(J), B(J)
                                                                    001979
 1001 FORMAT(15, 1X, 13, F11.0, F15.0, F10.0)
                                                                     001030
      IF (I1 . EQ . 999) GO TO 120
I(J) = 1000 * I1 + I2

J = J + 1

GO TO 100

120 NCOLORS = J - 1

NHIN1 = NCOLORS - 1

ITER = 0
                                                                      001090
                                                                   001100
                                                                  001110
                                                                      001120
                                                                  001130
                                                             0011>-
00116i
001170
00118f
 130 OK = .TR E.

ITER = IFER + 1

PRINT 1004, ITER

1004 FORMAT(1H≤,I4)

00 160 J = 1, NMIN1

IF (I(J) . LE . I(J + 1)) GO TO 160
                                                                      001195
                                                                      001200
     OK = .FALSE.

ITEMP = I(J)

I(J) = I(J + 1)

I(J + 1) = ITEMP

TEMP = L(J)
                                                                   001210
                                                              001220
                                                                      001230
                                                                      081240
                                                                      001250
      L(J) = L(J+1)
                                                                      001260
     L(J) = L(J+1)
L(J+1) = TENP
TENP = A(J)
A(J) = A(J+1)
                                                                     - 001270
                                                                      001280
                                                                      001290
                                                                      001300
      A(J + 1) = TEMP

TEMP = B(J)
                                                                      BB1310
      8(J) = 8(J + 1)
                                                                      001320
B(J + 1) = TEMP

160 CONTINUE

IF (.NOT . OK) GO TO 130

00 180 J = 1, NCOLORS

I1 = I(J) / 1000

I2 = I(J) - 1000 * I1
                                                                   001330
                                                                      001340
                                                                      001350
                                                                      001360
                                                                      001370
                                                                      001380
  HRITE (1, 1002) I1, I2, L(J), A(J), B(J)
                                                                      001390
  1002 FORMAT(15, 1H-, 13, F11.2, 2F10.2)
                                                                      001400
                                                                      001410
   180 CONTINUE
                                                                       001420
      STOP
END
                                                                       001438
```

Appendix C

Program to Find Sample Pairs

(supplied by Dr. Eugene M. Allen)

```
PROGRAM SIXWAYS (INPUT, OUTPUT, TAPE1, TAPE7)
                                                                    001000
                                                                    001010
         IN A GROUP OF COLOR POINTS IN CIELAB SPACE, DETERMINES 001020
         ALL CCLORS THAT ARE ON ISO(HUE-LIGHTNESS),

ISO(HUE-CHROMA) AND ISO(CHROMA-LIGHTNESS)

LINES RADIATING FROM EACH POINT IN TURN.

001030
001040
         ALL CCLORS THAT ARE ON ISO(HUE-LIGHTNESS),
DIMENSION A(400), B(400), NUMBER.

+DE(40, 3, 2), NP(3, 2)

REAL L(400)

READ FILE OF COLOR POINTS.

001120

01120

REHIND 7

100 READ (1, 1001) NUMBER(J), L(J), A(J), B(J)

IF (NUMBER(J), EQ. 7 H9999999) GO TO 120

01170

J = J + 1

001120

001120

001220

001220

001220

001220

001220
    DIMENSION A(400), B(400), NUMBER(400), NUMB(40, 3, 2), 001060
+DE(40, 3, 2), NP(3, 2) 001080
 DO 300 J = 1, NCOLORS
                                                                     001240
                                                                    001250
     PRINT 1014, J
                                                                  001260
    WRITE (7, 1002) NUMBER(J) 001270 001280
C SET UP DO LOOP BASED ON THE THREE ISO LINES IN
        COLOR SPACE.
                                                                    001290
                                                                    001300
                                                                    001310
     DO 220 IVIA = 1, 3
     M1 = 0 001320 M2 = 0 001330
                                                                  001320
     M2 = 0
                                                                 001340
                                                                    001350
   SET UP DO LOOP BASED ON TESTING EACH POINT TO SEE 001360 IF IT IS ON THE ISO LINE. 001370
          001380
    DO 200 K = 1, NCOLORS

IF (J . EQ . K) GO TO 200

GO TO (130, 135, 140), IVIA

001410
   GO TO (130, 135, 148), IVIA
                                                                    001420
    FORMULAS FOR DISTANCE BETWEEN COLOR POINT AND ISO LINE.
                                                                    001430
                                                                    00144D
 001470
   35 DIST = SQRT((L(J) - L(K)) ** 2 + (A(J) ** 2 + B(J) ** 2
+ - A(K) * A(J) - B(K) * B(J)) ** 2 / (A(J) ** 2 + B(J) ** 2))
 135 DIST = SQRT((L(J) - L(K)) ++ 2 + (A(J) ++ 2 + B(J) ++ 2
                                                                    001480
                                                                    001490
    GO TO 150
                                                                    001500
 140 DIST = SQRT((A(J) - A(K)) ** 2 + (B(J) - B(K)) ** 2) 001510
                                                                   001520
                                                                001530
         IF DISTANCE IS TOO GREAT, ELIHINATE THE POINT.
                                                                    001540
 150 IF (DIST . GT . 8.1) GO TO 200
                                                                    001550
                                                                    00156D
         DETERMINE ON WHICH SIDE OF THE ISO LINE THE POINT LIES.
                                                                    001570
         CALCULATE THE COLOR DIFFERENCE BETHEEN THE POINT
                                                                    001580
        AND THE REFERENCE COLOR.
                                                                 001590
                                                                   001600
     GO TO (160, 165, 170), IVIA
                                                                 001610
```

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IF (BI . GT . B(J)) GO TO 180
                                                               001650
165 AI = A(J) + B(J) + (A(K) + B(J) - A(J) + B(K)) / (A(J) ++ 2
                                                              001660
                                                              001670
 IF (AI . GT . A(J)) GO TO 190
GO TO 180
                                                               001680
GO TO 180 001690
770 IF (L(K) . GT . L(J)) GO TO 180 001710
GO TO 190 001720
   NUMB(M1, IVIA, 1) = NUMBER(K)
180 H1 = H1 + 1
                                                             001740
   DE(M1, IJIA, 1) = SQRT((L(J) - L(K)) ** 2 + (A(J) - A(K))
                                                               001750
  + ++ 2 + (B(J) - B(K)) ++ 2)
                                                               001760
GO TO 200
190 H2 = H2 + 1
                                                               001770
    NUMB(H2, IVIA, 2) = NUMBER(K)
                                                               001780
    DE(H2, IVIA, 2) = SQRT((L(J) - L(K)) ** 2 + (A(J) - A(K))
                                                                001790
   + ** 2 + (B(J) - B(K)-) ** 2)
                                                                001800
                                                               001810
200 CONTINUE
NP(IVIA, 1) = M1
NP(IVIA, 2) = M2
                                                                001820
                                                           001830
                                                                081340
                                                                001850
                                                                001860
        PRINT OUT RESULTS FOR EACH STANDARD POINT.
                                                            001870
  NMAX = MAXO(NP(1, 1), NP(1, 2), NP(2, 1), NP(2, 2), NP(3, 1), 001880
                                                                085100
   + NP(3, 2))
                                                                DD1900
    IF (NHAX . EQ . 0) GO TO 270
                                                                001905
    HRITE (7, 1011)
DO 250 K = 1, NHAX
                                                                001910
                                                                001920
    HRITE (7, 1004)
DO 250 M1 = 1, 3
DO 250 M2 = 1, 2
                                                                001930
                                                          001940
     IF (K . GT . NP(M1, M2)) GO TO 250
                                                                 001950
     IF (M1 . EQ . 1 . AND . M2 . EQ . 1) HRITE (7, 1005)
                                                                001960
                                                                001970
   + NUMB(K, M1, M2), DE(K, M1, M2)
IF (H1 . EQ . 1 . AND . H2 . EQ . 2) WRITE (7, 1006)
                                                                 DD1980
                                                                 001990
+ NUMB(K, H1, H2), DE(K, H1, H2)
  IF (M1 . EQ . 2 . AND . M2 . EQ . 1) WRITE (7, 1007)
                                                                002000
                                                                 002010
    + NUMB(K, H1, H2), DE(K, H1, H2)
                                                                 002020
   IF (M1 . EQ . 2 . AND . H2 . EQ . 2) WRITE (7, 1008)
                                                                 002030
 IF (H1 · EQ · 3 · AND · H2 · EQ · 1) HRITE (7, 1009)

- NUMB(K, H1 ,H2), DE(K, H1 ,H2)

- NUMB(K, H1 ,EQ · 3 · AND · H2 · EQ · 2) WRITE (7, 1010)
+ NUMB(K, M1, M2), DE(K, M1 ,M2)
                                                                 002040
                                                                 002050
                                                                 002060
                                                                 002070
  + NUMB(K, H1 ,H2), DE(K, H1, M2)
                                                                 002080
                                                                 002090
  250 CONTINUE
                                                                002100
 GO TO 300
 270 WRITE (7, 1012)
300 CONTINUE
                                                                 002110
                                                              002120
                                                                  002130
  FORMAT-STATEMENTS
                                                                  002148
                                                                  002150
                                                                  002160
    1001 FORHAF(2X,A7,F12.2,2F10.2)
1002 FORMAT(///* SAMPLE NUMBER *, A7)

1003 FORMAT(15)

1005 FORMAT(1+*)

1005 FORMAT(1+*)

1005 FORMAT(1+*)

1007 FORMAT(1+*)
                                                                  002170
                                                                  002200
                                                                  082210
                                                                  002220
                                                                  002240
  1006 FORHAT(1H+,17X,A7,F6.2)
                                                                  002250
 1007 FORHAT(1H+,34X,A7,F6.2)
                                                                  002260
  1008 FORMAT(1H+,51X,A7,F6.2)
                                                                  B02270
  1009 FORNAT(1H+,68X,A7,F6.2)
                                                                  002280
  1010 FORMAT(1H+,85X,A7,F6.2)
                                                                  002290
  1011 FORHAT CTEPLUS CHROMA*, 5X, *HINUS CHROMA*, 7X,
```

++HINUS LIGHT+) 002305 1912. FORHAT(\* NO POINTS FOUND IN ANY DIRECTION\*) 002310 -1014 FORMAT(1H5,15) 002315 002320 END 002330 

Appendix D

Program to Randomize the Order of Sample Pairs
(supplied by Dr. Eugene M. Allen)

(1)

-	PROGRAHTEUN	FER TINPUT	OUTPU	T, TAP	E1)	mhanna m.	· • • • • • • • • • • • • • • • • • • •				8
	PREPARES	SRANDIMIZ	ED LIST	OF CO	MPARISON .	S FOR	THE	INS	PECTO	)R	
) (	DIMENSION NA	AME (2, 24)	, ITAL	(24)							0
C	LOGICAL DONE	o wo hada na manada a a a a a a a a a a a a a a a a a	55 - 1	•	· · ·					••	0
` :	DATA NAME			. 7/70	7070				• • • • • • •	·	- 01 - 01
	+1001,8444,84 +7291,8443,84	443,7291,7	052,700	0,7000	,7052,	·	•			• •	υ :0 :0
•	+0709,7023,71 +0866,0650,00 +0681,0984,0	650,0866,0	006,083	7,0837	.0006,						0 0
	+5000+5327+5	•	•	-			· · · · · · · · · · · · · · · · · · ·		•		0 0
100	DO 100 J = :	1, 24					•	-			. 0
	K = IFIX(RAN IF (ITAL(K)	NF(0.0) *	24. + 1	. }			•		•		. D
	-WRITE_(1,-1) ITAL(K) = I	DO11(NAME	(J-K)-	_J_=1	• <del>-2</del> )	*					0 0
	DONE = .TRUE 	E• 7 1•-24		. gas - mai - ga ( - m <del>a</del>					•	**	- 0 0
200	IF (ITAL(J) CONTINUS	· · · · · ·	DONE	= .FALS	SE•		·				0
	_IF_(00NE)_S1 G0 T0 150										0 0
1001	FCRPAT(//1X	, 14, 19)	wane mee e sameere c				· · · · · · · · · · · · · · · · · · ·				0 0
			•	•		. •					
*****	* 17.25,57. * 17.25,57.	HANNYL H HANNYL H	000081	LINES	PRINTED PRINTED	111	END END	OF OF	LIST	111	<u>L</u> 1
											. <del></del>
						<b>,</b>		. <u></u>			
1		and the second	arterior	1-					<del></del>		·
							٠.				

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Appendix D

Program to Randomize the Order of Sample Pairs (supplied by Dr. Eugene M. Allen)

	PROGRAM FUN FE					_ =			C	001	
	PREPARES	RANDIMIZE	D LIST	OF COM	PARISON	S FOR	THE I	INSPECTO	K ···	.3016	
	DIMENSION NAM	E (2, 24)	, ITAL	24)					<b>.</b>	001	0
<del></del> :	LOGICAL DONE							•		001	0
	.DATA NAHE/ +1001,8444,844 +7291,8443,844	4.1001.70	30,7430 152,7600	,7430,	7030, 7052,	·.			•	001 001 081	0
•	40709,7023,702 40866,0650,065 40681.0984.098	23,0709,08 50,0866,00 14.0681.07	347,0979 306,0837 714,0644	,0979, ,0837, ,0644,	.0006, .0006, .0714,	· · · · · · · · · · · · · · · · · · ·				001 001 001	1
	_+5000 <sub>+</sub> 5327 <sub>+</sub> 532 	27-,5000,10 , 24	100,5310	,5310,	1000/-					001 001 001 001	2
	O TAL(J) = O  O K = IFIX(RANF  IF (ITAL(K)	F(0.0) * 3	GO TO	150						001 001 	2
	HRITE_(1,-10( ITAL(K) = ITA DONE = TRUE	AL(X) + 1	(JgKJ-9·						•••	001 - 001 001	3
201	DO_200_J==1: IF (ITAL(J): O CONTINUS	LT . 10	DONE :	= oFALS	SE•	•	•			001 001	
	-		•		-			·		001	. :
	IF_(DONE)_SI( GO TO 150 1 FCRPAT(//1X,	1::								001 001 001 001	
	IF_(OONE)_SIG	1::								001	
	IF_(DONE)_SI( GO TO 150 1 FCRPAT(//1X,	I4, 19)	000081 300081	LINES LINES	PRINTE PRINTE	ייי ס ייי מ	END END	OF LIST	///	001	
	IF_(00NE)_SI(     GO TO 150 1 FCRPAT(//1X,    END	I4, 19)	000081	LINES LINES	PRINTE PRINTE	D ///	END END	OF LIST	///	001 001 001 LQ	
	IF_(00NE)_SI(     GO TO 150 1 FCRPAT(//1X,    END	I4, 19)	000081	LINES LINES	PRINTE	D ///	END END	OF LIST	///	001 001 001 LQ	
	IF_(00NE)_SI(     GO TO 150 1 FCRPAT(//1X,    END	I4, 19)	000081	LINES LINES	PRINTE	D ///	END	OF LIST	///	001 001 001 LQ	
	IF_(00NE)_SI(     GO TO 150 1 FCRPAT(//1X,    END	I4, 19)	000081	LINES LINES	PRINTE	D ///	END	OF LIST	///	001 001 001 LQ	
	IF_(00NE)_SI(     GO TO 150 1 FCRPAT(//1X,    END	I4, 19)	000081	LINES LINES	PRINTE	D ///	END	OF LIST OF LIST	///	001 001 001 LQ	