

UNITED STATES AIR FORCE
RESEARCH LABORATORY

INTERLABORATORY STUDY (ILS) FOR
THE DETERMINATION OF THE ANGULAR
DISPLACEMENT OF MULTIPLE IMAGES
IN TRANSPARENT PARTS

Alan R. Pinkus
Harry L. Task

HUMAN EFFECTIVENESS DIRECTORATE
CREW SYSTEM INTERFACE DIVISION
WRIGHT-PATTERSON AFB OH 45433-7022

MARCH 1998

REPORT FOR THE PERIOD APRIL 1996 TO DECEMBER 1997

19980602 145

Approved for public release; distribution is unlimited

Human Effectiveness Directorate
Crew System Interface Division
2255 H Street
Wright-Patterson AFB, OH 45433-7022

NOTICES

When US Government drawings, specifications, or other data are used for any purpose other than a definitely related Government procurement operation, the Government thereby incurs no responsibility nor any obligation whatsoever, and the fact that the Government may have formulated, furnished, or in any way supplied the said drawings, specifications, or other data, is not to be regarded by implication or otherwise, as in any manner licensing the holder or any other person or corporation, or conveying any rights or permission to manufacture, use, or sell any patented invention that may in any way be related thereto.

Please do not request copies of this report from the Air Force Research Laboratory. Additional copies may be purchased from:

National Technical Information Service
5285 Port Royal Road
Springfield, Virginia 22161

Federal Government agencies registered with the Defense Technical Information Center should direct requests for copies of this report to:

Defense Technical Information Center
8725 John J. Kingman Road, Suite 0944
Ft. Belvoir, Virginia 22060-6218

DISCLAIMER

This Technical Report is published as received and has not been edited by the Air Force Research Laboratory, Human Effectiveness Directorate.

TECHNICAL REVIEW AND APPROVAL

AFRL-HE-WP-TR-1998-0011

This report has been reviewed by the Office of Public Affairs (PA) and is releasable to the National Technical Information Service (NTIS). At NTIS, it will be available to the general public, including foreign nations.

This technical report has been reviewed and is approved for publication.

FOR THE COMMANDER



JOHN F. KENT, COL, USAF, BSC
Acting Chief
Crew System Interface Division
Air Force Research Laboratory

REPORT DOCUMENTATION PAGE			Form Approved OMB No. 0704-0188	
Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, DC 20503.				
1. AGENCY USE ONLY (Leave blank)		2. REPORT DATE March 1998	3. REPORT TYPE AND DATES COVERED INTERIM (April 1995-December 1997)	
4. TITLE AND SUBTITLE Interlaboratory Study (ILS) for the Determination of the Angular Displacement of Multiple Images in Transparent Parts			5. FUNDING NUMBERS PE 62202F PR 7184 TA 18 WU 07	
6. AUTHOR(S) Alan R. Pinkus Harry L. Task				
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)			8. PERFORMING ORGANIZATION REPORT NUMBER	
9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES) Air Force Research Laboratory Human Effectiveness Directorate Crew System Interface Division Air Force Materiel Command Wright-Patterson AFB OH 45433-7022			10. SPONSORING / MONITORING AGENCY REPORT NUMBER AFRL-HE-WP-TR-1998-0011	
11. SUPPLEMENTARY NOTES				
12a. DISTRIBUTION / AVAILABILITY STATEMENT Approved for public release; distribution is unlimited			12b. DISTRIBUTION CODE	
13. ABSTRACT (Maximum 200 words) An Interlaboratory Study (ILS) was undertaken in order to determine the precision of the test method for measuring the angular displacement of multiple images by transparent parts. Multiple imaging is defined as the angular separation of secondary images from their respective primary images as viewed from the design eye position of an aircraft transparency. Newer aircraft now utilize thick, curved, highly angled transparencies resulting in multiple imaging being more frequently cited as an optical problem by pilots. Secondary images vary in intensity and displacement across the transparency thus giving the observer deceptive cues of attitude, velocity and approach angle. Test method F 1165-88 standardizes the measurement technique. This ILS determined the precision of this method.				
14. SUBJECT TERMS multiple images, aircraft windscreens, transparencies, angular displacement			15. NUMBER OF PAGES 80	
			16. PRICE CODE	
17. SECURITY CLASSIFICATION OF REPORT Unclassified	18. SECURITY CLASSIFICATION OF THIS PAGE Unclassified	19. SECURITY CLASSIFICATION OF ABSTRACT Unclassified	20. LIMITATION OF ABSTRACT Unlimited	

This Page Intentionally Left Blank

Acknowledgments

The authors gratefully recognize the excellent support provided by Martha Hausmann of Logicon Technical Services, Inc., and Chuck Goodyear, independent consultant, during the data reduction and statistical analysis phases of this study.

THIS PAGE INTENTIONALLY LEFT BLANK

1. TITLE

INTERLABORATORY STUDY (ILS) FOR THE DETERMINATION OF THE ANGULAR DISPLACEMENT OF MULTIPLE IMAGES IN TRANSPARENT PARTS

Committee F-7 on Aerospace and Aircraft Enclosures.
Subcommittee F-7.08 on Transparent Enclosures and Materials
Designation No. F 1165-88. File No. F07-1003

2. INTRODUCTION

This ILS was undertaken in order to determine the precision of the test method for measuring the angular displacement of multiple images by transparent parts. Multiple imaging is defined as the angular separation of secondary images from their respective primary images as viewed from the design eye position of an aircraft transparency (see Appendix A). Newer aircraft now utilize thick, curved, highly angled transparencies resulting in multiple imaging being more frequently cited as an optical problem by pilots. Secondary images vary in intensity and displacement across the transparency thus giving the observer deceptive cues of attitude, velocity and approach angle. Test method F 1165-88 standardizes the measurement technique. This ILS determined the precision of this method.

3. TEST METHOD

The source of error in the test method derives from the physical measurement of the spatial separation of multiple images in a photograph and not from the angular displacement calculation, itself. The ILS was simplified by requiring the labs to only perform the caliper measurements. The body of the test method sent to the labs follows.

You will make two different types of measurements. One type is the measurement of the 5 primary light distance which is used to derive a scale factor (see Figure 1). From the *center* of the 1st primary to the *center* of the 5th primary light (e.g., data point #1), use the digital calipers to measure the linear separation in mm's. The other type of measurement is between the primary and secondary images (see Figure 2; e.g., data point #2). Again, when making your measurements, place the calipers such that you are measuring from the center of the primary image to the center of the secondary image. Record, with 2 significant decimal places, the 60 measurements onto the supplied data sheets.

Thank you for your time and participation in this study.

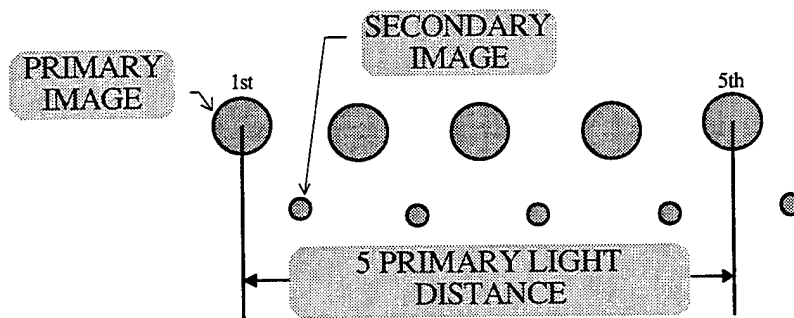


Figure 1. Five primary light distance defined.
(data points 1, 7, 13, 19, 25, 31, 37, 43, 49, 55)

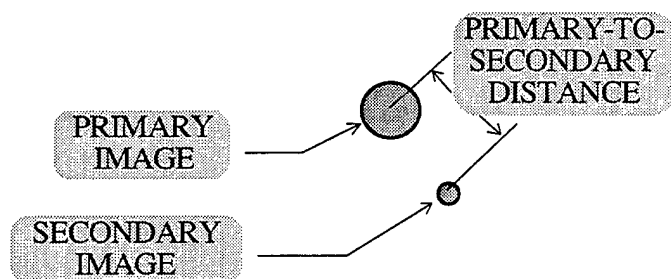


Figure 2. Primary and secondary multiple images defined.
(data points 2 through 6, 8 through 12, etc.)

Photos of the scale factor and the five differently spaced multiple images were randomized and mounted onto a card (see Appendix B). Multiple imaging ILS data sheet:

Name: _____ Organization: _____
Date: _____ Photo Set: _____

PAGE 1 of 5

MEASUREMENT	DATA POINT #	DISTANCE (mm)
5 Primary Light Distance	1	_____
Primary-to-Secondary distance	2	_____
Primary-to-Secondary distance	3	_____
Primary-to-Secondary distance	4	_____
Primary-to-Secondary distance	5	_____
Primary-to-Secondary distance	6	_____
5 Primary Light Distance	7	_____
Primary-to-Secondary distance	8	_____
Primary-to-Secondary distance	9	_____
Primary-to-Secondary distance	10	_____
Primary-to-Secondary distance	11	_____
Primary-to-Secondary distance	12	_____

PAGE 2 of 5

MEASUREMENT	DATA POINT #	DISTANCE (mm)
5 Primary Light Distance	13	_____
Primary-to-Secondary distance	14	_____
Primary-to-Secondary distance	15	_____
Primary-to-Secondary distance	16	_____
Primary-to-Secondary distance	17	_____
Primary-to-Secondary distance	18	_____
5 Primary Light Distance	19	_____
Primary-to-Secondary distance	20	_____
Primary-to-Secondary distance	21	_____
Primary-to-Secondary distance	22	_____
Primary-to-Secondary distance	23	_____
Primary-to-Secondary distance	24	_____

PAGE 3 of 5

MEASUREMENT	DATA POINT #	DISTANCE (mm)
5 Primary Light Distance	25	_____
Primary-to-Secondary distance	26	_____
Primary-to-Secondary distance	27	_____
Primary-to-Secondary distance	28	_____
Primary-to-Secondary distance	29	_____
Primary-to-Secondary distance	30	_____
5 Primary Light Distance	31	_____
Primary-to-Secondary distance	32	_____
Primary-to-Secondary distance	33	_____
Primary-to-Secondary distance	34	_____
Primary-to-Secondary distance	35	_____
Primary-to-Secondary distance	36	_____

PAGE 4 of 5

MEASUREMENT	DATA POINT #	DISTANCE (mm)
5 Primary Light Distance	37	_____
Primary-to-Secondary distance	38	_____
Primary-to-Secondary distance	39	_____
Primary-to-Secondary distance	40	_____
Primary-to-Secondary distance	41	_____
Primary-to-Secondary distance	42	_____
5 Primary Light Distance	43	_____
Primary-to-Secondary distance	44	_____
Primary-to-Secondary distance	45	_____
Primary-to-Secondary distance	46	_____
Primary-to-Secondary distance	47	_____
Primary-to-Secondary distance	48	_____

PAGE 5 of 5

MEASUREMENT	DATA POINT #	DISTANCE (mm)
5 Primary Light Distance	49	_____
Primary-to-Secondary distance	50	_____
Primary-to-Secondary distance	51	_____
Primary-to-Secondary distance	52	_____
Primary-to-Secondary distance	53	_____
Primary-to-Secondary distance	54	_____
5 Primary Light Distance	55	_____
Primary-to-Secondary distance	56	_____
Primary-to-Secondary distance	57	_____
Primary-to-Secondary distance	58	_____
Primary-to-Secondary distance	59	_____
Primary-to-Secondary distance	60	_____

4. LIST OF PARTICIPATING LABORATORIES

Lab #1: 11-29-95 PPG Industries, Inc. Works #22 PO Box 2200 Huntsville, AL 35804 205-859-2500 POC: Tommy Seals	Grand Prairie, TX 75053-4036 214-647-1366 POC: Elmer L'Roy	Sierracin/Sylmar Corp. POC: Mike J. Keith
Lab #2: 11-29-95 PPG Industries, Inc. POC: Carter Adams	Lab #8: 11-29-95 Texstar, Inc. POC: Bobby	Lab #15: 2-14-96 Pilkington Aerospace 12122 Western Ave Garden Grove, CA 92641-2990 714-893-7531 POC: Jeanisa Chang
Lab #3: 11-28-95 PPG Industries, Inc. POC: Thomas Tipton	Lab #9: 11-29-95 Texstar, Inc. POC: Tom	Lab #16: 2-15-96 Pilkington Aerospace POC: Mike Winstead
Lab #4: 11-29-95 PPG Industries, Inc. POC: Ron Barrett	Lab #10: 11-29-95 Texstar, Inc. POC: Jim Irion	Lab #17: 2-15-96 Pilkington Aerospace POC: Dave Larson
Lab #5: 11-29-95 PPG Industries, Inc. POC: Johnny Tucker	Lab #11: 12-5-95 Texstar, Inc. POC: Lisa V.	Lab #18: 2-19-96 Pilkington Aerospace POC: Elsie Wilson
Lab #6: 11-28-95 PPG Industries, Inc. POC: Charles McGehee	Lab #12: 1-16-96 Sierracin/Sylmar Corp. 12780 San Fernando Rd Sylmar, CA 91342 818-362-6711 POC: Michael J. Smith	Lab #19: 2-20-96 Pilkington Aerospace POC: Raymond Rodriguez
Lab #7: 11-29-95 Texstar, Inc. 1170 108th St. PO Box 534036	Lab #13: 2-5-96 Sierracin/Sylmar Corp. POC: Ron Maglalamy	Lab #20: 2-14-96 Pilkington Aerospace POC: Julie Garcia
	Lab #14: 2-9-96	

5. INTERLABORATORY TEST PROGRAM INSTRUCTIONS

The cover letter for test instructions to participating labs.

Subject: Round-robin testing to determine precision for *ASTM Standard Test Method for Measuring Angular Displacement of Multiple Images in Transparent Parts* F 1165-88

Enclosed please find test materials for a study to determine the precision and bias of Standard Test Method ASTM F 1165-88. Included are instructions, multiple image photographic samples, and answer sheets. The test requires simple linear measurements using a caliper accurate to 0.01 mm. The test procedures and goals will be best understood by people who have previously worked on windscreen multiple imaging analysis and therefore would be the best test subjects. In order to achieve a statistically valid estimate of the precision and bias for this method, at least three different people (more is better) need to complete the test, per company. The test takes about 20 minutes. Also, we have limited test materials that need to be rotated through several different companies, so please test and then return all materials to us as soon as possible. If you have any

questions, please do not hesitate to call either H. Lee Task (937-255-8816) or Alan Pinkus (937-255-8767) for assistance. Your help with this study will allow us to add the precision and bias section to the test method thus completing the standard for submission to ASTM. Thank you very much for your valuable time and help.

The test instructions to participating labs.

Instructions for the Determination of Precision and Bias of the Multiple Imaging Measurements Study

Overview

You have volunteered to participate in a study to determine the precision and repeatability with which measurements of angular displacement of multiple images can be made. You will be provided with five (5) test sheets to perform angular displacement measurements. These measurements are to be made using a digital caliper capable of 0.01 mm accuracy. Please review your particular caliper's instructions for their proper use. Assure that the instrument is properly zeroed, displays units in mm's, and is calibrated. Your task in this study will involve the measurement of the linear separations, in mm's, of multiple imaging test samples and writing these values down on data sheets.

If you have any questions, please do not hesitate to call either H. Lee Task (937-255-8816) or Alan Pinkus (937-255-8767) for clarification.

6. DATA REPORT FORMS

see Appendix C

7. STATISTICAL DATA SUMMARY

The ILS involved 20 labs (people) from four aerospace transparency companies. The test stimuli were samples of actual multiple image (MI) photographs. Five MI and one scaling factor distances were selected. Ten photographic copies of each MI were created and glued to a cardboard sheet (8.5 by 11 in.) randomly ordered and oriented. There was one scale factor measured for every 5 MI measurements. The stimuli were then placed in a protective, clear plastic protector so the calipers points would not damage the photographic surfaces during the measurements. Five MI distances were measured 10 times each by each of 20 labs. A scale factor was also measured 10 times by each of the 20 labs. The one scale factor was used for all of the MI measurements.

Tables 1 through 6 summarize labs 1 - 20: means (in mm's), standard deviations (s), cell deviations (d), h and k statistics, grand mean (GM), repeatability (S_r), standard deviation of cell averages ($S_{\bar{x}}$), as defined in ASTM Practice E 691.

Tables 1 through 6. Summary statistics for Samples 1 through 5 and the scale factor (20 labs 10 replications each). The "*" denotes a flagged lab that exceeded the critical value of $k = 1.59$

Table 1	Sample 1		crit. value =	2.56	1.59
lab #	mean (mm)	s	d	h	k
1	2.29	0.08	-0.04	-0.25	0.49
2	2.34	0.16	0.01	0.06	1.00
3	1.93	0.13	-0.40	-2.48	0.85
4	2.42	0.08	0.09	0.57	0.50
5	2.48	0.10	0.15	0.93	0.64
6	2.39	0.08	0.05	0.33	0.51
7	2.15	0.15	-0.19	-1.16	0.94
* 8	2.40	0.49	0.07	0.42	3.09
9	2.21	0.06	-0.12	-0.74	0.35
10	2.20	0.16	-0.13	-0.83	1.04
11	2.47	0.07	0.14	0.86	0.45
12	2.22	0.07	-0.11	-0.69	0.42
13	2.19	0.09	-0.14	-0.88	0.54
14	2.27	0.10	-0.07	-0.42	0.64
15	2.57	0.18	0.24	1.50	1.14
16	2.30	0.10	-0.04	-0.23	0.62
17	2.56	0.11	0.23	1.40	0.69
18	2.53	0.14	0.20	1.24	0.90
19	2.26	0.10	-0.07	-0.43	0.62
20	2.46	0.16	0.13	0.80	1.02
	2.33	0.158	0.161		
	<i>GM</i>	<i>S_r</i>	<i>S_x</i>		

Table 2	Sample 2				
lab #	mean (mm)	s	d	h	k
1	2.94	0.08	-0.03	-0.12	0.50
2	3.09	0.12	0.11	0.42	0.79
3	2.57	0.12	-0.41	-1.54	0.76
4	3.02	0.13	0.05	0.17	0.84
5	3.04	0.20	0.07	0.25	1.28
6	2.96	0.10	-0.02	-0.07	0.66
7	2.70	0.09	-0.27	-1.02	0.55
* 8	3.73	0.32	0.76	2.86	2.04
9	2.77	0.10	-0.21	-0.78	0.65
10	2.79	0.11	-0.18	-0.70	0.69
11	3.10	0.06	0.12	0.46	0.38
12	2.83	0.09	-0.15	-0.55	0.58
13	2.58	0.12	-0.39	-1.48	0.80
14	2.84	0.12	-0.13	-0.50	0.78
15	3.19	0.17	0.21	0.81	1.11
16	2.90	0.10	-0.07	-0.28	0.61
17	3.25	0.12	0.28	1.05	0.74
* 18	3.10	0.27	0.12	0.47	1.69
19	2.88	0.10	-0.10	-0.37	0.64
* 20	3.22	0.28	0.25	0.93	1.80
	2.97	0.157	0.26		
	<i>GM</i>	<i>S_r</i>	<i>S_x</i>		

Table 3	Sample 3				
lab #	mean (mm)	s	d	h	k
1	3.72	0.07	-0.05	-0.32	0.46
2	3.87	0.16	0.09	0.59	1.07
3	3.46	0.09	-0.31	-1.96	0.60
4	3.85	0.12	0.07	0.46	0.83
5	3.88	0.14	0.10	0.66	0.91
6	3.80	0.07	0.02	0.14	0.49
7	3.55	0.17	-0.23	-1.45	1.15
* 8	3.73	0.32	-0.04	-0.27	2.13
9	3.68	0.06	-0.10	-0.61	0.39
10	3.60	0.07	-0.17	-1.10	0.47
11	3.93	0.15	0.15	0.95	0.99
12	3.70	0.10	-0.07	-0.47	0.67
13	3.60	0.08	-0.17	-1.08	0.51
14	3.63	0.18	-0.14	-0.89	1.20
15	4.04	0.13	0.26	1.66	0.86
16	3.82	0.10	0.04	0.26	0.68
17	4.03	0.13	0.25	1.59	0.86
* 18	3.98	0.29	0.20	1.27	1.94
19	3.79	0.08	0.02	0.10	0.51
20	3.85	0.17	0.07	0.47	1.10
	3.77	0.151	0.16		
	<i>GM</i>	<i>S_r</i>	<i>S_x</i>		

Table 4	Sample 4				
lab #	mean (mm)	s	d	h	k
1	5.33	0.20	0.07	0.37	1.23
2	5.39	0.16	0.14	0.69	0.96
3	4.96	0.11	-0.29	-1.42	0.67
4	5.37	0.10	0.11	0.56	0.61
5	5.35	0.18	0.10	0.48	1.08
6	5.24	0.15	-0.02	-0.08	0.93
7	4.92	0.08	-0.33	-1.63	0.46
* 8	5.14	0.36	-0.11	-0.55	2.15
9	5.04	0.11	-0.21	-1.05	0.64
10	5.09	0.13	-0.16	-0.81	0.79
11	5.38	0.13	0.13	0.63	0.79
12	5.15	0.09	-0.10	-0.49	0.53
13	4.90	0.12	-0.35	-1.73	0.76
14	5.12	0.18	-0.14	-0.68	1.06
15	5.51	0.19	0.26	1.28	1.15
16	5.30	0.12	0.04	0.20	0.74
17	5.59	0.17	0.33	1.64	1.00
18	5.53	0.24	0.28	1.35	1.48
19	5.36	0.10	0.10	0.50	0.62
20	5.41	0.15	0.15	0.74	0.89
	5.25	0.165	0.20		
	GM	S _r	S _x		

Table 5	Sample 5				
lab #	mean (mm)	s	d	h	k
1	7.50	0.06	0.01	0.03	0.42
2	7.64	0.13	0.14	0.72	0.90
3	7.14	0.14	-0.35	-1.80	0.95
4	7.50	0.16	0.00	0.01	1.13
5	7.68	0.17	0.18	0.93	1.17
6	7.51	0.12	0.01	0.06	0.81
7	7.18	0.13	-0.31	-1.60	0.90
* 8	7.39	0.24	-0.10	-0.53	1.66
9	7.40	0.13	-0.10	-0.50	0.87
10	7.28	0.09	-0.22	-1.10	0.62
11	7.66	0.13	0.17	0.85	0.91
12	7.39	0.11	-0.11	-0.54	0.76
13	7.23	0.13	-0.26	-1.33	0.92
14	7.40	0.09	-0.09	-0.47	0.63
15	7.82	0.16	0.33	1.67	1.10
16	7.50	0.14	0.01	0.03	0.97
17	7.80	0.10	0.31	1.56	0.70
18	7.74	0.16	0.25	1.25	1.09
19	7.56	0.09	0.06	0.31	0.65
* 20	7.58	0.26	0.09	0.44	1.78
	7.49	0.144	0.20		
	GM	S _r	S _x		

Table 6	Scale Factor				
lab #	mean (mm)	s	d	h	k
1	111.91	0.14	-0.24	-1.10	0.80
2	112.25	0.14	0.10	0.45	0.81
3	111.82	0.12	-0.33	-1.51	0.67
4	112.03	0.13	-0.12	-0.54	0.72
5	112.22	0.18	0.08	0.34	1.02
6	112.08	0.12	-0.07	-0.33	0.69
7	111.90	0.10	-0.25	-1.14	0.55
8	112.35	0.14	0.20	0.89	0.79
9	112.02	0.05	-0.13	-0.57	0.31
10	112.32	0.05	0.17	0.77	0.25
11	112.35	0.19	0.20	0.91	1.10
12	111.87	0.09	-0.28	-1.27	0.49
13	111.78	0.17	-0.37	-1.69	0.97
14	112.07	0.17	-0.08	-0.35	0.94
15	112.40	0.11	0.25	1.13	0.61
16	112.35	0.14	0.20	0.92	0.78
17	112.51	0.16	0.36	1.64	0.91
* 18	112.11	0.55	-0.04	-0.18	3.07
19	112.40	0.11	0.25	1.14	0.62
20	112.26	0.10	0.11	0.49	0.54
	112.15	0.178	0.22		
	GM	S _r	S _x		

The critical values for the h and k statistics are 2.56 and 1.59 ($p = 20$ labs and $n = 10$ replications), respectively (ASTM Practice E 691, Table 12). If these critical values are exceeded, the data are re-examined. These data are marked with an "*", in Tables 1 through 6. All 10 flagged labs (k exceeded 1.59) were checked for possible transcription errors during the data analysis but none were found. Close examination of the original data indicated that those labs did not follow the prescribed test method ("measuring from the center of the primary image to the center of the secondary image") so their data were removed and the remaining data reanalyzed as summarized below in Tables 7 through 12.

Tables 7 through 12 summarize: means (in mm's), standard deviations (s), cell deviations (d), h and k statistics, grand mean (GM), repeatability (S_r) and standard deviation of cell averages ($S_{\bar{x}}$) values were calculated as defined in ASTM Practice E 691.

Tables 7 through 12. Summary statistics for Samples 1 through 5 and the scale factor (* denotes removed lab data).

Table 7	Sample 1		crit. value =	2.56	1.59
lab #	mean (mm)	s	d	h	k
1	2.29	0.08	-0.04	-0.22	0.68
2	2.34	0.16	0.01	0.08	1.38
3	1.93	0.13	-0.40	-2.40	1.18
4	2.42	0.08	0.09	0.57	0.69
5	2.48	0.10	0.15	0.93	0.88
6	2.39	0.08	0.06	0.34	0.70
7	2.15	0.15	-0.18	-1.11	1.30
8	*	*	*	*	*
9	2.21	0.06	-0.12	-0.70	0.49
10	2.20	0.16	-0.13	-0.79	1.44
11	2.47	0.07	0.14	0.87	0.63
12	2.22	0.07	-0.11	-0.65	0.58
13	2.19	0.09	-0.14	-0.83	0.75
14	2.27	0.10	-0.06	-0.39	0.88
15	2.57	0.18	0.24	1.49	1.58
16	2.30	0.10	-0.03	-0.20	0.86
17	2.56	0.11	0.23	1.39	0.95
18	2.53	0.14	0.20	1.23	1.25
19	2.26	0.10	-0.07	-0.40	0.86
20	2.46	0.16	0.13	0.80	1.41
	2.33	0.114	0.165		
	GM	S_r	$S_{\bar{x}}$		

Table 8	Sample 2				
lab #	mean (mm)	s	d	h	k
1	2.94	0.08	0.03	0.17	0.67
2	3.09	0.12	0.18	0.92	1.04
3	2.57	0.12	-0.34	-1.75	1.01
4	3.02	0.13	0.11	0.58	1.11
5	3.04	0.20	0.13	0.68	1.69
6	2.96	0.10	0.05	0.25	0.87
7	2.70	0.09	-0.20	-1.05	0.73
8	*	*	*	*	*
9	2.77	0.10	-0.14	-0.72	0.86
10	2.79	0.11	-0.12	-0.61	0.92
11	3.10	0.06	0.19	0.97	0.51
12	2.83	0.09	-0.08	-0.41	0.77
13	2.58	0.12	-0.33	-1.67	1.05
14	2.84	0.12	-0.07	-0.34	1.03
15	3.19	0.17	0.28	1.44	1.47
16	2.90	0.10	-0.01	-0.04	0.80
17	3.25	0.12	0.34	1.76	0.97
18	*	*	*	*	*
19	2.88	0.10	-0.03	-0.16	0.85
20	*	*	*	*	*
	2.91	0.119	0.19		
	GM	S_r	$S_{\bar{x}}$		

Table 9		Sample 3			
lab #	mean (mm)	s	d	h	k
1	3.72	0.07	-0.04	-0.27	0.57
2	3.87	0.16	0.10	0.64	1.33
3	3.46	0.09	-0.30	-1.89	0.74
4	3.85	0.12	0.08	0.51	1.03
5	3.88	0.14	0.11	0.71	1.12
6	3.80	0.07	0.03	0.19	0.61
7	3.55	0.17	-0.22	-1.38	1.42
8	*	*	*	*	*
9	3.68	0.06	-0.09	-0.55	0.48
10	3.60	0.07	-0.17	-1.04	0.59
11	3.93	0.15	0.16	1.00	1.23
12	3.70	0.10	-0.07	-0.41	0.83
13	3.60	0.08	-0.16	-1.02	0.63
14	3.63	0.18	-0.13	-0.83	1.49
15	4.04	0.13	0.27	1.70	1.07
16	3.82	0.10	0.05	0.32	0.84
17	4.03	0.13	0.26	1.64	1.06
18	*	*	*	*	*
19	3.79	0.08	0.02	0.15	0.64
20	3.85	0.17	0.08	0.52	1.37
	3.77	0.122	0.16		
	GM	S_r	S_{x̄}		

Table 10		Sample 4			
lab #	mean (mm)	s	d	h	k
1	5.33	0.20	0.07	0.33	1.37
2	5.39	0.16	0.13	0.64	1.07
3	4.96	0.11	-0.30	-1.43	0.74
4	5.37	0.10	0.11	0.52	0.68
5	5.35	0.18	0.09	0.45	1.21
6	5.24	0.15	-0.02	-0.10	1.03
7	4.92	0.08	-0.34	-1.63	0.51
8	*	*	*	*	*
9	5.04	0.11	-0.22	-1.06	0.71
10	5.09	0.13	-0.17	-0.82	0.87
11	5.38	0.13	0.12	0.59	0.87
12	5.15	0.09	-0.11	-0.51	0.58
13	4.90	0.12	-0.36	-1.72	0.84
14	5.12	0.18	-0.14	-0.70	1.18
15	5.51	0.19	0.25	1.23	1.28
16	5.30	0.12	0.04	0.17	0.82
17	5.59	0.17	0.33	1.58	1.11
18	5.53	0.24	0.27	1.30	1.64
19	5.36	0.10	0.10	0.47	0.69
20	5.41	0.15	0.15	0.70	0.99
	5.26	0.149	0.21		
	GM	S_r	S_{x̄}		

Table 11		Sample 5			
lab #	mean (mm)	s	d	h	k
1	7.50	0.06	0.00	0.02	0.48
2	7.64	0.13	0.14	0.68	1.01
3	7.14	0.14	-0.36	-1.73	1.08
4	7.50	0.16	0.00	0.00	1.28
5	7.68	0.17	0.18	0.88	1.32
6	7.51	0.12	0.01	0.06	0.91
7	7.18	0.13	-0.32	-1.54	1.02
8	*	*	*	*	*
9	7.40	0.13	-0.10	-0.48	0.99
10	7.28	0.09	-0.22	-1.05	0.70
11	7.66	0.13	0.17	0.81	1.03
12	7.39	0.11	-0.11	-0.52	0.85
13	7.23	0.13	-0.26	-1.28	1.04
14	7.40	0.09	-0.09	-0.46	0.72
15	7.82	0.16	0.33	1.60	1.25
16	7.50	0.14	0.01	0.03	1.10
17	7.80	0.10	0.31	1.49	0.79
18	7.74	0.16	0.24	1.19	1.24
19	7.56	0.09	0.06	0.29	0.74
20	*	*	*	*	*
	7.49	0.128	0.21		
	GM	S_r	S_{x̄}		

Table 12 Scale Factor					
lab #	mean (mm)	s	d	h	k
1	111.91	0.14	-0.25	-1.08	1.08
2	112.25	0.14	0.10	0.43	1.08
3	111.82	0.12	-0.33	-1.48	0.90
4	112.03	0.13	-0.12	-0.53	0.96
5	112.22	0.18	0.07	0.33	1.36
6	112.08	0.12	-0.08	-0.33	0.93
7	111.90	0.10	-0.25	-1.12	0.74
8	112.35	0.14	0.20	0.86	1.06
9	112.02	0.05	-0.13	-0.57	0.41
10	112.32	0.05	0.17	0.74	0.34
11	112.35	0.19	0.20	0.87	1.47
12	111.87	0.09	-0.28	-1.25	0.66
13	111.78	0.17	-0.37	-1.65	1.29
14	112.07	0.17	-0.08	-0.35	1.26
15	112.40	0.11	0.25	1.09	0.81
16	112.35	0.14	0.20	0.89	1.04
17	112.51	0.16	0.36	1.59	1.21
18	*	*	*	*	*
19	112.40	0.11	0.25	1.10	0.83
20	112.26	0.10	0.11	0.47	0.72
	112.15	0.133	0.23		
	<i>GM</i>	S_r	S_R		

Table 13. Repeatability (S_r) and reproducibility (S_R) values in mm's, derived from data sets with flagged results removed.

	REPEATABILITY (S_r) WITHIN LABS	REPRODUCIBILITY (S_R) BETWEEN LABS
SAMPLE #1	0.114	0.198
SAMPLE #2	0.119	0.226
SAMPLE #3	0.122	0.199
SAMPLE #4	0.149	0.253
SAMPLE #5	0.128	0.240
SCALE FACTOR	0.133	0.261
MEAN	0.128	0.230

Table 14. 95% repeatability (r) limits and 95% reproducibility (R) limits in mm's.

	95% r LIMITS WITHIN LABS	95% R LIMITS BETWEEN LABS
SAMPLE #1	0.316	0.550
SAMPLE #2	0.329	0.627
SAMPLE #3	0.337	0.550
SAMPLE #4	0.412	0.701
SAMPLE #5	0.354	0.665
SCALE FACTOR	0.368	0.723
MEAN	0.353	0.636

S_r ranged from 0.114 to 0.149 mm
 S_R ranged from 0.198 to 0.261 mm

r ranged from 0.316 to 0.412 mm
 R ranged from 0.550 to 0.723 mm

Since the accuracy of the measurements should not and did not depend upon the size of the measured object, it is logical to take a mean of the 6 sample sizes to derive the composite precision values indicative of this method.

The composite (mean) repeatability (S_r) and reproducibility (S_R) values:

Mean $S_r = 0.128$ mm
Mean $S_R = 0.230$ mm

The composite (mean) 95% limits for repeatability (r) and 95% limits for reproducibility (R) values:

Mean $r = 0.353$ mm
Mean $R = 0.636$ mm

The 95% limits were calculated using the formulae, below. Because the 95% limits are based on the difference between two test results, the $\sqrt{2}$ factor was incorporated into the calculation (ASTM Practice E 177; 27.3.3).

r = 95% repeatability limit (within laboratories)
 S_r = repeatability standard deviation

$$r = 1.960 * \sqrt{2} * S_r$$

R = 95% reproducibility limit (between laboratories)
 S_R = reproducibility standard deviation

$$R = 1.960 * \sqrt{2} * S_R$$

The final value determined by method F 1165-88 is angular displacement (in mrad). This final angular value depends upon and is relative to the original photographic geometry and enlargement size, therefore, no precision value in terms of angular displacement can be calculated or expressed. The error in the method is due to people using calipers to make actual physical measurements of separated dots of lights on photographs, not in the calculation of angular displacement.

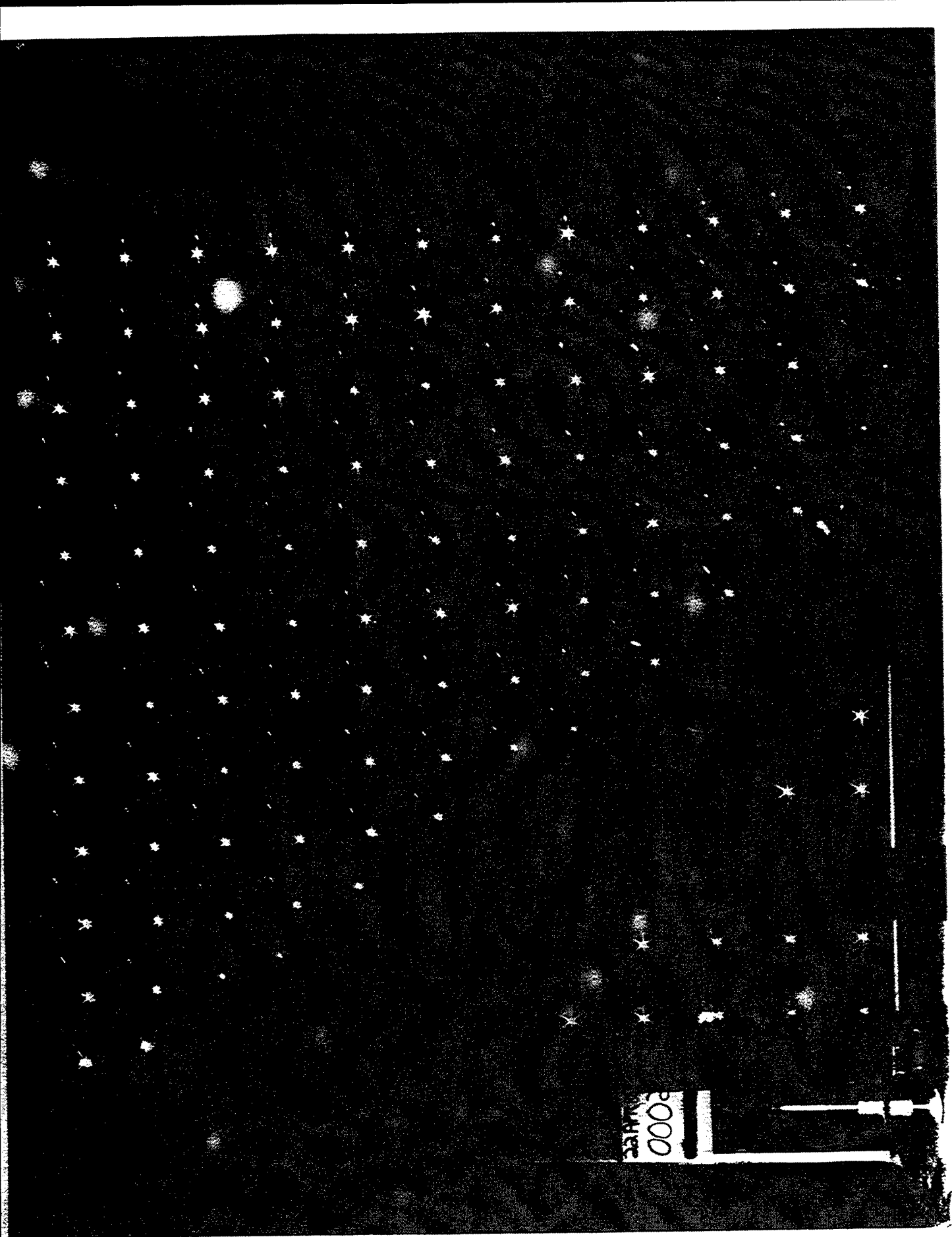
8. RESEARCH REPORT SUMMARY

Precision: An interlaboratory study was conducted to determine the precision of the Standard Test Method for Measuring Angular Displacement of Multiple Images in Transparent Materials F 1165-88. Twenty labs (people) measured five different multiple image (MI) photographic distances plus one scale factor, 10 times each. Statistical analysis (ASTM Standard Practices E 691 and E 177) revealed that the method's mean repeatability (S_r) was 0.128 mm and the mean reproducibility (S_R) was 0.230 mm. The mean 95% limits for repeatability (r) was 0.353 mm and the mean 95% limits for reproducibility (R) was 0.636 mm.

Bias: The procedure in this test method has no bias because the angular separation of the multiple image is defined only in terms of the test method.

APPENDIX A

Photographic example of multiple imaging through a B-1B windscreen.



APPENDIX B

Example of randomized test samples that were measured using digital calipers. Their numbers coincide with the data sheet numbers.

1

2

3

4

5

6

7

8

9

10

11

12

APPENDIX C

Data report forms from laboratories 1 through 20.

Multiple Imaging Round Robin Test Data Sheet			
Name: <i>Tommy Seals</i>	Organization: <i>PPG (Quality Control)</i>		
Date: <i>11-29-95</i>	Photo Set: <i>B</i>		
PAGE 1			
MEASUREMENT	DATA POINT #	DISTANCE (mm)	
5 Primary Light Distance	1	<i>111.83</i>	<i>2.40</i>
Primary-to-Secondary distance	2	<i>3.64</i>	<i>medium</i>
Primary-to-Secondary distance	3	<i>2.31</i>	<i>smallest</i>
Primary-to-Secondary distance	4	<i>2.97</i>	<i>small</i>
Primary-to-Secondary distance	5	<i>5.12</i>	<i>med lg</i>
Primary-to-Secondary distance	6	<i>7.44</i>	<i>large</i>
5 Primary Light Distance	7	<i>112.14</i>	<i>2.36</i>
Primary-to-Secondary distance	8	<i>5.22</i>	<i>med lg</i>
Primary-to-Secondary distance	9	<i>7.43</i>	<i>large</i>
Primary-to-Secondary distance	10	<i>3.71</i>	<i>med</i>
Primary-to-Secondary distance	11	<i>2.24</i>	<i>smallest</i>
Primary-to-Secondary distance	12	<i>2.73</i>	<i>small</i>
PAGE 2			
MEASUREMENT	DATA POINT #	DISTANCE (mm)	
5 Primary Light Distance	13	<i>111.93</i>	<i>2.37</i>
Primary-to-Secondary distance	14	<i>7.54</i>	<i>large</i>
Primary-to-Secondary distance	15	<i>3.75</i>	<i>medium</i>
Primary-to-Secondary distance	16	<i>5.41</i>	<i>med lg</i>
Primary-to-Secondary distance	17	<i>2.97</i>	<i>small</i>
Primary-to-Secondary distance	18	<i>2.14</i>	<i>smallest</i>
5 Primary Light Distance	19	<i>111.90</i>	<i>2.37</i>
Primary-to-Secondary distance	20	<i>2.39</i>	<i>smallest</i>
Primary-to-Secondary distance	21	<i>5.27</i>	<i>med lg</i>
Primary-to-Secondary distance	22	<i>3.02</i>	<i>small</i>
Primary-to-Secondary distance	23	<i>7.58</i>	<i>large</i>
Primary-to-Secondary distance	24	<i>3.81</i>	<i>medium</i>

#

Name: <i>Tommy SEALS</i>			
PAGE 3			
MEASUREMENT	DATA POINT #	DISTANCE (mm)	
5 Primary Light Distance	25	<i>111.74</i>	<i>2.31</i>
Primary-to-Secondary distance	26	<i>5.25</i>	<i>med. lg</i>
Primary-to-Secondary distance	27	<i>3.70</i>	<i>medium</i>
Primary-to-Secondary distance	28	<i>7.48</i>	<i>large</i>
Primary-to-Secondary distance	29	<i>2.33</i>	<i>smallest</i>
Primary-to-Secondary distance	30	<i>2.95</i>	<i>small</i>
5 Primary Light Distance	31	<i>111.71</i>	<i>2.31</i>
Primary-to-Secondary distance	32	<i>7.58</i>	<i>large</i>
Primary-to-Secondary distance	33	<i>2.34</i>	<i>smallest</i>
Primary-to-Secondary distance	34	<i>5.39</i>	<i>med. lg</i>
Primary-to-Secondary distance	35	<i>3.62</i>	<i>medium</i>
Primary-to-Secondary distance	36	<i>2.96</i>	<i>small</i>
PAGE 4			
MEASUREMENT	DATA POINT #	DISTANCE (mm)	
5 Primary Light Distance	37	<i>111.89</i>	<i>2.31</i>
Primary-to-Secondary distance	38	<i>3.76</i>	<i>medium</i>
Primary-to-Secondary distance	39	<i>2.39</i>	<i>smallest</i>
Primary-to-Secondary distance	40	<i>5.39</i>	<i>med. lg</i>
Primary-to-Secondary distance	41	<i>2.92</i>	<i>small</i>
Primary-to-Secondary distance	42	<i>7.45</i>	<i>large</i>
5 Primary Light Distance	43	~~<i>111.8</i>~~ <i>112.03</i>	<i>2.31</i>
Primary-to-Secondary distance	44	<i>5.27</i>	<i>med. lg</i>
Primary-to-Secondary distance	45	<i>7.51</i>	<i>large</i>
Primary-to-Secondary distance	46	<i>2.54</i>	<i>small</i>
Primary-to-Secondary distance	47	<i>2.28</i>	<i>smallest</i>
Primary-to-Secondary distance	48	<i>3.69</i>	<i>medium</i>

Name: <i>Tommy Seals</i>			
PAGE 5			
MEASUREMENT	DATA POINT #	DISTANCE (mm)	
5 Primary Light Distance	49	112.08	2.36
Primary-to-Secondary distance	50	2.23	smallest
Primary-to-Secondary distance	51	3.84	medium
Primary-to-Secondary distance	52	5.83	med lg
Primary-to-Secondary distance	53	7.43	large
Primary-to-Secondary distance	54	2.99	small
5 Primary Light Distance	55	111.80	2.37
Primary-to-Secondary distance	56	7.55	large
Primary-to-Secondary distance	57	2.56	small
Primary-to-Secondary distance	58	2.27	smallest
Primary-to-Secondary distance	59	3.71	medium
Primary-to-Secondary distance	60	5.13	med lg

#

Multiple Imaging Round Robin Test Data Sheet			
Name: CARTER, ADAM		Organization: QUALITY FOUNDATION	
Date: 11-29-15		Photo Set: B	
PAGE 1			
MEASUREMENT	DATA POINT #	DISTANCE (mm)	
5 Primary Light Distance	1	112.08	2.34
Primary-to-Secondary distance	2	3.93	medium
Primary-to-Secondary distance	3	2.52	smallest
Primary-to-Secondary distance	4	3.05	small
Primary-to-Secondary distance	5	5.25	med lg
Primary-to-Secondary distance	6	7.85	large
5 Primary Light Distance	7	112.33	2.34
Primary-to-Secondary distance	8	5.47	med lg
Primary-to-Secondary distance	9	7.65	large
Primary-to-Secondary distance	10	2.86	medium
Primary-to-Secondary distance	11	2.54	smallest
Primary-to-Secondary distance	12	3.37	small
PAGE 2			
MEASUREMENT	DATA POINT #	DISTANCE (mm)	
5 Primary Light Distance	13	112.17	2.34
Primary-to-Secondary distance	14	7.65	large
Primary-to-Secondary distance	15	4.26	medium
Primary-to-Secondary distance	16	5.74	med lg
Primary-to-Secondary distance	17	3.02	small
Primary-to-Secondary distance	18	2.30	smallest
5 Primary Light Distance	19	112.07	2.34
Primary-to-Secondary distance	20	2.20	smallest
Primary-to-Secondary distance	21	5.25	med lg
Primary-to-Secondary distance	22	3.10	small
Primary-to-Secondary distance	23	7.53	large
Primary-to-Secondary distance	24	3.75	medium

Name: CARTER ADAMS			
PAGE 3			
MEASUREMENT	DATA POINT #	DISTANCE (mm)	
5 Primary Light Distance	25	112.37	2.34
Primary-to-Secondary distance	26	5.41	med lg
Primary-to-Secondary distance	27	3.68	medium
Primary-to-Secondary distance	28	7.82	large
Primary-to-Secondary distance	29	2.24	smallest
Primary-to-Secondary distance	30	3.01	small
5 Primary Light Distance	31	112.25	2.34
Primary-to-Secondary distance	32	7.51	large
Primary-to-Secondary distance	33	2.56	smallest
Primary-to-Secondary distance	34	5.31	med lg
Primary-to-Secondary distance	35	3.94	medium
Primary-to-Secondary distance	36	3.14	small
PAGE 4			
MEASUREMENT	DATA POINT #	DISTANCE (mm)	
5 Primary Light Distance	37	112.29	2.34
Primary-to-Secondary distance	38	3.79	medium
Primary-to-Secondary distance	39	2.09	smallest
Primary-to-Secondary distance	40	5.56	med lg
Primary-to-Secondary distance	41	3.20	small
Primary-to-Secondary distance	42	7.67	large
5 Primary Light Distance	43	112.09	2.34
Primary-to-Secondary distance	44	5.32	med lg
Primary-to-Secondary distance	45	7.68	large
Primary-to-Secondary distance	46	3.02	small
Primary-to-Secondary distance	47	2.33	smallest
Primary-to-Secondary distance	48	3.85	medium

#

Name: CARTER ADAMS			
	PAGE 5		
MEASUREMENT	DATA POINT #	DISTANCE (mm)	
5 Primary Light Distance	49	112.33	2.34
Primary-to-Secondary distance	50	2.38	smallest
Primary-to-Secondary distance	51	3.71	medium
Primary-to-Secondary distance	52	5.36	med lg
Primary-to-Secondary distance	53	7.51	large
Primary-to-Secondary distance	54	2.96	small
5 Primary Light Distance	55	112.50	2.32
Primary-to-Secondary distance	56	7.48	large
Primary-to-Secondary distance	57	2.99	small
Primary-to-Secondary distance	58	2.26	smallest
Primary-to-Secondary distance	59	3.72	medium
Primary-to-Secondary distance	60	5.26	med lg

Multiple Imaging Round Robin Test Data Sheet			
Name: <i>Thomas Tipton</i>	Organization: <i>P.P.G</i>		
Date: <i>NOV 28 1995</i>	Photo Set: <i>B</i>		
	PAGE 1		
MEASUREMENT	DATA POINT #	DISTANCE (mm)	
5 Primary Light Distance	1	111.93	2.37
Primary-to-Secondary distance	2	3.41	medium
Primary-to-Secondary distance	3	2.03	smallest
Primary-to-Secondary distance	4	2.64	small
Primary-to-Secondary distance	5	4.91	med lg.
Primary-to-Secondary distance	6	7.33	large
5 Primary Light Distance	7	111.56	2.38
Primary-to-Secondary distance	8	5.09	med lg.
Primary-to-Secondary distance	9	7.10	large
Primary-to-Secondary distance	10	3.62	medium
Primary-to-Secondary distance	11	1.95	smallest
Primary-to-Secondary distance	12	2.59	small
	PAGE 2		
MEASUREMENT	DATA POINT #	DISTANCE (mm)	
5 Primary Light Distance	13	111.90	2.37
Primary-to-Secondary distance	14	7.17	large
Primary-to-Secondary distance	15	3.52	medium
Primary-to-Secondary distance	16	5.09	med lg.
Primary-to-Secondary distance	17	2.74	small
Primary-to-Secondary distance	18	2.03	smallest
5 Primary Light Distance	19	111.85	2.37
Primary-to-Secondary distance	20	2.19	smallest
Primary-to-Secondary distance	21	5.05	med lg.
Primary-to-Secondary distance	22	2.69	small
Primary-to-Secondary distance	23	7.23	large
Primary-to-Secondary distance	24	3.57	medium

#

Name: <u>Thomas Tipton</u>			
NOV 28 1995			
PAGE 3			
MEASUREMENT	DATA POINT #	DISTANCE (mm)	
5 Primary Light Distance	25	111.86	2.37
Primary-to-Secondary distance	26	5.07	med large
Primary-to-Secondary distance	27	3.49	medium
Primary-to-Secondary distance	28	7.24	large
Primary-to-Secondary distance	29	1.83	smallest
Primary-to-Secondary distance	30	2.54	small
5 Primary Light Distance	31	4.57	→ no data
Primary-to-Secondary distance	32	6.92	
Primary-to-Secondary distance	33	2.21	large
Primary-to-Secondary distance	34	4.96	smallest
Primary-to-Secondary distance	35	3.40	med lg
Primary-to-Secondary distance	36	2.52	medium
			small
PAGE 4			
MEASUREMENT	DATA POINT #	DISTANCE (mm)	
5 Primary Light Distance	37	111.82	2.37
Primary-to-Secondary distance	38	3.40	medium
Primary-to-Secondary distance	39	1.84	smallest
Primary-to-Secondary distance	40	4.81	med lg
Primary-to-Secondary distance	41	2.45	small
Primary-to-Secondary distance	42	7.20	large
5 Primary Light Distance	43	111.68	2.37
Primary-to-Secondary distance	44	4.88	med large
Primary-to-Secondary distance	45	7.10	large
Primary-to-Secondary distance	46	2.62	small
Primary-to-Secondary distance	47	1.76	smallest
Primary-to-Secondary distance	48	3.40	medium

Name: <u>Thomas Tipton</u>			
NOV 28 1995	PAGE 5		
MEASUREMENT	DATA POINT #	DISTANCE (mm)	
5 Primary Light Distance	49	111.90	2.37
Primary-to-Secondary distance	50	1.94	smallest
Primary-to-Secondary distance	51	3.37	medium
Primary-to-Secondary distance	52	4.86	med lg
Primary-to-Secondary distance	53	6.87	large
Primary-to-Secondary distance	54	2.40	small
5 Primary Light Distance	55	111.84	2.37
Primary-to-Secondary distance	56	7.01	large
Primary-to-Secondary distance	57	2.43	small
Primary-to-Secondary distance	58	1.83	smallest
Primary-to-Secondary distance	59	3.39	medium
Primary-to-Secondary distance	60	4.91	med lg

Multiple Imaging Round Robin Test Data Sheet			
Name: <u>RON BARRETT</u>		Organization: <u>PPG IND.</u>	
Date: <u>11-29-95</u>		Photo Set: <u>B</u>	
PAGE 1			
MEASUREMENT	DATA POINT #	DISTANCE (mm)	
5 Primary Light Distance	1	111.97	2.37
Primary-to-Secondary distance	2	3.86	med
Primary-to-Secondary distance	3	2.41	smallest
Primary-to-Secondary distance	4	2.79	small
Primary-to-Secondary distance	5	5.24	med lg
Primary-to-Secondary distance	6	7.35	large
5 Primary Light Distance	7	112.34	2.36
Primary-to-Secondary distance	8	5.19	med lg
Primary-to-Secondary distance	9	7.58	large
Primary-to-Secondary distance	10	3.79	med
Primary-to-Secondary distance	11	2.46	smallest
Primary-to-Secondary distance	12	2.93	small
PAGE 2			
MEASUREMENT	DATA POINT #	DISTANCE (mm)	
5 Primary Light Distance	13	112.02	2.37
Primary-to-Secondary distance	14	7.28	large
Primary-to-Secondary distance	15	3.86	medium
Primary-to-Secondary distance	16	5.44	med lg
Primary-to-Secondary distance	17	3.12	small
Primary-to-Secondary distance	18	2.40	smallest
5 Primary Light Distance	19	111.88	2.37
Primary-to-Secondary distance	20	2.35	smallest
Primary-to-Secondary distance	21	5.29	med lg
Primary-to-Secondary distance	22	2.98	small
Primary-to-Secondary distance	23	7.43	large
Primary-to-Secondary distance	24	3.74	medium

Name: RON BARRETT			
PAGE 3			
MEASUREMENT	DATA POINT #	DISTANCE (mm)	
5 Primary Light Distance	25	111.98	2.37
Primary-to-Secondary distance	26	5.43	med. lg
Primary-to-Secondary distance	27	3.63	medium
Primary-to-Secondary distance	28	7.27	large
Primary-to-Secondary distance	29	2.52	smallest
Primary-to-Secondary distance	30	3.04	small
5 Primary Light Distance	31	112.07	2.38
Primary-to-Secondary distance	32	7.72	large
Primary-to-Secondary distance	33	2.41	smallest
Primary-to-Secondary distance	34	5.33	med. lg
Primary-to-Secondary distance	35	4.04	medium
Primary-to-Secondary distance	36	3.06	small
PAGE 4			
MEASUREMENT	DATA POINT #	DISTANCE (mm)	
5 Primary Light Distance	37	112.13	2.38
Primary-to-Secondary distance	38	3.95	medium
Primary-to-Secondary distance	39	2.45	smallest
Primary-to-Secondary distance	40	5.37	med. lg
Primary-to-Secondary distance	41	2.86	small
Primary-to-Secondary distance	42	7.62	large
5 Primary Light Distance	43	111.98	2.37
Primary-to-Secondary distance	44	5.44	med. lg
Primary-to-Secondary distance	45	7.43	large
Primary-to-Secondary distance	46	3.22	small
Primary-to-Secondary distance	47	2.27	smallest
Primary-to-Secondary distance	48	3.73	medium

Name: RON BARRETT			
	PAGE 5		
MEASUREMENT	DATA POINT #	DISTANCE (mm)	
5 Primary Light Distance	49	111.96	2.37
Primary-to-Secondary distance	50	2.54	smallest
Primary-to-Secondary distance	51	3.92	medium
Primary-to-Secondary distance	52	5.45	med lg
Primary-to-Secondary distance	53	7.66	large
Primary-to-Secondary distance	54	3.13	small
5 Primary Light Distance	55	111.97	2.37
Primary-to-Secondary distance	56	7.61	large
Primary-to-Secondary distance	57	3.07	small
Primary-to-Secondary distance	58	2.42	smallest
Primary-to-Secondary distance	59	3.95	medium
Primary-to-Secondary distance	60	5.49	med lg

Multiple Imaging Round Robin Test Data Sheet			
Name: Johnny Tucker		Organization: PPG	
Date: 11/25/75		Photo Set: B	
PAGE 1			
MEASUREMENT	DATA POINT #	DISTANCE (mm)	
5 Primary Light Distance	1	112.00	2.37
Primary-to-Secondary distance	2	3.63	med large
Primary-to-Secondary distance	3	2.45	smallest
Primary-to-Secondary distance	4	2.75	small
Primary-to-Secondary distance	5	5.32	med large
Primary-to-Secondary distance	6	7.78	large
5 Primary Light Distance	7	112.07	2.38
Primary-to-Secondary distance	8	5.82	med large
Primary-to-Secondary distance	9	7.50	large
Primary-to-Secondary distance	10	3.91	med
Primary-to-Secondary distance	11	2.49	smallest
Primary-to-Secondary distance	12	3.01	small
PAGE 2			
MEASUREMENT	DATA POINT #	DISTANCE (mm)	
5 Primary Light Distance	13	112.40	2.36
Primary-to-Secondary distance	14	7.78	large
Primary-to-Secondary distance	15	3.94	med
Primary-to-Secondary distance	16	5.13	med lg
Primary-to-Secondary distance	17	3.34	small
Primary-to-Secondary distance	18	2.67	smallest
5 Primary Light Distance	19	112.28	2.36
Primary-to-Secondary distance	20	2.42	smallest
Primary-to-Secondary distance	21	5.52	med lg
Primary-to-Secondary distance	22	2.96	small
Primary-to-Secondary distance	23	7.42	large
Primary-to-Secondary distance	24	3.89	medium

#:

Name: Johnny Tucker			
PAGE 3			
MEASUREMENT	DATA POINT #	DISTANCE (mm)	
5 Primary Light Distance	25	112.60	2.35
Primary-to-Secondary distance	26	5.45	med lg
Primary-to-Secondary distance	27	4.07	medium
Primary-to-Secondary distance	28	7.98	large
Primary-to-Secondary distance	29	2.52	smallest
Primary-to-Secondary distance	30	3.26	small
5 Primary Light Distance	31	112.30	2.34
Primary-to-Secondary distance	32	7.53	large
Primary-to-Secondary distance	33	2.43	smallest
Primary-to-Secondary distance	34	5.49	med lg
Primary-to-Secondary distance	35	3.71	med
Primary-to-Secondary distance	36	2.96	small
PAGE 4			
MEASUREMENT	DATA POINT #	DISTANCE (mm)	
5 Primary Light Distance	37	112.10	2.34
Primary-to-Secondary distance	38	3.79	med
Primary-to-Secondary distance	39	2.31	smallest
Primary-to-Secondary distance	40	5.32	med lg
Primary-to-Secondary distance	41	3.00	small
Primary-to-Secondary distance	42	7.63	large
5 Primary Light Distance	43	112.10	2.34
Primary-to-Secondary distance	44	5.21	med lg
Primary-to-Secondary distance	45	7.82	large
Primary-to-Secondary distance	46	3.12	small
Primary-to-Secondary distance	47	2.59	smallest
Primary-to-Secondary distance	48	4.04	medium

Name: Johnny Tucker			
PAGE 5			
MEASUREMENT	DATA POINT #	DISTANCE (mm)	
5 Primary Light Distance	49	112.14	2.34
Primary-to-Secondary distance	50	2.42	smallest
Primary-to-Secondary distance	51	3.92	medium
Primary-to-Secondary distance	52	5.46	mid large
Primary-to-Secondary distance	53	7.69	large
Primary-to-Secondary distance	54	3.24	small
5 Primary Light Distance	55	112.25	2.34
Primary-to-Secondary distance	56	7.63	large
Primary-to-Secondary distance	57	2.76	small
Primary-to-Secondary distance	58	2.51	smallest
Primary-to-Secondary distance	59	3.89	mid
Primary-to-Secondary distance	60	5.55	mid lg

Johnny Tucker

Multiple Imaging Round Robin Test Data Sheet			
Name: <i>Charles McGehee</i>		Organization: <i>PPG</i>	
Date: <i>11/28/95</i>		Photo Set: <i>B</i>	
PAGE 1			
MEASUREMENT	DATA POINT #	DISTANCE (mm)	
5 Primary Light Distance	1	<i>112.18</i>	<i>2.36</i>
Primary-to-Secondary distance	2	<i>3.92</i>	<i>med lg</i>
Primary-to-Secondary distance	3	<i>2.49</i>	<i>Smallest</i>
Primary-to-Secondary distance	4	<i>2.98</i>	<i>Small</i>
Primary-to-Secondary distance	5	<i>5.37</i>	<i>med lg</i>
Primary-to-Secondary distance	6	<i>7.71</i>	<i>lg</i>
5 Primary Light Distance	7	<i>112.27</i>	<i>2.36</i>
Primary-to-Secondary distance	8	<i>5.21</i>	<i>med lg</i>
Primary-to-Secondary distance	9	<i>7.55</i>	<i>large</i>
Primary-to-Secondary distance	10	<i>3.75</i>	<i>med</i>
Primary-to-Secondary distance	11	<i>2.43</i>	<i>smallest</i>
Primary-to-Secondary distance	12	<i>3.14</i>	<i>small</i>
PAGE 2			
MEASUREMENT	DATA POINT #	DISTANCE (mm)	
5 Primary Light Distance	13	<i>112.08</i>	<i>2.36</i>
Primary-to-Secondary distance	14	<i>7.65</i>	<i>large</i>
Primary-to-Secondary distance	15	<i>3.80</i>	<i>med</i>
Primary-to-Secondary distance	16	<i>5.50</i>	<i>med lg</i>
Primary-to-Secondary distance	17	<i>2.84</i>	<i>small</i>
Primary-to-Secondary distance	18	<i>2.35</i>	<i>smallest</i>
5 Primary Light Distance	19	<i>111.84</i>	<i>2.37</i>
Primary-to-Secondary distance	20	<i>2.43</i>	<i>smallest</i>
Primary-to-Secondary distance	21	<i>5.24</i>	<i>med lg</i>
Primary-to-Secondary distance	22	<i>3.10</i>	<i>small</i>
Primary-to-Secondary distance	23	<i>7.41</i>	<i>large</i>
Primary-to-Secondary distance	24	<i>3.71</i>	<i>medium</i>

Name: <i>Mc Gehee</i>			
PAGE 3			
MEASUREMENT	DATA POINT #	DISTANCE (mm)	
5 Primary Light Distance	25	<i>112.01</i>	<i>2.37</i>
Primary-to-Secondary distance	26	<i>5.34</i>	<i>med lg</i>
Primary-to-Secondary distance	27	<i>3.92</i>	<i>medium</i>
Primary-to-Secondary distance	28	<i>7.42</i>	<i>large</i>
Primary-to-Secondary distance	29	<i>2.42</i>	<i>smallest</i>
Primary-to-Secondary distance	30	<i>3.00</i>	<i>small</i>
5 Primary Light Distance	31	<i>112.01</i>	<i>2.37</i>
Primary-to-Secondary distance	32	<i>7.60</i>	<i>large</i>
Primary-to-Secondary distance	33	<i>2.40</i>	<i>smallest</i>
Primary-to-Secondary distance	34	<i>5.19</i>	<i>med lg</i>
Primary-to-Secondary distance	35	<i>3.74</i>	<i>med</i>
Primary-to-Secondary distance	36	<i>2.85</i>	<i>small</i>
PAGE 4			
MEASUREMENT	DATA POINT #	DISTANCE (mm)	
5 Primary Light Distance	37	<i>~~112.01~~ 112.06</i>	<i>2.36</i>
Primary-to-Secondary distance	38	<i>~~7.60~~ 3.82</i>	<i>medium</i>
Primary-to-Secondary distance	39	<i>~~2.40~~ 2.40</i>	<i>smallest</i>
Primary-to-Secondary distance	40	<i>5.23</i>	<i>med lg</i>
Primary-to-Secondary distance	41	<i>2.96</i>	<i>small</i>
Primary-to-Secondary distance	42	<i>7.48</i>	<i>large</i>
5 Primary Light Distance	43	<i>112.17</i>	<i>2.36</i>
Primary-to-Secondary distance	44	<i>5.25</i>	<i>med large</i>
Primary-to-Secondary distance	45	<i>7.41</i>	<i>large</i>
Primary-to-Secondary distance	46	<i>2.95</i>	<i>small</i>
Primary-to-Secondary distance	47	<i>2.28</i>	<i>smallest</i>
Primary-to-Secondary distance	48	<i>3.73</i>	<i>medium</i>

#

Name: <i>Mc Ghee</i>			
PAGE 5			
MEASUREMENT	DATA POINT #	DISTANCE (mm)	
5 Primary Light Distance	49	111.98	2.37
Primary-to-Secondary distance	50	2.28	<i>smallest</i>
Primary-to-Secondary distance	51	3.76	<i>medium</i>
Primary-to-Secondary distance	52	5.13	<i>mid lg</i>
Primary-to-Secondary distance	53	7.47	<i>large</i>
Primary-to-Secondary distance	54	2.86	<i>small</i>
5 Primary Light Distance	55	112.15	2.36
Primary-to-Secondary distance	56	7.36	<i>large</i>
Primary-to-Secondary distance	57	2.88	<i>small</i>
Primary-to-Secondary distance	58	2.29	<i>smallest</i>
Primary-to-Secondary distance	59	3.81	<i>medium</i>
Primary-to-Secondary distance	60	4.92	<i>mid large</i>

Multiple Imaging Round Robin Test Data Sheet			
Name: Elmer A. L'Roy		Organization: TEXSTAR, INC	
Date: 11-29-95		Photo Set: A	
PAGE 1			
MEASUREMENT	DATA POINT #	DISTANCE (mm)	
5 Primary Light Distance	1	111.90	2.37
Primary-to-Secondary distance	2	~~5.22~~ 4.89	med lg
Primary-to-Secondary distance	3	~~3.90~~ 3.58	med
Primary-to-Secondary distance	4	~~6.75~~ 7.23	large
Primary-to-Secondary distance	5	2.77	small
Primary-to-Secondary distance	6	2.13	smallest
5 Primary Light Distance	7	111.79	2.37
Primary-to-Secondary distance	8	2.71	small
Primary-to-Secondary distance	9	7.23	large
Primary-to-Secondary distance	10	2.21	smallest
Primary-to-Secondary distance	11	4.85	med lg
Primary-to-Secondary distance	12	3.43	medium
PAGE 2			
MEASUREMENT	DATA POINT #	DISTANCE (mm)	
5 Primary Light Distance	13	111.96	2.37
Primary-to-Secondary distance	14	7.31	large
Primary-to-Secondary distance	15	3.95	medium
Primary-to-Secondary distance	16	4.90	med lg
Primary-to-Secondary distance	17	2.45	smallest
Primary-to-Secondary distance	18	2.51	small
5 Primary Light Distance	19	111.94	2.37
Primary-to-Secondary distance	20	2.09	smallest
Primary-to-Secondary distance	21	4.84	med lg
Primary-to-Secondary distance	22	3.64	medium
Primary-to-Secondary distance	23	7.00	lg
Primary-to-Secondary distance	24	2.75	small

Name:			
PAGE 3			
MEASUREMENT	DATA POINT #	DISTANCE (mm)	
5 Primary Light Distance	25	111.99	2.37
Primary-to-Secondary distance	26	2.73	small
Primary-to-Secondary distance	27	4.93	med lg
Primary-to-Secondary distance	28	2.15	smallest
Primary-to-Secondary distance	29	3.56	med
Primary-to-Secondary distance	30	7.25	large
5 Primary Light Distance	31	111.96	2.37
Primary-to-Secondary distance	32	3.35	medium
Primary-to-Secondary distance	33	5.03	med lg
Primary-to-Secondary distance	34	2.83	small
Primary-to-Secondary distance	35	1.96	smallest
Primary-to-Secondary distance	36	7.26	large
PAGE 4			
MEASUREMENT	DATA POINT #	DISTANCE (mm)	
5 Primary Light Distance	37	111.85	2.37
Primary-to-Secondary distance	38	7.13	large
Primary-to-Secondary distance	39	2.13	smallest
Primary-to-Secondary distance	40	4.94	med lg
Primary-to-Secondary distance	41	2.74	small
Primary-to-Secondary distance	42	3.58	medium
5 Primary Light Distance	43	112.04	2.37
Primary-to-Secondary distance	44	3.55	medium
Primary-to-Secondary distance	45	6.93	large
Primary-to-Secondary distance	46	1.94	smallest
Primary-to-Secondary distance	47	4.97	med lg
Primary-to-Secondary distance	48	2.65	small

Name:			
	PAGE 5		
MEASUREMENT	DATA POINT #	DISTANCE (mm)	
5 Primary Light Distance	49	111.73	2.37
Primary-to-Secondary distance	50	4.82	med lg
Primary-to-Secondary distance	51	2.28	smallest
Primary-to-Secondary distance	52	7.32	large
Primary-to-Secondary distance	53	2.65	small
Primary-to-Secondary distance	54	3.37	medium
5 Primary Light Distance	55	111.88	2.37
Primary-to-Secondary distance	56	2.69	small
Primary-to-Secondary distance	57	5.04	med lg
Primary-to-Secondary distance	58	2.11	smallest
Primary-to-Secondary distance	59	3.44	medium
Primary-to-Secondary distance	60	7.13	large

#

Multiple Imaging Round Robin Test Data Sheet			
Name:	Organization: <i>Texstar</i>		
Date:	Photo Set: <i>A</i>		
PAGE 1			
MEASUREMENT	DATA POINT #	DISTANCE (mm)	
5 Primary Light Distance	1	112.24	2.36
Primary-to-Secondary distance	2	4.98	med lg.
Primary-to-Secondary distance	3	3.48	medium
Primary-to-Secondary distance	4	7.17	large
Primary-to-Secondary distance	5	2.56	small
Primary-to-Secondary distance	6	1.90	smallest
5 Primary Light Distance	7	112.26	2.36
Primary-to-Secondary distance	8	2.57	small
Primary-to-Secondary distance	9	7.24	large
Primary-to-Secondary distance	10	1.97	smallest
Primary-to-Secondary distance	11	4.93	med lg.
Primary-to-Secondary distance	12	3.45	medium
PAGE 2			
MEASUREMENT	DATA POINT #	DISTANCE (mm)	
5 Primary Light Distance	13	112.19	2.36
Primary-to-Secondary distance	14	7.32	large
Primary-to-Secondary distance	15	3.49	medium
Primary-to-Secondary distance	16	4.93	med lg.
Primary-to-Secondary distance	17	1.94	smallest
Primary-to-Secondary distance	18	2.51	small
5 Primary Light Distance	19	112.20	2.36
Primary-to-Secondary distance	20	1.95	smallest
Primary-to-Secondary distance	21	4.90	med lg.
Primary-to-Secondary distance	22	3.48	medium
Primary-to-Secondary distance	23	7.18	large
Primary-to-Secondary distance	24	2.60	small

Name:			
	PAGE 3		
MEASUREMENT	DATA POINT #	DISTANCE (mm)	
5 Primary Light Distance	25	112.30	2.36
Primary-to-Secondary distance	26	2.49	small
Primary-to-Secondary distance	27	4.87	med lg
Primary-to-Secondary distance	28	1.99	smallest
Primary-to-Secondary distance	29	3.49	medium
Primary-to-Secondary distance	30	7.14	large
5 Primary Light Distance	31	112.29	2.36
Primary-to-Secondary distance	32	3.80	medium
Primary-to-Secondary distance	33	5.60	med lg
Primary-to-Secondary distance	34	3.33	small
Primary-to-Secondary distance	35	2.78	smallest
Primary-to-Secondary distance	36	7.30	large
	PAGE 4		
MEASUREMENT	DATA POINT #	DISTANCE (mm)	
5 Primary Light Distance	37	112.59	2.35
Primary-to-Secondary distance	38	7.67	large
Primary-to-Secondary distance	39	2.68	smallest
Primary-to-Secondary distance	40	5.51	med lg
Primary-to-Secondary distance	41	3.42	small
Primary-to-Secondary distance	42	3.93	medium
5 Primary Light Distance	43	112.42	2.36
Primary-to-Secondary distance	44	3.70	medium
Primary-to-Secondary distance	45	7.39	large
Primary-to-Secondary distance	46	2.84	smallest
Primary-to-Secondary distance	47	5.72	med lg
Primary-to-Secondary distance	48	3.58	small

Name:			
	PAGE 5		
MEASUREMENT	DATA POINT #	DISTANCE (mm)	
5 Primary Light Distance	49	112.49	2.34
Primary-to-Secondary distance	50	5.27	med. lg
Primary-to-Secondary distance	51	3.59	smallest
Primary-to-Secondary distance	52	7.70	large
Primary-to-Secondary distance	53	3.12	smallest
Primary-to-Secondary distance	54	4.35	medium
5 Primary Light Distance	55	112.42	2.34
Primary-to-Secondary distance	56	3.20	small
Primary-to-Secondary distance	57	4.70	med. lg
Primary-to-Secondary distance	58	2.83	smallest
Primary-to-Secondary distance	59	4.15	medium
Primary-to-Secondary distance	60	7.78	large

Multiple Imaging Round Robin Test Data Sheet			
Name:	Organization: <i>Texstar</i>		
Date:	Photo Set: <i>A</i>		
PAGE 1			
MEASUREMENT	DATA POINT #	DISTANCE (mm)	
5 Primary Light Distance	1	111.90	2.37
Primary-to-Secondary distance	2	5.08	med lg
Primary-to-Secondary distance	3	3.70	medium
Primary-to-Secondary distance	4	7.39	large
Primary-to-Secondary distance	5	2.85	small
Primary-to-Secondary distance	6	2.15	smallest
5 Primary Light Distance	7	112.05	2.37
Primary-to-Secondary distance	8	2.80	small
Primary-to-Secondary distance	9	7.36	large
Primary-to-Secondary distance	10	2.20	smallest
Primary-to-Secondary distance	11	5.00	med lg
Primary-to-Secondary distance	12	3.68	medium
PAGE 2			
MEASUREMENT	DATA POINT #	DISTANCE (mm)	
5 Primary Light Distance	13	112.00	2.37
Primary-to-Secondary distance	14	7.53	large
Primary-to-Secondary distance	15	3.66	medium
Primary-to-Secondary distance	16	5.05	med lg
Primary-to-Secondary distance	17	2.19	smallest
Primary-to-Secondary distance	18	2.78	small
5 Primary Light Distance	19	112.05	2.37
Primary-to-Secondary distance	20	2.26	smallest
Primary-to-Secondary distance	21	4.98	med lg
Primary-to-Secondary distance	22	3.58	medium
Primary-to-Secondary distance	23	7.25	large
Primary-to-Secondary distance	24	2.61	small

Name:			
PAGE 3			
MEASUREMENT	DATA POINT #	DISTANCE (mm)	
5 Primary Light Distance	25	112.09	2.36
Primary-to-Secondary distance	26	2.85	small
Primary-to-Secondary distance	27	4.83	med lg
Primary-to-Secondary distance	28	2.18	smallest
Primary-to-Secondary distance	29	3.77	medium
Primary-to-Secondary distance	30	7.60	large
5 Primary Light Distance	31	112.16	2.36
Primary-to-Secondary distance	32	3.60	medium
Primary-to-Secondary distance	33	5.09	med lg
Primary-to-Secondary distance	34	2.65	small
Primary-to-Secondary distance	35	2.19	smallest
Primary-to-Secondary distance	36	7.54	large
PAGE 4			
MEASUREMENT	DATA POINT #	DISTANCE (mm)	
5 Primary Light Distance	37	111.99	2.37
Primary-to-Secondary distance	38	7.27	large
Primary-to-Secondary distance	39	2.29	smallest
Primary-to-Secondary distance	40	5.10	med lg
Primary-to-Secondary distance	41	2.70	small
Primary-to-Secondary distance	42	3.67	medium
5 Primary Light Distance	43	112.03	2.37
Primary-to-Secondary distance	44	3.74	medium
Primary-to-Secondary distance	45	7.38	large
Primary-to-Secondary distance	46	2.13	smallest
Primary-to-Secondary distance	47	4.96	med lg
Primary-to-Secondary distance	48	2.90	small

Name:			
	PAGE 5		
MEASUREMENT	DATA POINT #	DISTANCE (mm)	
5 Primary Light Distance	49	112.06	2.36
Primary-to-Secondary distance	50	5.07	med lg
Primary-to-Secondary distance	51	2.26	smallest
Primary-to-Secondary distance	52	7.24	large
Primary-to-Secondary distance	53	2.67	small
Primary-to-Secondary distance	54	3.66	medium
5 Primary Light Distance	55	112.03	2.37
Primary-to-Secondary distance	56	2.86	small
Primary-to-Secondary distance	57	5.23	med large
Primary-to-Secondary distance	58	2.28	smallest
Primary-to-Secondary distance	59	3.72	medium
Primary-to-Secondary distance	60	7.40	large

Multiple Imaging Round Robin Test Data Sheet			
Name: <i>Jim Irion</i>	Organization: <i>TEXSTAR, INC.</i>		
Date: <i>11/29/95</i>	Photo Set: <i>A</i>		
PAGE 1			
MEASUREMENT	DATA POINT #	DISTANCE (mm)	
5 Primary Light Distance	1	<i>112.34</i>	<i>2.3e</i>
Primary-to-Secondary distance	2	<i>5.22</i>	<i>med lg</i>
Primary-to-Secondary distance	3	<i>3.68</i>	<i>medium</i>
Primary-to-Secondary distance	4	<i>7.25</i>	<i>large</i>
Primary-to-Secondary distance	5	<i>2.72</i>	<i>small</i>
Primary-to-Secondary distance	6	<i>2.16</i>	<i>smallest</i>
5 Primary Light Distance	7	<i>112.33</i>	<i>2.3e</i>
Primary-to-Secondary distance	8	<i>2.70</i>	<i>small</i>
Primary-to-Secondary distance	9	<i>7.18</i>	<i>large</i>
Primary-to-Secondary distance	10	<i>2.30</i>	<i>smallest</i>
Primary-to-Secondary distance	11	<i>4.94</i>	<i>med lg</i>
Primary-to-Secondary distance	12	<i>3.55</i>	<i>medium</i>
PAGE 2			
MEASUREMENT	DATA POINT #	DISTANCE (mm)	
5 Primary Light Distance	13	<i>112.26</i>	<i>2.3e</i>
Primary-to-Secondary distance	14	<i>7.20</i>	<i>large</i>
Primary-to-Secondary distance	15	<i>3.53</i>	<i>medium</i>
Primary-to-Secondary distance	16	<i>5.22</i>	<i>med lg</i>
Primary-to-Secondary distance	17	<i>1.92</i>	<i>smallest</i>
Primary-to-Secondary distance	18	<i>2.75</i>	<i>small</i>
5 Primary Light Distance	19	<i>112.29</i>	<i>2.3e</i>
Primary-to-Secondary distance	20	<i>2.47</i>	<i>smallest</i>
Primary-to-Secondary distance	21	<i>4.91</i>	<i>med lg</i>
Primary-to-Secondary distance	22	<i>3.70</i>	<i>medium</i>
Primary-to-Secondary distance	23	<i>7.41</i>	<i>large</i>
Primary-to-Secondary distance	24	<i>2.88</i>	<i>small</i>

Name: <i>Tim Irion</i>			
PAGE 3			
MEASUREMENT	DATA POINT #	DISTANCE (mm)	
5 Primary Light Distance	25	112.30	2.36
Primary-to-Secondary distance	26	3.04	small
Primary-to-Secondary distance	27	5.16	med. lg.
Primary-to-Secondary distance	28	2.28	smallest
Primary-to-Secondary distance	29	3.53	medium
Primary-to-Secondary distance	30	7.28	large
5 Primary Light Distance	31	112.33	2.36
Primary-to-Secondary distance	32	3.69	medium
Primary-to-Secondary distance	33	4.98	med. lg.
Primary-to-Secondary distance	34	2.68	small
Primary-to-Secondary distance	35	2.07	smallest
Primary-to-Secondary distance	36	7.31	large
PAGE 4			
MEASUREMENT	DATA POINT #	DISTANCE (mm)	
5 Primary Light Distance	37	112.36	2.36
Primary-to-Secondary distance	38	7.30	large
Primary-to-Secondary distance	39	2.13	smallest
Primary-to-Secondary distance	40	5.20	med. lg.
Primary-to-Secondary distance	41	2.73	small
Primary-to-Secondary distance	42	3.53	medium
5 Primary Light Distance	43	112.30	2.36
Primary-to-Secondary distance	44	3.55	medium
Primary-to-Secondary distance	45	7.13	large
Primary-to-Secondary distance	46	2.04	smallest
Primary-to-Secondary distance	47	5.21	med. lg.
Primary-to-Secondary distance	48	2.81	small

Name: <i>Jim Irion</i>			
	PAGE 5		
MEASUREMENT	DATA POINT #	DISTANCE (mm)	
5 Primary Light Distance	49	<i>112.35</i>	<i>2.36</i>
Primary-to-Secondary distance	50	<i>5.10</i>	<i>med lg</i>
Primary-to-Secondary distance	51	<i>2.32</i>	<i>Smallest</i>
Primary-to-Secondary distance	52	<i>7.33</i>	<i>large</i>
Primary-to-Secondary distance	53	<i>2.74</i>	<i>small</i>
Primary-to-Secondary distance	54	<i>3.64</i>	<i>medium</i>
5 Primary Light Distance	55	<i>112.41</i>	<i>2.36</i>
Primary-to-Secondary distance	56	<i>2.84</i>	<i>small</i>
Primary-to-Secondary distance	57	<i>4.95</i>	<i>med lg</i>
Primary-to-Secondary distance	58	<i>2.30</i>	<i>Smallest</i>
Primary-to-Secondary distance	59	<i>3.60</i>	<i>medium</i>
Primary-to-Secondary distance	60	<i>7.39</i>	<i>large</i>

Multiple Imaging Round Robin Test Data Sheet			
Name: <i>LISA</i>	Organization: <i>Texstar</i>		
Date: <i>12/5/95</i>	Photo Set: <i>A</i>		
PAGE 1			
MEASUREMENT	DATA POINT #	DISTANCE (mm)	
5 Primary Light Distance	1	111.99	2.37
Primary-to-Secondary distance	2	5.45	med.lg
Primary-to-Secondary distance	3	3.75	medium
Primary-to-Secondary distance	4	7.50	large
Primary-to-Secondary distance	5	2.99	small
Primary-to-Secondary distance	6	2.45	smallest
5 Primary Light Distance	7	112.29	2.36
Primary-to-Secondary distance	8	3.11	small
Primary-to-Secondary distance	9	7.71	large
Primary-to-Secondary distance	10	2.52	smallest
Primary-to-Secondary distance	11	5.26	med.lg
Primary-to-Secondary distance	12	3.80	medium
PAGE 2			
MEASUREMENT	DATA POINT #	DISTANCE (mm)	
5 Primary Light Distance	13	112.42	2.36
Primary-to-Secondary distance	14	7.71	large
Primary-to-Secondary distance	15	4.03	medium
Primary-to-Secondary distance	16	5.20	med.lg
Primary-to-Secondary distance	17	2.40	smallest
Primary-to-Secondary distance	18	3.15	small
5 Primary Light Distance	19	112.58	2.35
Primary-to-Secondary distance	20	2.44	smallest
Primary-to-Secondary distance	21	5.30	med.lg
Primary-to-Secondary distance	22	3.64	medium
Primary-to-Secondary distance	23	7.70	large
Primary-to-Secondary distance	24	3.10	small

Name:			
	PAGE 3		
MEASUREMENT	DATA POINT #	DISTANCE (mm)	
5 Primary Light Distance	25	112.35	2.36
Primary-to-Secondary distance	26	3.08	small
Primary-to-Secondary distance	27	5.25	med. lg.
Primary-to-Secondary distance	28	2.45	smallest
Primary-to-Secondary distance	29	3.90	medium
Primary-to-Secondary distance	30	7.74	large
5 Primary Light Distance	31	112.29	2.36
Primary-to-Secondary distance	32	4.06	medium
Primary-to-Secondary distance	33	5.61	med. lg.
Primary-to-Secondary distance	34	3.18	small
Primary-to-Secondary distance	35	2.51	smallest
Primary-to-Secondary distance	36	7.37	large
	PAGE 4		
MEASUREMENT	DATA POINT #	DISTANCE (mm)	
5 Primary Light Distance	37	112.61	2.35
Primary-to-Secondary distance	38	7.67	large
Primary-to-Secondary distance	39	2.35	smallest
Primary-to-Secondary distance	40	5.43	med. large
Primary-to-Secondary distance	41	3.17	small
Primary-to-Secondary distance	42	3.96	medium
5 Primary Light Distance	43	112.23	2.36
Primary-to-Secondary distance	44	3.98	medium
Primary-to-Secondary distance	45	7.64	large
Primary-to-Secondary distance	46	2.55	smallest
Primary-to-Secondary distance	47	5.36	med. lg.
Primary-to-Secondary distance	48	3.07	small

Name:			
	PAGE 5		
MEASUREMENT	DATA POINT #	DISTANCE (mm)	
5 Primary Light Distance	49	112.54	2.35
Primary-to-Secondary distance	50	5.50	med lg
Primary-to-Secondary distance	51	2.59	smallest
Primary-to-Secondary distance	52	7.74	large
Primary-to-Secondary distance	53	3.03	small
Primary-to-Secondary distance	54	4.06	medium
5 Primary Light Distance	55	112.18	2.36
Primary-to-Secondary distance	56	3.08	small
Primary-to-Secondary distance	57	5.46	med lg
Primary-to-Secondary distance	58	2.45	smallest
Primary-to-Secondary distance	59	4.07	medium
Primary-to-Secondary distance	60	7.82	large

Multiple Imaging Round Robin Test Data Sheet			
Name: Michael J. Smith		Organization: Sierracin	
Date: 1-16-96		Photo Set: B	
PAGE 1			
MEASUREMENT	DATA POINT #	DISTANCE (mm)	
5 Primary Light Distance	1	111.87	
Primary-to-Secondary distance	2	3.66	medium
Primary-to-Secondary distance	3	2.23	smallest
Primary-to-Secondary distance	4	2.92	small
Primary-to-Secondary distance	5	5.15	med lg
Primary-to-Secondary distance	6	7.35	large
5 Primary Light Distance	7	111.94	
Primary-to-Secondary distance	8	5.16	med lg
Primary-to-Secondary distance	9	7.40	large
Primary-to-Secondary distance	10	3.85	med
Primary-to-Secondary distance	11	2.20	smallest
Primary-to-Secondary distance	12	2.72	small
PAGE 2			
MEASUREMENT	DATA POINT #	DISTANCE (mm)	
5 Primary Light Distance	13	111.96	
Primary-to-Secondary distance	14	7.51	large
Primary-to-Secondary distance	15	3.75	medium
Primary-to-Secondary distance	16	5.22	med lg
Primary-to-Secondary distance	17	2.92	small
Primary-to-Secondary distance	18	2.32	smallest
5 Primary Light Distance	19	111.89	
Primary-to-Secondary distance	20	2.29	smallest
Primary-to-Secondary distance	21	5.09	med lg
Primary-to-Secondary distance	22	2.95	small
Primary-to-Secondary distance	23	7.48	large
Primary-to-Secondary distance	24	3.76	medium

Name: Michael J. Smith			
PAGE 3			
MEASUREMENT	DATA POINT #	DISTANCE (mm)	
5 Primary Light Distance	25	111.80	
Primary-to-Secondary distance	26	5.25	med lg
Primary-to-Secondary distance	27	3.69	medium
Primary-to-Secondary distance	28	7.51	large
Primary-to-Secondary distance	29	2.26	smallest
Primary-to-Secondary distance	30	2.74	small
5 Primary Light Distance	31	111.68	
Primary-to-Secondary distance	32	7.39	large
Primary-to-Secondary distance	33	2.26	smallest
Primary-to-Secondary distance	34	5.05	med lg
Primary-to-Secondary distance	35	3.80	medium
Primary-to-Secondary distance	36	2.82	small
PAGE 4			
MEASUREMENT	DATA POINT #	DISTANCE (mm)	
5 Primary Light Distance	37	111.97	
Primary-to-Secondary distance	38	3.59	medium
Primary-to-Secondary distance	39	2.18	smallest
Primary-to-Secondary distance	40	5.12	med lg
Primary-to-Secondary distance	41	2.91	small
Primary-to-Secondary distance	42	7.42	large
5 Primary Light Distance	43	111.81	
Primary-to-Secondary distance	44	5.32	med lg
Primary-to-Secondary distance	45	7.29	large
Primary-to-Secondary distance	46	2.76	small
Primary-to-Secondary distance	47	2.18	smallest
Primary-to-Secondary distance	48	3.52	medium

Name: Michael J. Smith			
	PAGE 5		
MEASUREMENT	DATA POINT #	DISTANCE (mm)	
5 Primary Light Distance	49	111.89	
Primary-to-Secondary distance	50	2.04	smallest
Primary-to-Secondary distance	51	3.75	medium
Primary-to-Secondary distance	52	5.11	med lg
Primary-to-Secondary distance	53	7.15	large
Primary-to-Secondary distance	54	2.82	small
5 Primary Light Distance	55	111.87	
Primary-to-Secondary distance	56	7.38	large
Primary-to-Secondary distance	57	2.72	small
Primary-to-Secondary distance	58	2.20	smallest
Primary-to-Secondary distance	59	3.63	medium
Primary-to-Secondary distance	60	5.06	med lg

Multiple Imaging Round Robin Test Data Sheet			
Name: <i>Ron Maglalang</i>		Organization: <i>SIERRA / SYLMAR</i>	
Date: <i>2/5/95</i>		Photo Set: <i>B</i>	
PAGE 1			
MEASUREMENT	DATA POINT #	DISTANCE (mm)	
5 Primary Light Distance	1	<i>112.00</i>	
Primary-to-Secondary distance	2	<i>3.48</i>	<i>medium</i>
Primary-to-Secondary distance	3	<i>2.20</i>	<i>smallest</i>
Primary-to-Secondary distance	4	<i>2.56</i>	<i>small</i>
Primary-to-Secondary distance	5	<i>4.85</i>	<i>med lg</i>
Primary-to-Secondary distance	6	<i>7.38</i>	<i>large</i>
5 Primary Light Distance	7	<i>111.90</i>	
Primary-to-Secondary distance	8	<i>5.17</i>	<i>med lg</i>
Primary-to-Secondary distance	9	<i>7.12</i>	<i>large</i>
Primary-to-Secondary distance	10	<i>3.69</i>	<i>med</i>
Primary-to-Secondary distance	11	<i>2.21</i>	<i>smallest</i>
Primary-to-Secondary distance	12	<i>2.47</i>	<i>small</i>
PAGE 2			
MEASUREMENT	DATA POINT #	DISTANCE (mm)	
5 Primary Light Distance	13	<i>111.88</i>	
Primary-to-Secondary distance	14	<i>7.20</i>	<i>large</i>
Primary-to-Secondary distance	15	<i>3.56</i>	<i>medium</i>
Primary-to-Secondary distance	16	<i>4.95</i>	<i>med lg</i>
Primary-to-Secondary distance	17	<i>2.72</i>	<i>small</i>
Primary-to-Secondary distance	18	<i>2.30</i>	<i>smallest</i>
5 Primary Light Distance	19	<i>111.93</i>	
Primary-to-Secondary distance	20	<i>2.17</i>	<i>smallest</i>
Primary-to-Secondary distance	21	<i>4.82</i>	<i>med lg</i>
Primary-to-Secondary distance	22	<i>2.49</i>	<i>small</i>
Primary-to-Secondary distance	23	<i>7.41</i>	<i>large</i>
Primary-to-Secondary distance	24	<i>3.52</i>	<i>medium</i>

Name: <i>Ron Maglalarang</i>			
PAGE 3			
MEASUREMENT	DATA POINT #	DISTANCE (mm)	
5 Primary Light Distance	25	<i>111.84</i>	
Primary-to-Secondary distance	26	5.02	<i>med lg</i>
Primary-to-Secondary distance	27	3.61	<i>medium</i>
Primary-to-Secondary distance	28	7.39	<i>large</i>
Primary-to-Secondary distance	29	2.16	<i>smallest</i>
Primary-to-Secondary distance	30	2.66	<i>small</i>
5 Primary Light Distance	31	<i>111.52</i>	
Primary-to-Secondary distance	32	7.30	<i>large</i>
Primary-to-Secondary distance	33	2.13	<i>smallest</i>
Primary-to-Secondary distance	34	4.82	<i>med lg</i>
Primary-to-Secondary distance	35	3.67	<i>medium</i>
Primary-to-Secondary distance	36	2.63	<i>small</i>
PAGE 4			
MEASUREMENT	DATA POINT #	DISTANCE (mm)	
5 Primary Light Distance	37	~~111.97~~ <i>111.77</i>	
Primary-to-Secondary distance	38	~~5.03~~ 3.70	<i>medium</i>
Primary-to-Secondary distance	39	2.22	<i>smallest</i>
Primary-to-Secondary distance	40	4.72	<i>med lg</i>
Primary-to-Secondary distance	41	2.45	<i>small</i>
Primary-to-Secondary distance	42	7.01	<i>large</i>
5 Primary Light Distance	43	<i>111.59</i>	
Primary-to-Secondary distance	44	~~5.03~~ 4.92	<i>med lg</i>
Primary-to-Secondary distance	45	7.17	<i>large</i>
Primary-to-Secondary distance	46	2.45	<i>small</i>
Primary-to-Secondary distance	47	2.23	<i>smallest</i>
Primary-to-Secondary distance	48	3.60	<i>medium</i>

Name: <i>Ron Maglalang</i>			
PAGE 5			
MEASUREMENT	DATA POINT #	DISTANCE (mm)	
5 Primary Light Distance	49	111.80	
Primary-to-Secondary distance	50	2.29	<i>smallest</i>
Primary-to-Secondary distance	51	3.54	<i>medium</i>
Primary-to-Secondary distance	52	4.85	<i>med lg</i>
Primary-to-Secondary distance	53	7.17	<i>large</i>
Primary-to-Secondary distance	54	2.82	<i>small</i>
5 Primary Light Distance	55	111.53	
Primary-to-Secondary distance	56	7.17	<i>large</i>
Primary-to-Secondary distance	57	2.57	<i>small</i>
Primary-to-Secondary distance	58	2.00	<i>smallest</i>
Primary-to-Secondary distance	59	3.66	<i>medium</i>
Primary-to-Secondary distance	60	4.90	<i>med lg</i>

Multiple Imaging Round Robin Test Data Sheet			
Name: <i>MIKE J KEITH</i>		Organization: <i>SIERRACIN/SYLVAR</i>	
Date: <i>2-9-96</i>		Photo Set: <i>B</i>	
PAGE 1			
MEASUREMENT	DATA POINT #	DISTANCE (mm)	
5 Primary Light Distance	1	<i>112.50</i>	
Primary-to-Secondary distance	2	<i>3.95</i>	<i>medium</i>
Primary-to-Secondary distance	3	<i>2.44</i>	<i>smallest</i>
Primary-to-Secondary distance	4	<i>3.08</i>	<i>small</i>
Primary-to-Secondary distance	5	<i>5.46</i>	<i>med lg</i>
Primary-to-Secondary distance	6	<i>7.50</i>	<i>large</i>
5 Primary Light Distance	7	<i>111.83</i>	
Primary-to-Secondary distance	8	<i>5.29</i>	<i>med lg</i>
Primary-to-Secondary distance	9	<i>7.26</i>	<i>large</i>
Primary-to-Secondary distance	10	<i>3.40</i>	<i>med</i>
Primary-to-Secondary distance	11	<i>2.20</i>	<i>smallest</i>
Primary-to-Secondary distance	12	<i>2.89</i>	<i>small</i>
PAGE 2			
MEASUREMENT	DATA POINT #	DISTANCE (mm)	
5 Primary Light Distance	13	<i>112.06</i>	
Primary-to-Secondary distance	14	<i>7.40</i>	<i>large</i>
Primary-to-Secondary distance	15	<i>3.51</i>	<i>medium</i>
Primary-to-Secondary distance	16	<i>5.16</i>	<i>med lg</i>
Primary-to-Secondary distance	17	<i>2.80</i>	<i>small</i>
Primary-to-Secondary distance	18	<i>2.16</i>	<i>smallest</i>
5 Primary Light Distance	19	<i>112.04</i>	
Primary-to-Secondary distance	20	<i>2.21</i>	<i>smallest</i>
Primary-to-Secondary distance	21	<i>5.16</i>	<i>med lg</i>
Primary-to-Secondary distance	22	<i>2.90</i>	<i>small</i>
Primary-to-Secondary distance	23	<i>7.40</i>	<i>large</i>
Primary-to-Secondary distance	24	<i>3.69</i>	<i>medium</i>

Name: <i>MIKE J KEITH</i>			
PAGE 3			
MEASUREMENT	DATA POINT #	DISTANCE (mm)	
5 Primary Light Distance	25	112.01	
Primary-to-Secondary distance	26	4.91	<i>med lg</i>
Primary-to-Secondary distance	27	3.90	<i>medium</i>
Primary-to-Secondary distance	28	7.46	<i>large</i>
Primary-to-Secondary distance	29	2.36	<i>smallest</i>
Primary-to-Secondary distance	30	2.85	<i>small</i>
5 Primary Light Distance	31	112.00	
Primary-to-Secondary distance	32	7.30	<i>large</i>
Primary-to-Secondary distance	33	2.23	<i>smallest</i>
Primary-to-Secondary distance	34	4.92	<i>med lg</i>
Primary-to-Secondary distance	35	3.60	<i>medium</i>
Primary-to-Secondary distance	36	2.87	<i>small</i>
PAGE 4			
MEASUREMENT	DATA POINT #	DISTANCE (mm)	
5 Primary Light Distance	37	112.05	
Primary-to-Secondary distance	38	3.57	<i>medium</i>
Primary-to-Secondary distance	39	2.31	<i>smallest</i>
Primary-to-Secondary distance	40	5.19	<i>med lg</i>
Primary-to-Secondary distance	41	2.63	<i>small</i>
Primary-to-Secondary distance	42	7.27	<i>large</i>
5 Primary Light Distance	43	112.10	
Primary-to-Secondary distance	44	4.98	<i>med lg</i>
Primary-to-Secondary distance	45	7.49	<i>large</i>
Primary-to-Secondary distance	46	2.90	<i>small</i>
Primary-to-Secondary distance	47	2.22	<i>smallest</i>
Primary-to-Secondary distance	48	3.72	<i>medium</i>

Name: <i>MIKE J KEITH</i>			
PAGE 5			
MEASUREMENT	DATA POINT #	DISTANCE (mm)	
5 Primary Light Distance	49	112.07	
Primary-to-Secondary distance	50	2.18	<i>smallest</i>
Primary-to-Secondary distance	51	3.52	<i>medium</i>
Primary-to-Secondary distance	52	5.11	<i>med lg</i>
Primary-to-Secondary distance	53	7.46	<i>large</i>
Primary-to-Secondary distance	54	2.78	<i>small</i>
5 Primary Light Distance	55	112.06	
Primary-to-Secondary distance	56	7.46	<i>large</i>
Primary-to-Secondary distance	57	2.71	<i>small</i>
Primary-to-Secondary distance	58	2.29	<i>smallest</i>
Primary-to-Secondary distance	59	3.17	<i>medium</i>
Primary-to-Secondary distance	60	4.97	<i>med lg</i>

Multiple Imaging Round Robin Test Data Sheet			
Name: JEANISA CHANG		Organization: PILKINGTON AEROSPACE	
Date: 2-14-96		Photo Set: A	
PAGE 1			
MEASUREMENT	DATA POINT #	DISTANCE (mm)	
5 Primary Light Distance	1	112.45	2.36
Primary-to-Secondary distance	2	5.70	med lg
Primary-to-Secondary distance	3	3.84	medium
Primary-to-Secondary distance	4	7.70	large
Primary-to-Secondary distance	5	3.19	small
Primary-to-Secondary distance	6	2.71	smallest
5 Primary Light Distance	7	112.45	2.36
Primary-to-Secondary distance	8	2.77	small
Primary-to-Secondary distance	9	7.86	large
Primary-to-Secondary distance	10	2.35	smallest
Primary-to-Secondary distance	11	5.23	med lg
Primary-to-Secondary distance	12	3.86	medium
PAGE 2			
MEASUREMENT	DATA POINT #	DISTANCE (mm)	
5 Primary Light Distance	13	112.37	2.36
Primary-to-Secondary distance	14	8.02	large
Primary-to-Secondary distance	15	3.97	medium
Primary-to-Secondary distance	16	5.54	med lg
Primary-to-Secondary distance	17	2.58	smallest
Primary-to-Secondary distance	18	3.26	small
5 Primary Light Distance	19	112.46	2.36
Primary-to-Secondary distance	20	2.44	smallest
Primary-to-Secondary distance	21	5.66	med lg
Primary-to-Secondary distance	22	4.15	medium
Primary-to-Secondary distance	23	8.04	large
Primary-to-Secondary distance	24	3.40	small

Name:			
PAGE 3			
MEASUREMENT	DATA POINT #	DISTANCE (mm)	
5 Primary Light Distance	25	112.27	2.36
Primary-to-Secondary distance	26	3.09	small
Primary-to-Secondary distance	27	5.50	med lg
Primary-to-Secondary distance	28	2.43	smallest
Primary-to-Secondary distance	29	4.24	medium
Primary-to-Secondary distance	30	7.97	large
5 Primary Light Distance	31	112.60	2.35
Primary-to-Secondary distance	32	4.09	medium
Primary-to-Secondary distance	33	5.87	med lg
Primary-to-Secondary distance	34	3.26	small
Primary-to-Secondary distance	35	2.60	smallest
Primary-to-Secondary distance	36	7.84	large
PAGE 4			
MEASUREMENT	DATA POINT #	DISTANCE (mm)	
5 Primary Light Distance	37	112.25	2.36
Primary-to-Secondary distance	38	7.63	large
Primary-to-Secondary distance	39	2.59	smallest
Primary-to-Secondary distance	40	5.41	med lg
Primary-to-Secondary distance	41	3.26	small
Primary-to-Secondary distance	42	4.16	medium
5 Primary Light Distance	43	112.43	2.36
Primary-to-Secondary distance	44	4.02	medium
Primary-to-Secondary distance	45	7.78	large
Primary-to-Secondary distance	46	2.68	smallest
Primary-to-Secondary distance	47	5.52	med lg
Primary-to-Secondary distance	48	3.30	small

Name:			
	PAGE 5		
MEASUREMENT	DATA POINT #	DISTANCE (mm)	
5 Primary Light Distance	49	112.41	2.36
Primary-to-Secondary distance	50	5.33	med lg
Primary-to-Secondary distance	51	2.95	smallest
Primary-to-Secondary distance	52	7.81	large
Primary-to-Secondary distance	53	3.26	small
Primary-to-Secondary distance	54	4.07	medium
5 Primary Light Distance	55	112.28	2.36
Primary-to-Secondary distance	56	3.09	small
Primary-to-Secondary distance	57	5.38	med lg
Primary-to-Secondary distance	58	2.40	smallest
Primary-to-Secondary distance	59	3.97	medium
Primary-to-Secondary distance	60	7.57	large

#

Multiple Imaging Round Robin Test Data Sheet			
Name: Mike Winstead		Organization: Pilkington Aerospace	
Date: 2-15-96		Photo Set: A	
PAGE 1			
MEASUREMENT	DATA POINT #	DISTANCE (mm)	
5 Primary Light Distance	1	112.23	2.36
Primary-to-Secondary distance	2	5.41	med lg
Primary-to-Secondary distance	3	3.78	medium
Primary-to-Secondary distance	4	7.34	large
Primary-to-Secondary distance	5	2.83	small
Primary-to-Secondary distance	6	2.09	smallest
5 Primary Light Distance	7	112.18	2.36
Primary-to-Secondary distance	8	2.78	small
Primary-to-Secondary distance	9	7.35	large
Primary-to-Secondary distance	10	2.38	smallest
Primary-to-Secondary distance	11	5.51	med lg
Primary-to-Secondary distance	12	3.74	medium
PAGE 2			
MEASUREMENT	DATA POINT #	DISTANCE (mm)	
5 Primary Light Distance	13	112.41	2.36
Primary-to-Secondary distance	14	7.75	large
Primary-to-Secondary distance	15	3.94	medium
Primary-to-Secondary distance	16	5.22	med lg
Primary-to-Secondary distance	17	2.43	smallest
Primary-to-Secondary distance	18	2.90	small
5 Primary Light Distance	19	112.40	2.36
Primary-to-Secondary distance	20	2.31	smallest
Primary-to-Secondary distance	21	5.34	med lg
Primary-to-Secondary distance	22	3.96	medium
Primary-to-Secondary distance	23	7.56	large
Primary-to-Secondary distance	24	2.98	small

Name:			
PAGE 3			
MEASUREMENT	DATA POINT #	DISTANCE (mm)	
5 Primary Light Distance	25	112.61	2.35
Primary-to-Secondary distance	26	2.92	small
Primary-to-Secondary distance	27	5.21	med lg
Primary-to-Secondary distance	28	2.26	smallest
Primary-to-Secondary distance	29	3.63	medium
Primary-to-Secondary distance	30	7.43	large
5 Primary Light Distance	31	112.42	2.36
Primary-to-Secondary distance	32	3.80	medium
Primary-to-Secondary distance	33	5.35	med lg
Primary-to-Secondary distance	34	3.04	small
Primary-to-Secondary distance	35	2.29	smallest
Primary-to-Secondary distance	36	7.42	large
PAGE 4			
MEASUREMENT	DATA POINT #	DISTANCE (mm)	
5 Primary Light Distance	37	112.47	2.36
Primary-to-Secondary distance	38	7.35	large
Primary-to-Secondary distance	39	2.35	smallest
Primary-to-Secondary distance	40	5.25	med lg
Primary-to-Secondary distance	41	2.78	small
Primary-to-Secondary distance	42	3.79	medium
5 Primary Light Distance	43	112.33	2.36
Primary-to-Secondary distance	44	3.93	medium
Primary-to-Secondary distance	45	7.60	large
Primary-to-Secondary distance	46	2.21	smallest
Primary-to-Secondary distance	47	5.37	med lg
Primary-to-Secondary distance	48	3.01	small

#1

Name:			
	PAGE 5		
MEASUREMENT	DATA POINT #	DISTANCE (mm)	
5 Primary Light Distance	49	112.17	2.34
Primary-to-Secondary distance	50	5.10	med lg
Primary-to-Secondary distance	51	2.26	smallest
Primary-to-Secondary distance	52	7.61	large
Primary-to-Secondary distance	53	2.81	small
Primary-to-Secondary distance	54	3.82	medium
5 Primary Light Distance	55	112.29	2.34
Primary-to-Secondary distance	56	2.94	small
Primary-to-Secondary distance	57	5.19	med lg
Primary-to-Secondary distance	58	2.37	smallest
Primary-to-Secondary distance	59	3.77	medium
Primary-to-Secondary distance	60	7.59	large

Multiple Imaging Round Robin Test Data Sheet

Name: Dave Larson Organization: Pilkington Aerospace Inc.Date: 2/15/96 Photo Set: A

PAGE 1

MEASUREMENT	DATA POINT #	DISTANCE (mm)	
5 Primary Light Distance	1	112.50	2.36
Primary-to-Secondary distance	2	5.82	med lg
Primary-to-Secondary distance	3	3.93	medium
Primary-to-Secondary distance	4	7.84	large
Primary-to-Secondary distance	5	3.16	small
Primary-to-Secondary distance	6	2.64	smallest
5 Primary Light Distance	7	112.45	2.36
Primary-to-Secondary distance	8	3.32	small
Primary-to-Secondary distance	9	7.91	large
Primary-to-Secondary distance	10	2.60	smallest
Primary-to-Secondary distance	11	5.65	med lg
Primary-to-Secondary distance	12	3.86	medium

PAGE 2

MEASUREMENT	DATA POINT #	DISTANCE (mm)	
5 Primary Light Distance	13	112.39	2.36
Primary-to-Secondary distance	14	7.68	large
Primary-to-Secondary distance	15	3.94	medium
Primary-to-Secondary distance	16	5.45	med lg
Primary-to-Secondary distance	17	2.36	smallest
Primary-to-Secondary distance	18	3.22	small
5 Primary Light Distance	19	112.54	2.35
Primary-to-Secondary distance	20	2.57	smallest
Primary-to-Secondary distance	21	5.65	med lg
Primary-to-Secondary distance	22	3.96	medium
Primary-to-Secondary distance	23	7.88	large
Primary-to-Secondary distance	24	3.40	small

Name:			
PAGE 3			
MEASUREMENT	DATA POINT #	DISTANCE (mm)	
5 Primary Light Distance	25	112.32	2.36
Primary-to-Secondary distance	26	3.19	small
Primary-to-Secondary distance	27	5.64	med lg
Primary-to-Secondary distance	28	2.63	smallest
Primary-to-Secondary distance	29	4.11	medium
Primary-to-Secondary distance	30	7.84	large
5 Primary Light Distance	31	112.89	2.35
Primary-to-Secondary distance	32	4.16	medium
Primary-to-Secondary distance	33	5.26	med lg
Primary-to-Secondary distance	34	3.27	small
Primary-to-Secondary distance	35	2.47	smallest
Primary-to-Secondary distance	36	7.80	large
PAGE 4			
MEASUREMENT	DATA POINT #	DISTANCE (mm)	
5 Primary Light Distance	37	112.36	2.36
Primary-to-Secondary distance	38	7.84	large
Primary-to-Secondary distance	39	2.67	smallest
Primary-to-Secondary distance	40	5.72	med lg
Primary-to-Secondary distance	41	3.44	small
Primary-to-Secondary distance	42	4.25	medium
5 Primary Light Distance	43	112.58	2.35
Primary-to-Secondary distance	44	3.97	medium
Primary-to-Secondary distance	45	7.66	large
Primary-to-Secondary distance	46	2.41	smallest
Primary-to-Secondary distance	47	5.55	med lg
Primary-to-Secondary distance	48	3.28	small

Name:			
PAGE 5			
MEASUREMENT	DATA POINT #	DISTANCE (mm)	
5 Primary Light Distance	49	112.59	2.35
Primary-to-Secondary distance	50	5.70	med lg
Primary-to-Secondary distance	51	2.66	smallest
Primary-to-Secondary distance	52	7.65	large
Primary-to-Secondary distance	53	3.17	small
Primary-to-Secondary distance	54	4.15	medium
5 Primary Light Distance	55	112.48	2.3e
Primary-to-Secondary distance	56	3.06	small
Primary-to-Secondary distance	57	5.43	med lg
Primary-to-Secondary distance	58	2.56	smallest
Primary-to-Secondary distance	59	3.94	medium
Primary-to-Secondary distance	60	7.91	large

#

Multiple Imaging Round Robin Test Data Sheet:			
Name: <i>ELSIE WILSON</i>		Organization: <i>PICKINGTON AEROSPACE INC.</i>	
Date: <i>2-19-96</i>		Photo Set: <i>A</i>	
PAGE 1			
MEASUREMENT	DATA POINT #	DISTANCE (mm)	
5 Primary Light Distance	1	112.13	2.34
Primary-to-Secondary distance	2	5.67	med lg
Primary-to-Secondary distance	3	4.34	medium
Primary-to-Secondary distance	4	8.03	large
Primary-to-Secondary distance	5	3.68	small
Primary-to-Secondary distance	6	2.47	smallest
5 Primary Light Distance	7	111.88	2.37
Primary-to-Secondary distance	8	2.95	small
Primary-to-Secondary distance	9	7.81	large
Primary-to-Secondary distance	10	2.41	smallest
Primary-to-Secondary distance	11	5.46	med lg
Primary-to-Secondary distance	12	3.97	medium
PAGE 2			
MEASUREMENT	DATA POINT #	DISTANCE (mm)	
5 Primary Light Distance	13	112.47	2.34
Primary-to-Secondary distance	14	7.84	large
Primary-to-Secondary distance	15	4.15	medium
Primary-to-Secondary distance	16	6.00	med lg
Primary-to-Secondary distance	17	2.61	smallest
Primary-to-Secondary distance	18	2.85	small
5 Primary Light Distance	19	112.28	2.34
Primary-to-Secondary distance	20	2.56	smallest
Primary-to-Secondary distance	21	5.56	med lg
Primary-to-Secondary distance	22	3.53	medium
Primary-to-Secondary distance	23	7.55	large
Primary-to-Secondary distance	24	3.42	small

Name:

PAGE 3

MEASUREMENT	DATA POINT #	DISTANCE (mm)	
5 Primary Light Distance	25	112.41	2.36
Primary-to-Secondary distance	26	3.19	small
Primary-to-Secondary distance	27	5.34	med. lg
Primary-to-Secondary distance	28	2.25	smallest
Primary-to-Secondary distance	29	3.77	medium
Primary-to-Secondary distance	30	7.74	large
5 Primary Light Distance	31	112.59	2.35
Primary-to-Secondary distance	32	4.00	medium
Primary-to-Secondary distance	33	5.31	med. lg
Primary-to-Secondary distance	34	2.99	small
Primary-to-Secondary distance	35	~~7.53~~ 2.61	smallest
Primary-to-Secondary distance	36	7.53	large

PAGE 4

MEASUREMENT	DATA POINT #	DISTANCE (mm)	
5 Primary Light Distance	37	112.24	2.36
Primary-to-Secondary distance	38	7.62	large
Primary-to-Secondary distance	39	2.48	smallest
Primary-to-Secondary distance	40	5.44	med. lg
Primary-to-Secondary distance	41	3.06	small
Primary-to-Secondary distance	42	4.16	medium
5 Primary Light Distance	43	110.66	2.39
Primary-to-Secondary distance	44	3.97	medium
Primary-to-Secondary distance	45	7.73	large
Primary-to-Secondary distance	46	2.55	smallest
Primary-to-Secondary distance	47	5.42	med. lg
Primary-to-Secondary distance	48	2.87	small

Name:			
	PAGE 5		
MEASUREMENT	DATA POINT #	DISTANCE (mm)	
5 Primary Light Distance	49	112.25	2.36
Primary-to-Secondary distance	50	5.85	med lg
Primary-to-Secondary distance	51	2.79	smallest
Primary-to-Secondary distance	52	7.65	large
Primary-to-Secondary distance	53	3.05	small
Primary-to-Secondary distance	54	4.34	medium
5 Primary Light Distance	55	112.17	2.36
Primary-to-Secondary distance	56	2.92	small
Primary-to-Secondary distance	57	5.24	med lg
Primary-to-Secondary distance	58	2.58	smallest
Primary-to-Secondary distance	59	3.53	medium
Primary-to-Secondary distance	60	7.89	large

Multiple Imaging Round Robin Test Data Sheet			
Name: <i>Raymond Rodriguez</i>		Organization: <i>TEST Lab Pilkington</i>	
Date: <i>2-20-96</i>		Photo Set: <i>A</i>	
PAGE 1			
MEASUREMENT	DATA POINT #	DISTANCE (mm)	
5 Primary Light Distance	1	112.33	2.36
Primary-to-Secondary distance	2	5.44	med lg
Primary-to-Secondary distance	3	3.77	medium
Primary-to-Secondary distance	4	7.55	large
Primary-to-Secondary distance	5	2.96	small
Primary-to-Secondary distance	6	2.29	smallest
5 Primary Light Distance	7	112.48	2.36
Primary-to-Secondary distance	8	2.91	small
Primary-to-Secondary distance	9	7.53	large
Primary-to-Secondary distance	10	2.44	smallest
Primary-to-Secondary distance	11	5.44	med lg
Primary-to-Secondary distance	12	3.77	medium
PAGE 2			
MEASUREMENT	DATA POINT #	DISTANCE (mm)	
5 Primary Light Distance	13	112.57	2.35
Primary-to-Secondary distance	14	7.54	large
Primary-to-Secondary distance	15	3.72	medium
Primary-to-Secondary distance	16	5.34	med lg
Primary-to-Secondary distance	17	2.15	smallest
Primary-to-Secondary distance	18	2.88	small
5 Primary Light Distance	19	112.45	2.36
Primary-to-Secondary distance	20	2.24	smallest
Primary-to-Secondary distance	21	5.15	med lg
Primary-to-Secondary distance	22	3.73	medium
Primary-to-Secondary distance	23	7.35	large
Primary-to-Secondary distance	24	2.91	small

Name:			
PAGE 3			
MEASUREMENT	DATA POINT #	DISTANCE (mm)	
5 Primary Light Distance	25	112.45	2.36
Primary-to-Secondary distance	26	2.95	small
Primary-to-Secondary distance	27	5.34	med lg
Primary-to-Secondary distance	28	2.17	smallest
Primary-to-Secondary distance	29	3.76	medium
Primary-to-Secondary distance	30	7.54	large
5 Primary Light Distance	31	112.49	2.36
Primary-to-Secondary distance	32	3.83	medium
Primary-to-Secondary distance	33	5.37	med lg
Primary-to-Secondary distance	34	2.71	small
Primary-to-Secondary distance	35	2.34	smallest
Primary-to-Secondary distance	36	7.72	large
PAGE 4			
MEASUREMENT	DATA POINT #	DISTANCE (mm)	
5 Primary Light Distance	37	112.28	2.36
Primary-to-Secondary distance	38	7.55	large
Primary-to-Secondary distance	39	2.21	smallest
Primary-to-Secondary distance	40	5.30	med lg
Primary-to-Secondary distance	41	2.68	small
Primary-to-Secondary distance	42	3.98	medium
5 Primary Light Distance	43	112.36	2.36
Primary-to-Secondary distance	44	3.80	medium
Primary-to-Secondary distance	45	7.53	large
Primary-to-Secondary distance	46	2.15	smallest
Primary-to-Secondary distance	47	5.51	med lg
Primary-to-Secondary distance	48	2.87	small

Name:			
	PAGE 5		
MEASUREMENT	DATA POINT #	DISTANCE (mm)	
5 Primary Light Distance	49	112.20	2.36
Primary-to-Secondary distance	50	5.27	med lg
Primary-to-Secondary distance	51	2.37	smallest
Primary-to-Secondary distance	52	7.63	large
Primary-to-Secondary distance	53	2.96	small
Primary-to-Secondary distance	54	3.82	medium
5 Primary Light Distance	55	112.38	2.36
Primary-to-Secondary distance	56	2.93	small
Primary-to-Secondary distance	57	5.40	med lg
Primary-to-Secondary distance	58	2.26	smallest
Primary-to-Secondary distance	59	3.72	medium
Primary-to-Secondary distance	60	7.61	large

#

Multiple Imaging Round Robin Test Data Sheet			
Name: Julie Garcia		Organization: Pilkington Aerospace	
Date: 2-14-96		Photo Set: A	
PAGE 1			
MEASUREMENT	DATA POINT #	DISTANCE (mm)	
5 Primary Light Distance	1	~~112.22~~ 112.20	2.36
Primary-to-Secondary distance	2	5.55	med lg.
Primary-to-Secondary distance	3	3.71	medium
Primary-to-Secondary distance	4	7.57	large
Primary-to-Secondary distance	5	3.05	small
Primary-to-Secondary distance	6	2.47	smallest
5 Primary Light Distance	7	112.27	2.36
Primary-to-Secondary distance	8	3.38	small
Primary-to-Secondary distance	9	7.69	large
Primary-to-Secondary distance	10	2.40	smallest
Primary-to-Secondary distance	11	5.17	med lg.
Primary-to-Secondary distance	12	3.95	medium
PAGE 2			
MEASUREMENT	DATA POINT #	DISTANCE (mm)	
5 Primary Light Distance	13	112.22	2.36
Primary-to-Secondary distance	14	7.81	large
Primary-to-Secondary distance	15	3.89	medium
Primary-to-Secondary distance	16	5.27	med lg.
Primary-to-Secondary distance	17	2.55	smallest
Primary-to-Secondary distance	18	2.94	small
5 Primary Light Distance	19	112.32	2.36
Primary-to-Secondary distance	20	2.66	smallest
Primary-to-Secondary distance	21	5.41	med lg.
Primary-to-Secondary distance	22	3.94	medium
Primary-to-Secondary distance	23	7.61	large
Primary-to-Secondary distance	24	3.59	small

Name:			
PAGE 3			
MEASUREMENT	DATA POINT #	DISTANCE (mm)	
5 Primary Light Distance	25	112.18	2.36
Primary-to-Secondary distance	26	3.29	small
Primary-to-Secondary distance	27	5.32	med lg.
Primary-to-Secondary distance	28	2.27	smallest
Primary-to-Secondary distance	29	3.91	medium
Primary-to-Secondary distance	30	7.85	large
5 Primary Light Distance	31	112.24	2.36
Primary-to-Secondary distance	32	3.78	medium
Primary-to-Secondary distance	33	5.49	med lg.
Primary-to-Secondary distance	34	3.34	small
Primary-to-Secondary distance	35	2.47	smallest
Primary-to-Secondary distance	36	7.67	large
PAGE 4			
MEASUREMENT	DATA POINT #	DISTANCE (mm)	
5 Primary Light Distance	37	112.40	2.36
Primary-to-Secondary distance	38	7.37	large
Primary-to-Secondary distance	39	2.26	smallest
Primary-to-Secondary distance	40	5.28	med lg.
Primary-to-Secondary distance	41	2.74	small
Primary-to-Secondary distance	42	3.87	medium
5 Primary Light Distance	43	112.42	2.36
Primary-to-Secondary distance	44	3.45	medium
Primary-to-Secondary distance	45	6.96	large
Primary-to-Secondary distance	46	2.74	smallest
Primary-to-Secondary distance	47	5.66	med lg.
Primary-to-Secondary distance	48	3.44	small

Name:			
	PAGE 5		
MEASUREMENT	DATA POINT #	DISTANCE (mm)	
5 Primary Light Distance	49	112.13	2.36
Primary-to-Secondary distance	50	5.44	med lg.
Primary-to-Secondary distance	51	2.30	smallest
Primary-to-Secondary distance	52	7.72	large
Primary-to-Secondary distance	53	3.49	small
Primary-to-Secondary distance	54	3.97	medium
5 Primary Light Distance	55	112.19	2.36
Primary-to-Secondary distance	56	2.94	small
Primary-to-Secondary distance	57	5.46	med lg.
Primary-to-Secondary distance	58	2.48	smallest
Primary-to-Secondary distance	59	4.01	medium
Primary-to-Secondary distance	60	7.54	large