Approved
Minutes
ASC OP1 ASC OP/SC 1, Performance Based Optical Imperfections Task Force Draft Standard Meeting
Monday May 14, 2007, 8:30 a.m. — 12 Noon

Present	Attendees (11 of 17 Entities)	
☒	**Committee Members**	**Representing**
☒	David Aikens	Zygo Corporation
☒	Gordon Boultbee	JDSU Corporation
☐	Andrei Brunfeld	Xyrtex
☐	Benjamin Catching (Alternate)	JDSU Corporation
☒	Walter Czajkowski	APOMA (Edmund Optics)
☒	Frank Dombrowski	Gage-Line Technology, Inc.
☒	Marla Dowell (by phone)	IEEE/LEOS (NIST)
☐	Lincoln Endelman	SPIE, (Endelman Enterprises)
☒	Charles Gaugh	Davidson Optronics, Inc.
☐	John Hamilton	Northrop Grumman
☐	Hal Johnson	Harold Johnson Optical Lab
☐	Rudolf Hartman	Retired
☒	Alan Krisiloff	Triptar Lens Co., Inc.
☒	Jonathan McGuire (Alternate)	Northrop Grumman Laser Systems
☐	Michael Morrill	Lockheed Martin Space Systems Company
☒	Sam Richman (Alternate)	Research Electro-Optics, Inc.
☐	William Royall	Eastman Kodak Company, Retired
☒	Trey Turner	Research Electro-Optics, Inc.
☐	Steve VanKerkhove	Corning Tropel
☒	Ray Williamson	Ray Williamson Consulting
	Observers (4)	
☒	Rich Beall	FLIR Systems, Inc.
☒	Gene Kohlenberg	OEOSC
☒	Stephen Martinek	4D Technology
☒	Ari Siletz	CCDMETRIX

Auditor's Summary of Meeting

Representatives from FLIR Systems and CCDMETRIX companies presented the new method for reducing scratch/dig artifact variability with machine vision. This method was developed to improve the production repeatability of the reference artifacts that suppliers buy to evaluate optics supplied to the military.

A Research Electro-Optics representative presented a microscope visual inspection method that is used in their company.

The task force reviewed suggested additions to section 3.7 of the draft standard supplied by the JDSU representative. The additions dealt with optical surface inspection methods for measured scratches and digs. A new Annex B dealt with recommended dimensions and characteristics of artifacts on a scale comparison plate for estimating the size of imperfections on optical elements, and two versions of Annex C covered the recommended layout of artifacts on a microscope eyepiece reticle for estimating the size of imperfections on optical elements.

Some word smithing was done on the draft. It was determined that pinholes had not been defined, and the draft was modified to add the definition with appropriate references added where necessary. Review of the annexes will continue at the next meeting to be held in San Diego, CA on August 26, 2007.

1 Welcome and Introductions

G. Boultbee opened the meeting at 8:37 a.m. Since there were several new persons attending the meeting, each person was introduced.

2 Adoption of Agenda

G. Boultbee asked for a motion to approve the published agenda. D. Aikens made the motion and R. Williamson provided the second. The motion carried unanimously.

3 Approval of the Saturday, January 20, 2007 ASC OP/SC 1, BSR/OEOSC-OP1.002, Optics and Electro-Optical unanimously. Instruments – Optical Elements and Assemblies — Appearance Imperfections Draft Review Minutes

The minutes had been posted on the web site. The Task Force Leader asked if there were any additions or corrections to the minutes. W. Czajkowski moved that the minutes be approved and D. Aikens seconded the motion. The motion carried unanimously.

4 Reducing scratch/dig standard variability with machine vision

G. Boultbee introduced R. Beall and A. Siletz, who both formerly worked at JDSU with him. G. Boultbee noted that R. Beall is with FLIR, which purchased Brysen Optical. Brysen is the producer of the official military scratch and dig reference standards. They described an evaluation tool to improve manufactured scratch and dig reference samples. A copy of this presentation is available on the OEOSC web site.

The limit samples that Brysen now uses were produced by Brysen. Re-certification would not be done on this tool; this is a production tool for verifying new reference standards. These standards would still be certified by the military. D. Aikens said that it would be good if there could be a new version designation for the drawings to indicate that the new production reference standards are being evaluated with the Brysen evaluation tool.

T. Turner asked if they have evidence that samples have reduced variability. They haven't had time to do that yet.

D. Aikens asked if there is a way that this committee could have time on the tool to evaluate other references such as the Edmund paddle to see how they compare to the the Brysen samples. The tool nest is designed to hold the reference samples; a new nest would have to be constructed to hold the Edmund paddle. A. Siletz has product rights for the tool, so OEOSC could purchase one for evaluating samples.

C. Gaugh asked if they have done any correlation studies with the SIRA machine. A. Siletz said that the SIRA machine is not very accessible.

5 Review of Revised OP1.002

G. Boultbee discussed his proposals for section 3.7. He passed his text around to several people for review. Versions 1 and 2 differ only in Annex C. The second version of Annex C is shorter.

T. Turner then discussed his microscope method of visual inspection. This is typical practice in his company. He has two methods, one for comparison use and one for dimensional evaluation. He knows of no good way of using comparison standards in a compound microscope. Comparison standards can be used with a low magnification stereo microscope.

G. Boultbee expressed a fundamental concern because the reference samples are being used in a different way than they were intended. T. Turner said that it is common practice to use reflection. Using them in reflection mode is necessary.

D. Aikens is concerned with zooming in on scratches for visibility evaluation; this is essentially a cosmetic inspection. He could understand the need for a new inspection technique for fiber tips and micro-lenses where sub-micron imperfections need to be controlled.. He thought that the committee should leave the appearance sections of the standard alone, and apply these techniques to the dimensional imperfection section.

T. Turner said that by forcing a dimensional evaluation, the dimensional standard doesn't correlate with what you want to specify. D. Aikens asked if T. Turner was wanting to see the bright spot, but the scratches are just too small to see. The answer was, “yes.” G. Boultbee said that he had no experience with evaluating such small imperfections.

D. Aikens suggested that this method should have to be called out on the drawing so that the vendor knows what he is up against.

T. Turner asked if there was a particular level in product size when this method should be invoked. Is it for 10 scratches? If a manufacturer needs to inspect for scratches smaller than 10 what do they do since there is no reference less than 10? T. Turner replied that there is a practice for lasers of calling out 10-5, whatever that means. D. Aikens agreed that he has product that he would like to call out imperfections less than 10. G. Boultbee said that when a number less than 10 is called out, the engineer is thinking that the number has a dimensional meaning. D. Aikens suggested that engineers are seeing sleeks, which can scatter a lot, and conclude that the sleek must be a 10.

D. Aikens asked if an engineer needs to call something out smaller than a 10, why not use a dimensional specification? T. Turner said he thought the problem was that the imperfections are just too small to measure with a reticle in a microscope. His company uses a Brysen 10 and extrapolates what they think the smaller scratch is.

F. Dombrowski said that his company uses a stereo microscope to evaluate imperfections on the order of a 10.

R. Beall said that Brysen is using their device to decide what level a 5 would be based upon what a 10 is. D. Aikens asked if they can still use brittle fracture to create a 5. R. Beall said that they are approaching the size limit for brittle fractures. G. Boultbee said that if this committee is contemplating a new reference standard, then a fresh approach to making the artifact should be considered. R. Williamson said that it probably should be a reflection artifact. D. Aikens agreed and added that there needs to be an artifact below 5. Cell phone lenses are being made by the millions and imperfections need to be below the sub-micron level.

T. Turner said that the laser manufacturers that his company works with are defining their own inspection methods, and we are lacking the tool for them to communicate what it is that they want. D. Aikens said that the laser manufacturers are trying to control ductile scratches and sleeks, if they are concerned with imperfections below 10. The shape of a ductile scratch is roughly 45° and prismatic. It has very limited scatter angle content. Therefore, one could measure its width and control scattering. R. Williamson asked if he was suggesting using a microscope to measure 0.5µ widths. D. Aikens confirmed that technique. R. Williamson said that it would be difficult to survey a surface. Such imperfections only show as an instantaneous flash when the part is turned under the test light because the reflection is specular. F. Dombrowski said that the SIRA device might not see anything under these conditions.

T. Turner said that having two light sources at 90° to one another helps make these imperfections visible.

D. Aikens noted that the current standard says that an imperfection that is greater than a number is automatically assigned the next higher number. If an engineer truly wants to control artifacts below 10, then this rule could not be applied. This should be specifically invoked on the drawing. All of the imperfections below 10 would be measured and accumulated according to the existing accumulation rule. This would be a new inspection and new specification.

G. Boultbee called for a break at 10:30 a.m. and then he suggested that the task force address the run of the mill dimensional inspection, then if there is time, return to T. Turners method.

Following the break the G. Boultbee asked the task force to begin looking at the revised section 3.7, which was placed on the optstd.org web site. D. Aikens said that he had a problem with referencing the buyer and seller in the standard, because it implies that the buyer and seller is being told to go make their own standard. He preferred that the standard state what should be done, and that it is implicit that the buyer and seller have the option to make their own agreement. C. Gaugh suggested that the wording not refer to only two annexes, since other techniques may be developed in the future. Then when that happens section 3.7 would not have to be reworded. G. Boultbee said that the standard would have to be revised to include other methods, and that 3.7 would have to be revised to recognize the other techniques. After some discussion the task force agreed that the wording be revised:

> **3.7 Inspection**
> Optical components with surface imperfection tolerances specified per 3.4 shall be visually inspected using the Comparison Standard referred to in 3.4.1 and the inspection conditions of one of the methods described below.
> Optical components with surface imperfection tolerances specified per 3.5 shall be visually inspected using a comparison standard such as that described in Annex B and the inspection conditions of one of the methods described below; or with the microscope eyepiece reticle described in Annex C.

G. Boultbee said that he made no changes to 3.7.1 – 3.7.2.1. He said that he added a comment permitting the use of brighter illumination, because the magnitude of the illumination should not change the evaluation of a measured imperfection. The default would be 40 watt illumination. C. Gaugh suggested that the section simply say that "alternate illumination may be used." T. Turner suggested that "used" be changed to "specified." The task force agreed to that modification.

> **3.7.2.1.1 Equipment.** When the Comparison Standard referred to in 3.4.1 is used, this inspection method requires either a 40 watt incandescent or a 15 watt cool white fluorescent lamp positioned approximately 75 mm from a ground or opal glass diffuser. When the Comparison Standard described in Annex B is used, alternate illumination may be specified.

G. Boultbee asked that the comma between "horizontal" and "black" be removed from the last statement.

The next suggested change occurred in section 3.7.2.2.1. It was modified to correspond to the changes made to the proposed

3.7.2.2.1 Equipment. When the Comparison Standard referred to in 3.4.1 is used, this inspection method requires a matte-black background material and either a

[insert Figure 3]

40 watt incandescent or a 15 watt cool white fluorescent lamp with a ground or opal glass diffuser. When the Comparison Standard described in Annex B is used, alternate illumination may be specified.

Next Annex B was reviewed. G. Boultbee said that he thought Annex B should be informative. C. Gaugh said that the gage manufacturer would prefer that the standard present a set of guidelines, rather than specifically dictate how the gage should be made. So this annex should be informative rather than normative. F. Dombrowski agreed that an example of the gage should be presented, but it should not be made mandatory.

There were questions concerning the suggestions about the type of artifacts proposed for size comparison in paragraphs two and three. After some discussion the following wording was agreed upon:

For size comparisons of imperfections on transmissive elements, opaque artifacts on a clear substrate are most useful.

For size comparisons of imperfections on reflective elements, clear artifacts on an opaque substrate are most useful.

F. Dombrowski asked if G. Boultbee thought that the word "pinholes" is appropriate on the artifact gage. G. Boultbee said that for highly reflective coatings, they are usually referred to as "pinholes" as opposed to "digs." F. Dombrowski then said that "pinhole" would have to be defined in the standard. The following edits were made to the draft standard:

2.1.3 Digs: Round (regular) and sometimes irregular shaped holes or voids (pinholes), including grinding pits and opened entrapped bubbles, in the polished or molded optical surface that may be filled with a residue, e.g., dried grinding or polishing slurry.

2.1.8 Pinhole: A void in a coating. Pinholes in coatings are analogous to digs.

3.3.6.3 Coating Imperfections. Coating spatter, voids (pinholes), and other point defects not removable by cleaning shall be considered to be digs and shall not exceed the allowable tolerance limits on dig size and quantity stated on the component drawing or procurement document. These coating imperfections shall be considered separate from the substrate imperfections.

3.6.8 Coating Imperfections. Coating spatter, voids (pinholes), and other point defects not removable by cleaning shall be considered to be digs and shall not exceed the allowable tolerance limits on dig size and quantity stated on the component drawing or procurement document. These coating imperfections shall be considered separate from the substrate imperfections.

G. Boultbee suggested that the task force stop at this point since time was running out. At the next meeting he suggested that the task force decide where the Research Electro-Optics proposals could be included in the draft. His Annex C drafts should also be evaluated. He said that he had some experience in designing and buying some program-specific reticles that had a 20µ scratch width specification. Before he joined the program, others had made two attempts to design an eyepiece reticle for use at 75X. Both attempts failed.

6 Other Business

C. Gaugh said that at the previous summer's meeting he had agreed to shepherd a round-robin evaluation. He was not able to complete that yet, because of company material issues with its manufacturing process. The problems have been solved and he is ready to address the round-robin. He said that the Secretary had told him that M. Dowell knew of some funding that might be available for such an evaluation. D. Aikens said that this funding was going to be discussed at the OEOSC Board meeting that followed the next day. M. Dowell said that there may be IEEE funding available. C. Gaugh

asked if J. Hamilton was still participating. J. McGuire said that he is working with J. Hamilton to do an independent verification of what he understands J. Hamilton's Gage R&R that he began for ASC OP. J. McGuire will use the Northrop Grumman Laser Systems staff to conduct the evaluation using J. Hamilton's artifacts and lighting conditions. There will be additional tests that will remain proprietary to his division. He hoped to complete the Gage R&R before the San Diego meeting.

7 Time and Place of next OP 1 Meeting

The Task Force agreed to meet next in San Diego,CA, August 26 2007, 8:30 a.m. – noon.

8 Adjourn

D. Aikens moved that the meeting be adjourned; C. Gough seconded the motion, which carried unanimously. The meeting adjourned at 12:05 p.m.