OIS/4.02 Optical Inspection Standard

Revision: 06
Issue date: 12th January 2011

Controlled document: The original electronic form is a controlled document. Distributed copies are not controlled. Copies more than 12 months old should be checked to ensure status.

Overview

These inspection criteria reflect the manufacturing and raw materials standards currently in use at Optical Filters Limited and level of quality required to satisfy most commercial and military requirements.

The criteria apply to products which are made using our standard raw materials:

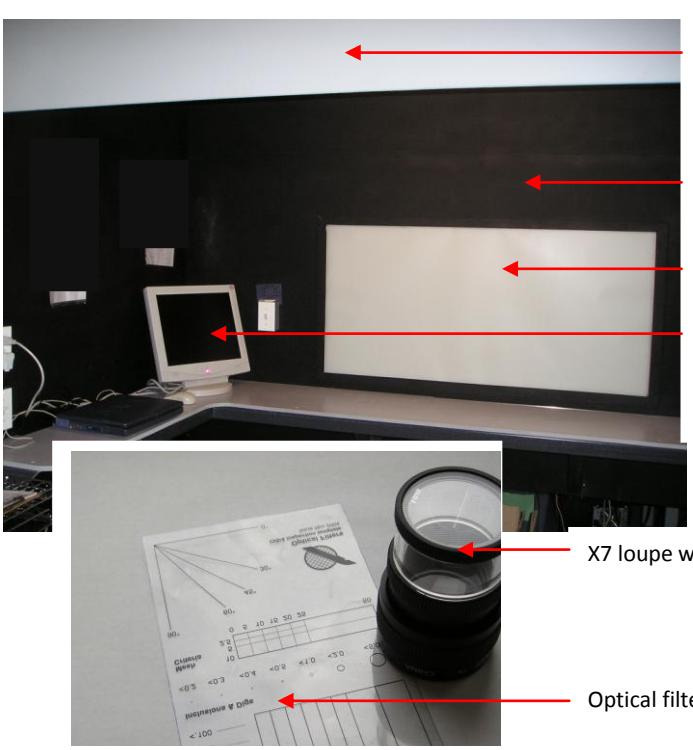
- Float glass with Plain or Non-Glare (Anti-Glare) surface finish
- Float glass with Multi-layer-Anti-Reflective (MLAR) coating
- Float glass with ITO coating
- Polycarbonate with Clear or Non-Glare hard coat
- Acrylic with Clear or Non-Glare hard coat
- EmiClare meshes.
- Polarizers
- 3M- Light control film (LCF)
- Tint layers.

Any other components are specifically excluded and if necessary will be subject to specific inspection criteria detailed in the Technical Master File (TMF) for that product.

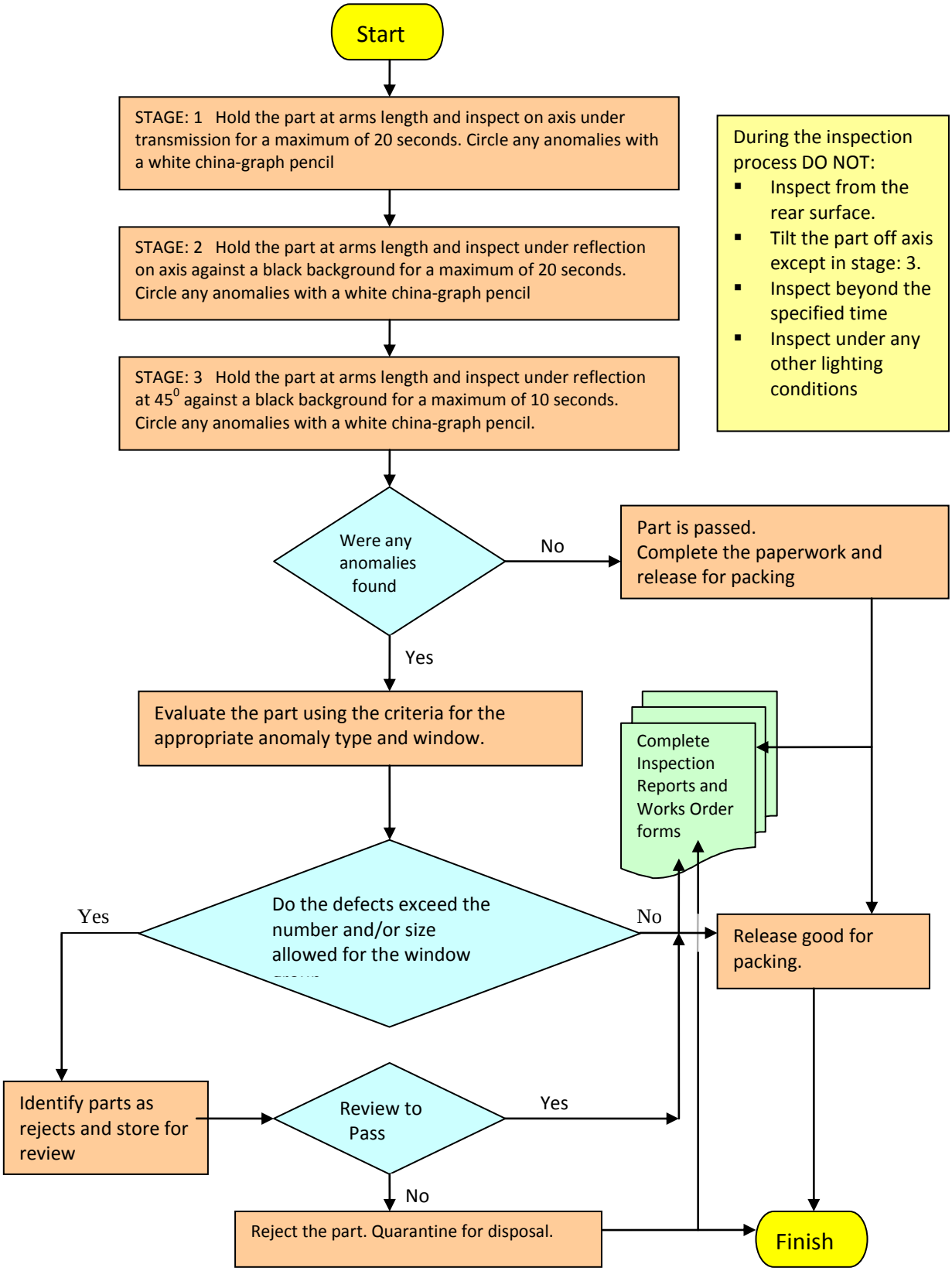
Inspection Procedure

The Inspection will be carried out in a controlled environment by a trained inspector experienced in optical inspection techniques using an eye loupe, template, transmitted and reflected light. The procedures are based around identifying anomalies and then using the inspection criteria to **objectively** determine if the anomaly is to be classified as a defect.

A typical inspection set-up and template and x7 loupe are shown below and the inspection procedure is detailed in Flow chart OIS/4.02 - FCI



Inspection procedure Flow chart OIS/4.02 - FCI



INCLUSION ANOMALIES – TYPE: I

These are anomalies within the laminate or materials of the laminate. Opaque/dark anomalies are seen under transmitted light. If above a certain size these anomalies will cause distraction and interference when the display is in use. Translucent anomalies are generally not visible when the display is in use but above a certain size they may be cosmetically unacceptable to the appearance of the display in the off state.

Accept Criteria for Opaque Circular Defects (Typically dirt spots)

Defect Size D (mm)	**Group:1** Area cm^2 <100	**Group:2** Area cm^2 100<400	**Group: 3** Area cm^2 400<1600	**Group:4** Area cm^2 1600<3600	**Group:5** Area cm^2 3600+
D less than 0.20	Ignore	Ignore	Ignore	Ignore	Ignore
D between 0.2 and 0.3	3	Ignore	Ignore	Ignore	Ignore
D between 0.3 and 0.4	1	3	5	5	Ignore
D between 0.4 and 0.5	0	1	3	5	10
D between 0.5 and 1.0	0	0	3	5	5
D more than 1.0	0	0	0	0	0
Separation of defects	>10	>10	>10	>10	>10
Total defects allowed	**3**	**3**	**5**	**7**	**10**

Accept Criteria for Opaque Linear Defects (Typically dark mesh fragments or hairs)

Defect Size D (mm) (W= width, L= length)	**Group:1** Area cm^2 <100	**Group:2** Area cm^2 100<400	**Group: 3** Area cm^2 400<1600	**Group:4** Area cm^2 1600<3600	**Group:5** Area cm^2 3600+
W less than 0.025	Ignore	Ignore	Ignore	Ignore	Ignore
W between 0.025 and 0.030 x L	3 x < 3	5 x <5	10 x <15	10 x <25	10 x <25
W between 0.030 and 0.050 x L	3 x < 3	5 x <5	5 x <10	10 x <15	15 x <25
W between 0.050 and 0.100 x L	0	0	5 x <10	5 x <15	10 x <25
W more than 0.100	0	0	5 x <10	5 x <15	5 x <25
Separation of defects	>10	>10	>10	>10	>10
Total defects allowed	**3**	**5**	**10**	**15**	**25**
Accumulated length	**<10**	**<30**	**<50**	**<150**	**<200**

Accept Criteria for Translucent Linear Defects (typically white fibres or lint)

Defect Size (mm)	**Group:1** Area cm^2 <100	**Group:2** Area cm^2 100<400	**Group: 3** Area cm^2 400<1600	**Group:4** Area cm^2 1600<3600	**Group:5** Area cm^2 3600+
W less than 0.025 and L less than 5 W less than 0.025 and L between 5 and 25	Ignore 0	Ignore 2	Ignore 5	Ignore Ignore	Ignore Ignore
W between 0.025 and 0.050 x L	5 x <10	5 x <10	10 x <15	10 x <25	10 x <25
W more than 0.050 x L less than 25	0	0	0	1 x <25	3 x <25
Separation of defects	>10	>10	>10	>10	>10
Total defects allowed	**3**	**5**	**10**	**10**	**10**
Accumulated length	**<20**	**<50**	**<100**	**<150**	**<200**

SURFACE ANOMALIES – TYPE: S

These are generally only visible under reflected light. Any surface anomalies which are visible under transmission, when the display is in use, are usually unacceptable.

Accept Criteria for surface scratches

Defect Size (mm)	**Group:1** Area cm^2 <100	**Group:2** Area cm^2 100<400	**Group: 3** Area cm^2 400<1600	**Group:4** Area cm^2 1600<3600	**Group:5** Area cm^2 3600+
W less than 0.010	Ignore	Ignore	Ignore	Ignore	Ignore
W between 0.010 and 0.025 x L	5 x <10	5 x <25	10 x < 25	15 x <25	15 x <50
W between 0.025 and 0.050 x L	0	2 x <25	5 x < 25	10 <25	10 <25
W between 0.050 and 0.10 x L	0	0	5 x < 25	5 x <25	5 x <25
W greater than 0.10	0	0	5 x < 5	5 x < 10	5 x < 10
Separation of defects	>10	>5	>5	>5	>5
Total defects allowed	**5**	**5**	**15**	**20**	**20**
Accumulated length	**<20**	**<50**	**<100**	**<150**	**<200**

Accept criteria for Non Glare Coating defects (Pin-holes and voids in the coating)

Defect type & size (mm)	**Group:1** Area cm^2 <100	**Group:2** Area cm^2 100<400	**Group: 3** Area cm^2 400<1600	**Group:4** Area cm^2 1600<3600	**Group:5** Area cm^2 3600+
Irregular patches missing	0	0	0	0	0
Bright circles. D less than 0.30, S greater than 5	Ignore	Ignore	Ignore	Ignore	Ignore
Bright circles. D between 0.30 and 1.0, S greater than 10	3	5	10	15	Ignore
Bright circles. D between 1.0 and 2.0, S greater than 10	0	0	5	10	15
Bright circles and Clusters. D between 2.0 and 5.0, S greater than 25 Cluster = multiple bright circles contained with D less than 5.0	0	0	0	5	10
Bright circles and Clusters D greater that 5.0	0	0	0	0	0
Total defects allowed	**3**	**5**	**10**	**20**	**25**

Accept criteria for Optical Coating (MLAR & ITO) defects (Pin-holes and voids in the coating)

Defect type & size (mm)	**Group:1** Area cm^2 <100	**Group:2** Area cm^2 100<400	**Group: 3** Area cm^2 400<1600	**Group:4** Area cm^2 1600<3600	**Group:5** Area cm^2 3600+
Irregular patches missing	0	0	0	0	0
Bright circles. D less than 0.30, S more than 5	5	10	20	Ignore	Ignore
Bright circles. D between 0.30 and 1.0, S greater than 10	3	5	5	15	Ignore
Bright circles. D between 1.0 and 2.0, S more than 25	0	0	5	10	15
Bright circles. D more than 2.0, S more than 25	0	0	0	5	10
Clusters– multiple bright circles contained with D	1, D≤2 0, D>2	3, D≤2 0, D>2	5, D≤2 0, D>2	5, D≤2 5, 2<D≤5	10, D≤2 5, 2<D≤5
Total defects allowed	**3**	**5**	**10**	**20**	**25**

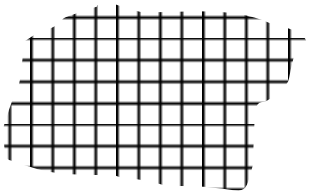
Surface distortion (Ripples and dimples)

Defect type & size (mm) These are identified by using the reflection of a lighted fluorescent tube on the surface and moving the part to travel the image across the surface.	**Group:1** Area cm^2 <100	**Group:2** Area cm^2 100<400	**Group: 3** Area cm^2 400<1600	**Group:4** Area cm^2 1600<3600	**Group:5** Area cm^2 3600+
Ripples – waves in the reflected image that cause distortion under transmission	**0**	**0**	**0**	**0**	**n/a**
Dimples – circular distortions in the reflected image that cause distortion under transmission	**0**	**0**	**0**	**0**	**n/a**

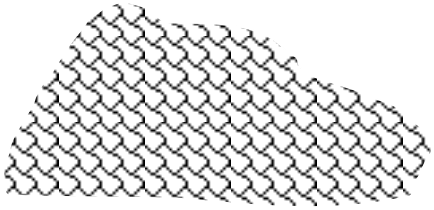
MESH ANOMALIES

This standard applies only to EmiClare meshes. Conventional meshes such as Copper 100/0022, Copper 70/0022, Copper/145/022, SS/230/0022, SS/100/0022, SS/100/0012, SS/50/0012, SS/80/0012, SS50/0012 and all knitted meshes are specifically excluded**.**

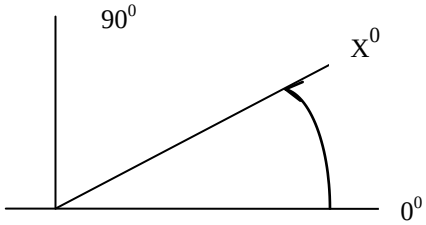
Terminology



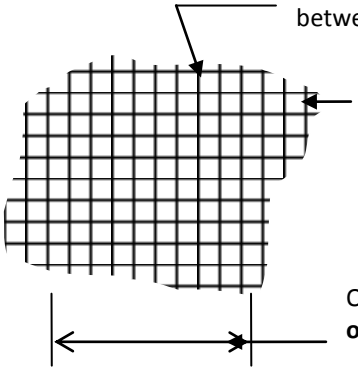
Woven mesh



Knitted mesh



Mesh Angle – measured CCW from the horizontal



Aperture = smallest opening between 4 wire

Wire Diameter = average width of the wire

Opi = number of **o**pening **p**er **i**nch

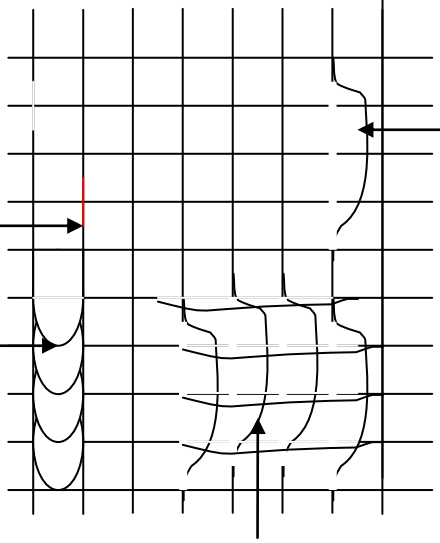
Broken wire

1 pitch/aperture width

TYPE: 1 wire displacement < 1 pitch

Unblackened wire

TYPE: 2 Herrin bone Displacement



TYPE: 3 multiple wire displacements contained within 10x25mm

Moiré fringing

Assessment of mesh anomalies

The dominant criteria for windows to be used in front of an electronic display is; does that the anomaly does not cause moiré fringing? If YES the window is a reject regardless of the size and shape of the mesh defect and regardless of any other consideration.

If a mesh anomaly does not cause moiré fringing and is within the above criteria it is not a defect.

Acceptance criteria for mesh defects

Anomaly type	**Group:1** Area cm^2 <100	**Group:2** Area cm^2 100<400	**Group: 3** Area cm^2 400<1600	**Group:4** Area cm^2 1600<3600	**Group:5** Area cm^2 3600+
Broken wire	0	0	0	5, S>50	10, S>50
Yellow patches – visible when viewed against a white background	0	0	0	0	0
Unblackened wire	0	0	0	10, L<5, S>5	20, L>5, S>5
Water marks visible against a black background	0	0	0	n/a	n/a
Water marks visible when viewing thru the window with normal room lighting both sides	n/a	n/a	n/a	0	0
Wire Displacement Type: 1 Wires moved less than 1 space and contained with 5x10mm rectangle	1	3, S>10	5, S>10	20, S>10	Ignore
Wire Displacement Type: 2 Herring bone distortion. Note: Type: 2 defects almost always cause moiré fringing.	1, L<50	3, L<5, S>10	5, L<10, S>10	Ignore	Ignore
Wire Displacement Type: 3 Multiple wire displacements within an area of 10x25mm. 1 type 3 defect = 1 area 10x25mm	1	3, S>5	5, S>5	Ignore	Ignore
Wire straightness/300mm					
Average Deviation less than or equal to +/-2.5mm	Ignore	Ignore	Ignore	Ignore	Ignore
Average Deviation between 2.5 and 5.0mm	0	0	Accept	Ignore	Ignore
Average Deviation more than 5.0mm	0	0	0	Ignore	Ignore
Total defects allowed	**3**	**5**	**10**	**20**	**20**

Inspection Decision – Pass or Fail

The decision to pass or fail the part is objectively based on an analysis of the results of classification of the various anomalies. The chart below summaries the analysis that is required to make the pass – fail decision.

Total defects allowed per anomaly type	**Group:1** Area cm^2 <100	**Group:2** Area cm^2 100<400	**Group: 3** Area cm^2 400<1600	**Group:4** Area cm^2 1600<3600	**Group:5** Area cm^2 3600+
Inclusion defects - Type: I					
Opaque circular defects	**3**	**3**	**5**	**7**	**10**
Opaque linear defects	3	5	10	15	25
Translucent linear defects	3	5	10	10	10
Surface defects – Type: S					
Scratch defects	5	5	15	20	20
Non-Glare surface defects	3	5	10	20	25
Optical coating defects (MLAR and ITO)	3	5	10	20	25
Surface distortions	0	0	0	n/a	n/a
Mesh defects – Type: M					
All mesh defects	3	5	10	20	20
Total defects allowed - all types	5	10	15	25	30
	Group:1 Area cm^2 <100	**Group:2** Area cm^2 100<400	**Group: 3** Area cm^2 400<1600	**Group:4** Area cm^2 1600<3600	**Group:5** Area cm^2 3600+

Pass – Fail decision

1. **If total defects in window > total defects allowed = Fail**
2. **Any mesh anomaly in a display window that causes moiré fringing = Fail**

Recommendations

1. **Inspect in the correct environment**
2. **Follow the standard**
3. **Use the work sheets in appendix: A to record your results and decisions**
4. **Remember optical inspection is an objective process against the defined standard OIS/4.0X**