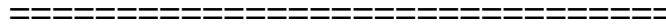


ACCEPTANCE TEST PROCEDURES
LAMINATED WINDSCREEN



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## ACCEPTANCE TEST PROCEDURES



## LAMINATED WINDSCREEN

Date - Modification		Prepared by	Approved by
	11/02/88	C. Bidault RAILWAY Division Product Quality Manager	B. Guillouet RAILWAY Division Glass Line Manager
A	09/06/88		
B	20/12/90		
C	18/12/95		
D	11/08/00		
E	20/04/04		

**MODIFICATIONS**

<b>Issue</b>	<b>Date</b>	<b>Para. Pages</b>	<b>Description of modification</b>
C	18/12/95	All	Complete revision of the document Add of plastic and silkscreen printing defects
D	11/08/00	All	Complete revision of the document
E	20/04/04	All	Complete revision of the document + appendix 2 : Optical test

SAINT GOBAIN SULLY will apply automatically all more restricting revisions

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## 1. SCOPE

This Acceptance Test Procedures are applicable to all heated and non-heated laminated transparencies, whatever their composition.

When there is no particular specification, this document will be used according to the decision of the Quality product manager and/or the Sale Department who will then inform the customer.

When it exists, this acceptance test procedure is an integral part of the quality plan.

It will be mentioned on the technical instruction (SAINT GOBAIN SULLY production data sheet).

## 2. GENERALITIES

The means of heating (Airplex® - Antex® - Indiex® - Electriplex®), the means of thermal regulation (thermostat, sensor), the type of electrical connections (cables, terminal box) and all other necessary information for the manufacturing shall be indicated on the drawing or on the purchase order.

See definitions in Appendix 1.

## 3. CHARACTERISTICS

### 3.1. Geometrical inspection

(except if there is different indication on drawing or other SAINT GOBAIN SULLY official document)

#### 3.1.1. Thickness

The thickness tolerances on the final product are obtained by summing the thickness tolerances of each component. (e = Thickness)

Tolerance on glass	$\pm 0,2$ mm for $e \leq 6$ mm
	$\pm 0,3$ mm for $6 < e \leq 12$ mm
	$\pm 0,5$ mm for $e = 15$ mm
	$\pm 1$ mm for $e = 19$ mm
Tolerance on interlayer and other layers	$\pm 0,02$ mm per 0,5 mm of thickness
Tolerance on plastic	$\pm 10$ % of the nominal thickness

## 3.1.2. Length - width

Whatever the type of finishing, the tolerances shall be the following

**A. Flat transparencies**

Thickness $\leq$ 14 mm :	+ 0 - 1,5 mm	peripheral with a -2 mm radius tolerance
Thickness $>$ 14 mm :	+ 0 - 2 mm	peripheral for transparencies including no glass ply of more than 12 mm thick, with a -3 mm radius tolerance
	+ 0 - 3 mm	in dimensions if one the glass components is more than 12 mm thick, with a -5 mm radius tolerance.

**B. Curved transparencies**

Whatever the transparency thickness, the trimming tolerance are  
+ 0 / -5 mm from a theoretical peripheral trim line.  
See Sketch on § 3.1.3.B

**C. Framed transparency or with moulded seal**

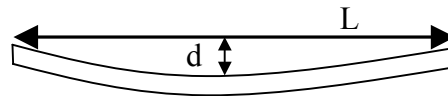
The dimension of the transparency with moulded seal is assured with the injection tool

The dimension of the framed transparency is assured by the dimension of the frame (see tolerance on the drawing)

### 3.1.3. Flatness – contour

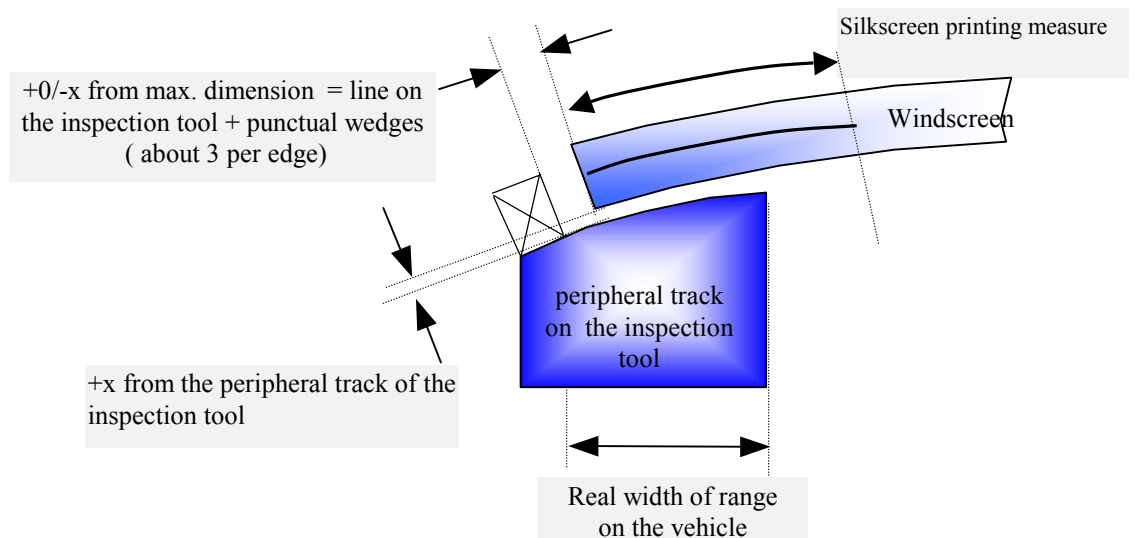
#### A. Flat transparencies

The maximum deflection (d) shall not be more than 0.15% of L.



#### B. Curved transparencies

Peripheral contour : the maximum allowable stand off from the gauged surface (of the inspection tool) shall be 6 mm (except for wide transparencies :  $S \geq 2 \text{ m}^2$  and product which is considered critical by SAINT GOBAIN SULLY).



If it's required, the central curve should be inspected by SAINT GOBAIN SULLY. The tolerance have to be defined with the customer.

### 3.1.4. Slippage tolerance

The slippage between glass plies must not exceed the tolerances of paragraph 3.1.2 (each glass component being in its own tolerances).

### 3.1.5. Case of specifically geometrical definitions

For transparencies being subject to specifically geometrical definitions (holes, notches, chamfer, ...) the tolerances shall be necessarily included in the drawing.

### 3.1.6. Decorative silk-screens printing

The silk-screen printing is measured from the real edge of the transparency (see sketch §3.1.3.B). The tolerance depends on printing process and is noted on the drawing or other official document.

### 3.1.7. General tolerance

The general tolerances of position of components such as label, terminal box, Heating system, ... will be  $\pm 10$  mm from a nominal location.

## 3.2. Visual inspection

See Inspection method in document MCTR attached

### 3.2.1. Definition of areas

The optical areas are defined by SAINT GOBAIN SULLY, in accordance with the customer

Each transparency is divided in 2 optical areas :

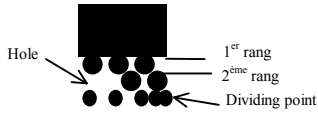

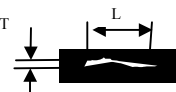
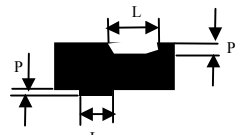
- Principal vision area (called area 1)
- Peripheral area (called area 2): depending to the fitting system or the printing area. The width is at least 1.5 x thickness of the transparency.

## 3.2.2. Defects classification

**Definition of defects**

	Negligible	Minor	Major
<b><u>PUNCTUAL DEFECTS :</u></b>			
<b>Bubble :</b> Air pocket, sometimes coloured entrapped in glass	$\varnothing \leq 0.8 \text{ mm}$	$0.8 < \varnothing \leq 2.4 \text{ mm}$	$\varnothing > 2.4 \text{ mm}$
<b>Impurities</b> Small seed set down over the glass / interlayer or embedded particle	$\varnothing \leq 0.8 \text{ mm}$	$0.8 < \varnothing \leq 2.4 \text{ mm}$	$\varnothing > 2.4 \text{ mm}$
<b>Seed :</b> Semi -reflecting or opaque	$\varnothing \leq 0.8 \text{ mm}$	$0.8 < \varnothing \leq 2.4 \text{ mm}$	$\varnothing > 2.4 \text{ mm}$
<b>Spot :</b> local translucent area on interlayer	$\varnothing \leq 0.8 \text{ mm}$	$0.8 < \varnothing \leq 2.4 \text{ mm}$	$\varnothing > 2.4 \text{ mm}$
<b>Blow :</b> Dense depleted area due to shock	$\varnothing \leq 0.8 \text{ mm}$	$0.8 < \varnothing \leq 2.4 \text{ mm}$	$\varnothing > 2.4 \text{ mm}$
<b>Crushing :</b> Local abrasion on glass due to foreign impurity crushing or rubbing between 2 plies	$\varnothing \leq 0.8 \text{ mm}$	$0.8 < \varnothing \leq 2.4 \text{ mm}$	$\varnothing > 2.4 \text{ mm}$
<b><u>ANTI-SPALL LAYER SPECIFIC DEFECTS</u></b>			
<b>Skin blister:</b> Transparent surface induce localised deformation	$\varnothing \leq 2 \text{ mm}$	$2 < \varnothing \leq 4 \text{ mm}$	$\varnothing > 4 \text{ mm}$
<b>Cord :</b> A relatively thick and very obvious thread of glass	$L \leq 6 \text{ mm}$	$6 < L \leq 12 \text{ mm}$	$L > 12 \text{ mm}$

	Negligible	Minor	Major
<b>LINEAR DEFECTS :</b> Defects which the longer to width ratio is high			
<b>Scratch, chipped scratch :</b> (Inside diameter) Superficial scratch, deep, rectilinear or curvilinear, with shell all around	-		All dimension
<b>Fine scratch</b> detectable with nail or rub: (Inside diameter)	$\varnothing \leq 13 \text{ mm}$	$13 < \varnothing \leq 76 \text{ mm}$	$\varnothing > 76 \text{ mm}$
<b>Sleek : (Inside diameter)</b> Hairline scratches hardly detectable with nail	All dimension	-	
<b>Print</b> of attenuated scratch	$\varnothing \leq 13 \text{ mm}$	$13 < \varnothing \leq 76 \text{ mm}$	$\varnothing > 76 \text{ mm}$
<b>Streak, Mark (drag) trace :</b> Whitish area in the interlayer, hardly detectable under daylight condition	All dimensions if not catch the eye at 3 m from the product	If catch the eye at 3 m from the product with cumulated surface $\leq 8 \text{ cm}^2$	If catch the eye at 3 m from the product with cumulated surface $> 8 \text{ cm}^2$
<b>Lint, fibber, hair :</b> (Inside diameter) Elongated impurity entrapped between glass ply and interlayer when laminating	$\varnothing \leq 13 \text{ mm}$	$13 < \varnothing \leq 76 \text{ mm}$	$\varnothing > 76 \text{ mm}$
<b>PLASTIC SPECIFIC DEFECTS</b>			
<b>Skin blister :</b> Transparent surface induce localised definition	$\varnothing \leq 2 \text{ mm}$	$2 < \varnothing \leq 4 \text{ mm}$	$\varnothing > 4 \text{ mm}$
<b>Coloured spot and impurities</b>	$\varnothing \leq 0.8 \text{ mm}$	$0.8 < \varnothing \leq 2.4 \text{ mm}$	$\varnothing > 2.4 \text{ mm}$
<b>Coating drip</b>	$L \leq 6 \text{ mm}$	$6 < L \leq 12 \text{ mm}$	$L > 12 \text{ mm}$

	Negligible	Minor	Major
<b>EDGE DEFECTS (Peripheral area)</b>			
<b>Tong marks :</b> Impressions made in glass by the tips of the tongs used to suspend the glass during tempering. It induces a local deformation, iridescence and 2 hairline scratches stemming from the glass removal.	Disregarded		
<b>Bending tool mark :</b> Impressions made in glass in the peripheral area by the bending tool	Disregarded		
<b>Shell, chips :</b> Small loss of glass fragment, generally conchoidal, not totally took over by grinding; Criteria are adapted to product characteristics. The cutting chip are not accepted. The criteria can be adapted to the glass characteristic. The grinding can take over shell up to 10mm from the edge of the glass. The grinding can take over shell up to 10mm from the edge of the glass.	$\varnothing \leq 2\text{mm}$	$2 < \varnothing \leq 3\text{mm}$	$\varnothing > 3\text{mm}$
<b>SILK-SCREEN PRINTING SPECIAL DEFECTS</b>			
<b>Impurities under silk screen :</b>	$\varnothing \leq 2\text{ mm}$	$2 < \varnothing \leq 4\text{ mm}$	$\varnothing > 4\text{ mm}$
<b>Dotted surface :</b> Visual inspection to estimate if the design is acceptable and if irregularity isn't "shocking" from outside view.			
<b>Plain surface :</b> <ul style="list-style-type: none"> <li>Blank : </li> </ul>	$\varnothing \leq 2\text{ mm}$	$2 < \varnothing \leq 4\text{ mm}$	$\varnothing > 4\text{ mm}$
$S = L * T$ 	$S \leq 20\text{ mm}^2$ with $T \leq 1\text{ mm}$	$20 < S \leq 80\text{ mm}^2$ with $T \leq 2\text{mm}$	$S > 80\text{ mm}^2$ with $T \leq 2\text{mm}$ or $T > 2\text{mm}$
<ul style="list-style-type: none"> <li><b>Defect on the silk-screen printing edge :</b>             Inner edge :             outer edge :         </li> </ul>	  $P \leq 2\text{ mm}$ and $L \geq 40\text{ mm}$  $P < 5\text{ mm}$	$2 < P \leq 3\text{mm}$ and $10 < L \leq 40\text{ mm}$  $P = 5\text{ mm}$ peripheral	$P > 3\text{ mm}$ and $L < 10\text{ mm}$  $P > 5\text{ mm}$

**DEFECTS ACCEPTANCE CRITERIA**

Vision area	Type of defect Negligible	Minor	Major
<b>Area 1</b>	Disregarded 1)	3 defects inside $\varnothing = 100 \text{ mm}$	0
<b>Area 2</b>	2)	2)	2)
<b>Printed Area</b>	3)	3 defects inside L max = 100 mm	0

The defects are detected at 1m (3.28 ft) in front of a luminous board. (See document MCTR attached)

**1)** Defects accumulation does not impair visibility

**2)** The negligible, minor and major defects shall be accepted provided they not impair the transparency mechanical resistance.

Are also accepted :

- interlayer striking (max. 5 mm/edge)
- bubbling
- delamination

- non transformation of the interlayer

with a maximum held surface of 5 % of the peripheral zone surface.

**3)** Defects accumulation shall not aesthetically shock from outside view and shall maintain a UV transmittance less than 0.1% in gluing area.

### 3.3. Optical inspection

It shall be checked that the vision shall not be notably impaired in vision areas (area 1 and 2) when looking through the transparency.

In case of doubt on distortion, an optical distortion measurement shall be performed on flat or faintly bent transparencies according the method and criteria attached in appendix 2.

For plane transparencies with critical composition or rake angle and bent transparencies the tolerances and the process are specific for each product. If it's necessary, SAINT GOBAIN SULLY establishes an optical proposal (criteria + process) according to the form, the composition of the transparency and customer requirements for these new products .

### 3.4. Spectrometric characteristics

If it's required, the luminous transmittance (ILL C) and the haze should be inspected once a year per type of product. The criteria should be defined with the customer. If required by the customer, the transmittive colour can be measured (type test).

### 3.5. Electrical inspection

#### 3.5.1. Heating element resistance

The resistance tolerance, whatever the heating system, is  $\pm 15\%$  from the nominal value at 20°C.

#### 3.5.2. Flash test

For transparencies heated by means of coating, a flash test shall be carried out to check that the heating area is insulated and that there is no current leakage  $I > 5\text{mA}$  with Voltage =  $2U + 1000$  Volts maintained.

### 3.5.3. Case of multiple independent heating area

The isolation between these area is tested with 500V. The minimal accepted resistance is 0.5MΩ.

### 3.5.4. Heating systems defects

(See method on document MCTR attached)

- **With nominal voltage and power:**

Hot points:  $\varnothing \leq 5 \text{ mm} \rightarrow$  negligible

$5 < \varnothing \leq 10 \text{ mm} \rightarrow$  5 maxi

$\varnothing > 10 \text{ mm} \rightarrow$  non conform

Wires : Inoperative wires shall be permitted provided the heating element resistance meets the requirements of § 3.5.1 and do not form disturbing optical deformation when system running.

- **With nominal voltage and maximum power**

(if it's different to de-ice).

If some evolved defect appears, it's a non conformity

- **Regulation**

It case of sensor regulation, SAINT GOBAIN SULLY shall add one or more additional sensor(s) in comparison with customer requirement. The non working of these, will not be a non conformity.

### 3.6. Specifics functions

#### 3.6.1. Solar protection

SAINT GOBAIN SULLY is equipped to measure colours by reflection. Tolerance should be defined with the customer.

#### 3.6.2. IEM or Anti-radar

The required attenuation, transliterated by calculation in square resistance, is checked by testing this resistance on the ply, for coating application.  
The tolerance is defined by SAINT GOBAIN SULLY and depending the type of coating.

## 4. IDENTIFICATION

The identification shall be generally made by a label legible from inside and shall consist in

Manufacturer Name	}	for non heated transparencies
Manufacturing date (month - year)		

Manufacturer Name	}	for heated transparencies
Theoretical voltage and power		
Heating system		
Serial number		
Manufacturing date (month - year)		

In case of a mistake in the contents or the position of the label, SAINT GOBAIN SULLY shall bond a new label on the inner surface of the window, at the exact place of the previous one, or if acceptable, advise the error by an adhesive label.

**DOCUMENTS DE REFERENCE**

NF F 15.818	Front windscreen for cab
NF B 32-003	Uncoloured Glass - Generality
MIL G 25667	Glass, monolithic, aircraft glazing
MIL G 25871	Glass, laminated, aircraft glazing
GGC 89/005	General Inspection Procedures
PLQ TI 87/01	Quality Plan - SNCF
UDC:001.4:666.11.019	Terminology of defects in Glass edited by Sub-committee A1 of the International Commission on Glass

**APPENDIX 1 : Definitions**

Bus bar	:	Metallic parts situated inside of the transparent near the edges and ensuring the electrical supplying of the transparent heated area
Heated area	:	Heated part of the transparency
Regulation	:	Ensured by means of thermostat stuck on the inner side of the transparency or sensor inside the laminate. Allow not to overpass the order points.
Glass component treatment	:	Rt : annealed : glass sheet without reinforcement RC : chemical reinforcement : chemical treatment of the glass sheet ST : semi-toughened glass } thermal reinforcement of glass T : toughened glass } sheets
Thermal processes	:	. AIRPLEX® : thin network of conductive wires . ANTEX® . INDIEX® . ELECTRIplex® } conductive metallic coatings
Anti-spall layer	:	Layer laid on the outer surface of the laminated glass, in the inner ply with a minimal function of anti-spall.
Silk screen printing	:	Opaque peripheral band which the principal function is the design.

## APPENDIX 2 : Optical test

### Optical Inspection : Distortion as ISO 3538

#### 1- EQUIPMENT

- Raster: Slide consisting of an array of circular shapes projected on a screen (Diameter: 20mm on the screen)
- Projector
- Screen board
- Portable cart with brackets to put the glass at the real rake angle ( $\beta$ )

#### 2 - METHODS

Measure the bigger and smaller diameter on the screen. The modification (in mm) of the projected diameter (d) allows to calculate the change in angular deviation in minutes of arc :  $\Delta d = 0.29 \Delta \alpha R_2$  ( $R_2$  = distance between windscreen and screen board)  
 Note : For curved transparency, the right thing to do is to observe and limit the visual area in order to limit the influence of the curve.

#### 3- ZONE DEFINITIONS

Zone 1 : Main visibility zone

Zone 2 : Zone without any visibility in particular (Zone covered by spoiler, windscreen wipers...) + Clamping zone or printing zone.

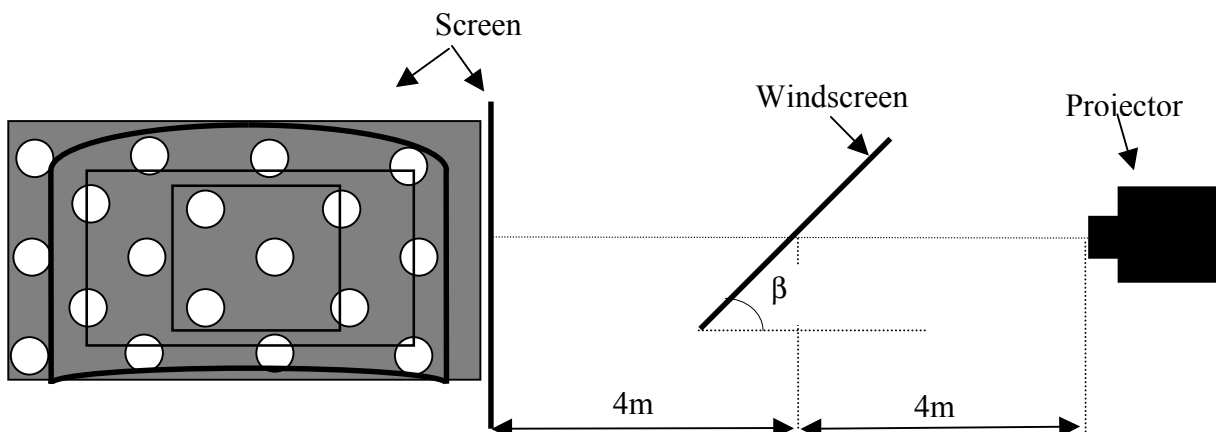
#### 4- ACCEPTANCE CRITERIA

Zone 1 : Maximum distortion: 6'

Zone 2 : No optical distortion required.

#### 5- TEST FREQUENCY

It's a type test, conducted during the First Article Inspection (First Serial windscreen) or in case of doubt with shadowgraph method



<b>INSPECTION METHODS</b>
<b>GENERAL</b>



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## **INSPECTION METHODS**

### **1- SHADOWGRAPH METHOD**

- **To check defect which can generate punctual optical distortion** (pits on glass, repair of scratch, skin blister, cord on anti spall layer...)

If the shadow reveals defect => Measure the dimensions of the defect on the glass if it's a punctual defect.

If the defect is on the limit or not measurable => The decision is taken by the inspector, looking through the transparency in front on landscape. (checking the inconvenience caused by the defect)

The inspector looks for severe discontinuity of the observed landscape.

- **To check heating system defect** (Inoperative wire, over heating, hot spot)

If the shadow reveals defect => Measure the dimensions of the defect on the glass

### **2- LUMINOUS and DAYLIGHT BOARD METHOD**

**To check all other defect** (scratch, impurity, streak, mark...)

If detection of a defect => Measure the dimension of the defect on the glass

If the defect is on the limit or not measurable => The decision is taken by the inspector, looking through the transparency in front of landscape. (checking the inconvenience caused by the defect)

### **3- OUTSIDE OBSERVATION METHOD**

**To check aesthetic defect. Method moreover used for glass without anybody behind it**

If the inspector's eye is attracted by a defect => Measure the dimension of the defect on the glass

If the defect is on the limit or not measurable => The decision is taken by the inspector.

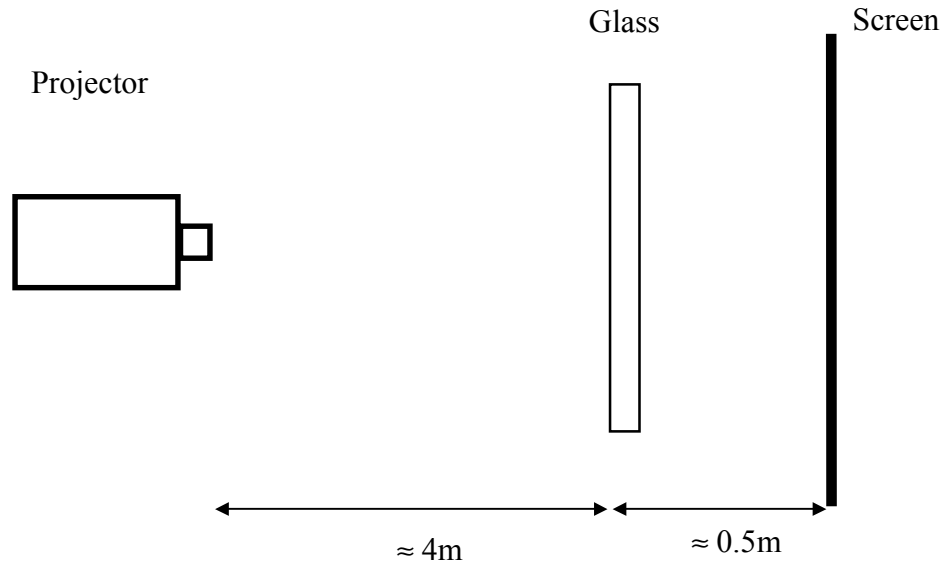
<b>INSPECTION METHODS</b>
<b>GENERAL</b>



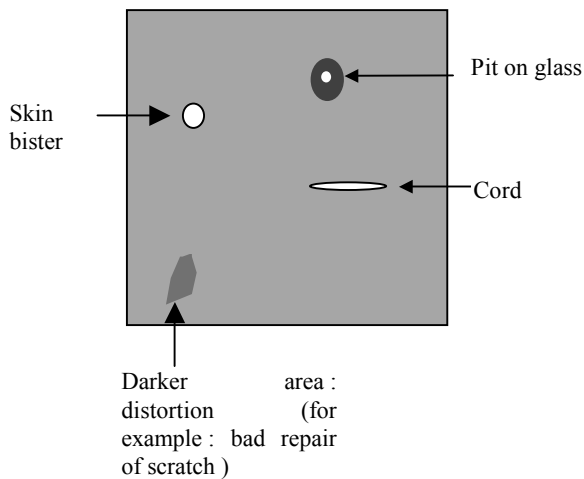
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## SHADOWGRAPH METHOD

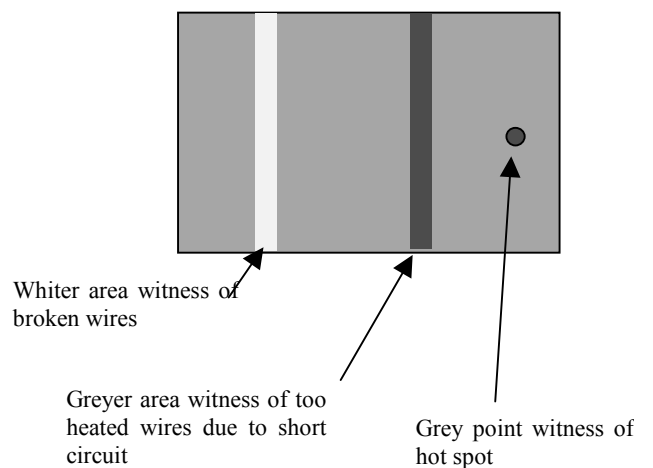
### Sketch:



In a dark room, the transparency is interlaid between the projector and the white screen.  
Check the shadow on the screen : darker area or whiter area



Heating defect : Switch on the heating power



This method is used to easily localise defect on the transparency :

To measure with reglet or magnifying glass

To appreciate the defect in face of daylight (see « direct observation face to daylight »)

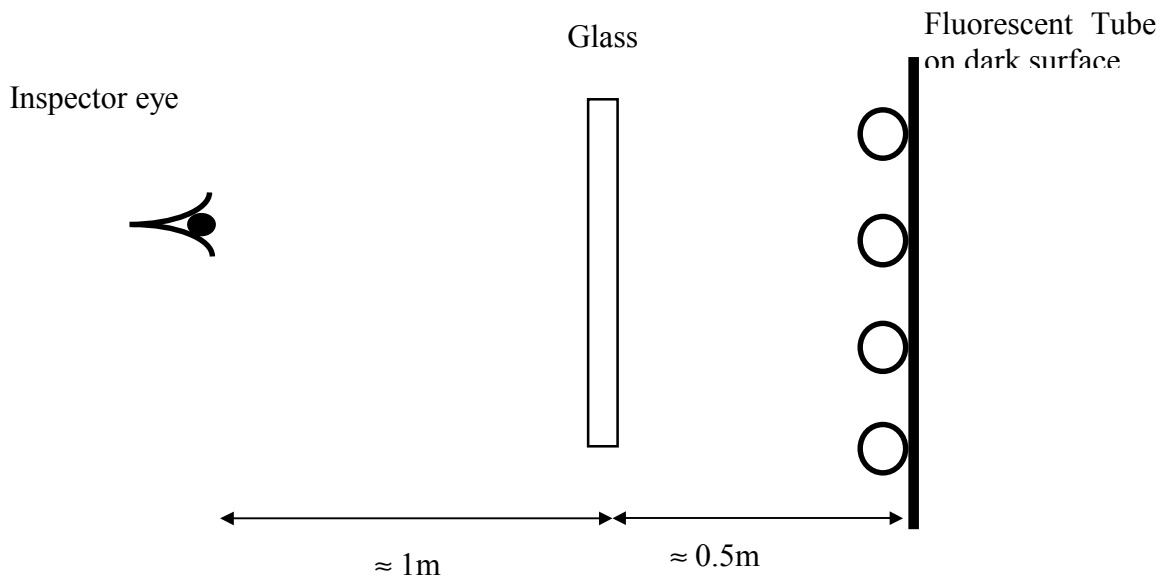
<b>INSPECTION METHODS</b>
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## LUMINOUS BOARD METHOD

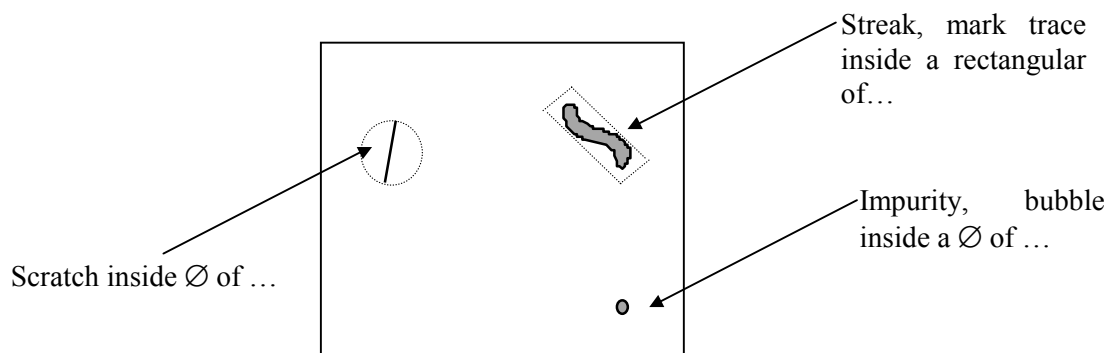
### Sketch



Observation on a dark background lighted by fluorescent tube 250 to 350 apart.

The transparency is inspected from inside to outside.

This method is using to localise the defect in order to measure it with reglet or magnifying glass.



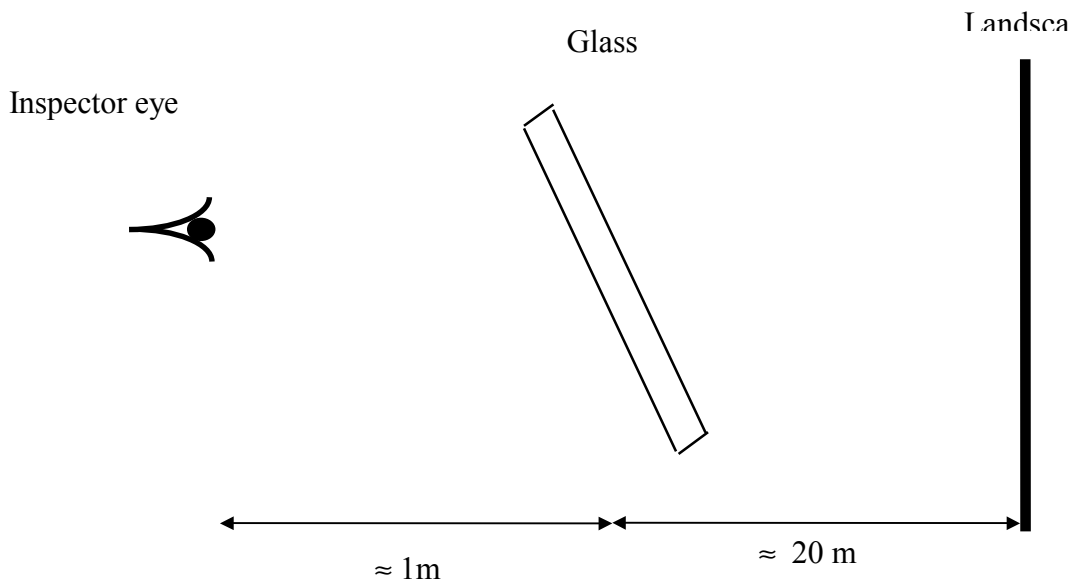
<b>INSPECTION METHODS</b>
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## DIRECT OBSERVATION FACE TO DAYLIGHT

### Sketch



Observation by transmission : Look a landscape (dark and white background) through the transparency

The transparency is inspected in it installed position (rake angle, vision area, rotation...), in dynamic (move the head in order to the eye look through the all area to inspect)

This method is used to check defects which are difficult to measure (smear, mark...)

The inspector eye does not be attracted by a defect

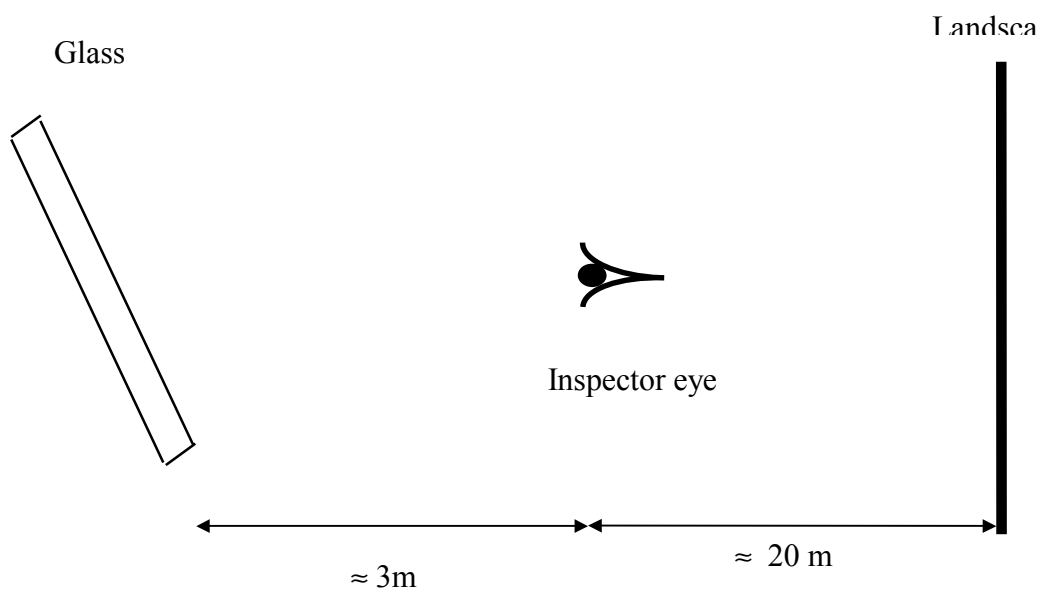
<b>INSPECTION METHODS</b>
<b>GENERAL</b>



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## OUTSIDE OBSERVATION METHOD

### Sketch



Observation by reflection : Look the outside surface of the transparency

The transparency is inspected in his installed position (rake angle, rotation...) by outside

The inspector eye does not be attracted by a defect