Brief description of the manufacturing process.

The manufacture of colour picture tube deflection unit packages uses principally the following raw materials:

- glass screen
- glass cone
- mask flat
- metal inner cone
- electron gun components
- fluorescent powders
- chemicals
- deflection unit

This manufacturing operation comprises the following steps:

- mask forming
- screen processing
- fritting
- gun assembly
- sealing-in and evacuating
- finishing and testing
- matching

Mask forming

The manufacture of the shadow mask is one of the more complicated process steps. Not only does the mask precisely position the electron beams on the fluorescent screen, but it also serves as a negative for use in the UV photo process that applies a three colour fluorescent pattern onto the screen.

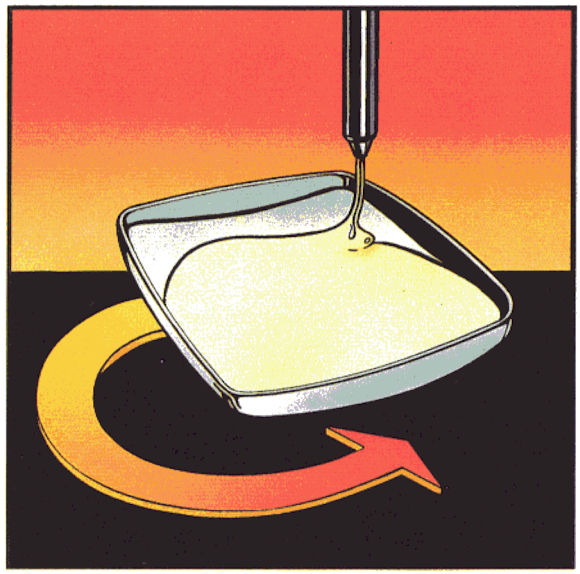
The mask flat is a thin metal plate with a photo etched pattern of slots. It is annealed at about 1000°C, then fashioned into a form similar to that of the glass screen.

The mask ring with its thermal compensating springs is blackened together with the mask by oxidizing the metal surfaces in an oven. The blackening is necessary to reduce the reflection of electrons and also for the removal of heat generated by electron bombardment.

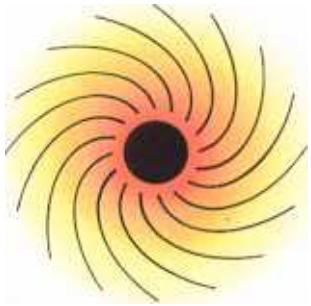
After blackening, the mask is welded to the mask ring so that the distance between mask and screen stays between accurately defined narrow limits when the tube is in operation. The mask ring assembly and the glass screen are then transported to the flowcoating department.

Screen processing

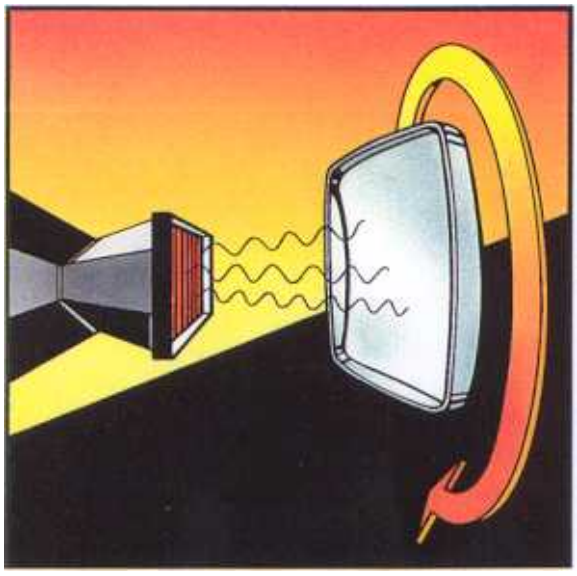
After ultrasonic cleaning of the mask and hydro-fluoric acid washing of the screen glass, a PVA layer is applied to the screen glass to ensure adhesion of the fluorescent layer (pre-coating).
Together with the mask the pre-coated screen glass is transported to the first flow-coating stage, where a measured amount of fluorescent powder in suspension is applied to the screen (1). In the screen 3 fluorescent line patterns have to be produced. Green, blue and red fluorescent material is used. This takes place by photographic exposure and subsequent developing.
First the green powder in suspension is applied to the screen. Centrifugal force turns the fluorescent material into a uniform layer which is then heated to dry it quickly.



1 *Dosing of fluorescent suspension*



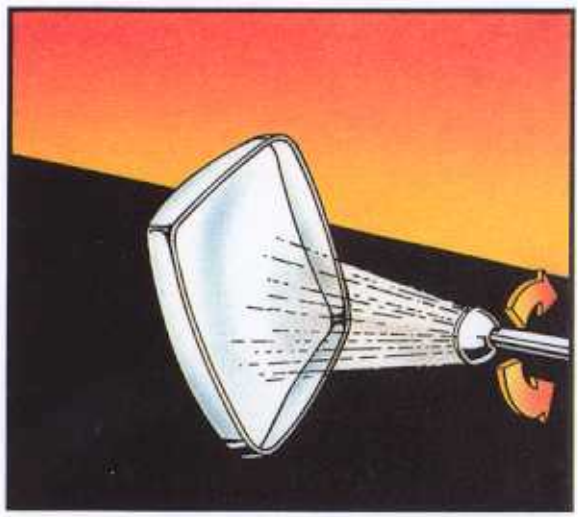
Equalizing of fluorescent layer



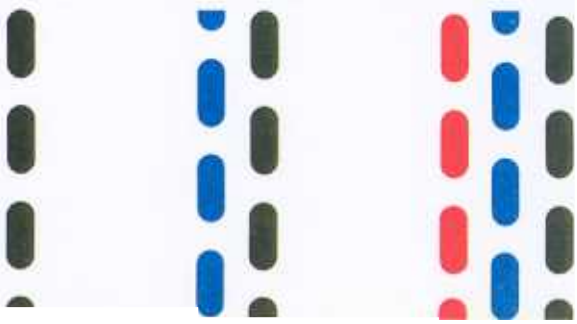
2 *Drying of the fluorescent layer*

The mask is then inserted into the screen (3) and the photo sensitive layer hardened by exposure to UV through the mask slots (4).
After development (5) a pattern of green stripes will remain. This operation is repeated using blue and red fluorescent powder suspensions.
In each case, the UV source will be positioned in the theoretical deflection point of the green, blue and red electron beams.
The end result is a screen of vertical green, blue and red stripes (6).

3&4 *Exposure of the light sensitive fluorescent layer by U.V. light via the holes in the metal mask*

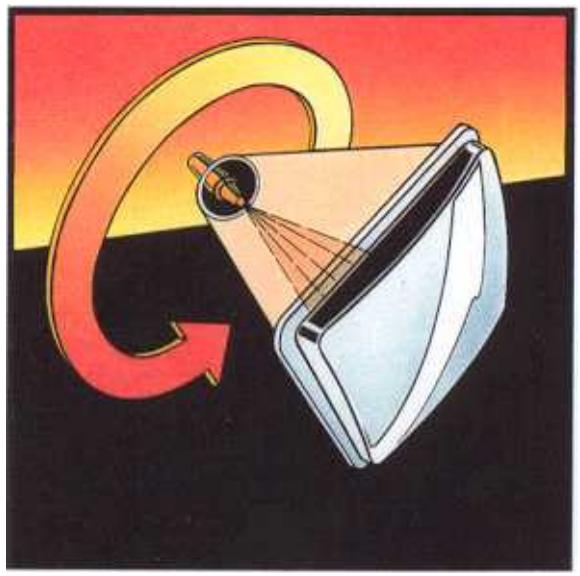


5 *Removal of the not hardened fluorescent material by water sprays*

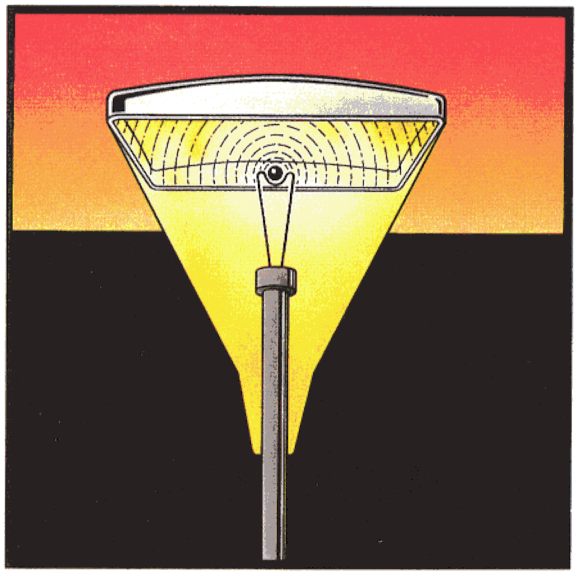


6 *Resulting fluorescent pattern*

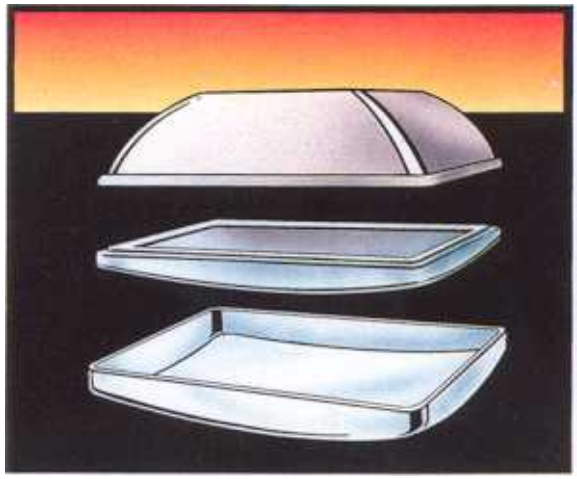
The fluorescent layer is then lacquered and aluminized to reflect light forward through the screen, so maximising the brightness of the picture (7 and 8). This aluminium layer not only acts as a mirror, but also forms part of the anode of the tube.



7 *Application of lacquer layer*

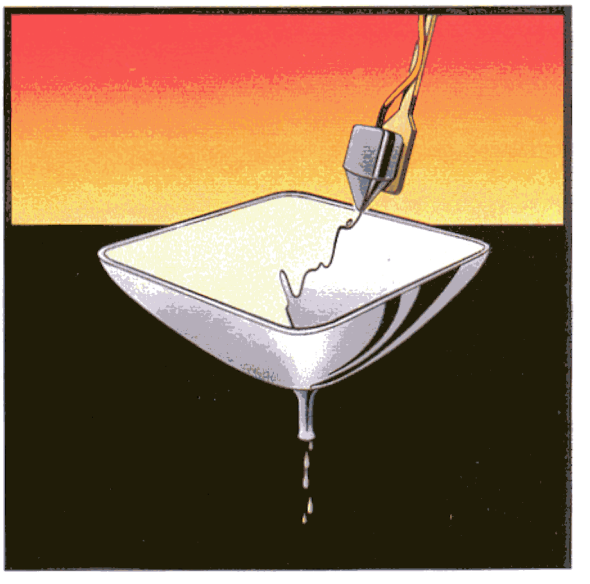


8 *Metalizing of the lacquered layer*

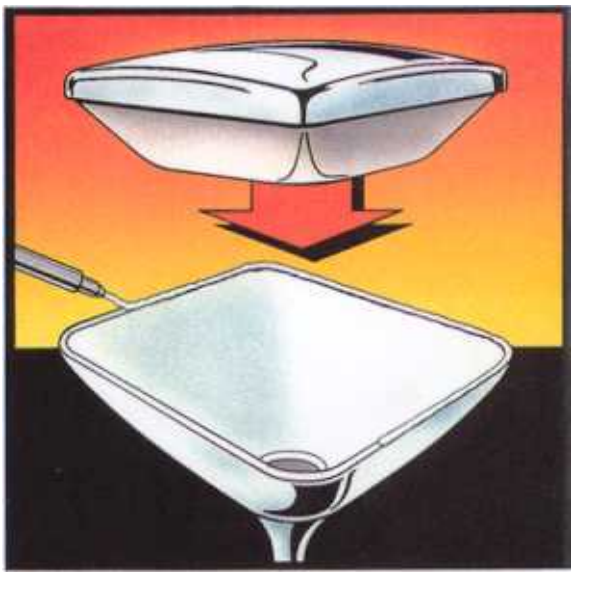


9 *Assembly of screen, mask, and inner cone*

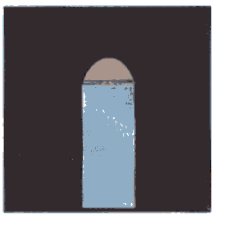
The glass cone must be coated on the inside with a high resistance layer (10) to deminish the effect of tube flash-over on the TV set.
A fillet of lead oxide enamel is now applied to the edge of the coated glass cone, and the complete screen-mask assembly, together with the metal inner cone, which acts as a shield for the earth's magnetic field, is carefully located in it (11). This assembly is then passed-on through a fritting oven with a defined temperature gradient to effect the vacuum seal (12).

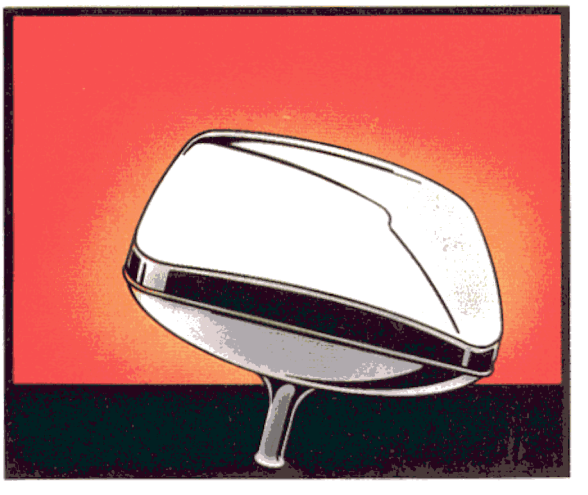


10 *Soft flash coating*



11 *Enamelling*





12 *Fritting*

Gun assembly

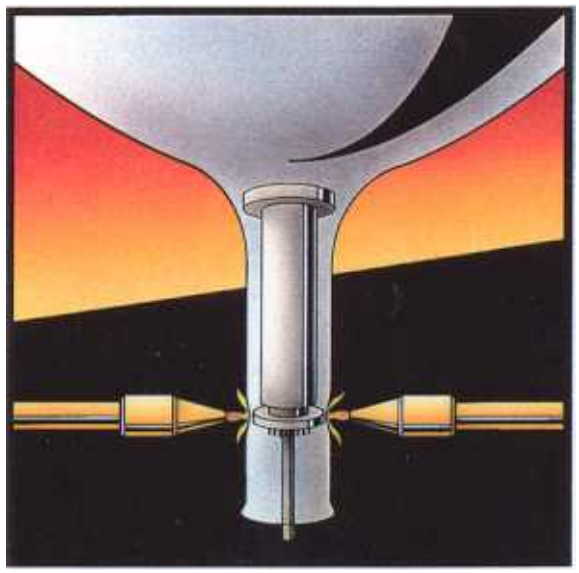
The electron guns are assembled in a dust-free room. This assembly must be accurate since the electron guns, and the shadow mask must be properly aligned to ensure perfect landing of the electron beams on the phosphor pattern.

Sealing-in and evacuating

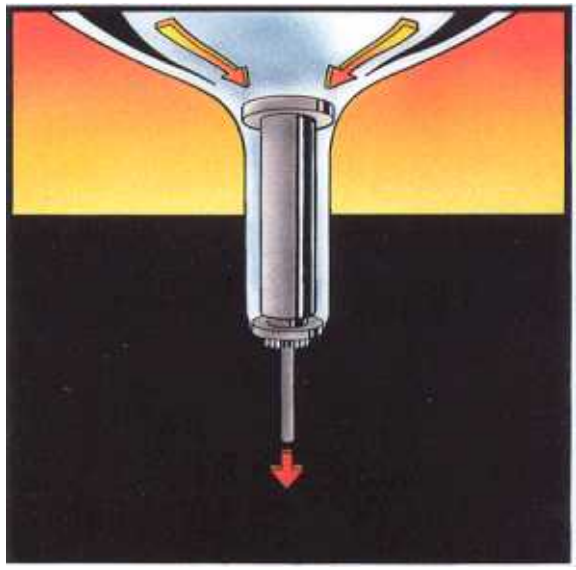
Once the bulb has been formed in the fritting oven and has subsequently been conditioned by filling with a special atmosphere, the integrated electron gun is sealed into its neck (13).
This sealing-in process, is carried out by melting the gun base into the neck with a fine blow torch. It is subject to narrow tolerances on vertical and angular positioning, and excentricity. The sealing-in process requires an accurate warming-up, sealing-in and cooling-cycle in order to assure a vacuum tight, and stress-free joint between neck and gun.
The evacuation of the tube and gun takes place on a continuous pumping line (14).
Air is pumped out via the glass stem protruding from the gun base. This glass stem is then sealed-off after the tube has passed through a defined temperature cycle.

Finishing

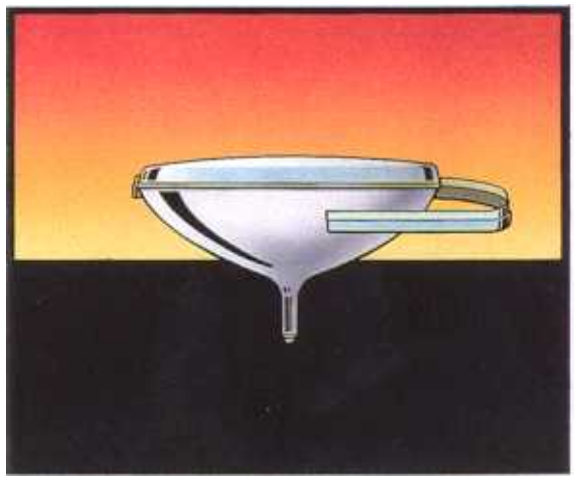
In order to protect the tube against implosion a steel rimband is shrunk around the four sides of the screen.
A getter is then fired inside the tube decreasing the gas level even further thus guaranteeing long tube life.



13 *Sealing-in of the electron gun*



14 *Evacuation of the bulb*



15 *Application of the rimband*

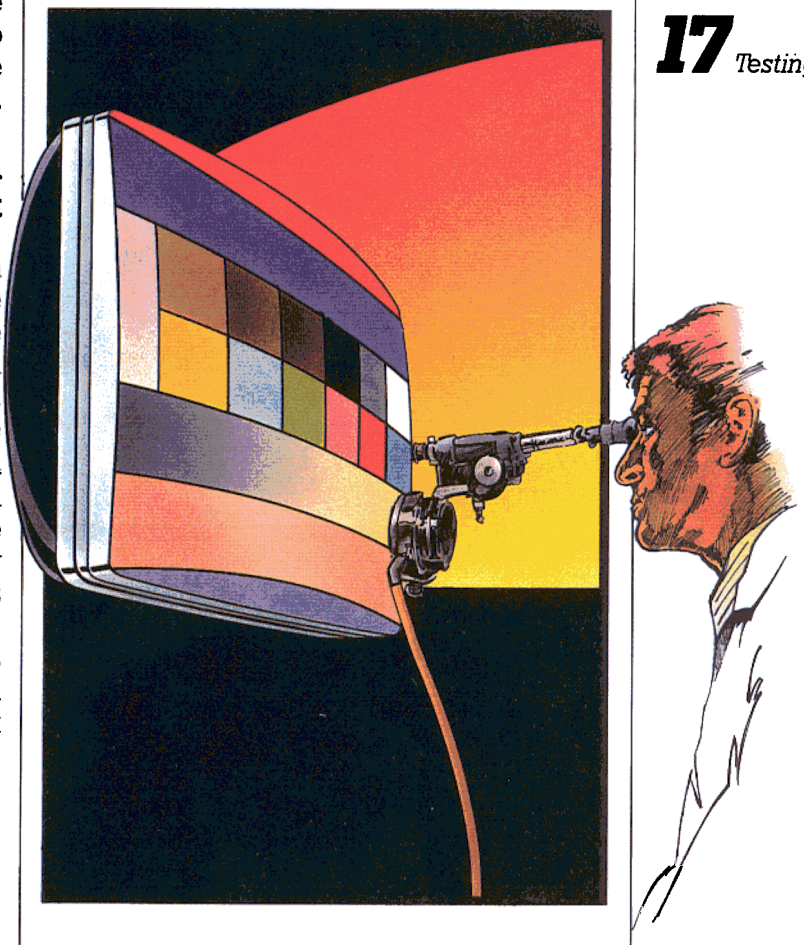
The cathodes are then activated by ageing and the gun grids cleaned by inducing flash-overs between them (15).

The testing of the tube includes visual control of, among other things, colour uniformity, blemishes, colour contamination, loose particles, automatic analysis of various electrical parameters connected with the functioning of the electron gun, measurement of gas pressure in the tube, and of insulation between the various gun components.
After testing the frit-seal for impurities, the outside of the cone is coated with graphite to accurately define its capacitance for use in TV circuits.

Matching of tube and deflection unit

Matching of tube and deflection unit comprises the fixing of the deflection unit to the neck-cone part of the tube so that optimal picture tube quality is achieved.
A matching table allows the position of the deflection unit on the tube to be adjusted in such a way that the landing of the electron beams on their respective phosphor patterns is optimised.
A number of other parameters are controlled, ensuring a high quality tube-deflection unit package.

16 *Outer coating*



17 *Testing*