T-4

TRIP REPORT

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Subject: Frit Techniques
Vendor: Owen Libby, Ford
Vendor
Personnel: Mr. K. Henry
Dr. F. Hodgdon
G. E.
Personnel: H. Evans, Thermionics Lab.
J. Steele CRT Bldg. #6
E. Schilling CRT Bldg. #6

A. General

The frit developed by the vendor is a type of lead borate consisting of:

71% PbO
17% B_2O_3
9% ZnO
3% CuO_3

It is referred to as frit #50 and has a sealing range from 415°C to 440°C. The higher temperatures are preferred as the frit is more fluid.

The frit is matched to the parent glass. The matching, however, results when the parent glass has a coefficient of expansion ten points higher than that of the frit (for example: parent glass 101 x 10^{-6}; frit 90 x 10^{-6}). In addition, contraction of the glass must be taken into account. They have studied the hysteresis loop of various glasses with the same coefficient of expansion and find that the contraction of the glass must be such as to set up the desired stress patterns. Because of this their frit cannot be used on Corning Glass having an expansion coefficent of 101 but can be used on their own.

The chemical stability of the frit is somewhat of a problem. The frit is soluble in water and is attacked by acids. They currently are proposing rubber or plastic gaskets to shield the frit during washing, screening, etc. They did not feel that the frit could withstand continuous washing.

They have run thermal shock tests with the seal. Number 50 frit has withstood 100°F changes.

Two of their assemblies were gun sealed by RCA and placed on life test. At the end of 700- 800 hours, the gas ratio decreased along with cathode emission. An RCA analysis of the cathode image claimed cathode failure not due to gas but due to water vapor in tube. I do not know how this evaluation is possible. The tubes are still on life.

They have reopened one tube three times and resealed it four times. This tube was on display. It is entirely feasible to regrind the facepanel and funnel edges if necessary for resealing. If this is done, however, the hydroxyl group cannot be used as a lubricant for it will attack the frit. Kerosene may be used or the grinding done dry.

The electrical resistance of the frit is reported to be in the neighborhood of 10^{17} ohms.

They also report that neither aluminum or aquadag can be placed on frit as they act as reducing agents. Actual tests have not been made but they feel that the results may be to reduce the number of times reseals can be made with the same frit.

In addition to frit #50 (glass to glass seal) they have developed a frit for glass to metal sealing. They showed us sample studs mounted on facepanels for supporting sandwiches, aperture masks, etc.

B. Bulb Processing

(a) Grinding - must edge grind both facepanel and funnel within ±.005". This operation takes about 3-1/2 minutes on conventional grinding equipment.

(b) Reforming - edge of rim on both facepanel and funnel must be reformed so that alignment of two pieces is within ±.025".

(c) Frit Application - both facepanel and funnel are preheated separately and dipped in molten frit (1600-1700°F) contained in a platinum trough. Care is taken when dipping to avoid air pockets which result in insufficient wetting of the glass surface and non-uniform frit coverage. Frit thickness runs around ten mils. After dipping the edge of the respective panel is pressed against a hot plate 500°F so as to maintain edge flatness within ±.007". They use approximately 1-1/2 oz. per 21" tube. Cost of frit about 18 cents per pound.

(d) Sealing - facepanel and funnel are held together with fixture in oven. The bulb is heated to the frit sealing range, 415-440°C, whence the pumps are turned on. The difference between atmospheric and bulb pressure compress the two parts together forming a seal. The exhaust cycle is completed by normal methods.

(e) Reopening - bulb must be maintained under vacuum. To reopen, raise temperature to 825°F, hold for 15 minutes then release about one pound of air into bulb forcing seal open. A calrod heater is placed next to the seal holding the seal temperature at about 450°C. The funnel is pulled away from the facepanel slowly. The entire bulb is in an oven at 400°C. This may be done instead of forcing air into bulb.

C. Frit Induced Problems

(a) An inert gas must be used to prevent gun oxidation during the exhaust cycle.

(b) Rework of the tube for low emission (that is, deneck, reneck, gun seal, and exhaust) require a different cycling on exhaust.

	Cycle
Tubes for seal, exhaust	temp, pump, seal
Tubes for rework gun	pump, heat

(There seems to be confusion among J. Steele, H. Evans, and myself on this point)

(c) Since frit is attacked by water, acids, gaskets must be used. This may introduce problems where screen application necessitates particular pour off without liquid disturbances.

(d) Special painting and aluminizing to avoid overlapping of frit. Will necessitate also some electrical spring connection across frit.

D. Frit Uses

(a) Facepanel to funnel seals.
(b) Chinese hat to funnel seals.
(c) Gun to neck seal.
(d) Frit seal of metal parts to either funnel or facepanel for alignment or sandwich support. Sample lugs they showed us withstood pulls of 100 - 400 lbs. perpendicular to axis of lug.

E. Vendor Comments

(a) They can put dimples in neck for aligning gun
(b) They could develop frit for gun sealing
(c) They can put anode buttons in facepanel
(d) They think if frit is used the facepanel skirt can be shortened. Problems exist however.
(e) They think that perhaps within a year they can press panels within ±.020". Suck-up two months ago was ±.100 - now ±.035".
(f) They have developed a higher annealing point glass designed to provide flater facepanels.

F. Glass Pans

The vendor felt he could make sample glass pans of either the flat or cylindrical type. They await drawings from us on the cylindrical pan. They propose using a combination of sagging and frit. They see no convient production method outside of pressing. Cylindrical grinding has not been adapted to production techniques as yet.

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