RCA VICTOR DIVISION
RADIO CORPORATION OF AMERICA
STANDARDIZING SEC., ENG. DEPT.
HARRISON, N. J., U.S.A.

SR1g6R

STANDARDIZING NOTICE 34-37-12A

SUBJECT GLASS QUALITY CONTROL TESTS
For Miniature and Midget Tubes

SUPERSEDED DATE 7/29/43

Three different types of glass failures occur in midget and miniature tubes which involve button and seal or seal alone. These are designated as 540V, 540H, and 650. The 540V failure starts vertically between the glass of the bulb and that of the button (Fig. 1). It is caused by shear components in the vertical plane. This crack usually extends around the seal proper for a short distance and then runs into the bulb.

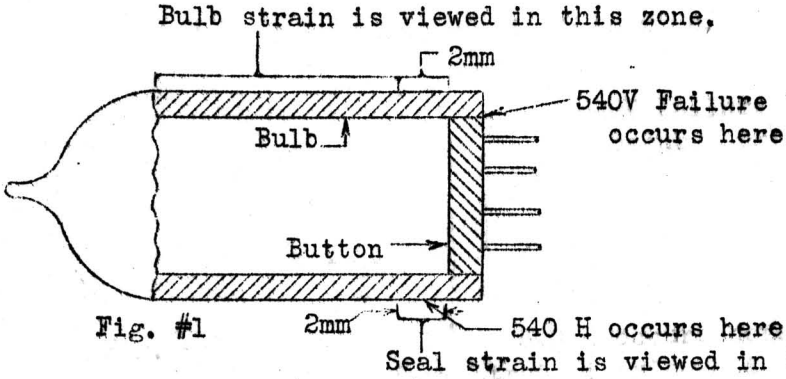


Fig. #1

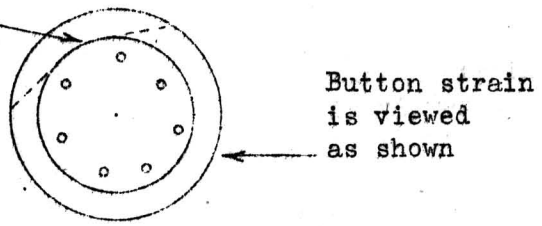


Fig. #2

The 540H failure occurs in a horizontal or nearly horizontal plane in the bulb next to the seal. It is caused by horizontal shear components and extends around glass of bulb never into seal proper.

The 650 failure occurs in the button itself. It may or may not run thru the leads and is caused by mechanical weakness of the button and strain in the button or by the strain alone.

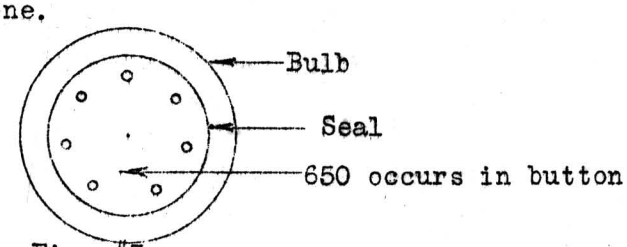
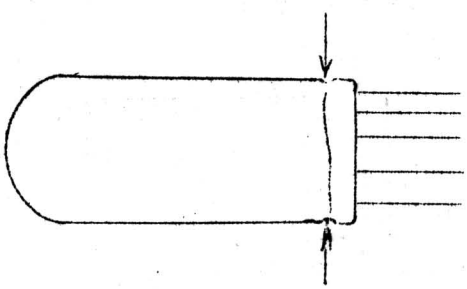


Fig. #3

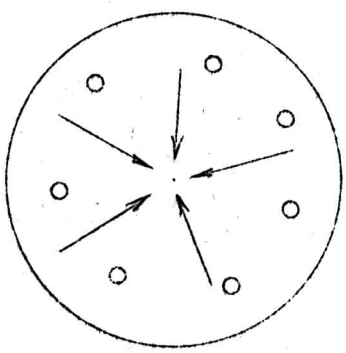
STRAINS

According to polariscopic analysis most of the glass strains in the midgets and miniatures are:

a. Circumferential compression in seal and glass just above seal (Fig. 4),
b. Radial tension or radial compression in button (Fig. 5).
c. Both tension and compression in bulb.



Seal - Circumferential Compression
Fig. 4

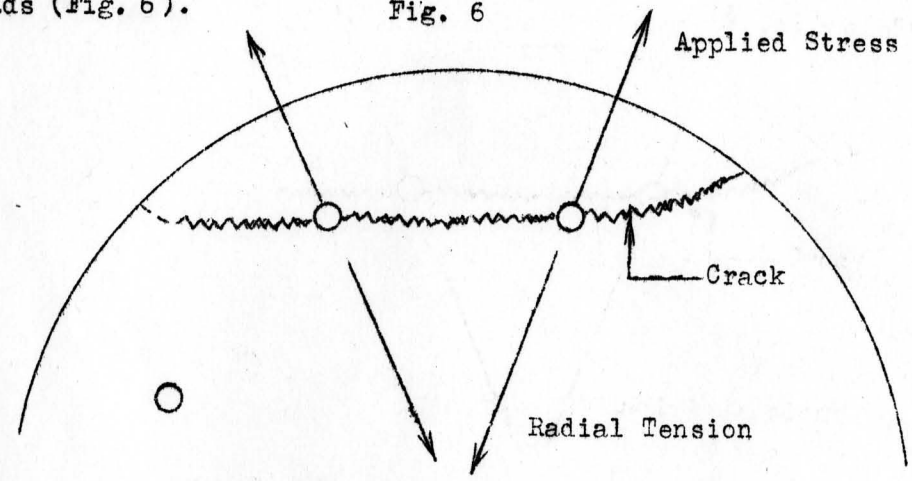


Button Radial Tension
Fig. 5

THE EFFECT OF STRESS APPLIED ON PINS

If a stress is applied to the leads which tends to bend them outward, the tension in the glass button will be increased. Glass is weak in tension and likely to fail under such a stress. The failure may run thru one or more of the leads (Fig. 6).

Fig. 6



There will be an equal but opposite stress at right angles to the radial tension. This tangential compression will be decreased by an outward force on the leads.

If a stress is applied to the leads to bend them inward, exactly the reverse is true. The radial tension will be relieved in the button within the circle of the leads. Outside the circle of the leads, it will be increased. And the tangential compression will also be increased. Now the failure may occur in two ways.

a. A tension failure on the outer edge of the button, which may run around the seal or through the leads (Fig. 7).
b. A compression failure§ at the seal which may run across the button and up into the bulb (Fig. 8).

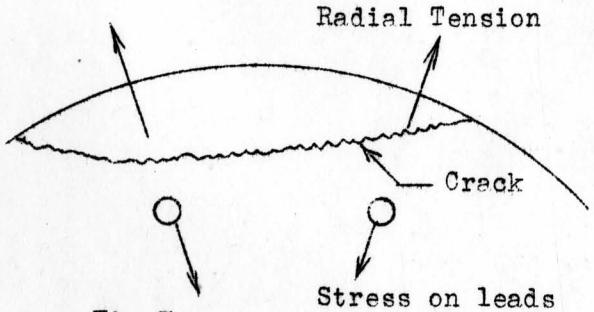


Fig. 7

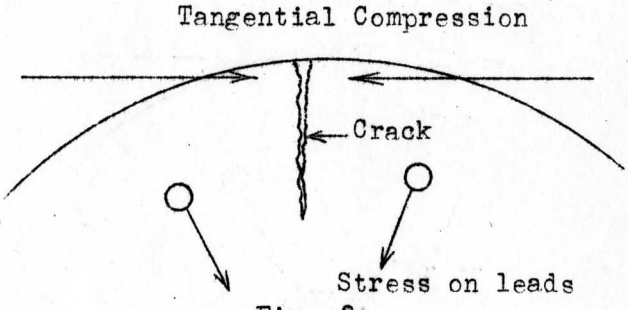


Fig. 8

Most of the failures encountered belong to one of these (3) types.
Cracked tubes returned from the field still have their leads bend outward, or in some cases, inward. This indicates that the sockets in use bend the leads, causing a stress on the glass.

§ Note: Actual failure results from shear since glass is considerably weaker in tension than in compression.

THE EFFECT OF STRESS APPLIED ON PINS

When the button is strained, there is a tendency to shear off the button from the bulb. For instance, a radial tension in the button, such as we may have, will tend to pull the button in at the seal. Any force applied to the leads will also be transmitted through the button to the seal. It will act together with the radial tension to produce a shear such as the resultant in Fig. 9.

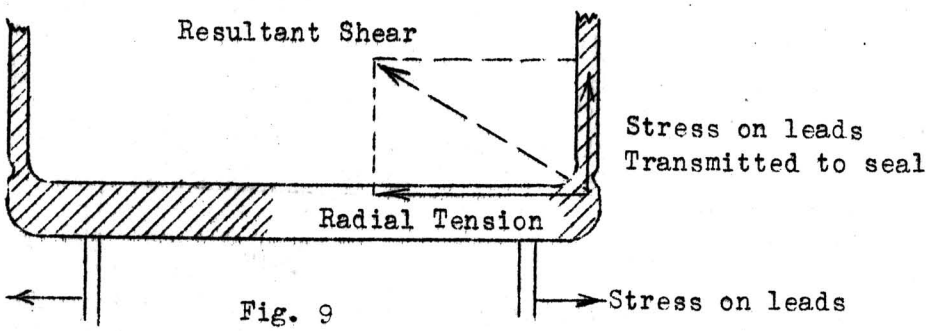


Fig. 9

It is obvious that both seal and button strains act together to produce failures. The actual failure may occur in either member, depending on the location of the largest strain and on mechanical weaknesses.

MECHANICAL WEAKNESSES

Mechanical weaknesses in the seal may come from sealing too cold or too hot, while those in the button may be caused by:

1. Incorrect button thickness
2. Incorrect depth of insertion of leads
3. Stiff leads
4. Low gas content around leads
5. Depressions or lines of air bubbles in the glass
6. Poor shape. Acute or sharp angles at seal between bulb and button.

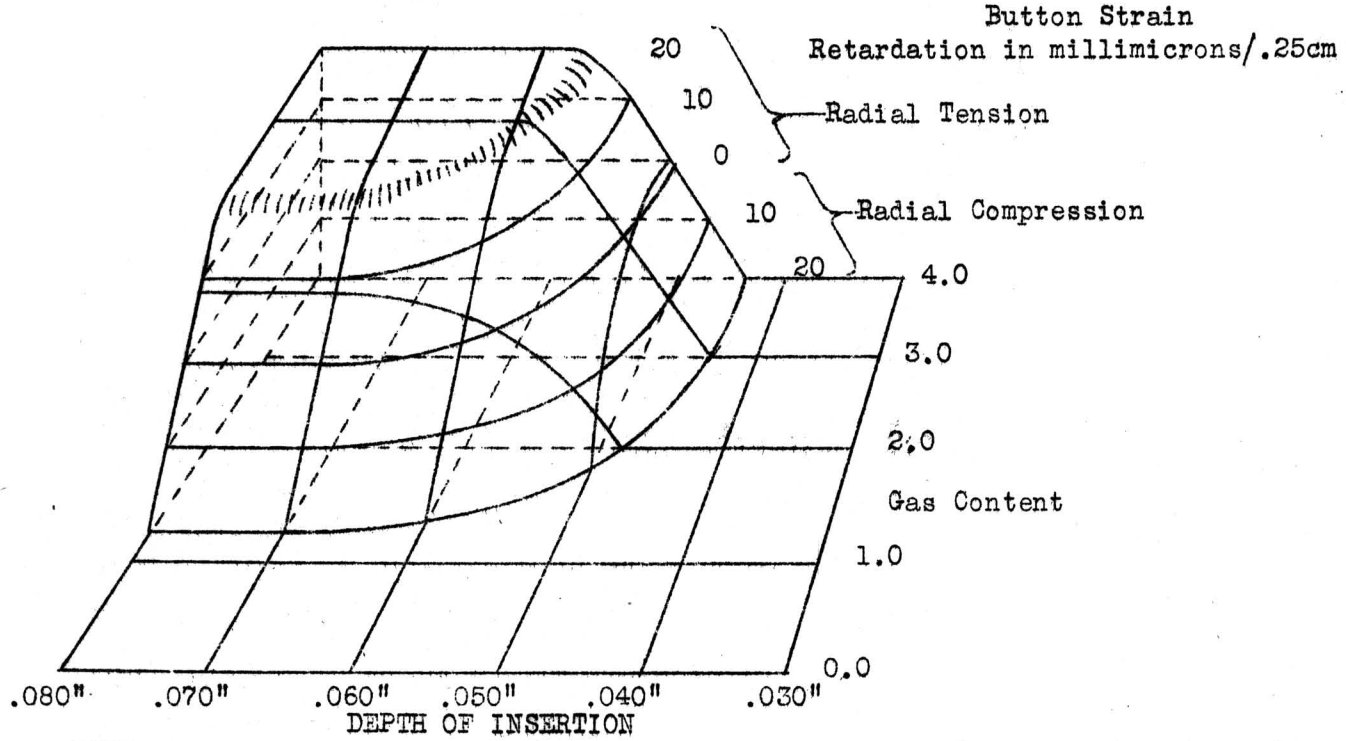
When a lead is bent, the total bending moment is applied directly to the glass button. If the metal of the lead is soft, it will yield and bend at a low applied force. If the metal is stiff, it will yield at a much higher stress. In that case, a much higher bending moment is applied to the glass, and a failure is likely to occur.

When all the strains are within bogie, or when the button strain is within bogie, a failure in the button may be attributed to the mechanical defects in the button.

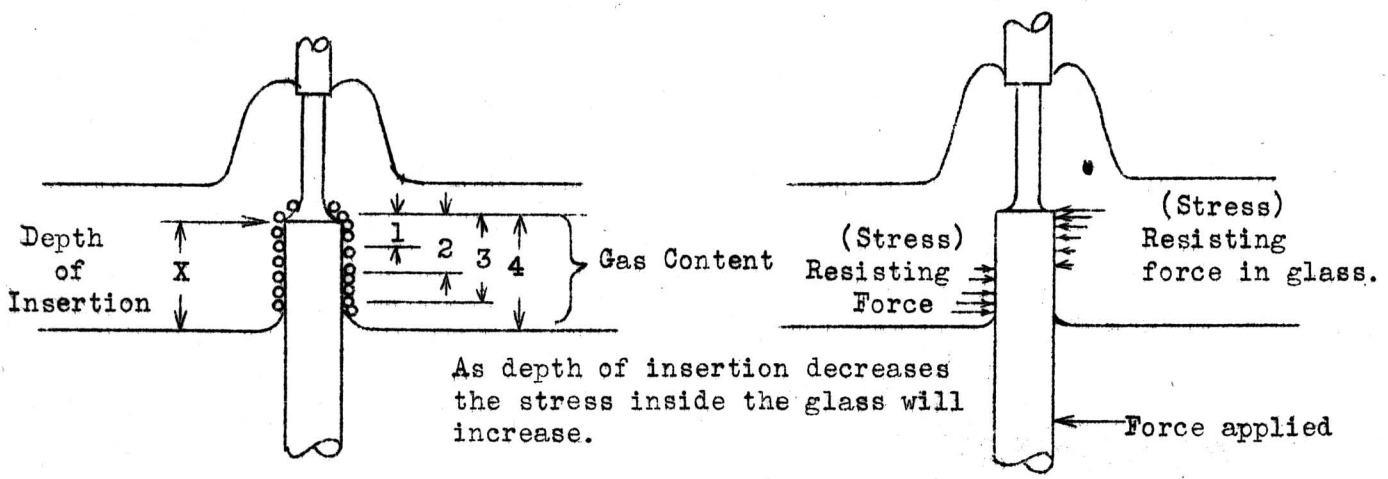
The most desirable strain in the button appears to be one slightly on the radial compression side. Any outward stress on leads will then tend to relieve the strain in the button and the glass will resist an inward stress because it is stronger in compression.

The most desirable strain in the bulb and seal is zero.

Graphical presentation of the approximate relation between button strain, gas content and depth of insertion as it affects mechanical strength.



NOTE: These values are not factory production limits. See other specifications for production control limits.
For satisfactory mechanical strength point should lie within solid shown above.



DESCRIPTION OF TESTS AND PROCEDURE

STRAIN CHECKS

To be made on polariscope Model 863YY or equivalent.

Note; Glass must be at room temperature before checking strain.

a. Button Strain

Button strain is to be measured by cutting off bulb removing mount, and placing plane of button perpendicular to light beam. Color pattern obtained is to be compared with strain standards.

b. Seal Strain

Seal strain is viewed by holding the tube at angle of 45° parallel to reference line in Model #863YY polariscope. Color in the zone approx. 2 mm wide at the juncture between bulb and seal is to be examined. The axis of the tube should be perpendicular to the light beam as shown on page #1, Fig. 1.

c. Bulb Strain

Bulb strain is viewed in a manner similar to seal strain except that the strain in the zone indicated on page 1, Fig. 1 constitutes seal strain.

Frequency of test is shown on page 9 under "CONTROL PROCEDURE".

STRAIN LIMITS

	Rejection Limits		Control Limits for Average of Sample of 3		Control Limits for Range
	Upper	Lower	Upper	Upper	
Button Strain	+0.5	-1.0	0.0	-0.5	1.5 units
Seal "	+0.5	-0.5	None		1.0 "
Bulb "	+0.5	-0.5	None		1.0 "

DESCRIPTION OF TESTS AND PROCEDURE (Cont'd)

To aid operators in glass strain analysis, the following arbitrary strain units have been set up for a polariscope with a tint plate having a retardation of 565 millimicrons as are specified in Polariscope Model 863YY.

Colors	Strain Units		Approx. Retardation millimicrons/cm	Approx. Retardation for Miniature Button Strain .100" = .25cm Thickness
Yellow (greenish tint)	+5	Radial Tension	400	100
Yellow green	+4		320	80
Green	+3		240	60
Blue green	+2		160	40
Blue	+1		80	20
Sensitive Violet	0	Neutral	0	0
Red	-1	Radial Compression	80	20
Orange Red	-2		160	40
Orange	-3		240	60
Yellow Orange	-4		320	80
Yellow (Reddish tint)	-5		400	100

NOTE - The strain standards have been depicted for factory use and their location can be obtained from the Standardizing Section.

Since the variables affecting the color produced by the strained glass are thickness of the glass, kind of glass and retardation (type of tint plate as well as orientation of specimen with respect to tint plate), it can readily be seen that strains of equal magnitude in same type of glass but with different thicknesses will not produce the same color. This is also true of strains of equal magnitude in glass of equal thickness but of different types of glass. Likewise in the case of the retardation plate, a piece of glass with a certain stress and certain thickness will show different colors in different polariscopes. This caused by differences in the retardation plates. The shades of color will not differ greatly when the variation is not more than 5 millimicrons but the difference is noticeable when the variation reaches as much as 15 millimicrons. In addition, the source of illumination will influence the colors seen as will also the efficiency of polarization of the polarizer and analyzer.

DESCRIPTION OF TESTS AND PROCEDURE (Cont'd)

THERMAL SHOCK TESTS

Definitions

1. "Boiling water" must be at a temperature of 97°C to 100°C. At this temperature it is "gently boiling", i.e., small size bubbles rising to surface.

2. "Ice water" must be at a temperature of 0°C to 2°C with a fairly large quantity of ice in it in order to keep the temperature from rising during the test.

3. "Cone". The cones used for the mechanical loading of the pins by uniform deflection of the pins must be made according to RCA Model No. 786-J, Part No. A-92. Badly worn or roughened cones should be replaced.

4. "Container for boiling water and ice water." The container must be sufficiently large that while the test is being made no tube is closer than 1-1/2" to the retaining wall of the vessel. The container must have a minimum capacity of 1 liter. This is to insure an approximately uniform temperature gradient for all tubes in the test.

5. Holders for the testing of individual tubes and stems and supports for the simultaneous testing of several tubes and stems.

   Holders and supports must be officially standardized previous to their employment in routine testing, such as Model 786 and part No. C-93.

"A" Test - (Boiling water without cone)

Place the tube into boiling water so that the bottom half of it is covered by the water and hold for ten seconds. Remove the tube and allow to cool to room temperature on a wooden support. Then examine the glass. Any cracks in the glass constitute a failure of the tube.

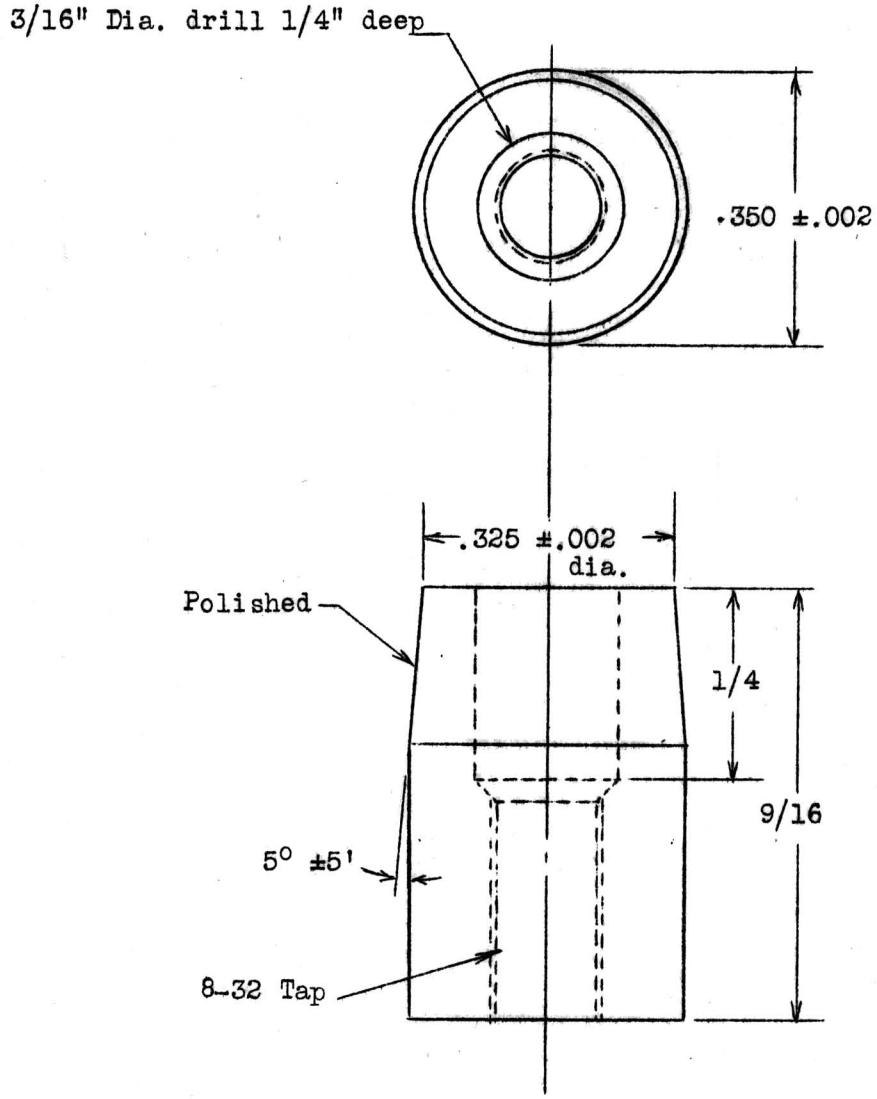
This test is not required and is not to be performed as routine. It can be made, however, on additional tubes of production hour when analysis of excessive failure by test B is necessary to isolate cause of failure.

"B" Test - (Boiling water with cone inserted)

Align the axis of the tube with the axis of the cone. Then carefully push the small end of the cone into the circle formed by the pins until the cone lies firmly against the tube bottom. NOTE: If observation after removal of cones shows some pins bent more than others, test is being made improperly. Place the tube into boiling water so that the bottom half of it is covered by the water, and remove after ten seconds. Allow to cool to room temperature on a wooden support. Examine for failure.

This test is to consist of 32 tubes each hour of production. Two tubes must be taken from each head. When some heads are shut down additional tubes must be taken from other heads to keep sample size at 32 tubes. The purpose of this requirement is to prevent penalizing the manufacturing departments due to small sample size.

BASE PIN DEFLECTION TEST CONE



Model No. 786-J
Part No. A-92
Made of stainless steel 3/8" diam. 5/8" lgth.

ALL DIMENSIONS IN Inches UNLESS OTHERWISE SHOWN
DIMENSIONS SHOWN WITHOUT TOLERANCES ARE NOMINAL
★ INDICATES A CHANGE ★★ INDICATES AN ADDITION SCALE— 4:1

DESCRIPTION OF TESTS AND PROCEDURE (Cont'd)

THERMAL SHOCK TESTS (Cont'd)

Rejection Basis

If more than three (3) failures occur on the "B" test as described above, the sample is to be considered out of limits. Three or less defects are allowable.

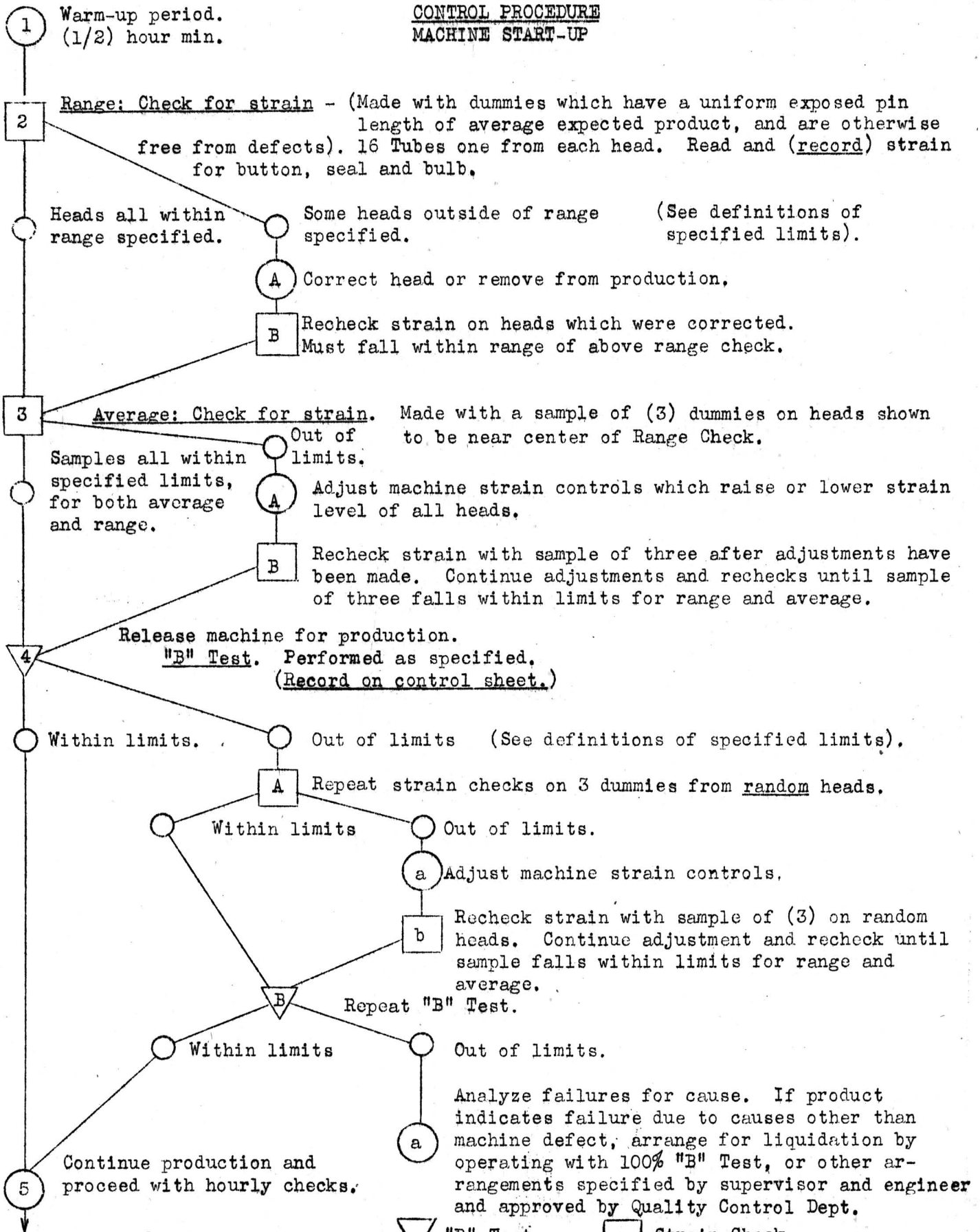
Hour lot rejection is to be made as specified on page 9 under "Control Procedure". "B" tests made on 10% of the previous production lot are considered out of limits when more than 10% of the tubes retested fail.

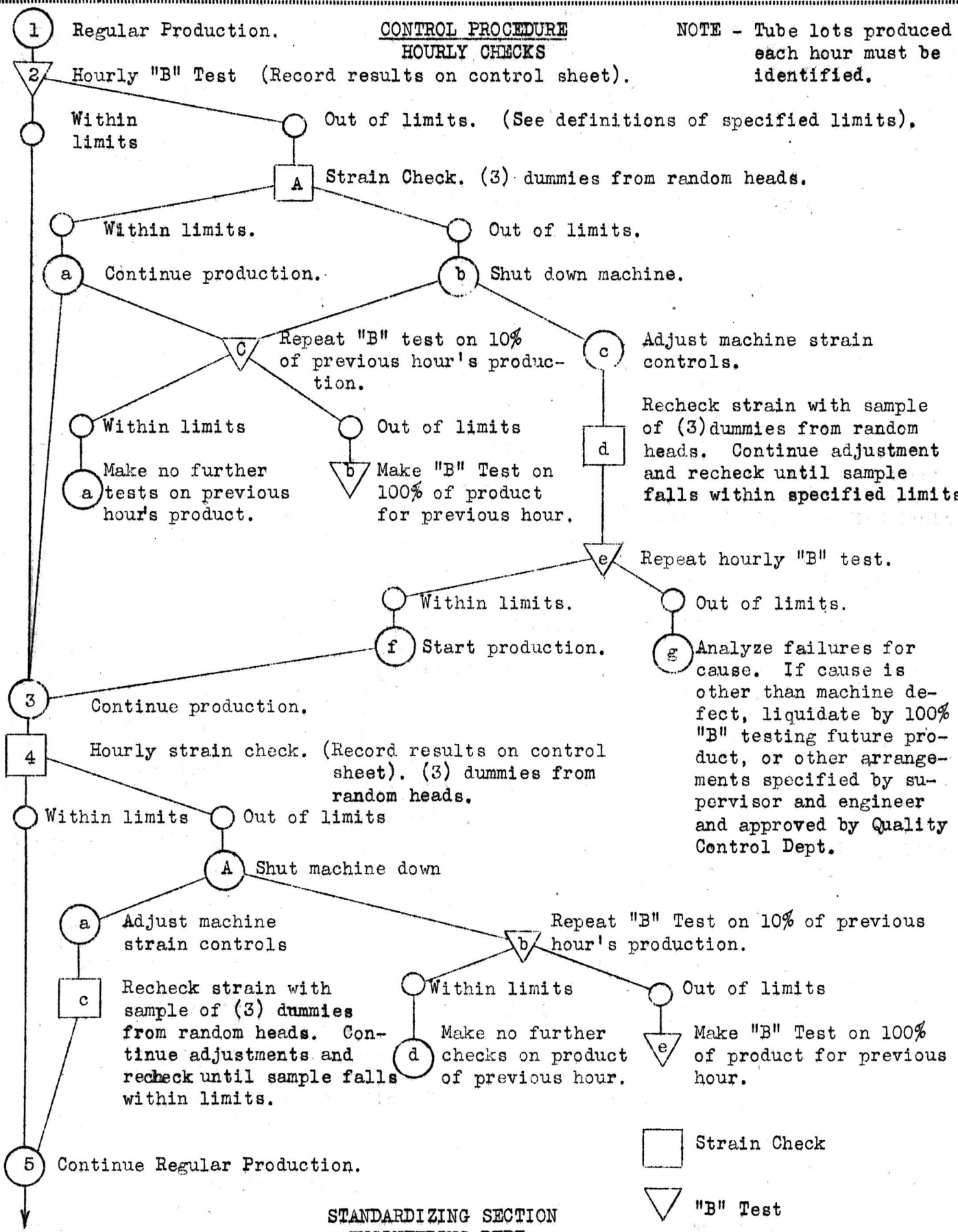
"C" Test - (Ice water to boiling water with cone inserted)

Take the tube (at room temperature) with cone inserted and place it in ice water for ten seconds. The lower half of the tube must be immersed. After ten seconds remove the tube from the ice water and place it immediately in boiling water for ten seconds. Remove tube from boiling water after ten seconds, and allow to cool to room temperature.

This test is to be made on tubes which pass the initial test B, but is made only for information purposes and is not required. The 20% failure criteria is for guidance only since this test is not to be used to restrict shipment.

(CONTINUED ON PAGE 9)


1
Warm-up period. (1/2) hour min.
CONTROL PROCEDURE
MACHINE START-UP
2
Range: Check for strain - (Made with dummies which have a uniform exposed pin length of average expected product, and are otherwise free from defects). 16 Tubes one from each head. Read and (record) strain for button, seal and bulb.
Heads all within range specified.
Some heads outside of range specified.
(See definitions of specified limits).
A
Correct head or remove from production.
B
Recheck strain on heads which were corrected. Must fall within range of above range check.
3
Average: Check for strain. Made with a sample of (3) dummies on heads shown to be near center of Range Check.
Samples all within specified limits, for both average and range.
Out of limits.
A
Adjust machine strain controls which raise or lower strain level of all heads.
B
Recheck strain with sample of three after adjustments have been made. Continue adjustments and rechecks until sample of three falls within limits for range and average.
4
Release machine for production.
"B" Test. Performed as specified.
(Record on control sheet.)
Within limits.
Out of limits (See definitions of specified limits).
A
Repeat strain checks on 3 dummies from random heads.
Within limits
Out of limits.
a
Adjust machine strain controls.
b
Recheck strain with sample of (3) on random heads. Continue adjustment and recheck until sample falls within limits for range and average.
B
Repeat "B" Test.
Within limits
Out of limits.
a
Analyze failures for cause. If product indicates failure due to causes other than machine defect, arrange for liquidation by operating with 100% "B" Test, or other arrangements specified by supervisor and engineer and approved by Quality Control Dept.
5
Continue production and proceed with hourly checks.
"B" Test
Strain Check



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ENGINEERING DEPT.