**Purpose:**

The purpose of this procedure is to describe the process used to stabilize ceramic crystals after polarization.

**Responsibilities:**

Crystal Department engineering / management is responsible for maintaining this procedure.

Crystal Department technicians are responsible for carrying out this procedure.

**Associated Documents: ISO 9001, QAM, QSM, AS9100, CR016**

**Procedure:**

**1.0 General Description and Practice**

This procedure describes the process used to stabilize piezoelectric ceramic sensing elements after poling. Once polarized, ceramic crystals become piezoelectric. One characteristic of polarized ceramic crystals is that the degree of polarization decays slightly over time after the poling voltage is removed. This results in a decrease in capacitance, charge, and voltage sensitivities over time. The aging process is a thermal stabilization process that accelerates this relaxation so that the properties remain stable once the crystals are tested and built into units.

1. **Safety Precautions**

In the following procedure, high temperature ovens are used. Caution and common sense should be used when working with this equipment.

**2.1 Use of Ovens**

When inserting into or removing anything from a oven that is warmer than 100°C (212°F), use a set of gloves or mitts and the appropriate utensils that allow the operator to perform the operation without risk of burns.

**2.2 Handling Polarized Ceramics**

Once ceramic crystals are polarized, they build up charge when subjected to stress (piezoelectricity) or temperature change (pyroelectricity). Even small changes in temperature experienced by crystals sitting on the lab bench can cause charge buildup in the poled crystals. While the amount of charge buildup is small, shorting out the crystals by picking them up with bare fingers will result in an uncomfortable shock. Use tweezers or finger cots when handling crystals after poling. In the aging process, the crystals are buried in steel shot for the oven bake, which shorts out the crystals and prevents charge buildup.

1. **Equipment**

Conditioned SS shot, low temperature

Conditioned SS shot, high temperature

Convection oven, 500°F capability

Cress furnace

SS pans with lids, pre-oxidized

Grease pencil

High temperature pencil

Tweezers

SS screens

**4.0 PZT Aging Procedure**

4.1 The appropriate aging temperature for PZT crystals to be aged is 500°F for at least 48 hours.

NOTE: Occasionally, PZT aging conditions may vary depending on the material properties. The operator should refer to the router for aging conditions. Any changes will be noted on the router by the engineer or leadperson.

4.2 Select the appropriate shot for the aging temperature. Two types of shot are available, low temperature and high temperature. Low temperature shot is used for aging at 500°F, while high temperature shot is used for 900°F aging. Never mix the two types together. (It is acceptable to use the low temperature shot for special PZT aging up to 650°F.)

4.3 Cover the bottom of a SS pan or pyrex dish with appropriate shot. Using tweezers, place a layer of crystals on top of the shot and then place a layer of shot over the crystals and between crystals and dish sides. Repeat as necessary.

4.4 Cover the dish with an appropriate lid, and use a grease pencil or high temperature pencil to label the dish with job number.

4.5 Place the container of crystals and shot into the appropriate oven or furnace for aging. Fill out the appropriate information in the oven / furnace log. Also, make the appropriate entry on the aging status board.

4.6 The 500°F aging ovens are maintained at the appropriate temperatures all the time. The 900°F furnaces need to be started for each aging run after being loaded. It is up to the operator to remove the crystals after 48 hours. For other conditions as specified by the leadperson / engineer, see the engineer for the appropriate oven.

4.7 After the aging run is complete, remove the dish from the oven using tongs and the appropriate insulating gloves. Set the dish on the rack provided on the countertop by the ovens. Allow the dish to cool to the point it can be handled comfortably.

4.8 It is important not to mix the two types of shot together when removing the crystals from the aging dish. Place the SS sieve over the container used to store the particular shot being used, and slowly dump the contents of the aging dish onto the screen. The shot will filter through the screen mesh into the storage container, while the crystals will remain on the screen.

4.9 Using tweezers, place the aged crystals into a plastic petri dish, and label the dish lid with part number and the job number if not already labeled.

4.10 Replace the cover onto the container of shot. Store the pans or dished for future use.

**5.0 BiT Aging Procedure**

5.1 The appropriate aging temperature for BiT crystals is 900°F for at least 48 hours.

Occasionally, aging conditions may vary depending on the material properties. The operator should refer to the router for aging conditions. Any changes will be noted on the router by the engineer or leadperson.

5.2 High Temp. Shot is used to age BiT parts.

5.3 Place a layer of the appropriate shot on the bottom of a pyrex dish or stainless steel pan. Using tweezers place a layer of crystals on top of the shot, Do not let the parts touch each other, and then a layer of shot on top of the crystals. Repeat until the entire job is loaded.

5.4 Use a grease pencil or high temperature pencil to label the dish with job number.

5.5 Place the container of crystals into the appropriate oven or furnace for aging. Fill out the appropriate information in the oven / furnace log. Also, make the appropriate entry on the aging status board.

*5.6 The 900°F furnaces need to be started for each aging run after being loaded. For instructions on how to run the oven refer to the PID Controller User’s Manual page 45 in the section entitled “Running a Profile.” BiT parts are aged using profile 1. For other conditions as specified by the leadperson / engineer, see the engineer or leadperson for the appropriate oven.*

5.8 After the aging run is complete, remove the dish from the oven using tongs and the appropriate insulating gloves. Set the dish or pan on the rack under the ovens, or on the countertop by the ovens. Allow the dish to cool to the point it can be handled comfortably.

5.9 Using tweezers, place the aged crystals into a plastic petri dish, and label the dish lid with the job number if not already labeled.

5.10 Store the dishes for future use.

5.11 Move the job to the next step or location on the router.

**Referenced Documents:**

PID Controller User’s Manual