Stress Relief and Thermal Cycling Requirements for FIRE Opto-Mechanical Components

Drawing: 33-08010
Rev: B

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1 Scope
This document describes the stress relief and thermal cycling heat treatments that are required for 6061-T6 aluminum opto-mechanical components for the FIRE project. The purpose of these treatments is to provide dimensional stability from room temperature to 100K.

2 General Requirements
All components shall be supported to prevent sagging during processing.

3 Stress relief and thermal cycle treatments

3.1 Preparation
Rough machine to within approximately 2.0 mm (0.080") per surface over finish dimensions, unless directed otherwise by the drawing.

3.2 Stress Relief
Stress relieve by heating to 175°C +6/-11°C (350°F +10/-20°F) at a rate not to exceed 3°C (5°F) per minute, hold for 8 hours and then air cool.

3.3 Thermal Cycle
Thermal cycle with heating and cooling rates not to exceed 3°C (5°F) per minute, with each cycle as follows:
- Cool to -190°C +11/-23°C and hold at temperature 30 minutes
- Heat to room temperature and hold 15 minutes
- Heat to 150°C +/-6°C (300°F +/-10°F) and hold at temperature 30 minutes
- Cool to room temperature and hold 15 minutes

The number of thermal cycles to be completed should be specified on each part drawing, with a minimum of two cycles.

3.4 Uphill quench
For optical surface finishes, extreme dimensional stability may be required. In this case, an “uphill quench” procedure may be called out for aluminum optics based on a
procedure developed at NOAO. The uphill quench procedure should be executed as follows:

1. Place part in liquid nitrogen (LN2) bath until it is cooled to LN2 temperature (the surface of the bath will stop boiling vigorously)
2. Remove the part from the LN2 and immediately place in either a steam blast or large container of boiling water. A steam blast at constant high temperature is preferred to maintain the high temperature of the thermal bath. If a boil is used, the liquid volume should be large enough to return the bath quickly to a rapid boil with the part still immersed.
3. Repeat steps 1-2 five times minimum.

3.5 **Finishing**

Finish machine to final drawing dimensions and tolerances.