Progress of Thermocompression Top Seal

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Equipment Progress

- Upper and lower bellows assemblies complete. Both have been installed.
- Modified framework has been complete and has been installed. Complete
- Load balls on order and will arrive Jan. 6 Dec. 21

Future Plans

- Complete installation of hydraulics – Jan. 13 Dec. 22
- Investigate the reduction and removal of the oxide layer on filler material and the substrate coatings.
- Continue to testing of wire Splices. – Jan 20 Jan. 13
- Look at a other coating materials such as: chromium, zirconium, and aluminum – Jan 20 Jan 12
- Start to do the tests in the in vacuum rather than in air. Start tests week of Jan 16 Jan. 13 and go for 2 months.
- New compression plates for 4 inch test pieces – complete Jan . 13 -Jan 30
- Start testing 4 inch test pieces Jan. 20 Feb 1

Items in Green are actual dates

Objectives for 1 inch and 4 inch samples

Nature of the work for 1 inch testing is the feasibility of using a cold compression seal. The 4 inch testing will show feasibility of scaling the 1 inch test results. Which includes:

1. Surface preparations
    1. Coatings for the tie layer Jan 12
    2. Treatment of the tie layer before bonding
2. Fixturing
    1. Upgrade 1 inch tooling as needed
    2. 4 inch fixturing Now complete with heater
3. Seal development
    1. Making a joint in the indium wire – Testing on 1.5 & 2 mm wire
    2. Mold design - Complete
    3. Mold fabrication – Complete Feb. 24
    4. Oven melting of indium – used laboratory hot plate
    5. Casting a seal – First text Feb. 24
4. Recipe development
    1. How low a load pressure is possible – Tests as low as 125 lbs
    2. What is the time factor in holding the load pressure
    3. Vacuum pressure - more an issue for coated samples
    4. Temperature – parts on hand

Test parameters
1 Inch Test Pieces : Glass on Glass

- Load (lbs.)
  - 800, 400, 336, 265, 200, 150, and 125
- Time (seconds)
  - 360, 270, 180, 60, 36, and 6
- Preparations
  - Gasket Preparations
    - Solvent & cloth abrasion, dry abrasion, dry scraping
  - Sample preparations
    - Solvent abrasion, heated solvent and ultrasonics
- Conditions
  - At air, at vacuum
- Gasket Configurations
  - Single, Double, 1.5 wire, 1.75 wire, and spiral
- Wire Diameter
  - 2 mm and 1.5 mm
- Splice
  - Overlap, side-by-side, vertical miter, horizontal miter
- Cast Seal

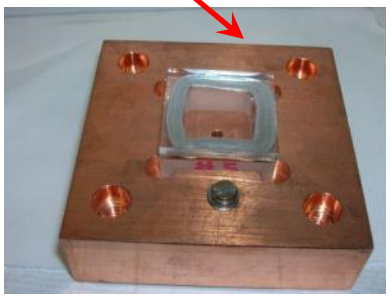
Notes on Results

- The format of the following results is to describe what has been proven to work *Consistently*.
- What is presented in the next slides is based on the 84 tests that were conducted in the January and February time frame.
- Everything that is in the list of 'prescriptions' has been verified by multiple confirming tests. None of these represent single point successes.
- Tests that were successful are those test samples where the leakage on the Alcatel leak detector was unmeasureable on the lowest scale. For this unit it was 1×10^{-10} mbar-liter/sec of helium.
- The following is a list of prescriptions for the different arrangements and what were the conditions that it required to get repeatable leak tight parts.

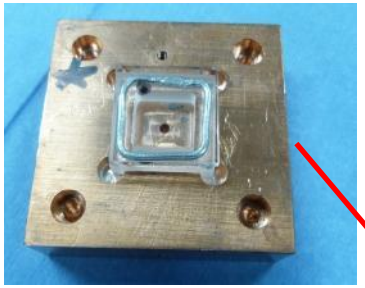
Results
1 Inch Test Pieces : Glass on Glass

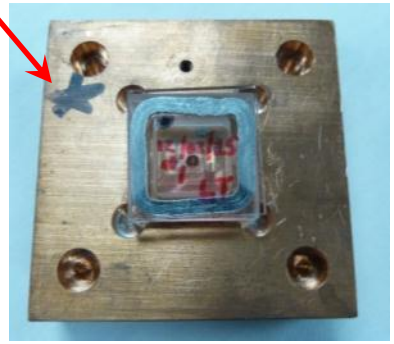
- Prescriptions
  - Dual 1.5 mm
    - 265 lbs. load for 360 seconds
    - 400 lbs. for 360 seconds in vacuum (only one load point tested)
  - Single 2 mm horizontal splice
    - 150 lbs. for 180 seconds with a horizontal splice in air
  - Cast Seal
    - 265 lbs. load for 180 seconds
  - Single 1.5 mm
    - 400 lbs. load for 360 seconds with a vertical splice
    - Promising result of 150 lbs. for 180 seconds with horizontal splice

Dual 1.5 mm

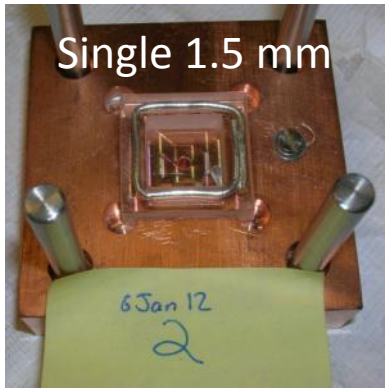


Single 2 mm

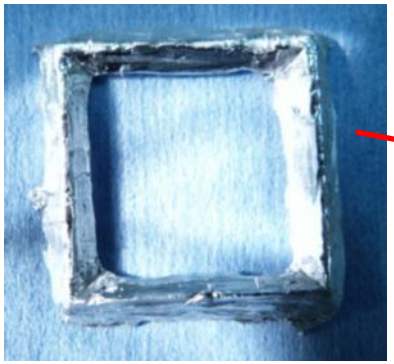


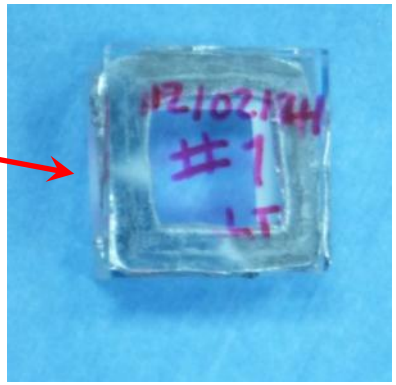


Single 1.5 mm



Cast Seal





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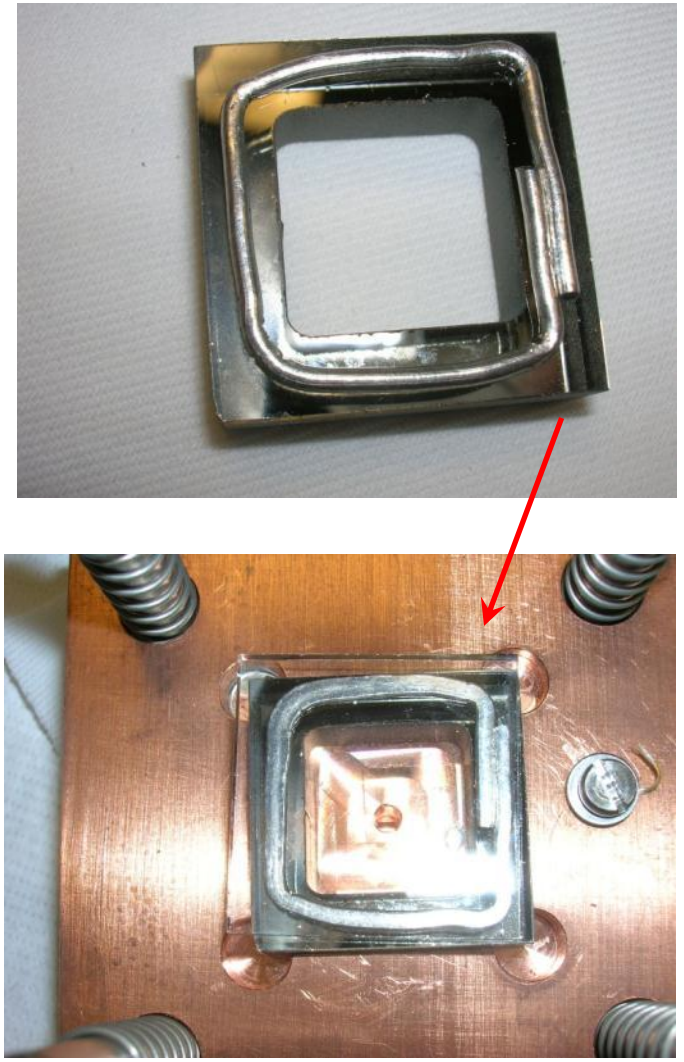
Results
1 Inch Test Pieces
Coated Samples

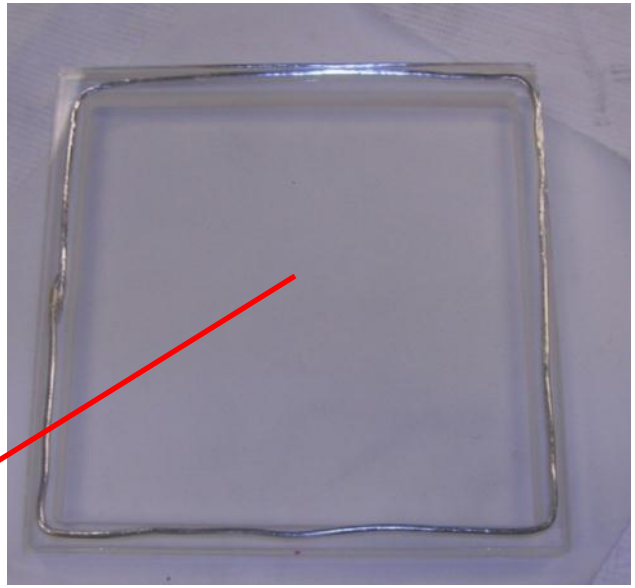
- Prescriptions
  - Aluminum
    - This has only recently begun work
    - 400 lbs. load for 36 seconds in air has been successful 4 of 7 with single 1.5 mm gasket
    - 400 lbs. load for 36 seconds in vacuum has not been successful with single 1.5 mm gasket
    - Aluminum has not been tested with dual, 2 mm. or cast gaskets yet.
  - Nichrome
    - This has only recently begun work
    - 400 lbs. load for 36 seconds in air has been successful 3 of 6 with single 1.5 mm gasket
    - 400 lbs. load for 36 seconds in vacuum has been successful 2 of 3 with single 1.5 mm gasket
    - Nichrome has not been tested with dual, 2 mm. or cast gaskets yet.

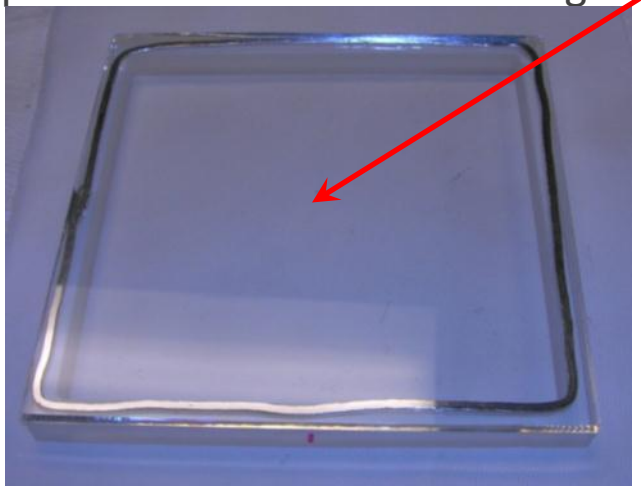
Nichrome



Results
4 Inch Test Pieces
Glass on Glass

- Early tests were performed at 1,600 lbs. before it was know that the load could be lowered. All those test piece broke as the steps in the test tooling was re-surfaced in the machine shop.
- It is now logical to start testing at a load range of 600 to 1000 lbs. in future tests.
  - Last test at 800 lbs.
- The test tooling is now fitted with a electrical heater. Theoretically higher temperatures can be used leading to even smaller loads.





Next Series of Tests

- 1 inch Coated Samples
  - When the first coated samples were done the gasket configurations, loading, and splices were very simple and a lot has been learned since then.
  - Focused tests on the 2 mm and the cast seal will be pursued first. There will not be a need to go through a bunch of preliminary tests as that work has been completed on uncoated glass.
    - To do these tests more 1 inch test parts will be needed.
    - Currently 2 mm indium wire is being ordered.
- Elevated Temperature Tests
  - This is an area where it is theoretically possible to further reduce the load by increasing the temperature.
  - The heater for this has been mounted onto the back of the tooling so that it is possible to heat the parts in the press.
- Vacuum Tests
  - Test will continue in this area. This is especially important with the coated samples.
- 4 inch tests
  - The approach will be to use the 1 inch results and scale it to the 4 inch test pieces.
  - More 4 inch glass test pieces are on order and are expected soon.
  - The heater will also be usable for the 4 inch test pieces which will be included in the next series of tests.

8 inch test

- System
  - The existing chamber will not accept a full 8 inch tile.
  - A simple and inexpensive sheet metal mock shell can take it place.
  - Tests will be performed in air
- Hydraulics
  - As seen from current results the load required for an 8 inch time might lie in the range of 1,200 to 2,000 lbs.
  - The frame is designed for loads as high as 3,500 lbs.
- Testing
  - Testing will focus on the size issues related from going from 4 inch to 8 inch.
  - Tests can be extended to add heating to the press tooling.
  - Sealing under an inert gas is another possible extension of this test by adding a gas curtain.

Re use of the Compression Components on the Single Tile Process System