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	SPECIFICATION	Drawing No Rev. Group
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Material, Process, Handling and Shipping Specification for Fluorel Parts		

APPROVALS	DATE
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1 OBJECTIVES AND SCOPE

This specification covers aspects important to the fabrication, cleaning, handling, identification, documentation, and shipping of Fluorel (fluoro-elastomer) rubber parts produced for installation within the LIGO vacuum systems.

2 PRECEDENCE

In the event of conflict, the order of precedence is

1. The Purchase Order
2. The Drawing
3. This Specification
4. Any Referenced Specification

3 GENERAL NOTES

Because of extremely tight requirements on outgassing and hydrocarbon pollution in the vacuum system, the molded Fluorel parts for in-vacuum installation must be kept extremely clean throughout the fabrication process. These tight cleanliness requirements apply to every step of the fabrication process, from preparation of the compound to final packaging.

All requirements listed in this document are judged essential. No substitutions of material types or brand names, or changes or additions to this specification are allowed unless explicitly approved by Caltech.

Note that sources for approved cleanroom sheeting material/bag and Latex gloves are listed in Appendix A.

4 MATERIAL


The part shall be molded from the following compound. The formulation was selected based on the ultra-high vacuum application and the need to minimize potential for outgassing; it was suggested by Dyneon. Any changes to the formulation below must be approved in writing by Caltech. This formulation will result in a Shore A 75 durometer material.

- * 100 parts, Fluorel FC2180 (or FE5641Q)
- * 30 parts, MT Black (N990)
- * 3 parts, Maglite (MgO)
- * 6 parts, Ca(OH)₂
- * 3 parts, CaO
- * absolutely no mold release agent allowed mixed into the formulation
- * any other additive - even in minute quantities - is subject to prior approval

Special care should be taken to insure that compound preparation is performed in a clean mixing environment. Cleaning the mixing machines with solvents and/or running a small amount of the same compound for scrap prior to preparation of the compound to be used for parts are acceptable techniques.

5 MOLDING

Because of the need to keep parts as clean as possible throughout production, the use of mold release agent(s) of any kind should be avoided if at all possible. If a mold release is absolutely necessary, a water soluble type may be put onto the surface of the mold. Parts should be kept clean at all times after they come out of the mold: they should be

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handled with clean tools, or by gloved hands (wearing clean, new gloves) and stored only on clean work areas (cleanroom sheeting material/bag or new UHV grade aluminum foil; see Appendix A)). Contamination by oils, grease, solvents, and other hydrocarbons must absolutely be avoided.

6 CLEANING AND FLASH REMOVAL

Mold design should be such that flash is minimized. Mold design shall be submitted to Caltech for approval prior to production (flash location in particular).

After removal from the mold and cool down:

1. cut off any burrs with clean scissors or a clean, sharp blade. Absolutely no abrasive removal allowed. Operator must wear clean Latex gloves.
2. wash part with deionized water and nylon scrub brush (operator must wear clean Latex gloves).
3. let dry in air at room temperature on a cleanroom sheeting material (aluminum foil not allowed for this operation), in a clean area.
4. store wrapped in cleanroom sheeting material/bag or new UHV grade aluminum foil if awaiting further processing.

7 POST CURE

The post cure is as follows; any deviation must be approved by Caltech:

1. ramp or step (25°F steps, 2 hrs each) from 175°F to 450°F in 24 hours.
2. bake at 450°F for 24 hrs.
3. cool
4. store wrapped in cleanroom sheeting material/bag or new UHV quality aluminum foil if awaiting further processing.

8 VACUUM BAKE

Note: The vacuum bake will be performed by Caltech, not the fabricator.

A vacuum bake is the last operation. It is intended to remove the last traces of outgassing materials.

1. Ramp up from room temperature to 182°C (360°F) at a rate not to exceed 2.5°C/min (4.5°F/min).
2. Maintain 182°C (360°F) +/- 1°C (2°F) and a vacuum pressure not to exceed 10^{-6} torr for 48 hours.
3. Cool down in vacuum at rate not to exceed 3°C/min (5°F/min). Handling of parts out of the vacuum oven is particularly critical. It should be performed with clean tools and/or gloved hands (Latex gloves only). Gloves must be changed for new ones, should operators touch anything other than the parts or the packaging material.
4. After cool down, perform an Residual Gas Assay (RGA) measurement (per LIGO-E960022). RGA test results shall indicate an outgassing rate (for AMU components 41, 43, 53, 55 and 57) of 2×10^{-12} torr-liters/cm²/s requirement. If necessary based on RGA test results, re-bake for an additional 24 hours, and repeat the RGA analysis; repeat this last step until satisfactory RGA results are achieved.

9 PACKAGING, IDENTIFICATION, AND SHIPPING

Handling of the parts after vacuum bake is particularly critical. All handling shall be done wearing new, clean Latex gloves. The operators' gloved hands cannot come in contact with anything but the cleaned parts, any required tool (also cleaned), or approved packaging material (cleanroom sheeting material/bag or UHV quality aluminum foil). Gloves shall be changed if they come in contact with any other object.

Immediately after removing parts from the post cure oven and vacuum bake chamber, they shall be wrapped individually in cleanroom sheeting material/bags or UHV quality Aluminum foil. Wrappers or bags may be sealed with a twist tie.

Each part shall be uniquely identified with a serial number (SN) applied on its wrapper. The wrapped or bagged parts shall then be double wrapped in a second bag or wrapper, in convenient quantities. The outer wrapper or bag may be sealed with tape (taking care to insure no contact between the tape and the part) or a twist tie.



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Each batch/shipment shall be accompanied by travelers identifying the production date, SN range, and any particularities of fabrication. The traveler will also identify the complete history of that batch, including operator signatures, dates, and notes for each processing step.

10 APPENDIX A. REQUIRED MATERIALS

10.1 Clean room sheeting or bags

Description	Vendor
Static control bags cleaned/assembled in Class 100 environment WITH ZIPPERS	Seco Industries/Gramatech 6909 E Washington Blvd Montebello, CA 90649-5425 (373) 726-9721 Sales@Seco-Ind.com

10.2 UHV (Ultra-High Vacuum) gloves

Description	Vendor
Ansell AccuTech Ultra-Clean latex gloves Sizes 6 ½, 7, 7 ½, 8, 8 ½, 9 Part# 91-300	VWR Grainger Magid Glove & Safety Co.
CT International SGPF Series, Class 100 latex gloves	CT International 4340 Old Santa Fe Road. San Luis Obispo, CA 93401. 800.755.7575 fax 805.544.5796

10.3 UHV (Ultra-High Vacuum) Quality Aluminum Foil

Description	Vendor
Part # ASTM B 479 0.015" x 24" x 500' and 0.015" x 48" x 500' UHV Certified Aluminum Foil	All Foil 4597 Van Epps Road Brooklyn Heights, Ohio 44131 (216)661-0211 Voice (216)398-4161 Fax