



*LIGO Laboratory / LIGO Scientific Collaboration*

LIGO-T080098-01-K *Advanced LIGO UK*

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**UK Glass masses FDR overview document**

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Distribution of this document:  
Inform aligo\_sus, review documentation

This is an internal working note  
of the Advanced LIGO Project, prepared by members of the UK team.

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# 1 Purpose of this document

Due to procurement timescales it is necessary to complete an FDR and PRR for the “UK Glass Masses of the Quad suspensions”. This document contains some overview information, sources for requirements and other notes.

## 1.1 Scope

The UK team is charged with the procurement of:-

- ETM penultimate mass (ETM-PM) to a proposed quantity of 8 (eight) including delivered spares
- ITM penultimate mass (ITM-PM) to a proposed quantity of 8 (eight) including delivered spares
- ETM suspension end reaction mass (ERM) to a proposed quantity of 8 (eight) including delivered spares.

In each case the quantity required for three working interferometers is six, and two spares are proposed. It may be noted that ETM-PM and ITM-PM should be identical apart from name and part/serial numbers.

In the case of ETM-PM and ITM-PM the scope includes the provision of flat bonding surfaces for the attachment of ears, but as the ear design is not final, the ears are not required to be reviewed at this time.

In the case of the ERM the scope includes provision for suitably polished surfaces to permit any required optical coatings to be applied, and also to permit a gold electrostatic drive (ESD) pattern to be applied.

The ESD pattern and AR coatings on the ERM are not part of the UK scope. At this stage the technical requirements may be established, but procurement of coatings will require to be looked at later.

Outline procedures for packing, shipping and handling are within the scope of the present review as these will be required at the point of procurement.

## 1.2 Documents for Review

### ERM

<b>D080116</b>	<b>ALIGO SUS ETM QUAD End Reaction Mass (ERM)</b>
<b>E080089</b>	<b>ALIGO SUS ETM QUAD End Reaction Mass (ERM) component specification</b>

Key features described by support notes in LIGO-T080048-03-K

### ETM-PM

<b>D080117</b>	<b>ALIGO SUS ETM QUAD Penultimate Mass</b>
<b>E080090</b>	<b>ALIGO SUS ETM QUAD Penultimate Mass component specification</b>

Key features described by support notes in LIGO-T080047-02-K.

**ITM-PM**

<b>D080128</b>	<b>ALIGO SUS ITM QUAD Penultimate Mass</b>
<b>E080112</b>	<b>ALIGO SUS ITM QUAD Penultimate Mass component specification</b>

Key features described by support notes in LIGO-T080047-02-K (remembering that ETM-PM and ITM-PM should be identical apart from name and part/serial numbers)

**1.3 Recent issues affecting the design of the masses: ERM**

- new optical requirements [RODA M080042-00]. There are new requirements for bubble class and homogeneity of the ERM material, and transmitted wavefront quality (or surface figure) for the ERM finishing. These requirements are incorporated. This restricts the range of materials allowed. This is a change from the design of the Noise Prototype ERM.
- change from “heavy glass” to silica. This results in a suspension design equivalent to that for the compensator plate (CP) of the ITM. This is a change from the design of the Noise Prototype ERM. See T060283-02-R. This change was proposed in order to maintain “commonality” between ERM and CP, as noted in T060283-02-R, i.e. to make those suspensions similar. Suspension parameters were checked at that time. Note that the ESD provides a force, and the operation as a reaction mass for the last stage is not affected.
- no bonding flats. The “break-off prisms” are to be bonded (nominally with vacseal) to the cylindrical barrel surface. [Compare CP design] This is a change from the design of Noise Prototype ERM.
- minor revisions (dimensions of small features) see drawing revisions and accompanying notes. Note that some tolerances have been improved based on experience with production of Noise Prototype.

**1.4 Recent issues affecting the design of the masses: PM**

PM (both types): no major changes, only details. See drawing revisions and accompanying notes. Note that some tolerances have been amended based on experience with production of the Noise Prototypes.

**1.5 Key points: ERM**

Mass and dimensions (note that CP design makes a good point of comparison). Re-confirm zero wedge.

Material choice and surface quality (a mixture of COC requirements and previously given standard finishes).

Minor features (recesses for mirror stops, 2 wire locating grooves around the full barrel, reference lines used during bonding and alignment).

Detailed physical inspection specified to maximise information available to LIGO scientists for the prism bonding process.

## 1.6 Key points: PM (both)

Mass and dimensions. Dimensions of flats. Note that the ETM/ITM optics design makes a good point of comparison (see e.g. D040431-C ETM Silica Test Mass).

Material choice (compatibility with silicate bonding, familiar material). Surface quality of flats (bonding flatness and polish). Surface quality in general.

Minor features (the recesses for the 4 “actuator magnet assemblies”, 2 wire locating grooves around the full barrel, reference lines used during bonding and alignment).

Detailed physical inspection specified to maximise information available to LIGO scientists for the ear/prism bonding process.

## 1.7 Packing, shipping and handling

The procedures and materials are to follow those set out for the LASTI test mass in E070070-00. Drawings of the mirror containers will be produced in due course.

## 1.8 Main References (see also notes in review documents)

LIGO-T010007-03	Cavity Optics Suspension Subsystem Design Requirements Document
T010103-05-D	Advanced LIGO Suspension System Conceptual Design
T050095-00-R	Response to Advanced LIGO Suspensions Subsystem (SUS) Design Requirements Review report L010161-00-D
LIGO-T050215-02-K	Monolithic Stage Conceptual Design or Advanced LIGO ETM/ITM
LIGO- T050245-00-R	Advanced LIGO Suspension Ribbon/Fiber/Ear/Bonding Preliminary Design Review Report
M080042-00	RODA : Transmission requirements for ETM and ERM
D040431-C	ETM Silica Test Mass
D060534-B	CP drawing
T060283-02-R	ETM and ITM reaction chain analysis/proposal.