Design Specifications for the OMC Suspension

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Further updated with comments for review 31 Aug 2007 DCC#: T070189-01-R

Further updated for FDR Feb 2009 by NAR (*updates in italics*) T070189-v1

Further updated by NAR Feb 7th 2014, updates in red. T070189-v3

Note I am calling this v3 as there is confusion in numbering on the DCC between v1 and v2.

Property	**Value or Description**	**Comment**	**Comments added for 2nd prototype readiness review Aug/ Sept 2007** ***Further comments Feb 2009***
Baseplate Dimensions	450 mm x 150 mm x 40 mm	Baseplate only	Actual silica bench (aka baseplate) 450 mm x 150 mm x 39 mm aLIGO size 450mm x 150mm x 41.275 mm (D1200105)
Payload Mass	6.0 kg *Current design has mass ~ 6.9 kg* ALIGO Target 7.0 kg (ref L0900064, pg 3)	Baseplate plus components	Design allows for +/-10% (i.e. maximum of 6.6 kg) *Blades redesigned for higher mass* Actual ~ 7.2 kg (in ICS entries)
Baseplate Material	Light-weighted aluminum, or fused silica	Baseplate provided by ISC	Al bench suspended and tested, silica bench still to be suspended *Silica benches now suspended*
Baseplate internal modes	First mode > 1000 Hz	Get it above IFO noise minimum and violin mode fundamental	FEA shows ~ 1100 Hz (see supporting documentation)

Isolation	Double pendulum, with two stages of blades for vertical isolation	Isolation of a double is estimated to be sufficient, but analysis of baseplate vibration needs to be written down	Isolation at 10 Hz Long: ~ 5 x 10^-4 Vert: ~ 4 x 10^-3 (exact values depend on level of damping and details of bench design)
Solid-body mode eigenfrequencies	0.8-2 Hz	This is a guideline only. Modes involving stretching of the bottom stage wires will of course be higher.	Actual frequencies are in range 0.5 Hz (lower yaw mode) to ~ 7 Hz (higher roll mode). Details on OMC Suspension wiki site under "Testing" link Final values in SUS Ops manual under OMCS https://awiki.ligo-wa.caltech.edu/aLIGO/Suspensions/OpsManual
Suspension fiber type	Steel - music wire		
Beam height	101.6 mm +/- 2 mm[4.0 inches] above HAM optics table; ~~25.4 mm +/- 2 mm [1.0 inch] above baseplate~~ *Current design has beam 20 mm below the baseplate*	same as iLIGO ISC table beam height	Beam is now below bench, not above
Suspension structure footprint	TBD	Keep as small as practical, to leave as much room as possible on HAM table for other components	
Structure resonances	First mode > 150 Hz		Lowest freq. is ~ 140 Hz (see supporting documentation)
Suspension structure height	725 mm ?	This is not really a spec that needs to defined here	Structure height has been looked at in HAM 6 layout to check it doesn't hit ceiling. (see supporting documentation)
Suspension point locations	4 points	Along (150mm) width, as close to	Susp. points moved in from edge in width direction to reduce higher pitch mode from 9

on baseplate		edges as possible; along length, position points to reduce plate motion (e.g., 22% of length from ends minimizes static deflection)	Hz to ~ 4 Hz. Susp points are at 20% of length from ends in the long axis direction. Updated – see FDD T0900060-v2 or above
Suspension point design	TBD	Slots in plate, or pegs inserted in side of plate	Countersunk through holes chosen for ease of manufacture of silica bench Updated – see FDD T0900060-v2 or above
Local damping	Active, 6 DOF	Same as IMC	
OSEM type	TBD	Probably 'Birmingham OSEMs'	B'ham OSEMS used
Baseplate positioning & pointing range (DC)	Few hundred microns, few hundred micro-rads	Guesstimate -- what's the IMC control range?	Pointing range using B'ham OSEMs of order 2 milliradians in roll, pitch and yaw
Actuator force spectrum	TBD	Not expected to be critical	
Actuator noise limits	TBD	Not expected to be difficult	
Optical line of sight/clearance reqs			
Electrical wiring to baseplate	TBD	No., gauge, type, connector type	
Accuracy of mechanical pitch and yaw positioning			
Accuracy of mechanical vertical positioning			
Beam dumps on SUS hardware	provide mounting holes on uprights, at beam height		Still to be specified

Mechanical stops for baseplate	In place – see detailed mechanical drawings