

LASER INTERFEROMETER GRAVITATIONAL WAVE OBSERVATORY  
-LIGO-  
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<b>Technical Note</b>	<b>LIGO-T1100416v1</b>	28 Jul 2011
<b>Advanced LIGO ISC/IO Enclosures: Materials and Assembly</b>		
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## Introduction

This document lays out the needed materials for the aLIGO ISC/IO table enclosures. The new version includes external patch panels to allow easier cable work, a HEPA fan filter (and exhausts) to ensure cleanliness, and an internal suspended cable tray to organize cables and keep them clear of beam paths. The design was developed at LHO by Dani Atkinson under the guidance of Daniel Sigg, and first applied to the single arm test's ALS enclosure (to be located at LHO EY, on the H2 interferometer).

Note that there are two ways to construct such enclosures: (1)modify an existing iLIGO enclosure. However, there are not enough iLIGO enclosures to meet our needs, so we must also (2)build (or more likely order) new ones from scratch. This document should detail how to do either, including purchasing information for the appropriate materials.

My apologies if this document is unclear or if parts of it are in error or are incomplete; it was written in the space of two days some months after actual assembly and in something of a hurry. Feel free to make updates or corrections as necessary.

## Bill of Materials

The enclosure as a whole can be broken down into several sections, with respective materials listed. (The difference between Minitec extrusions and 80/20 extrusions is the size: Minitec extrusions are 45mm x 45mm, while 80/20 extrusions are 25mm x 25mm.)

New Enclosure:

1x Newport RS 4000 Optical Table 1500mmx3000mmx305mm

(and appropriate legs)  
1x Minitec C91698 custom enclosure

Modifications to iLIGO Enclosure:

4x Minitec 20.1063 45x45UL T-Slotted Profile  
    2x cut to 44.46"  
    2x cut to 23.62"  
3x Panel-Tec .50" XPS foam core with .063" aluminum skin on both sides  
    2x cut to 32.26"x33.34"  
    1x cut to 32.26"x22.23"  
    (these are to replace the old back panels, which probably have old  
    periscope holes)  
4x Minitec 21.1472 Connecting Plate 45x90  
8x Minitec 21.1320/2 M5 Square Nut w/ Position Fixing

Internal Lighting:

2x Super Bright LEDs LBFA-NW24 LED Light Fixtures  
1x Super Bright LEDs LBFA-DT Mini Touch Dimmer  
2x Super Bright LEDs LBFA-I100 Interconnect Jumper  
5x Super Bright LEDs LBFA-MC1 Flat Mounting Clip  
1x Super Bright LEDs 24VDS-PS 24V DC Power Supply

HEPA Fan Filter:

2x Minitec 71.260 AL Angle .75" x 1.5" x 1/8"  
    cut to 35.63"  
    with machining and fastening hardware (M6)  
1x Envirco MAC10 Orig. 2x3 120V Fan Filter Unit (Supplier: Gerbig)  
2x McMaster-Carr 2016K9 Mini Round Wall Louver, 4" Diameter

Cable Trays and Patch Panels:

16x 80/20 25-2525 T-Slot Extrusion (Supplier: TECO Pneumatic)  
    2x 25-7005 cut to 300mm and 25-7042 countersunk AC one end  
    4x 25-7005 cut to 150mm and 25-7042 countersunk AC one end  
    4x 25-7005 cut to 142mm and 25-7042 countersunk AC one end BD other  
    2x 25-7005 cut to 1988mm  
    4x 25-7005 cut to 1127mm and 25-7042 countersunk AC both ends  
20x 80/20 13116 Drop-In T-Nut M5x0.8 (Supplier: TECO Pneumatic)  
20x 80/20 25-3396 Anchor Fastener for 25mm (Supplier: TECO Pneumatic)  
20x McMaster-Carr 95263A388 M5x0.8 20mm SHCS  
4x 80/20 25-3094 Double Anchor Fastener (Supplier: TECO Pneumatic)  
10x 80/20 25-2491 Single Wire Mesh Retainer  
4x 80/20 65-2472 PVC-Coated Wire Mesh  
    x1 65-7095 cut to 305mmx160mm  
    x1 65-7095/7100 cut to 1988mmx160mm  
    x2 65-7095 cut to 1030mmx160mm  
8x 25-8901 Slide-In T-Nut  
    custom design, 551.6mm long with threaded M5 holes 12.5mm from the  
    ends and 25mm from each other down the whole length

8x Minitec 21.1472 Connecting Plate 45x90  
16x Minitec 21.1320/2 M5 Square Nut w/ Position Fixing  
4x Front Panel Express D1100441 End Piece  
other panels as appropriate (for blanks/templates, see D1101138, D1101139,  
D1100442, and D1100443)

**Rack-Mounted Electronics Addition Slot (Optional):**

2x Minitec 20.1065 45x32 UL Profile  
2x 25.1094 cut to 10"  
2x Minitec 21.1346 Connecting Plate 90x32  
10x Minitec 21.1330/2 M6 Square Nut w/ Pos. Fixing  
10x Minitec 21.1238 M6x16 Cap Screw



### **Modifications to an Old Enclosure**

The iLIGO enclosures require a few modifications to adapt them to the aLIGO version:

-The side panels must be cut down from 44.46"x32.46" (1127mm x 824mm) to 44.46"x25.39" (1127mm x 645mm). Angle brackets must be cut to match.

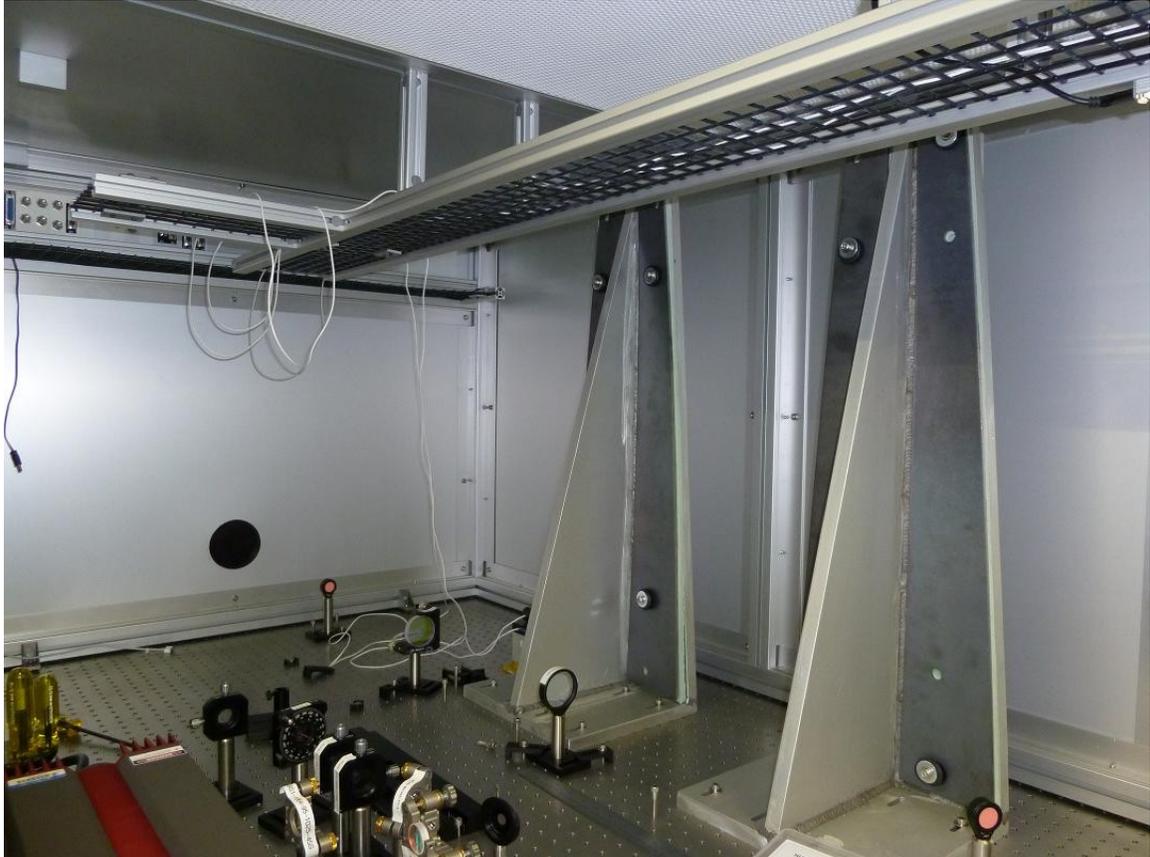
-The 44.46" (1127mm) crossbars must be installed just above the new top of the side panel leaving a gap of 5.20" (132mm), and the side panel's top angle bracket move to the crossbar's lower side. The crossbar defines the bottom of the patch panel row.

-One of the larger panels on top of the enclosure must be cut down from 44.46"x33.34" (1127mm x 847mm) to 44.46"x31.50" (1127mm x 800mm), to accommodate the widening of the middle section for the HEPA fan filter.

-The 23.62" (600mm) extrusions must be installed in between the two struts on top, 35.63" (905mm) apart.

-The top middle panel must be cut into two thin panels 23.90"x2.52" (607mm x 64mm).

-The back panels will probably have to be replaced as the old ones likely have large holes cut in them for the iLIGO periscope paths.



### **Cable Tray, Shelves, and Branch Installation**

I recommend making the aluminum extrusion modifications and adding other hardware before cutting, drilling, and installing the new panels.

If working with an iLIGO enclosure, you should've already adjusted the spacing of the extrusions on top to accommodate the HEPA fan filter (widening the center gap to 600 mm, at the expense of one or both of the other top panels). If using a brand new enclosure, the extrusions should already be in the right position.

You'll need to affix the 80/20 25-2525 142mm extrusions to the larger Minitec crossbeams first using the 13116 Drop-In T-Nuts, 25-3396 Anchor Fasteners, and M5 screws. The 142mm posts should be countersunk on both sides of each end, so they'll take 2 anchor fasteners each if desired but 1 should suffice. Attach at least one on each crossbeam, preferably on opposite sides of the cable tray (so, one per 1988mm extrusion) so the longer 1988mm piece won't get caught up sliding down two posts that aren't exactly aligned. Use the standard 25-3094 double anchor fasteners to connect the 142mm posts to the 1988mm rails, and once the rails are fixed the posts can be slid down them into the correct position to mate with the enclosure ceiling's crossbeams. The two rails should be far enough apart to slide the 1988mmx160mm mesh in between them easily,

and then use at least 4 of the 25-2491 single wire mesh retainers to fix the mesh in place. Once completed, the assembly should be quite sturdy. The LBFA-NW24 LED lights should be attached to the underside of the cable tray rails.

The cable shelves on either end of the enclosure should be added in a similar but simpler manner. The 150mm posts attach to the extrusion underneath the patch panel space with the same 13116 Drop-In T-Nuts, 25-3396 Anchor Fasteners, and M5 screws just like the suspended posts, and the 1030mmx160mm mesh affixed between the two posts with the same 25-2491 mesh retainers.

The 'branch' tray is very similar to the shelves, but narrower and longer, and attached to the side of the cable tray wherever it is most useful (and may be moved at a later date by loosening the anchor fasteners). Attach the 300mm extrusions at slightly over 150mm spacing to allow the 160mmx305mm grid to slide into place, and the same wire mesh retainers installed to hold it there.



### Patch Panel Row Installation

If working with an old enclosure, the Minitec 1127mm crossbars should already have been installed to leave a gap of 132mm between it and the top of the side. First, two of the 25-8901 custom slide-in T-nuts must be slid into one face of each of the 80/20 25-7005 1127mm rails. Then, the 1127mm rails should be installed on the inside of this gap (with the custom T-nuts facing out, of course) using the 25-3396 anchor fasteners and M5 screws, received on the other side by the 13116 drop-in T-nuts. Put these as close to the Minitec crossbars as possible. Once in place, install the D1100441 end pieces into the custom T-nuts, which should hold them in place against the ends of the row. Other patch

panels may then be installed as required, or blanks put into place to complete the enclosure.



### **HEPA Fan Filter Unit Installation**

Once the crossbars on top of the enclosure are properly spaced, the Minitec 35.63" angle brackets simply need to be installed into the longer sides of the gap using M6 screws and fasteners. The Envirco MAC10 fan filter can then be dropped (carefully) into the slot. It may be necessary to loosen the shorter crossbars to widen the gap a little, then push them back in once the fan filter is properly in place.

The fan filter will have to be wired into a switch and monitor by an electrician qualified for high-voltage work. The lighting can be done at the same time and both switches installed side by side.



### **Rack-Mounted Electronics Addition Slot (Optional)**

The two Minitec 20.1065 45x32 profiles can be installed anywhere on the outside (preferably top) of the enclosure, most likely on one side above one of the patch panel rows to allow the use of shorter cables. Use the 90x32 connecting plates with the M6 hardware to attach the posts, and simply put them at the proper spacing to accept the device to be installed. Use the additional 21.1330/2 M6 square nut w/ position fixing to accept the M6 screws passing through the mounting holes of your equipment.

### **Miscellaneous**

It may be necessary to make additional small modifications to accommodate the requirements of the specific table. For example, lasers sitting on a table with external controllers may need a grommeted hole on one panel to allow the power cable to pass through. Just keep an eye towards ease of use when making your changes.

Note also that access controls have not yet been addressed for these tables, and may have to be installed at a later time, though the default doors have key locks available for use.