LIGO-T1400385-v2 Incursion/installation plan for WHAM6, June 2014

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# 1 References

1. R. Abbott and K. Arai, alog about WHAM6 hardware install, Nov 2013 (https://alog.ligo-wa.caltech.edu/aLOG/index.php?callRep=8633)
2. L. Barsotti, ISC HAM6 Assembly, LIGO-D1000342 (https://dcc.ligo.org/D1000342)
3. E. Chavez and E. Sanchez, "HAM6-H1 Top Level Chamber Assembly", LIGO-D0901822 (https://dcc.ligo.org/D0901822)
4. E. Sanchez, "CABLE HARNESS ROUTING CONFIGURATION, HAM 6", LIGO-D1300122 (https://dcc.ligo.org/D1300122)
5. Chavez and Sanchez, "AdvLIGO SUS HAM6-H1, XYZ Local CS for Output Mode Cleaner Suspension (OMC)", LIGO-D1300240 (https://dcc.ligo.org/LIGO-D1300240)
6. R. Abbott, "RFPD Build Status and Locator", LIGO-T1200506 (https://dcc.ligo.org/LIGO-T1200506)
7. https://awiki.ligo-wa.caltech.edu/aLIGO/PicomotorList
8. WHAM6 pictures on Jun/02/2014 (https://ligoimages.mit.edu/?c=1478)
9. LHAM6 installation alogs (7486, 7494, 7505, 7631)
10. E. Sanchez, Flange Layout - H1 Horizontal Access Module 6 (HAM 6) (https://dcc.ligo.org/D1002877-v7)

# 2 Relevant assemblies

| Assembly | Already in HAM6 | Hardware to use |
|---|---|---|
| 1 HAM6 WFS sled D1200037 with picomotor assy | No | ¼-20 screws, up to 8, and/or ISC dog clamps |
| 1 HAM6 QPD sled D1200036 with QPD cable assy D1101654 (S1108061) | No | ¼-20 screws, up to 8, and/or ISC dog clamps |
| 1 High power beam dump for | No | Baseplate, 3 or four ¼-20 screws |

| | | |
|---|---|---|
| fast shutter | | |
| 1 AS QPD (D1101654, S1202409) | No | Baseplate, 1 or 2 pc ¼-20 |
| | | |
| OMC and OMC suspension | Yes | SOS dog clamps, D1100640-04 6pc, D1100640-05 4pc, D1100640-06 2pc, ¼-20x1.25 12pt bolt 12pc |
| OM1 tip-tilt | yes | ISC dogs 4pc |
| OM2 tip-tilt | yes | ISC dogs 4pc |
| OM3 tip-tilt | yes | ISC dogs 4pc |
| M4 (steering behind OM1) | Yes | Baseplate, 1 or 2 pc ¼-20 |
| M5 (steering downstream of M4) | Yes | Baseplate, 1 or 2 pc ¼-20 |
| M6 (AS air 50:50 splitter) | Yes | Baseplate, 1 or 2 pc ¼-20 |
| M7 (AS QPD steering with pico) | Yes, but without picos | Baseplate, 1 or 2 pc ¼-20 |
| M8 (OMC REFL steering) | Yes | Baseplate, 1 or 2 pc ¼-20 |
| M9 (OMC REFL sled steering, Pico) | Yes | Baseplate, 1 or 2 pc ¼-20 |
| M10 (OMC REFL sled steering, Pico) | Yes | Baseplate, 1 or 2 pc ¼-20 |
| M11 (OMC REFL sled splitter) | Yes | Baseplate, 1 or 2 pc ¼-20 |
| M12 (WFS steering behind OM3) | Yes | Baseplate, 1 or 2 pc ¼-20 |
| M13 (WFS steering downstream of M12) | Yes | Baseplate, 1 or 2 pc ¼-20 |
| M14 (OMC TRANS air steering) | Yes | Baseplate, 1 or 2 pc ¼-20 |
| L1 (lens for AS QPD) | Yes | Baseplate, 1 or 2 pc ¼-20 |
| BDV1 (AS AIR beam diverter) | Yes | Two or three ISC dog clamps |
| BDV2 (OMC REFL AIR beam diverter) | Yes | Two or three ISC dog clamps |
| | | |
| WFS 36/45MHz for ASC-AS-A (D1101202, S1300635) | Yes | ¼-20 bolts and/or ISC dog clamps |
| WFS 36/45MHz for ASC-AS-B (D1101202, S1300634) | Yes | ¼-20 bolts and/or ISC dog clamps |
| 5 cable brackets, each with two or more ports D1001346 | Yes (two on OMCS, three on ISI) | ¼-20 screws, two each |

During the installation procedure, four additional beam dumps were found missing from the above table. These are all V-type black glass beam dumps. When the 3rd IFO is installed, don't forget to prepare these also.

Fast shutter for OMC protection is not ready for installation this time.

# 3 Preparation

It was decided after the first installation in WHAM6 that M7 (steering mirror for the single QPD in AS path) should have picomotors [4, 7]. A new mount and optic should be assembled and will be swapped in chamber, or a new mount is prepared and the optic will be swapped, or existing M7 will be retrofitted with picomotors and a connector bracket by HAM6.

# 4 Door removal

North and South doors of HAM6 are removed, while the East door is closed.

# 5 Locking ISI

Make sure that ISI is locked. Push the ISI table gently. The table should not move at all. If it's not locked, lock ISI. If you don't know how, consult with SEI.

# 6 Checking existing cables

One or two persons should look at the cabling status.

Before starting to move things around, check the availability of cables in chamber, so that one person outside of the chamber can get any cables that are missing.

In general, refer to D1300122 [4] to find how the cable routing should be done.

From the pictures of the HAM6 [8], it seems that everything except two picomotor cable assy (D1000238) are already accounted for, but you need to check that everything is connected to the right locations.

## *6.1 CB1 and CB2: OMC and OMCS cables*

These brackets are already mounted on the OMC suspension frame.

In D1300122 [4] CB1-1st is specified as OMC DCPD and CB1-2nd as OMC PZT. However, Rich Abbott noted the opposite in his alog [1]. Look at the connection and make sure that we follow D1300122.

| Cable number | Feedthrough | Cable | Bracket | Cable/Assy |
|---|---|---|---|---|
| 1 | D6-F1 | D1000225-180 | CB1-1 | D1300369 DCPD preamp cable assy |
| 2 | D6-F2 | D1000225-180 | CB1-2 | D1300376 OMC PZT cable assy |

| | | | | |
|---|---|---|---|---|
| 3 | D6-F3 | D1000225-180 | CB2-1 | D1300373 OMC QPD cable assy |
| 19 | D3-1C1 | D1000225-180 | CB2-2 | D1000234-60, four OMCS BOSEMs |
| 20 | D3-1C2 | D1000225-180 | CB2-3 | D1000234-60, two OMCS BOSEMs |

### 6.2 CB3: Beam Diverter

| | | | | |
|---|---|---|---|---|
| 7 | D6-F8 | D1000225 | CB3-1 | D1000237, BDV1 |
| 8 | D6-F9 | D1000225 | CB3-2 | D1000237, BDV2 |

### 6.3 CB4: AS port Picomotors and QPD

| | | | | |
|---|---|---|---|---|
| 9 | D6-F7 | D1000223 | CB4-1 | D1000238, AS port (incl. WFS sled) picomotors |
| 10 | D6-F5 | D1000225 | CB4-2 | D1101654, AS single QPD |

### 6.4 CB5: OMC REFL QPD sled Picomotors and QPDs

| | | | | |
|---|---|---|---|---|
| 5 | D6-F6 | D1000223 | CB5-1 | D1000238, Picomotors for QPD sled |
| 4 | D6-F4 | D1000225 | CB5-2 | QPD sled QPDs |

### 6.5 Cables not on the cable brackets: WFS and Tip-Tilts

These are directly routed to the feedthroughs.

| | | | | |
|---|---|---|---|---|
| 6 | D6-F10 | D1000225 | NA | OM1 (Named Tip-Tilt 1 in D1300122) |
| 11 | D6-F12 | D1000225 | NA | OM3 (Tip-Tilt 2) |
| 18 | D6-F11 | D1000225 | NA | OM2 (Tip-Tilt 3) |
| 12 | D5-1D1 | D1300278 | NA | WFSA |
| 13 | D5-1D2 | D1300278 | NA | WFSA |
| 14 | D5-3C1 | D1300225 | NA | WFSA |
| 15 | D5-2D1 | D1300278 | NA | WFSB |
| 16 | D5-2D2 | D1300278 | NA | WFSB |
| 17 | D5-3C2 | D1300225 | NA | WFSB |

## 7 Moving and fixing down components

To avoid leaving any component unchecked, moving/fixing should be done methodically, following the order described here. Even if you find a better order, stick to the document once you start working in chamber.

### 7.1 Moving OMCS in place, connecting up OMCS and OMC

Confirm that OMC breadboard itself as well as the top mass are held securely by the earthquake stop

screws. If not, tighten EQ stops.

OMCS cookie cutter is already installed at correct position.

OMCS should be pushed toward south, and this is done by three persons. OMCS is already on temporary teflon pieces to make it easier to slide on ISI table. Two person should be on the south door, relieving the weight of OMCS from the teflon pieces as best as can be done. The third person pushes from the north until the OMCS is flush against the cookie cutter. You may need to repeat it several times.

Once the OMCS is at the correct position, two persons lift one edge of the OMCS slightly while another person slides the teflon pieces out. Do it one side at the time.

Finally, use dog clamps to fix the OMCS on ISI table.

Connect the cables 1, 2, 3, 19 and 20 to CB1 and CB2.

Temporarily unlock OMC and the top mass for OSEM testing later.

Remove cookie cutter from HAM6.

## 7.2 OMC TRANS path

Move and fix M14 to the nominal position according to D1000342.

Move and fix one V-dump by the OMC according to D1000342.

## 7.3 OM2, M8 and OM3

Move and fix OM2, M8 and OM3 to the nominal position according to D1000342, in this order.

Note that M8 is mounted on a lens holder, and you need to make sure that the HR surface is facing the OMC, and the PEEK ring is on the opposite side of HR surface.

Connect OM2 and OM3 cable if they're not connected yet.

Move and fix one V-dump behind OM2.

## 7.4 AS WFS path

Move M12, M13, WFS sled, then WFSA and WFSB, in this order, and fix them down.

OM2-OM3-M12 should form a straight line.

Connect AS picomotor cable to the picomotors on the sled. The cable has four spigots. WFSA pico is the first, WFSB pico the second. The other end of this cable goes to CB4-1.

Connect the WFS cables to the WFSA and WFSB heads.

It was found that the layout diagrams in D1000342-V14 and D0901822-V5 are both inaccurate for WFS head positions. You might have to move WFSA away from the sled, and move the steering mirror for WFSB downstream so that WFSB doesn't interfere with balast mass on the ISI while keeping the nominal distance from the lens.

## 7.5 AS AIR and QPD path

M4, M5, M6, M7, L1, AS QPD, BDV1 and a V-damp in this order.

Pay attention to the BDV1 direction. The PEEK washers should be behind the mirror, not in front of it. The edge of the mirror that cuts the beam should be open (should not be covered by BDV1 mirror holder), and the high reflective coating should face M6.

V-damp is placed next to OM1 to receive the reflected beam from BDV1.

Connect BDV1 to CB3-1 with D1000237 cable.

Connect the third spigot of the AS picomotor cable to M7 picomotors. The fourth spigot is left unused.

Connect the AS QPD cable to CB4-2.

### *7.6 OMC REFL path*

M9, M10, M11, QPD sled, BDV2 and a V-damp in this order.

Pay attention to BDV2 direction. PEEK washers should be behind the black glass. If it's possible to make it such that the edge of the mirror cuts the beam first (instead of aluminum rim of the mirror holder), that's good, but it is more important that the PEEK washers are not exposed to high power beam.

V-damp is installed on the QPD sled base to receive the reflection from BDV2.

Connect BDV2 to CB3-2 with D1000237 cable.

Connect the sled QPD cable to CB5-2.

Connect the OMC REFL path picomotor cable to M9 (the first spigot) and M10 (the second). The 3rd and 4th spigots are left unused. The other end of this cable goes to CB5-1.

### *7.7 Highe Power Beam Dump*

Place the high power beam dump roughly according to D1000342.

Fast shutter is not installed this time.

## 8 Checking electronics

Use a flashlight to see if two DCPDs on OMC, five QPDs (two on the OMC, two on the sled, one on the ISI), and two WFSs respond to light.

Check OMCS BOSEM readings, and see if they respond to OMC motion. If necessary, move BOSEMs. Satelite amplifier might be disconnected outside, so check with SUS.

Also check BOSEMs of OM1, OM2 and OM3.

Measure the capacitance of the OMC pzt from outside and see if it makes sense.

At this stage, you are quite certain that DCPDs, QPDs, WFSs, OMC PZT and all in-chamber OSEMs are cabled correctly.

Test two beam diverters from outside.

Stop here. Do NEVER test picomotors at this stage. Cool down for a day or so, make sure that everything except picomotors are connected right, and only after that you will come back to testing picomotors.

# 9 Handing it off to SEI

~~Lock OMC and the top mass using EQ stops.~~ ~~(Is this necessary?~~ No!)

Fix cables down on the ISI table using cable clamps as necessary. Routing from the ISI table to the feedthroughs are done by SEI.

Do not leave any unused screws, washers, tools etc. inside.

HAM6 is now ready for ISI balancing.