LIGO Laboratory / LIGO Scientific Collaboration

LIGO- E1300840-v1 *LIGO* 02/11/15

aLIGO HEPI H1 ITMY Assembly Validation Report

E1300840

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Distribution of this document:
Advanced LIGO Project

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of the LIGO Laboratory

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Contents

1. Introduction

This document summarizes the steps to be done to validate HEPI assemblies. Corresponding reports must be posted in :

LIGO-E1300454: aLIGO HEPI Testing Reports

2. Sub-Components Testing

- Kaman Inductive Position Sensors: calibration, linearity, factory data, noise measurements (E0900426 – HEPI Kaman Sensor Receiving Analysis - Results posted in the SVN)
- HEPI actuator linearity test (E1100338 – aLIGO HEPI Actuators Test Results)
- L4C test (Q0900007)

3. Load Cells assembly--BSC1

BSC HEPI load cell capacity → 3000 lbs
HAM HEPI load cell capacity → 2000 lbs

	Left Spring (lbs)	Right Spring (lbs)
Pier 1	2230	2070
Pier 2	1970	2020
Pier 3	2090	2220
Pier 4	1880	1960

Acceptance criteria:

- The values must not exceed 80% of the load cell capacity (2400lbs for BSC and 1600lbs for HAM).

Test result: **Passed: X** **Failed: ___**

4. Boot Location—Test Not Performed, HR

	Pier 1	Pier 2	Pier 3	Pier 4
Point 1a (Tangential)				
Point 1b (Tangential)				
Point 2a (Tangential)				
Point 2b (Tangential)				
Point 3 (Radial Back)				
Point 4 (Radial Front)				
Point 5 (Vertical)				

	Pier 1	Pier 2	Pier 3	Pier 4
Point 1a (Tangential)				
Point 1b (Tangential)				
Point 2a (Tangential)				
Point 2b (Tangential)				
Point 3 (Radial Back)				
Point 4 (Radial Front)				
Point 5 (Vertical)				

Acceptance criteria:

-

Test result: **Passed: ___** **Failed: ___**

5. Check Stops Gaps—Test Not Performed, HR

The stops must not touch the boot. There is 15 stops per boot, 5 per F bracket.

	Bracket 1	Bracket 2	Bracket 3														
	Gap1	Gap2	Gap3	Gap4 above	Gap4 under	Gap5	Gap1	Gap2	Gap3	Gap4 above	Gap4 under	Gap5	Gap1	Gap2	Gap3	Gap4 above	Gap4 under	Gap5
Pier 1																		
Pier 2																		
Pier 3																		
Pier 4																		

Test result: **Passed: ___** **Failed: ___**

6. Gaps check—Test Not Performed, HR

Four particular gaps need to be check.

Acceptance criteria:

- a 0.08” shim must fit in these two gaps

Issues/difficulties/comments regarding this test: Gap#1 is tricky to reach. At LASTI, the solution found was to tape the shim to an extension (rod, rigid ruler, etc.).
Gap#2 should be reachable by hand.
Gap#3 and 4 are tricky, but should also be doable (no picture)

	Gap#1	**Gap#2**	**Gap#3**	**Gap#4**
Pier 1				
Pier 2				
Pier 3				
Pier 4				

Test result: **Passed: ___** **Failed: ___**

7. IPS Centering-BSC10

Scripts files for processing and plotting in SVN at:
/SeiSVN/seismic/HEPI/Common/Testing_Functions_HEPI/
Offset_STD_IPS_Readback_HEPI.m

Data in SVN at:
/ligo/svncommon/SeiSVN/seismic/HEPI/H1/ITMY/Data/Static_Tests/
H1_HPI_ITMY_IPS_Read_Back_Unlocked_20130802.mat

All the loops must be turned off during this test.

	H1	H2	H3	H4	V1	V2	V3	V4
Mean (counts)	1499	-3135	918	-3384	-1973	1926	-511	-6243
Accep-tance	+/- 15000	+/- 15000	+/- 15000	+/- 15000	+/- 15000	+/- 15000	+/- 15000	+/- 15000

Test result: **Passed: _X_** **Failed: ___**

8. Sensor ASD

Scripts files for processing and plotting in SVN at:
/SeiSVN/seismic/HEPI/Common/Testing_Functions_HEPI/ASD_Measurements_Local_HEPI.m

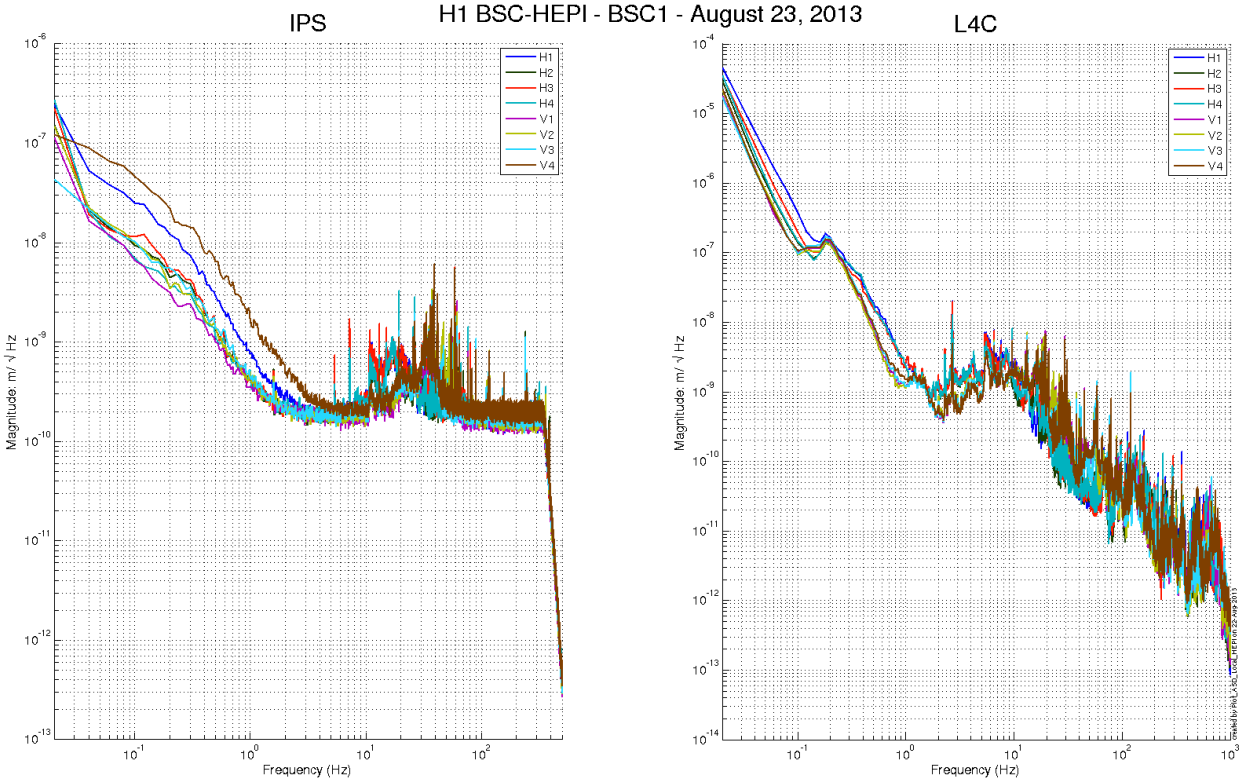
Data in SVN at:
SeiSVN/seismic/HEPI/H1/ITMY/Data/Spectra/Undamped/

H1_HPI_ITMY_ASD_m_IPS_L4C_2020_08_22_3 0:5:.mat

Figures in SVN at:

/SeiSVN/seismic/HEPI/H1/ITMY/Data/Figures/Spectra/Undamped/

H1_HPI_ITMY_ASD_m_IPS_L4C_2020_08_22_3 0:5:.fig



Measurement length: 1900s - Sample window: 50s - Overlap: 50% - Frequency resolution: 20mHz - Averages: 75 - Measurement start (GPS): 1061190933

Issues/difficulties/comments regarding this test:

Acceptance criteria:

-

Test result: **Passed: _?__** **Failed: ____**

9. SUS-watchdogs interaction test—Test not performed

This test will be obsolete very soon, as the payload-HEPI WD connection is planned for removal.

. Set up a zero value on the payload watchogs.
. Check that the payload watchdog screen of HEPI tripped.

. In the payload watchdog screen, click on the OVERRIDE button and reset the watchdog.

. Do the same process for all the payloads

Acceptance criteria:

- The HEPI must trip when the payload watchdogs are tripped
- The HEPI watchdogs could be reset when the OVERRIDE button is ON

Test result: **Passed: ____** **Failed: ____**

When this test is done, reset everything (OVERRIDE button OFF, put back the value on the payload watchdog).

10.Static Test local drive-BSC10

Scripts files for processing in SVN at:
/SeiSVN/seismic/HEPI/Common/Testing_Functions_HEPI/Static_Test_Local_Basis_HEPI.m
Data File: /SeiSVN/seismic/HEPI/H1/ITMY/Data/Static_tests/
H1_HPI_ITMY_Offset_Local_Drive_20130802.mat

. ***Drive of 5000 counts***

	H1	H2	H3	H4	V1	V2	V3	V4
H1	8916	-3363	-722	-2792	214	204	50	-238
H2	-3010	8134	-2569	-737	18	-96	-319	59
H3	-576	-2164	7444	-3043	39	-186	51	171
H4	-2826	-718	-3351	9010	-262	62	180	-63
V1	253	60	54	-194	6734	1029	-1755	1310
V2	237	-71	-203	123	1062	6175	1218	-1620
V3	90	-298	82	238	-1675	1372	6468	999
V4	-206	124	236	-26	1464	-1679	1139	6668

Table - Main couplings and cross couplings

Issues/difficulties encountered during this test:

Acceptance criteria:

-

Test result: **Passed: _X_** **Failed: ____**

11. Linearity Test/Range of motion in the local basis

0.7mm clear range of Motion: see ../HEPI/H1/Data/Static_Tests/
H1_HPI_ITMY_Range_Of_Motion_20140723all.mat

Scripts files for processing and plotting in SVN at:

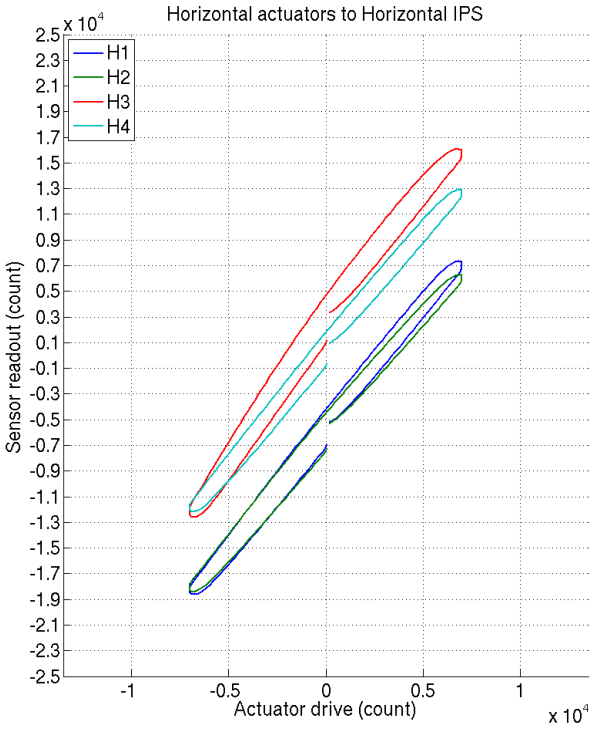
/SeiSVN/seismic/HEPI/Common/Testing_Functions_HEPI/Linearity_Test_Awgstream_HEPI.m

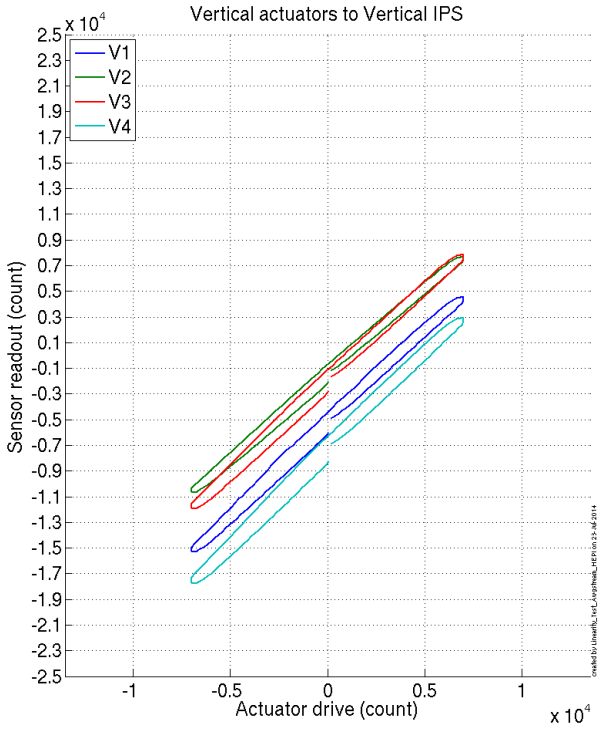
Data in SVN at:

SeiSVN/seismic/HEPI/H1/ITMY/Data/Linearity_Test/
H1_HPI_ITMY_Linearity_test_20140723T133926.mat

Figures in SVN at:

/SeiSVN/seismic/HEPI/H1/ITMY/Data/Figures/Linearity_Test/
H1_HPI_ITMY_Linearity_test_20140723T133926.fig





	Slopes	Offsets
H1	1.89	-5528
H2	1.80	-5825
H3	2.09	2569
H4	1.82	559
V1	1.44	-5207
V2	1.33	1389
V3	1.43	-1935
V4	1.50	7253

Issues/difficulties encountered during this test:

Acceptance criteria:

- ???????

Test result: Looks Good **Passed: _?_** **Failed: ____**

12. Actuator Plate to Shields gap—Test Not Performed, HR

Perform this test ONLY if the range of motion test failed.

Three gaps per actuator need to be checked.

Acceptance criteria:

- A 0.1" shim must fit into the gap #1
- A 0.05 shim must fit into gap #2 and #3

	Horizontal	Vertical				
	Gap #1	**Gap #2**	**Gap #3**	**Gap #1**	**Gap #2**	**Gap #3**
Pier 1						
Pier 2						
Pier 3						
Pier 4						

Test result: **Passed: ____** **Failed: ____**

13. Valve Check—BSC-10, Test Not Performed

Scripts files for processing and plotting in SVN at:

/SeiSVN/seismic/HEPI/H1//Scripts/Valve_Check/plot_valve_check.m

Data in SVN at:

SeiSVN/seismic/HEPI/H1//Data/Spectra/Undamped/
/SeiSVN/seismic/HEPI/H1//Scripts/Valve_Check

Figures in SVN at:
/SeiSVN/seismic/HEPI/H1//Scripts/Valve_Check

Acceptance criteria: ????

-

Test result: **Passed: ___** **Failed: ___**

14.Local-to-local measurements

Band (Hz)	Res	Amplitude	Nreps	Time (s)	Time (min)	Time (h)
500-1000	0.25	1.0x1500 – 1500	250	4176*	69.6	1*
100 - 500	0.5	1.0x4000 – 4000	250	4176*	69.6	1.2*
10 - 100	0.25	1.0x4000 – 4000	200	6592*	109.9	1.8*
0.7 - 10	0.05	1.0x4000 – 4000	75	12320*	205.3	3.4*
0.1 - 0.7	0.025	1.0x4000 – 4000	30	10080*	168.0	2.8*
0.01 - 0.1	0.01	1.0x4000 – 4000	10	8960*	149.3	2.5*
0.002 - 0.01	0.002	1.0x4000 – 4000	2	12160*	202.7	3.4*
						16.1*

*: Values Need to be updated

Data files in SVN at:
/SeiSVN/seismic/HEPI/H1/ETMY/Data/Transfer_Functions/Measurements/Undamped/

LHO_HPI_BSC1_Data_L2L_2mHz_10mHz_20130817-034652.mat
LHO_HPI_BSC1_Data_L2L_10mHz_100mHz_20130816-213722.mat
LHO_HPI_BSC1_Data_L2L_100mHz_700mHz_20130816-184438.mat
LHO_HPI_BSC1_Data_L2L_700mHz_10Hz_20130817-001928.mat
LHO_HPI_BSC1_Data_L2L_10Hz_100Hz_20130816-165455.mat
LHO_HPI_BSC1_Data_L2L_100Hz_500Hz_20130816-154541.mat
LHO_HPI_BSC1_Data_L2L_500Hz_1000Hz_20130816-132912.mat

Data is called by Case #7 of:
/ligo/svncommon/SeiSVN/seismic/HEPI/H1/ITMY/Data/Transfer_Functions/Measurements/
/Measurements_List_H1_HPI_ITMY.m

Data collection script files:
/SeiSVN/seismic/HEPI/Common//Transfer_Function_Scripts/

- Run_TF_L2L_500Hz_1000Hz_HEPI.m
- Run_TF_L2L_100Hz_500Hz_HEPI.m
- Run_TF_L2L_10Hz_100Hz_HEPI.m
- Run_TF_L2L_700mHz_10Hz_HEPI.m
- Run_TF_L2L_100mHz_700mHz_HEPI.m
- Run_TF_L2L_10mHz_100mHz_HEPI.m
- Run_TF_L2L_2mHz_10mHz_HEPI.m

Scripts files for processing and plotting in SVN at:
/SeiSVN/seismic/HEPI/H1/ITMY/Scripts/Control_Scripts/Version_5/

- Step_1_TF_Loc_to_Loc_H1_HEPI_ITMY.m

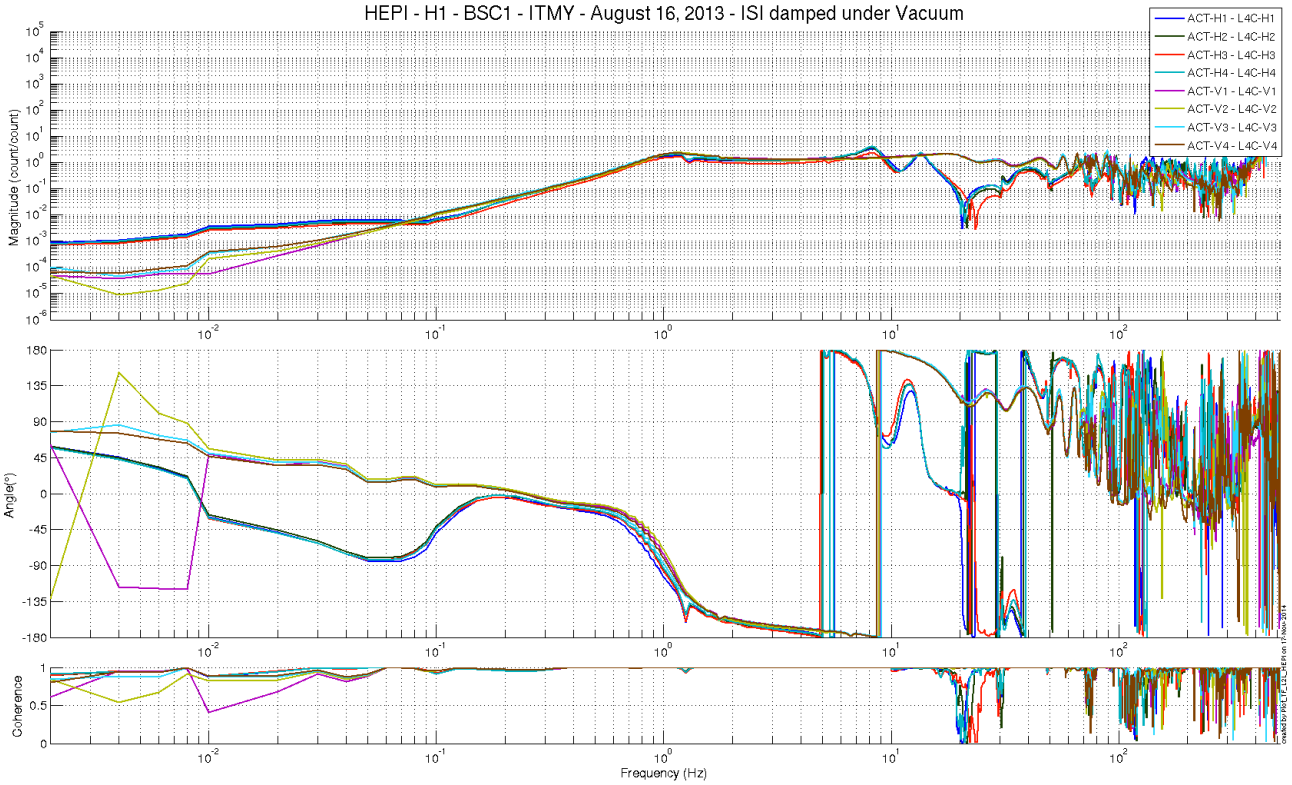
Figures in SVN at:
/SeiSVN/seismic/HEPI/H1/ITMY/Data/ Figures/Transfer_Functions/Measurements/Undamped/

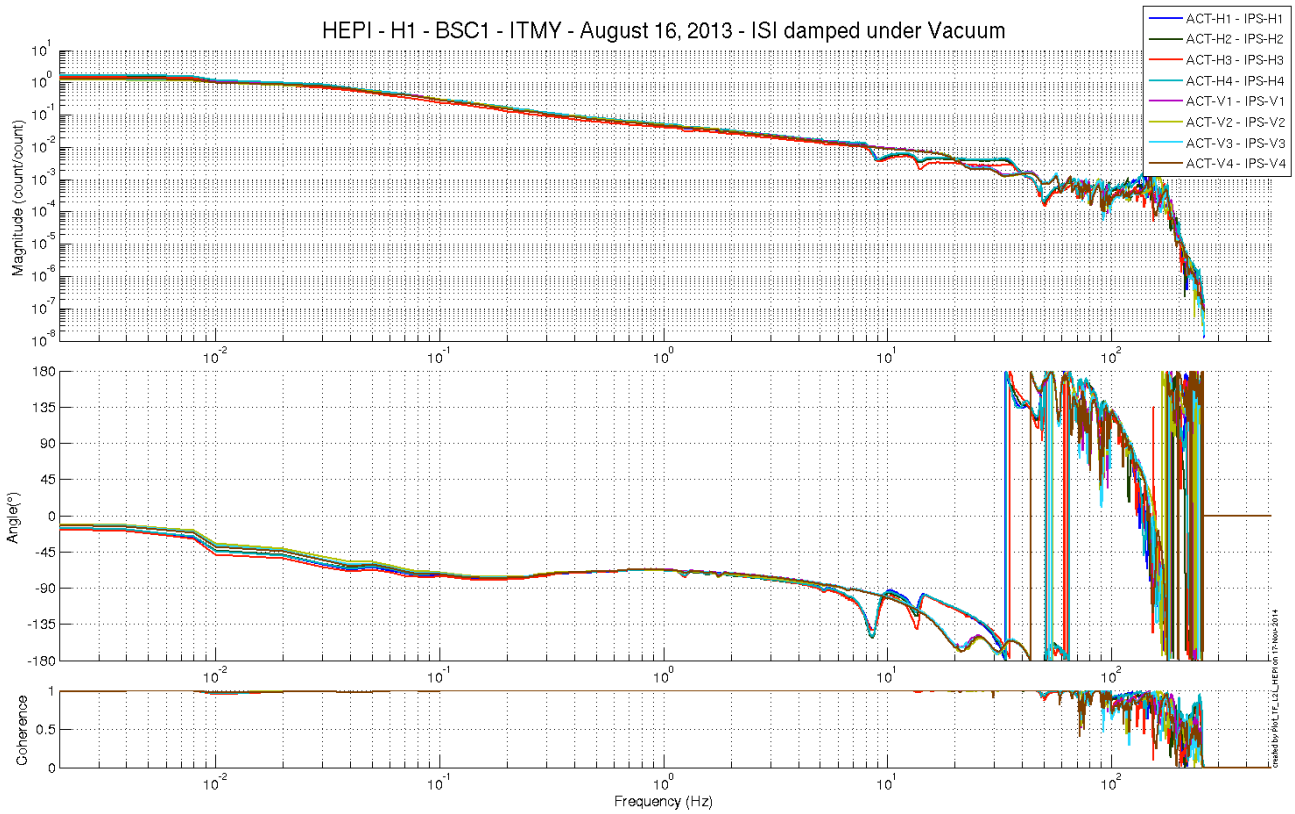
- H1_HPI_ITMY_TF_L2L_Raw_from_ACT_to_IPS_2013_08_16.fig
- H1_HPI_ITMY_TF_L2L_Raw_from_ACT_to_L4C_2013_08_16.fig

Storage of measured transfer functions in the SVN at:
/SeiSVN/seismic/HEPI/H1/ITMY/Data/Transfer_Functions/Simulations/Undamped/

- H1_HPI_ITMY_TF_L2L_Raw_2013_08_16.mat

The local-to-local transfer functions are presented below.





Issues/difficulties/comments regarding this test: – Under vacuum w/ ISI Damped

Acceptance criteria:

- On IPS, the phase must be 0º at DC
- On geophones, the phase must be 90º at DC
- Identical shape in each corner

Test result: **Passed: __X__** **Failed: ___**

15. Alignment offsets:

Those are the IPS readouts that were recorded, after alignment work was performed—These numbers would nominally be all zero because after alignment and we attached the actuator and got a confirm that alignment was good, the IPS would be set to zero. However, once testing commences, the platforms will settle more, splay out if you will etc.
The numbers below are with the platform now in its nominal alignment and where the system operates. These values are good for the performance of the IPS. Much above 15000 would start to approach badness where the response loses linearity

	IPS Readouts HEPI Isolated	Cartesian DOF	TARGET
H1	10720	X	600000
H2	-12880	Y	-63300
H3	-13470	Z	-189000
H4	6700	RX	15140
V1	-5860	RY	60130
V2	-2760	RZ	-16200
V3	-2490	HP	-87000
V4	-8380	VP	27000

Issues/difficulties encountered during this test:
Readings were retrieved from medms 11 Feb 2015.

Acceptance criteria:
Values near and certainly above 15000 should be reduced by centering or other action.

Test result: **Passed: _X_** **Failed: ___**