

**Ingalls
Shipbuilding**

A Division of Huntington Ingalls Industries

Flexible Infrastructure Update

Presentation to NSRP Panel Meeting

June 2017



- Ingalls Shipbuilding – Project Lead
 - Sean Murphy, Mike Poslusny, Davida Cunningham, John Walks
- NTS
 - Calvin Milam
- Hilti
 - Mark Sackett
- ATI
 - Chad Bryant, Project Manager
- Newport News
 - David Rice, Program Technical Representative



- Flexible Infrastructure (deck, overhead and bulkhead track) has been previously tested and qualified by Newport News Shipbuilding for use aboard CVN class ships. This NSRP project attempts qualification of FI for all other surface ships.
- Deck, overhead and bulkhead track payloads were shock tested in July 2015 at NTS Rustburg with satisfactory results.
- Vibration testing was conducted on the bulkhead track items at NTS Rustburg in June 2016. Half of the test items failed during the test series.
- HII received funding to modify and retest the bulkhead track failures. Testing commenced in February 2017.



Project Work Breakdown Structure (WBS)



- The project will consist of seven major tasks over 11 months:
 - Task 1: Project Initiation
 - Task 2: Develop Test Plan
 - Task 3: Test Preparation
 - Task 4: Test Execution - Vibration
 - Task 5: Interpretation of Test Results
 - Task 6: Final Report and Final Project Workshop
 - Task 7: Technology Transfer and Program Management



- Modifications

- Upgraded attachment hardware (saddle nuts and hex head bolts) from 3/8" to 1/2" for larger payloads
- All vertical track to horizontal track connections upgraded to 1/2" hardware (1/2" saddle nuts and socket head cap screws)
- Utilized HII designed T-brackets for large dummy weights
- Changed the test requirement to **4-25 Hz** to attempt qualification for LHA, LPD, DDG and CVN applications (most failures occurred above 30 Hz)

- Test Procedure

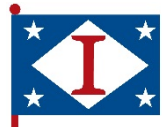
- Two vibration test series performed on 11 test items
 - Exploratory (4 – 25 Hz in increments of 1 Hz, for 15 seconds each)
 - Variable (4 – 25 Hz in increments of 1 Hz, for 5 minutes each)
 - Endurance (at least 2 hours at resonant frequency or 1 hour at each resonance if two exist, if more than two, each frequency at 40 minutes)

- Major failure classified by the following:

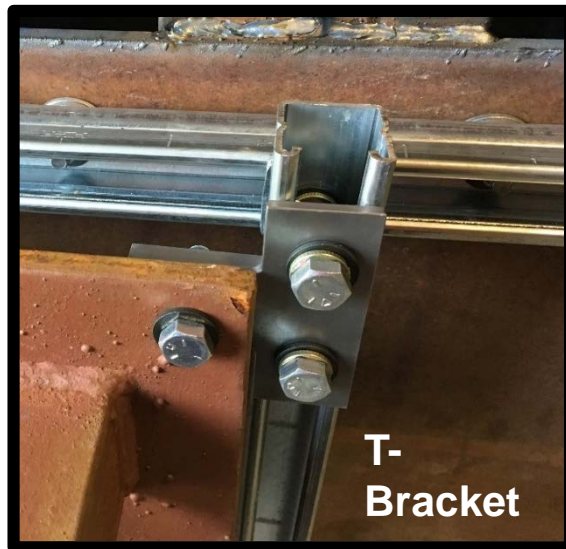
- Dummy masses attached to Flexible Infrastructure becomes adrift
- Flexible Infrastructure tracks become detached from test pedestal



Item #	Item Description	Dummy Weight	Result
5a	Qty 2 Saddle Nuts (3/8") with Flat Bar, Vertical Track, Max CG 6"	10	PASSED (see note - stronger strut connections)
6a	Qty 2 Saddle Nuts (3/8") with Flat Bar, Vertical Track, Max CG 6"	15	PASSED (see note - stronger strut connections)
11	Z mount 11" - 1 pair Vertical Track, 2 tracks 22" spacing, 1/2" Saddle Nuts, <u>Max CG 6.5"</u>	80	FAILED - 18 Hz resonance caused the vertical track to split
14	Z mount 11" - 1 pair Horizontal Track, 2 tracks 22" spacing, 1/2" Saddle Nuts, <u>Max CG 6.5"</u>	80	PASSED by reducing the CG of the dummy weight to 6.5"
17	Qty 8, 1/2" Saddle Nuts (4 per track) on 2 Horizontal Tracks spaced 22" Apart	300	PASSED
18	Qty 2 Horizontal Hilti Tracks Spaced 22" Apart installed on 3" tall EFPMs (5/8" studs, 3/8" hardware) with 200 lb Dummy Mass, 1/2" Saddle Nuts	200	PASSED
19	Qty 2 Horizontal Hilti Tracks Spaced 22" Apart installed on 6" tall EFPMs (5/8" studs, 3/8" hardware) with 200 lb Dummy Mass, 1/2" Saddle Nuts	200	PASSED
23	Qty 2 Saddle Nuts (<u>1/2"</u>) on 1 Vertical Hilti Track, Method 816-NG	40	PASSED - upgraded 3/8" to 1/2" hardware attachment to track
24	Qty 4 Saddle Nuts (1/2") on 2 Vertical Hilti Tracks spaced 12" apart, mounted on T-brackets	120	PASSED - added T brackets, doubling connections to track
24a	Qty 4 Saddle Nuts (1/2") on 2 Vertical Hilti Tracks spaced 12" apart	120	PASSED - proved T brackets not required
25	Qty 4 Saddle Nuts (1/2") on 2 Vertical Hilti Tracks spaced 12" apart, mounted on T-brackets, cantilevered on Vertical Track	120	PASSED - added T brackets, doubling connections to track. T-brackets required for cantilevered situations?
Note:	Vertical track was attached to Horizontal Track using 1/2" Saddle Nuts, socket head cap screws, lock / flat washers; torqued to 60 ft-lbs. Saddle Nut Hardware: All 1/2" bolts were torqued to 60 ft-lbs. All 3/8" bolts were torqued to 30 ft-lbs.		



Test Setup



NTS

HILTI





Vertical Track Connection



Test Setup – Test #2



Vertical Track Connection

- 3/8" attachment hardware may be used for items up to 25 lbs.
- 1/2" hardware must be used for items heavier than 25 lbs. and for all vertical to horizontal track connections.
- Horizontal bulkhead track can support payloads up to 300 lbs.
- Vertical bulkhead track can support payloads up to 120 lbs.
- Tracks installed on EFPMs can support payloads up to 200 lbs. The new EFPM designs were successful.
- T-brackets are only required for large cantilevered payloads.
- Z-mounts cannot be used on vertical track.
- Further testing may be desired to prove that T-brackets increase the weight capacity of bulkhead track (vertical and horizontal).



BHD Items that Survived Shock and Vibration Tests



Item No.	Description	Dummy Weight
2	Qty 1, 3/8" Saddle Nut on Vertical Track	10 & 15 lbs
4	Qty 2, Saddle Nuts (3/8") w Flat bar on Horizontal Track	10 & 15 lbs
6	Qty 2, Saddle Nuts (3/8") with Flat Bar, Vertical Track, Max CG 6"	10 & 15 lbs
8	Qty 1, 3/8" Saddle Nut on Horizontal Track	10 & 15 lbs
10	Single Z-mount 11" on Horizontal Track (1/2" Saddle Nuts)	20 & 40 lbs
13	Single Z-mount 11" on Vertical Track (1/2" Saddle Nuts)	20 & 40 lbs
14	Qty 2, Z mount 11" - 1 pair on Horizontal Track, 22" spacing, 1/2" Saddle Nuts, <u>Max CG 6.5"</u>	80 lbs
16	Single Z-mount 7.5" on Vertical Track (1/2" Saddle Nuts)	20 & 40 lbs
17	Qty 8, 1/2" Saddle Nuts (4 per track) on Horizontal Tracks Spaced 22" Apart	300 lbs
18	Qty 2, Horizontal Hilti Tracks Spaced 22" Apart installed on 3" Tall EFPMs (5/8" studs, 3/8" hardware) with 200 lb Dummy Mass, 1/2" Saddle Nuts.	200 lbs
19	2 Horizontal Hilti Tracks Spaced 22" Apart installed on 6" Tall EFPMs (5/8" studs, 3/8" hardware) with 200 lb Dummy Mass, 1/2" Saddle Nuts.	200 lbs
22	Qty 4, Z- mounts -7.5" on Horizontal Tracks- 22" spacing (1/2" Saddle Nuts)	100 lbs
23	Qty 2, Saddle Nuts <u>(1/2")</u> on 1 Vertical Hilti Track, Method 816-NG	40 lbs
24	Qty 4, Saddle Nuts (1/2") on 2 Vertical Hilti Tracks spaced 12" apart, mounted on T-brackets	120 lbs
24	Qty 4, Saddle Nuts (1/2") on 2 Vertical Hilti Tracks spaced 12" apart	120 lbs
25	Qty 4, Saddle Nuts (1/2") on 2 Vertical Hilti Tracks spaced 12" apart, mounted on T-brackets, cantilevered on vertical track	120 lbs
26	Qty 1, Saddle Nut (3/8") with Method 817-NG	10 lbs
27	Qty 2, Saddle Nuts with Method 806-NG mounted vertical (3/8")	25 lbs



OVHD Items that Survived Shock Tests

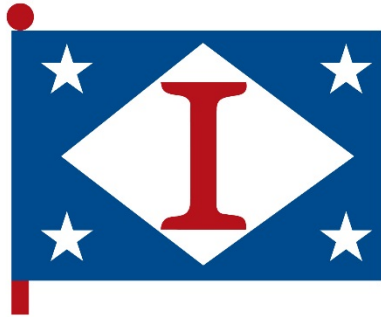


Item No.	Description	Dummy Weight
35	Lightweight Fitting	25
36	Lightweight Fitting	30
37	Lightweight Fitting	35
38	Lightweight Fitting	40
39	1 Hilti Track as bridge between two overhead tracks. Method Mount 806-NG Detail 806D-C	25
40	1 Hilti Track as bridge between two overhead tracks	10
41	Pair of Hilti Track as bridge between two overhead tracks. Method Mount 806-NG Detail 806D-C	25
42	Overhead Track Capacity Test 800 lb dummy mass	100lb/ft
43	Method Mount 808-NG (Flat Bar)	5
44	Method Mount 808-NG (Flat Bar)	10
45	Flat Bar (6.5") attached to Service Holes. Method Mount 825-NG	12
46	Flat Bar (6.5") attached to Service Holes. Method Mount 825-NG	15
47	Flat Bar (9") attached to Service Holes. Method Mount 825-NG (MOD)	12
48	Flat Bar (9") attached to Service Holes. Method Mount 825-NG (MOD)	15
49	Angle Bar attached to Service Holes	10
50	Angle Bar attached to Service Holes	20
51	Method 808-NG (Angle)	5
52	Method 808-NG (Angle)	10



- Workshop to go over results with the relevant Navy Technical Warrants (Flexible Infrastructure, Shock, and Vibration)
- Each Ship will require shock test qualification approval or shock extension approval for each track type (Deck, Bulkhead, Overhead)
- The successful testing of Flexible Infrastructure will support the planned implementation of the bulkhead track on LPD and LHA classes





**Ingalls
Shipbuilding**

A Division of Huntington Ingalls Industries