GM WORLDWIDE ENGINEERING STANDARDS	Test Procedure	GMW17072

Electric Power Steering Gear Hardware in the Loop (HIL) Test Stand General Operating Procedure

1 Introduction

Note: Nothing in this standard supercedes applicable laws and regulations.

Note: In the event of conflict between the English and domestic language, the English language shall take precedence.

1.1 Purpose. To provide general guidelines for the operation of Electric Power Steering (EPS) Gear Hardware in the Loop (HIL) Test Stand.

1.2 Applicability. This test procedure is applicable to any electrically assisted rack and pinion steering system, including column EPS.

1.3 Remarks. This document describes the general operation procedure for conducting a test on the EPS HIL Test stand. This is not a user's guide to the test machine or its control software.

2 References

Note: Only the latest approved standards are applicable unless otherwise specified.

2.1 External Standards/Specifications.

ISO 9001

2.2 GM Standards/Specifications.

GMW17394

2.3 Additional References.

- CarSim software, available from carsim.com
- dSPACE software, available from dspace.org
- Hardware in the Loop (HIL) software, available from Siemens PLM Software
- MTS Systems Corporation, Eden Prairie, MN
- Vehicle Spy software, available from Intrepid Control Systems, Inc.

3 Resources

3.1 Facilities.

3.1.1 Calibration. The test facilities and equipment shall be in good working order and shall have a valid calibration label.

3.1.2 Alternatives. Alternative test facilities and equipment may also be used. However, all measuring variables as specified in this standard shall be determined correctly with respect to their physical definition.

3.2 Equipment.

3.2.1 MTS Systems Corporation EPS HIL test stand.

3.2.2 MTS FlexTest Digital Controller.

3.2.3 PC with MTS 793, and HIL software installed (available from Siemens PLM Software).

3.2.4 dSPACE simulator.

3.2.5 PC with dSPACE, CarSim, and MATLAB software installed.

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3.3 Test Vehicle/Test Piece. This test procedure applies to any electrically assisted rack and pinion steering system, including column EPS.

3.3.1 Parts Required. The following parts are required to test an EPS system:

- Manual, Dual Pinion, or Belt Drive Steering Gear complete with inner and outer tie rods
- I-Shaft (I-Shaft upper and lower mounting screws)
- Steering Column (Column Electric Power Steering (CEPS))
- Output shaft of the steering column for rack assist gears (this part is needed to fabricate adapter to connect input of MTS machine to the I-Shaft)
- Gear Mounting Bolts
- Proper Wire Harness

3.4 Test Time. Time shown is typical per test and per test specimen.

Calendar time:	1 day
Test time:	1 hour
Coordination time:	0.5 hours

3.5 Test Required Information. The plot points X, Y and Z coordinates for inner and outer tie rod design heights and X, Y and Z coordinates for all I-Shaft joints. The correlated vehicle model, including detailed kingpin geometry information, must be supplied by the appropriate expert.

3.6 Personnel/Skills. Operator must be qualified and documented as capable to run this test as required by ISO 9001.

4 Procedure

4.1 Preparation.

Note: Interruption of communication between the MTS controller and the PC may occur when the PC goes into a non-active mode (e.g., Log off, Lock or Sleep), potentially introducing errors in system configurations or settings. It is, therefore, a good practice to perform a complete system reboot on a regular basis or after an extended period of idle. The controller should be rebooted by cycling power after the PC reboots, according to the shutdown procedure available on the PC.

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4.1.1 Software Setup.

4.1.1.1 Launch Station Manager. From the Steer HIL Host PC desktop, click the Station Manager icon, see Figure 1. This icon is found on the PC/desktop as shown in Figure 2.

Figure 1: Station Manager Icon

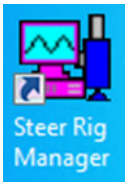
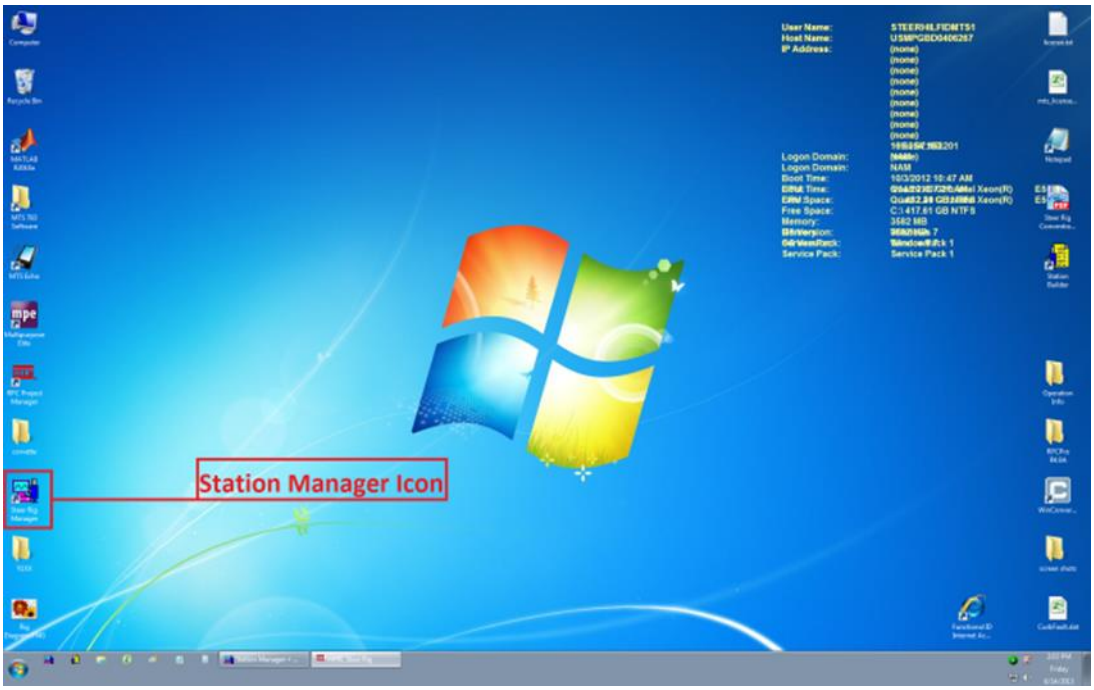


Figure 2: PC Desktop Showing the Station Manager Icon, Station Desktop Organizer Toolbar and Start Station Manager Button



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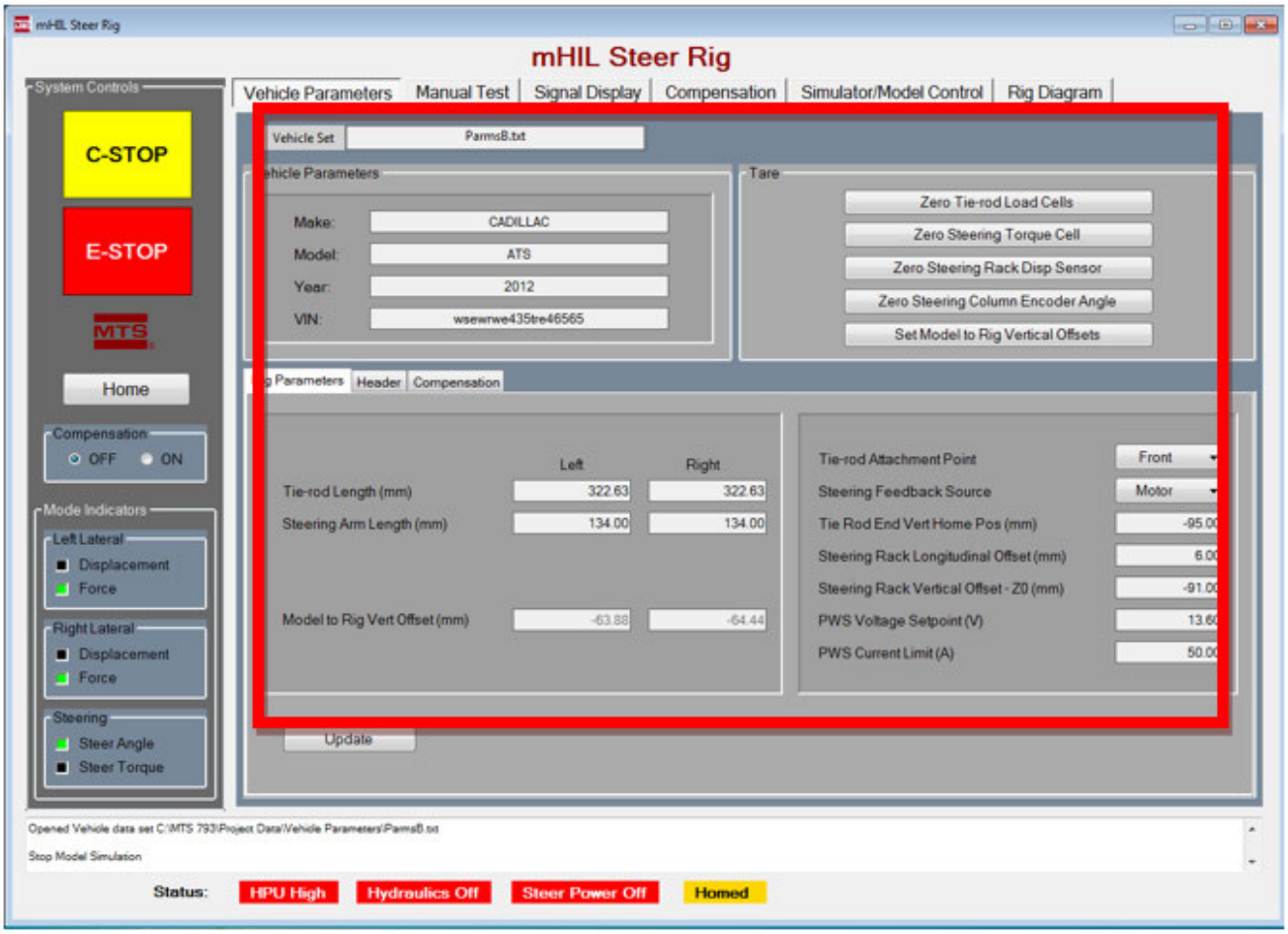
4.1.1.2 Set Up HIL Steer Rig Parameters. After Station Manager boots up, the Station manager "mHIL Steer Rig" window will appear. In the "mHIL Steer Rig" window under the Vehicle Parameters tab shown in Figure 3, enter the required vehicle information and fill in the following specimen parameters:

- Tie Rod Attachment Points
- Steering Feedback Source
- Tie Rod End Vertical Home Position
- Steering Rack Longitudinal Offset
- Steering Rack Vertical Offset
- Power Supply (PWS) Set Point
- PWS Current Limit
- Tie Rod Length
- Steer Arm Length

This information is supplied or obtained from calculations from supplied steering geometry. Click update to apply changes and save parameters to a unique file for the given specimen.

Figure 3: Station Manager "mHIL Steer Rig" Window



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4.1.1.3 Set Up Scopes and Meters. In the MTS Station Manager Window, shown in Figure 4, click on the Meters icon shown in Figure 5.

Figure 4: MTS Station Manager Window

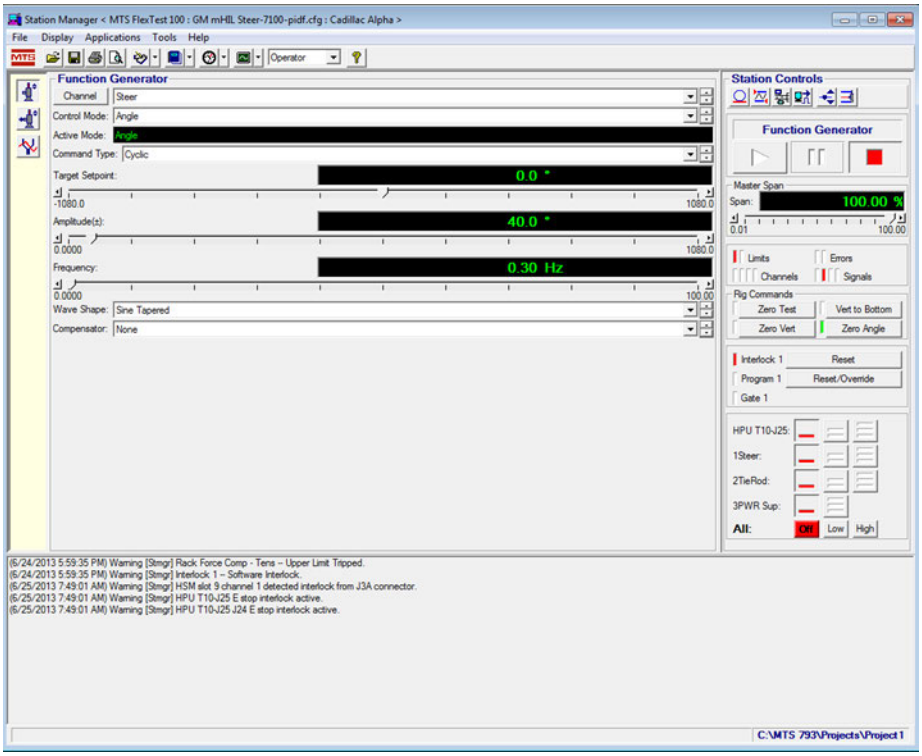
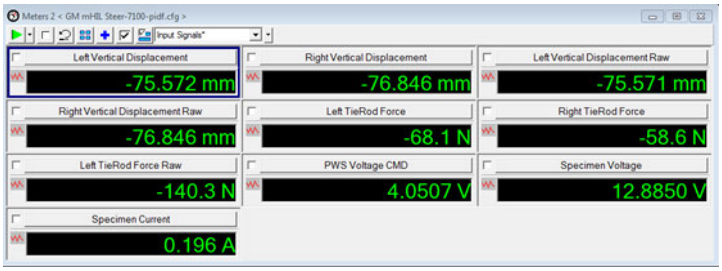


Figure 5: Meters Icon

Set up any meters that may be needed for monitoring test being run. Examples would be meters used to monitor steer angle, steer torque, and tie rod force. An example meter is shown in Figure 6.

Figure 6: Meters



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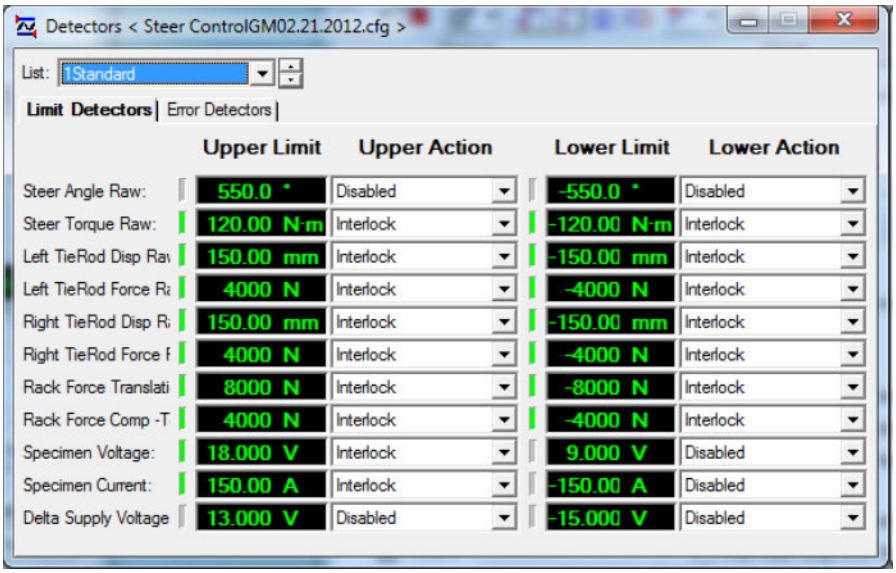
4.1.1.4 Limits To Be Set. The limits, at which faults are detected, open detector window from MTS Station Manager Window (shown in Figure 4), by clicking on Limits icon shown in Figure 7.

Figure 7: Limits Icon

With dialogue box open, examine the limits and adjust appropriately considering the mechanical limits of the test specimen, the limits of the transducers used, and the range over which testing will be performed. The dialog box is shown in Figure 8.

Figure 8: Detector Dialogue Box



4.2 Conditions.

4.2.1 Environmental Conditions. Not applicable.

4.2.2 Test Conditions. Deviations from the requirements of this standard shall have been agreed upon. Such requirements shall be specified on component drawings, test certificates, reports, etc.

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