



Navigation Performance Test

Table of Contents

1 Scope	4
1.1 Purpose..	4
1.2 Foreword.....	4
1.3 Applicability.....	4
2 References	4
2.1 External Standards/Specifications.....	4
2.2 GM Standards/Specifications.	4
2.3 Additional References.	4
3 Resources	4
3.1 Facilities.....	4
3.1.1 Calibration.....	4
3.1.2 Alternatives.	4
3.2 Equipment.	4
3.3 Test Vehicle/Test Piece.....	5
3.4 Test Time.....	5
3.5 Test Required Information.	5
3.6 Personnel/Skills.. ..	5
4 Procedure	6
4.1 Preparation.	6
4.2 Conditions.....	7
4.2.1 Environmental Conditions.....	7
4.2.2 Test Conditions.....	7
4.3 Instructions.	7
4.3.1 Routes.....	7
4.3.1.1 Left Hand Drive vs. Right Hand Drive Regions Routes.	8
4.3.2 Route Calculation Timing.....	8
4.3.3 Navigation Performance Routing on Digitized Road Network.....	9
4.3.3.1 Legal Routing and Impossible Maneuvers.....	9
4.3.3.2 Basic Acoustical Turn by Turn (TBT) Directions on Digitized Road Network.	9
4.3.3.3 Basic Graphical TBT Directions Icons on Digitized Road Network.....	10
4.3.3.4 Highway Exit List.	11
4.3.3.5 Enlarged Intersection Guide – Intersection Auto Zoom.	11

GM Confidential

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September 2013

Page 1 of 26

4.3.3.6 Highway Lane Guidance - Signpost Information ("SignAsReal")	11
4.3.3.7 Extended City Lane Guidance.	12
4.3.3.8 Turn List.	12
4.3.3.9 Estimated Time of Arrival (ETA), Estimated Time En Route (ETE), and Estimated Travel Time (ETT).	12
4.3.3.10 Automatic Reroute.	12
4.3.3.11 Routing Options.....	13
4.3.3.12 Destination via Map.....	14
4.3.3.13 Close by POI/POI Along Route Selection.	14
4.3.3.14 Speech Destination Entry (One Shot Destination Entry).	15
4.3.3.15 Map Modes.....	15
4.3.3.16 Street Names/Number.	16
4.3.3.17 GPS Status Icon.....	16
4.3.3.18 POI Display.	16
4.3.3.19 Bread Crumbs.	16
4.3.3.20 Compass.	16
4.3.3.21 Roundabouts.....	17
4.3.3.22 Manual Detours.....	17
4.3.3.23 Adding Stopovers or Waypoints.....	17
4.3.3.24 Verbal Street Names and Text-to-Speech Performance.	17
4.3.3.25 Speed Limit Display.	18
4.3.3.26 Alert Points – POI Announcer.	18
4.3.3.27 Parking Garage Extended Information.....	18
4.3.3.28 Backwards Driving.....	18
4.3.3.29 Alternate Route Feature.....	19
4.3.4 Navigation Performance Routing on Non-Digitized Roads or Off-Road.	19
4.3.4.1 Route Calculation with Vehicle Position on a Non-digitized Road or Off-Road.....	19
4.3.4.2 Route Calculation with Destinations on a Non-digitized Road or Off-Road.....	19
4.3.4.3 Route Guidance with Vehicle Position on a Non-digitized Road or Off-Road.	19
4.3.5 Vehicle/Map Display Accuracy..	20
4.3.5.1 Normal Drive Scenarios (Map Matching)..	20
4.3.5.2 Repositioning, Parking Garage..	20
4.3.5.3 Stop and Go Driving with Turn Maneuvers.	21
4.3.5.4 GPS Shadowing, Urban Canyon.....	21
4.3.5.5 Forced Loss of GPS Signal.....	21
4.4. Regional Specific Tests.	21
4.4.1 General Motors North America (GMNA) Tests.....	21
4.4.1.1 OnStar Destination Download.....	21
4.4.1.2 XM Traffic/Weather/Stock.	22

GM Confidential

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September 2013

Page 2 of 26

4.4.1.3 XM Traffic Dynamic Rerouting.	22
4.4.2 General Motors Europe (GME) Tests.	23
4.4.2.1 Traffic Message Channel (TMC).	23
4.4.2.2 TMC Dynamic Rerouting.	23
4.4.3 General Motors Korea (GMK) Tests.	23
4.4.3.1 Transport Protocol Expert Group (TPEG) Function Test.	23
4.4.3.2 TPEG Traffic Dynamic Rerouting.	23
4.4.4 Other Regions Special Test Section.	24
4.5. HMI Subjective Overall Performance.	24
4.5.1 Startup time.	24
4.5.2 HMI Reaction Time/Speed of System.	24
4.5.3 Search Time.	24
5 Data.	24
5.1 Calculations.	24
5.2 Interpretation of Results.	24
5.3 Test Documentation.	25
6 Safety.	25
7 Notes.	25
7.1 Glossary.	25
7.2 Acronyms, Abbreviations, and Symbols.	25
8 Coding System.	26
9 Release and Revisions.	26

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September 2013

Page 3 of 26

1 Scope

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. The purpose of this test procedure is to exercise the Navigation System at the vehicle level as part of the overall validation plan. This procedure will include a variety of tests designed to verify vehicle level compliance.

1.2 Foreword. This test is intended to test the functionality of the Navigation System at the vehicle level. This test is not intended to test the map database or navigation disk.

1.3 Applicability. This procedure is applicable to all GM integrated navigation radio systems.

2 References

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

2.1 External Standards/Specifications.

None

2.2 GM Standards/Specifications.

GMW14264

2.3 Additional References.

- CG3438 – Navigation Datasheet
- Component Technical Specification (CTS)
- Global Infotainment Standard (GIS)-320, Navigation Functional Requirements
- GIS-322, Navigation and Global Positioning System (GPS) Performance Requirements
- GIS-400, Human Machine Interface (HMI) Specification
- GIS-406, Form and Behavior Specification Cluster and Heads-up Display (HUD)
- OTS29284, OnStar Technical Specification

3 Resources

3.1 Facilities. This test is to be performed on the road and test tracks as determined by the specified regions identified in the separate Navigation Datasheet CG3438.

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.

- Laptop computer, one (1) per vehicle. In order to review and document the driven route all way data shall be traced by a notebook with an appropriate map data program connected to a GPS receiver
- Serial data tool (Mobile Operations Center for Communication and Analysis (MOCCA) (Media Oriented System Transport (MOST) tool), test and development software tool (CANoe), vehicle network tool (neoVI), Serial Interface Adapter (VSI), etc.)
- Three (3) video cameras and recording equipment
- Camera mounting hardware
- Power supplies for cameras and laptop
- Extension cables
- Jump style battery charger
- Multimedia (iPod, compact disc (CD), music player (MP3) or universal serial bus (USB) stick with audio/picture files)

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September 2013

Page 4 of 26

- Navigation System under test. The Navigation System shall be in a production ready state and have passed all applicable component level tests and shall be programmed for the tested vehicle. System shall have the ability to access the Navigation System Display Engineering Diagnostic Screen
- Navigation System spare units and test software (SW), as backup

3.3 Test Vehicle/Test Piece. Not applicable.

3.4 Test Time.

Calendar time: 5 days

Test hours: 40 hours

Coordination hours: Not applicable

Note: It is expected that there will be development and validation phases of executing this procedure.

In general, a test time of 5 days to cover the listed test cases is sufficient for a best case test scenario. Repeated tests for Electrical Software Issue Management System (ESIMS) verification or follow up checks also including error reporting and overall ESIMS handling depending on severity of discovered issues, will increase the time required for testing and should be considered when reserving vehicle time.

Any additional test time requirements shall be listed in each regional CG datasheet.

3.5 Test Required Information.

The following basic information shall be recorded for each of the test vehicles into the CG3438 datasheet(s) prior to testing:

- Vehicle make and model
- Vehicle Identification Number (VIN)
- Other key vehicle reference information
- Navigation System part number, software and CalFile part numbers
- Map database supplier name, version number and compile version
- Applicable telematics system and SW versions (OnStar, XM, etc.)
- Phone based Navigation System: Phone model number, application version and name (where applicable)
- Antenna part number
- Start of test (SOT) time
- End of test (EOT) time
- Tire pressure
- Tire size

During and/or after the test, all the individual scores per test case, a short issue description in case of non-conformances, as well as the number of resets and/or lockups during the test period, will be recorded in the datasheet (CG3438).

3.6 Personnel/Skills. The test personnel should have a working knowledge of computers, vehicle bus interface tools, camera equipment, and a fundamental understanding of Navigation Systems and the OnStar interface for destination download. The test personnel should be thoroughly familiar with the test routes and the Navigation System for their specific test region to ensure each test is performed with high quality, complete results. The driver must possess a valid driver's license and have the ability to drive (or have a designated individual to drive) vehicles equipped with manual or automatic transmissions, and shall have the ability to follow the optical and acoustical driving instructions given by the Navigation System. If any region is not able to validate a particular vehicle model that has not been approved for road usage, then an appropriate development vehicle should be used to execute this procedure.

Test personnel shall be familiar with the application of the Subjective Rating Scale (formerly known as the General Motors Uniform Test Specification Scale) method.

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Page 5 of 26

4 Procedure

4.1 Preparation.

4.1.1 Before any road test is performed the main functionality like destination input, map and turn by turn display and voice output needs to be checked at the bench.

4.1.2 Prior to test, start the vehicle to power up the Navigation System and verify proper operation in a known area.

4.1.3 Ensure proper calibrations are loaded for each test region.

4.1.4 Verify that the latest full coverage map data for the test region is available and used for test.

4.1.5 Verify that GPS data acquisition is functioning either by diagnostic trouble code (DTC) verification or direct display icon indication.

4.1.6 Verify voice recognition is active and functional with any convenient voice command.

4.1.7 Verify that telematics modules (if applicable) (i.e., OnStar, XM, etc.) are activated and fundamentally functional.

4.1.8 Verify proper wheel speed signal by monitoring the appropriate GM Local Area Network (GMLAN) message(s).

Note: DTCs shall be checked and cleared if necessary. If any radio related DTCs are set and cannot be cleared, the problem(s) shall be corrected before the test is run. Where applicable, clearing error memory buffers by suppliers prior to drive is recommended.

4.1.9 Check tire pressure and adjust if necessary to recommended pressures.

4.1.10 Set up camera(s) and recording equipment. A minimum of one camera with a view of the navigation display is to be set up, a second camera is to be positioned with a forward view of the road, a third camera for cluster display where navigation related content is displayed, and a fourth camera, where applicable and possible, to record a HUD image.

Set up an input to the video recording equipment from a laptop computer or GPS antenna/controller area network (CAN) logger to monitor GPS signal, wheel speeds, steering wheel angle and any additional information as needed.

4.1.11 The evaluation datasheets are to be distributed electronically to each vehicle and associated participant's laptop. An alternative way is to record the results on a latest printout of a local paper copy to later transfer on the electronic version.

4.1.12 The participants of the test/validation drive are informed of the procedure/execution and distance.

4.1.13 Each participant is familiar with the Subjective Rating Scale in Table 1. (Reference GMW14264.)

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Page 6 of 26

Table 1: Radio Performance Subjective Rating Scale

Subjective Rating Scale	
Rating	
10	Not Noticeable Even by Trained Auditor
9	Noticeable Only by Trained Evaluators
8	Noticeable by Critical Customers
7	Noticeable by All Customers
6	Rated Disturbing by Some Customers
5	Rated Disturbing by All Customers
4	Rated as Intolerable by Critical Customers
3	Rated as Intolerable by All Customers
2	Perceived as Potential Loss of Vehicle Function
1	Perceived as Potential Safety Issue
0	Not Applicable (Component cannot be rated, not functioning, missing, etc.)

Note: For any of the conditions above that are not performing as expected, test engineer shall assess and discuss design release engineer (DRE) to reach an agreement if the procedure (or any part of it) should continue to be executed.

4.2 Conditions.

4.2.1 Environmental Conditions. Environmental conditions will be recorded as part of the video recording. Loss of GPS, road conditions with low traction should be noted separately on the test reports.

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.

4.3 Instructions.

4.3.1 Routes. A set of test routes are to be used to evaluate as many scenarios as possible without the need for additional extra tests. Those routes are to be set up for each of the regions to cover as many of the below tested functions and scenarios within that test route.

The following is a comprehensive list of all dynamic navigation functions to be covered for the navigation performance test; however, some test conditions may not apply to all systems and not on all routes depending upon the route location and destinations chosen. For any conditions that do not apply, record not applicable (N/A) in the appropriate column(s) on the datasheet (CG3438) with reasoning. For any of the conditions that cannot be covered during a route test a separate test has to be conducted.

The following destination types shall be used as route locations (each type applicable if the feature is supported by the system):

- Address Entry – full address, intersection, street only, city only
- Point of Interest (POI) Entry – by category, name, phone number
- POI Search – distance and direction to current location, along route, other location
- Destination via Map

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September 2013

Page 7 of 26

- Destination via coordinate destinations – Latitude/Longitude
- Downloadable destinations (D-POI, MyPOI, etc.)
- Downloadable destinations via OnStar
- Tours/Waypoints
- My Home

Note: Stress tests/conditions to be induced during tests: To stress the system the following tasks shall be performed periodically while in active route, as well as simultaneously during startup phase while the system gathers data for the XM Traffic and Weather features.

- Play audio from external media source
 - If system has multiple USB ports utilize all ports with individual USB sticks of different content
- Need to ensure indexing for digital audio media is being executed for each test that is “load” critical.

4.3.1.1 Left Hand Drive vs. Right Hand Drive Regions Routes.

Performance requirement: Test is passed if right hand drive guidance behavior is correctly adapted to left hand drive.

Objective: All cases that apply for right hand drive tests have to be verified as well for left hand drive test situations.

Test cases: For left hand drive scenarios the same principles apply as for right hand drive scenarios.

4.3.2 Route Calculation Timing.

Performance requirements: GIS-322-007 Route Calculation Timing Requirements.

Objective: Verify that route calculation is possible in several situations and in an adequate time frame.

Test cases: Destinations shall be entered manually or via previously added destinations in address if the system has no previous stored information.

Execution: As destinations are entered during the navigation test sequence, record the time to obtain the first turn instructions after initiating the route calculation.

Record a passing score if the instructions were available per the GIS Performance requirements.

Enter destinations as:

- Short (30 km to 80 km (20 mi to 50 mi))
- Intermediate (300 km to 800 km (200 mi to 500 mi))
- Far destinations (3000 km to 8000 km (2000 mi to 5000 mi))
- Entering multiple waypoint destinations (trips). (Where possible, focus is on short and intermediate distances).

Measurement shall start once route is initialized via a **Start Guidance/Go** button and shall stop when first acoustical driving recommendation is audible. Target value to get a route displayed and driving instructions issued is 1 s. Penalty added for every additional 2 s. Higher values result in worse rating.

- Worst case scenario: System is restarted after the communication bus shows no further activities and the Navigation System has entered the sleep mode. Destinations shall be entered and immediately after the **Start Guidance/Go** button is pressed. Additional multimedia load shall be put on the system by connecting and using either an iPod (or other supported similar device), CD MP3, or USB stick with audio/picture files during this test. During this time the vehicle shall be driven so that the map Car Vehicle Position (CVP) graphic is forced to be updated. In map display, zoom in and out functions shall be performed. This procedure shall be done while XM Traffic and Weather data is still downloading/decoding in the background to force additional software application loads drawing processing power. Target value for worst case scenario to get a route displayed and driving instructions issued is 3 s. Penalty added for every additional 2 s. Higher values result in worse rating.

Note: Ensure indexing for digital audio media is being executed for each test that is “load” critical. Route calculation performance in off-road situations (either vehicle position being off-road or destination entered being off-road destinations) will be covered in 4.3.4.1 and 4.3.4.2.

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Page 8 of 26