



Telematics System – Subjective Hands Free Phone Performance Test

1 Scope

Note: Nothing in this standard supersedes 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 intent of this test procedure is to evaluate the speech quality exhibited by a Telematics System Cellular Phone.

1.2 Foreword. An expert listener places a phone call using the in-vehicle Telematics System to another expert listener. The listeners subjectively evaluate the quality of the phone call.

1.3 Applicability. This test procedure is applicable to vehicles with Telematics 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.

None

2.3 Additional References.

- CG190, GM Evaluation Report.
- CG2252, Telematics System Subjective Hands Free Performance Test Data Sheets, Appendices E and F.
- GIS-4A, Revision 4.3, Global A Infotainment Chime, Volume, and Tone Audio Processing Requirements.
- ITU-T Series P: Telephone Transmission Quality, Telephone Installations, Local Line Networks. Transmission Characteristics and Speech Quality Parameters of Hands-Free Terminals, P.340 (05/2000).

3 Resources

3.1 Facilities. Office with analog and digital telephones. Public roads.

3.2 Equipment.

3.2.1 Hands-Free Land-Line Station.

3.2.1.1 Personal computer and sound card.

3.2.1.2 Telephone auto-coupler.

3.2.1.3 Audio amplifier.

3.2.1.4 Land line phone.

3.2.1.5 Speech recording software.

3.2.1.6 Three Bluetooth enabled cellular phones.

3.2.1.7 Telematics System Performance Qualities and Suggested Exercises, Appendix A.

3.2.1.8 List of Phonetically Balanced Sentences, Appendix C.

3.2.1.9 List of Minimal Pair Words, Appendix D.

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3.2.2 Optional Equipment.

3.2.2.1 Wireless Protocol Analyzer. This device allows the user to monitor the communications link between the vehicle Telematics/Infotainment system and any wireless phone paired to it. In the event that distorted downlink speech is detected in the vehicle, the test conductor can utilize this tool to identify if the distortion is caused by the infotainment system, the wireless phone or the network.

3.3 Test Vehicle/Test Piece. The test vehicle must be as close to production intent as possible. In addition, the following items must be production-intent and are a minimum requirement to perform the test:

- Telematics Module.
- Microphone type, packaging and location.
- Microphone should exhibit a nominal frequency response.
- All cables, including their positioning, type, and length.
- Vehicle interior/exterior components and materials.
- Audio system.
- Cellular antenna.

3.3.1 Vehicle should be driven to determine if it can be used for validation testing. Vehicle should:

- Have minimal squeak and rattle.
- Be acoustically sound.
- Have reliable brakes.
- Have tight-fitting wind and door seals.

3.4 Test Time.

Calendar time: 4 days

Test hours: 24 hours

Coordination hours: 8 hours

3.5 Test Required Information. Prior to testing the applicable Telematics system, the vehicle component information shall be entered into the Telematics System Subjective Hands Free Performance Test Data Sheet, page 1. Refer to CG2252, Appendix F.

3.6 Personnel/Skills. Two expert listeners will assess performance. They will evaluate performance on each end of the phone connection. Expert listeners are people who have experience in identifying and diagnosing the cause of audio impairments.

4 Procedure

4.1 Preparation.

4.1.1 Acoustic Tuning. Telematics System and Audio System acoustic tuning must be completed prior to this testing.

4.1.2 Volume Validation. Volume tuning must be completed prior to this testing.

4.1.3 Vehicle Setup.

4.1.3.1 All windows and doors must be completely shut.

4.1.3.2 Install a nominal sensitivity microphone.

4.1.3.3 All necessary equipment must be secured so that no squeaks or rattles are audible.

4.1.3.4 All unnecessary equipment, personnel, and items must be removed from the car.

4.1.3.5 The sunroof, if present, must be closed, including the carpet or pullover.

4.1.3.6 Telematics system must be functional with a working telephone number assigned to it.

4.1.3.7 Phone numbers of the other end points must be readily available so as to be easily located while driving.

4.1.3.8 Exterior vehicle camouflage must be secure to minimize wind noise.

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4.1.3.9 Measure the distance from the integrated vehicle microphone (IVM) to the mouth reference point (MRP) of the driver. Record the measurement in the data sheet located in CG2252, Appendix F.

4.1.3.10 Measure the seat position relative to the full front setting. Record the distance in the data sheet located in CG2252, Appendix F.

4.1.4 Far End Recording Device.

4.1.4.1 The phone call recording device must be powered and ready to record the conversation between the expert listeners.

4.1.4.2 The far end recording location should be a quiet office or conference room where only the conversation with the vehicle is taking place. This type of office atmosphere promotes easier listening.

4.1.4.3 Scoring data sheets should be placed at the recording location.

4.2 Conditions.

4.2.1 Environmental Conditions. The test should be performed during relatively clear atmospheric conditions. The test cannot be performed during periods of precipitation that drastically increase the ambient noise in the vehicle, i.e., extremely heavy rain elevates the noise levels in the vehicle to a point at which testing cannot be performed.

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. This test is made up of two parts:

- Part 1 – Hands Free Speech Quality Evaluation
- Part 2 – Wireless Communications Link Interior Interference Evaluation

4.2.2.1 Part 1 – Hands Free Speech Quality Evaluation. The vehicle is driven under normal operating conditions and the speech quality is evaluated. Table 1 identifies the vehicle conditions that will be used during this portion of the procedure. This part is performed on Embedded Telematics Systems and Bluetooth Enabled Telematics Systems. CG2252 - Appendix E is the Test Plan and it contains verbal exercises and listening instructions for the test conductors. CG2252 - Appendix F are the data sheets. Expert listeners will also perform informal testing of other test conditions to identify major problems with:

- High receive direction (Rx) volume.
- Changes in Rx volume.
- Driving with driver's window down 5 cm (2 in).
- Etc.

4.2.2.2 Part 2 – Wireless Communications Link Interior Interference Evaluation (Wireless Enabled Systems Only, i.e., Bluetooth, 802.11 Wireless). In a stationary vehicle, a wireless phone is paired to the infotainment system and then a call is placed to a continuous speech server. The wireless phone is moved to several locations in the vehicle while the test conductor listens to the incoming speech quality. This part is conducted with three wireless phones and test results are recorded in CG2252 - Appendix G.

4.2.2.3 Embedded Telematics System Recommendations. Embedded telematics systems, like OnStar, have a Network Access Device (NAD), built into them. The NAD is the cellular phone transmitter and receiver. For this type of system, it is recommended that the number of far end cell phones tested be equal to the number of distinctly different cellular networks in the projected target sale market. For example, in the Detroit, Michigan area there are three distinctly different networks.

1. Verizon, CDMA 2000 network
2. AT&T, GSM network
3. Sprint, PCS network

Because there are three unique networks, three far end cell phones should be used for validation, one from each network.

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Table 1: Hands Free Speech Quality Test Conditions

Condition	Near End (Vehicle Side)		Near End (Vehicle Side)		Far End
	Vehicle Speeds (km/h)	HVAC Settings	Receive Volume (in vehicle)	Vehicle Side Cellular Phone/s	Terminal Equipment (recommended)
1	Idle	Defrost/ Fan Minimum	Preferred Listening Level	Device Under Test (DUT)	1. Land Line 2. Cell Phones 3. Vehicle
2	Idle	Defrost/ Fan Minimum	Comfortable Maximum Listening Level	DUT	1. Land Line 2. Cell Phones 3. Vehicle
3	70 km/h	Defrost/ Fan Minimum	Preferred Listening Level	DUT	1. Land Line 2. Cell Phones 3. Vehicle
4	70 km/h	Defrost/ Fan 80%	Preferred Listening Level	DUT	1. Land Line 2. Cell Phones 3. Vehicle
5	115 km/h	Defrost/ Fan Minimum	Preferred Listening Level	DUT	1. Land Line 2. Cell Phones 3. Vehicle 4. Speech Server
6	115 km/h	Vent Mode/ Recirc ON/ Fan Maximum	Preferred Listening Level	DUT	1. Land Line 2. Cell Phones 3. Vehicle 4. Speech Server

4.2.2.4 Bluetooth Enabled Telematics System Recommendations. Bluetooth Enabled Telematics Systems do not have an embedded NAD. This type of system utilizes a Bluetooth communications link to pair to a Bluetooth enabled cellular phone. Once paired, the Bluetooth Telematics system uses the Bluetooth cellular phone to establish a phone call. Care should be taken when choosing the cellular phones for the validation so that testing is accomplished using popular, high volume phones. Each additional Bluetooth phone tested will be documented on a separate CG2252 – Appendix F data sheet.

4.2.3 False Speech Recognition Triggers on Far End Servers. The Telematics System should be evaluated for false speech recognition triggers on far end servers. This means that the Telematics System in the vehicle should not incorrectly trigger far end speech recognition systems when the vehicle encounters rough road surface conditions. Evaluation of this condition is performed by driving the vehicle over rough road surfaces while using a far end server with speech recognition. If the far end speech recognition system does not trigger while driving over rough surfaces the system meets the requirements.

4.3 Instructions. This procedure utilizes the test plan and data sheets provided in CG2252 – Appendices E, F, and G.

4.3.1 Part 1 - Hands Free Speech Quality Performance.

4.3.1.1 Test Plan. Begin the test by using CG2252 - Appendix E as a guide to prepare the vehicle and Telematics System for each condition in Table 1.

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4.3.1.2 Scoring. Expert listeners will grade the near side and far side performance of several phone calls as they progress through the test plan in Appendix E. The scores will be recorded for each of the performance criteria identified in the CG2252 - Appendix F data sheet.

4.3.1.3 Land Line Far End. For conditions where the Land Line is the far end, only one “overall” grade will be given for each of the performance criteria in the Appendix F data sheet. The “overall” grade will be based upon the performance across all operating conditions in Table 1. CG2252 – Appendix F is utilized to document performance.

4.3.1.4 Cellular Phone, Vehicle, or Speech Server Far End. For conditions where the far-end terminal is a Cellular Phone, Vehicle, or Speech Server a pass/fail score will be entered based on basic usability of the system across all operating conditions in Table 1. CG2252 – Appendix F is utilized to document performance.

4.3.1.5 Generate GM Evaluation Report (CG190).

4.3.2 Part 2 – Wireless Communications Link Interior Interference Evaluation.

4.3.2.1 Test Plan. Begin this part of the test by using CG2252 - Appendix G as a test plan.

4.3.2.2 Scoring. The scoring scale is included on CG2252 – Appendix G at the top of each page.

5 Data

5.1 Calculations. The procedure is subjective and no calculations are required.

5.2 Interpretation of Results. All performance qualities shall be judged on a 5-point Mean Opinion Score (MOS) rating. Definitions of the rating with respect to the individual levels are attached in Appendix B.

5.3 Test Documentation. Results will be reported using CG2252 - Telematics System Subjective Hands Free Performance Test Data Sheets – Appendices E, F and G. Recordings will be stored for auditing later.

6 Safety

This standard may involve hazardous materials, operations, and equipment. This standard does not propose to address all the safety problems associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

7 Notes

7.1 Glossary. Not applicable.

7.2 Acronyms, Abbreviations, and Symbols.

AMPS	Advanced Mobile Phone Service
CDMA	Code Division Multiple Access
CTIA	Cellular Telecommunications Industry Association
DR	Detection Rate
ERP	Ear Reference Point
GIS	Global Infotainment Standard
GSM	Global System for Mobile Communication
HATS	Head and Torso Simulator
HF	Hands Free
ITU	International Telecommunications Union
ITU-T	ITU Telecommunications Division
IVM	Integrated Vehicle Microphone
IVMRP	Integrated Vehicle Microphone Reference Point
LS	Land Side
MOS	Mean Opinion Score
MRP	Mouth Reference Point

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N/A	Not Applicable
NAD	Network Access Device
PCS	Personal Communications Service
RCAT	Recorded Conversation Analysis Tool
RR	Recognition Rate
Rx	Receive Direction (LS -> VS)
SPL	Sound Pressure Level
SRR	Stress Recognition Rate
TCU	Telematics Control Unit
Tx	Transmit Direction (VS -> LS)
VCP	Vehicle Communications Processor (same as TCU)
VDA	Verband der Automobilindustrie (German Automobile Industry Standards Organization)
VS	Vehicle Side
WL	Wireless

7.3 Appendix Notes.

7.3.1 At the End of this Procedure.

Appendix A:	Telematics System Performance Qualities and Suggested Exercises
Appendix B:	Rating Levels
Appendix C:	Phonetically Balanced Sentences
Appendix D:	Minimal Pair Words

7.3.2 In CG2252 Procedure.

Appendix E:	CG2252 – Hands Free Performance Validation Test Plan. (Test Plan Sheets 1 thru 4)
Appendix F:	CG2252 – Hands Free Phone Call Performance Evaluation. (Data Sheets)
Appendix G:	CG2252 – Wireless Phone Interior Interference Evaluation. (Data Sheets 1 thru 5)

8 Coding System

This standard shall be referenced in other documents, drawings, etc., as follows:
Test to GMW15997

9 Release and Revisions

This standard was originated in July 2008. It was first approved by Infotainment/Telematics Performance of Electrical Development/Validation in September 2008. It was first published in October 2008.

Issue	Publication Date	Description (Organization)
1	OCT 2008	Initial publication.
2	DEC 2010	Various content and table revisions. (Electrical Dev/Val)
3	OCT 2011	Additional content revisions. (Electrical Dev/Val)

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