INCH - POUND

MIL-PRF-71196 (AR)
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PERFORMANCE SPECIFICATION

SENSOR, VEHICLE MOTION

This specification is approved for use by the U.S. Army Armament Research, Development and Engineering Center, and is available for use by all Departments and Agencies of the Department of Defense.

1. SCOPE

1.1 Scope. This specification covers the requirements, examinations and tests for the Vehicle Motion Sensor (VMS) used in conjunction with a Dynamic Reference Unit (DRU)/Dynamic Reference Unit Hybrid (DRU-H) or other navigation device (see 6.1).

2. APPLICABLE DOCUMENTS

2.1 General. The documents listed in this section are specified in sections 3 and 4 of this specification. This section does not include documents in other sections of this specification or recommended for additional information or as examples. While every effort has been made to ensure the completeness of this list, document users are cautioned that they must meet all requirements documents cited in sections 3 and 4 of this specification, whether or not they are listed.

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document, should be addressed to: Commander, U.S. Army TACOM-ARDEC, ATTN: AMSTA-AR-QAW-E, Picatinny Arsenal, New Jersey 07806-5000 by using the Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

AMSC N/A **FSC** 1290

DISTRIBUTION STATEMENT A. Approved for public release; distribution is unlimited.

2.2 Government documents.

2.2.1 Specifications, standards, and handbooks. The following specifications, standards, and handbooks form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those listed in the issue of the Department of Defense Index of Specifications and Standards (DODISS) and supplement thereto, cited in the solicitation (see 6.2).

SPECIFICATIONS

DEPARTMENT OF DEFENSE

MIL-C-53072	-	Chemical Agent Resistant Coating (CARC) System Application Procedures and Quality Control Inspection

STANDARDS

FEDERAL

FED-STD-595	-	Colors Used in Government Procurement

DEPARTMENT OF DEFENSE

MIL-STD-108	-	Definitions of and Basic Requirements for Enclosures for Electric and Electronic Equipment
MIL-STD-129	-	Standard Practice For Military Marking
MIL-STD-331	-	Fuze And Fuze Components Environmental And Performance Tests For
MIL-STD-461	-	Requirements for the Control of Electromagnetic Interference Characteristics of Subsystems and Equipment
MIL-STD-810	-	Environmental Engineering Considerations and Laboratory Tests
MIL-STD-1916	-	DOD Preferred Methods for Acceptance Of Product

(Unless otherwise indicated, copies of the above specifications, standards, and handbooks are available from the Standardization Documents Order Desk, 700 Robbins Avenue, Bldg. 4D, Philadelphia, PA 19111-5094.)

2.2.2 Other Government documents, drawings, and publications. The following other Government documents, drawings, and publications form a part of this document to the extent specified herein. Unless otherwise specified, the issues are those cited in the solicitation.

DRAWINGS (see 6.3)

U.S. ARMY ARMAMENT RESEARCH, DEVELOPMENT AND ENGINEERING CENTER (ARDEC)

12927632	-	VMS Assembly
MS27468	-	Connector, Receptacle, Electrical, Jam Nut Mounting, Crimp Type, Bayonet Coupling, Series I

(Copies of other Government documents, drawings, and publications required by contractors in connection with specific acquisition functions should be obtained from U.S. Army TACOM-ARDEC, AMSTA-AR-QAW-E)

2.3 Non-Government publications. The following document(s) form a part of this document to the extent specified herein. Unless otherwise specified, the issue of documents, which DOD adopted are those listed in the issue of the DODISS cited in the solicitation. Unless otherwise specified, the issue of documents not listed in the DODISS are the issues of the documents cited in the solicitation (see 6.2).

TELECOMMUNICATIONS INDUSTRY ASSOCIATION

EIA-TIA422	-	Electrical Characteristics of Balanced Voltage Digital Interface Circuits

(Copies are available from the TIA, Standards and Technology Dept. 2500 Wilson Blvd, Arlington, VA 22201.)

AMERICAN SOCIETY OF TESTING AND MATERIALS

ASTM G21	-	Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi

(Copies are available from ASTM, 100 Barr Harbor Drive, West Conshohocken, Pennsylvania, USA 19428-2959)

2.4 Order of precedence. In the event of a conflict between the text of this document and the references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

3. REQUIREMENTS

3.1 Design verification. When specified in the contract, a sample of the VMS shall be subjected to design verification in accordance with 4.2.

3.2 First Article. When specified in the contract order (see 6.2), a sample shall be subjected to first article inspection in accordance 4.3.

3.3 Interface requirements. The VMS shall meet the requirements specified herein when operated at shaft speeds within the range of 0 to 1400 rpm, forward or reverse.

3.3.1. Electrical interface requirements.

3.3.1.1. Shield grounding. The connector on the VMS shall be such that it will allow the inner shields and outer shields of the mating cable to be grounded through the backshell of the mating connector. Mating connectors are defined on drawing 12927632.

3.3.1.2. Input power. The VMS shall operate from on input power within 5 ± 0.25 VDC power with peak to peak ripple up to 300 mV from DC to 20 MHz. The related requirements below also apply:

a. The VMS shall not require more than 2.5 watts at 5 VDC.

b. The DC returns, J1, pins 18 and 30, per 12927632, shall be isolated from chassis ground.

c. The VMS shall not be damaged by and shall operate after exposure to short circuits to ground of the power voltage.

d. The VMS shall not be damaged by and shall operate after any power voltages within the range of 0 to +6.0 VDC.

3.3.1.3 Signal interface requirements.

3.3.1.3.1. Digital. Data shall be transferred between the VMS and a control device via digital (two-state) signal circuits. Data shall be formatted as pulse trains (odometer signals) and discrete signals (BIT Commands). Digital signal pin assignments shall be in accordance with 12927632. All digital signal circuits shall be balanced differential voltage circuits in accordance with EIA Standard TIA/EIA-422. All line drivers shall comply with the generator electrical characteristics specified in TIA/EIA-422. All receivers shall comply with the requirements of TIA/EIA-422 with the following changes:

a. The common mode voltage range shall be -15 to +15 volts.

b. Over the entire common mode voltage range, the receiver shall not require a differential input voltage of more than 500 millivolts to correctly assume the intended binary state.

c. The maximum voltage (signal plus common mode) present between either receiver input terminal and receiver circuit ground shall not exceed 18 volts in magnitude nor cause the receiver circuit to operationally fail.

d. The allowable input current versus input voltage characteristics shall be extended as follows:

Input Voltage Range	Input Current Range
-18 to -10 Volts	0 to -3.25 ma
+10 to +18 Volts	0 to +3.25 ma

e. Over the entire common mode voltage range, the balance of the receiver input voltage-current characteristics and bias voltages shall be such that the receiver will remain in the intended binary state when a differential voltage of 1,000 millivolts is applied through 500 ohms ± 1 percent to each input terminal.

The VMS shall not be damaged or malfunction when signal circuits are connected or disconnected with power on or off. BIT 1 and BIT 2 inputs shall be internally terminated with 120 Ohm resistors connected between the "Hi" and "Lo" lines.

3.3.1.3.2 Logic levels. A binary "1" or "set", condition shall be represented by a positive voltage on the "Hi" line with respect to the "Lo" line in accordance with 12927632. A logic "0" or "reset" condition shall be represented by a positive voltage on the "Lo" line with respect to the "Hi" line.

3.3.2 Mechanical interface requirements.

3.3.2.1 Mechanical breakaway torque. The mechanical breakaway torque of the shaft shall not exceed 2.0 ounce-inches.

3.3.2.2 Mechanical damping. Shaft rotation shall be damped such that a sinusoidal vibration input in any of three mutually perpendicular axes, at a constant amplitude of 1/32 inch peak to peak from 5 - 56 Hz, and a constant 5 g's from 56 to 200 Hz does not cause any signal indication (forward or reverse pulses) when the shaft is unrestrained.

3.3.2.3 Inertia. The VMS inertia (measured at the shaft) shall be 0.0037 ± .0031 inch-ounce-seconds^2.

3.3.2.4 Weight. The weight of the VMS shall not exceed 6 pounds.

3.3.2.5 Dimensions. The dimensions of the VMS shall be as shown on 12927632.

3.3.2.6 Mechanical drive. The interface to the mating mechanical drive cable shall be as shown on 12927632.

3.3.3 Operational interface requirements.

3.3.3.1 Operation. The VMS shall provide forward and reverse pulse outputs with a 32:1 ratio of electrical pulses to shaft rotation cycles. The VMS shall produce 1 pulse for every 11.25° of rotation of the shaft. Pulses shall be 800 ± 80 microseconds in width. The VMS shall determine forward or reverse vehicle motion and shall output pulses on the appropriate forward or reverse signal link.

3.3.3.2 Built-In-Test. The VMS shall provide BIT capability that can detect ninety-five percent of the total of the malfunctions that occur in the VMS. The VMS shall perform BIT when directed according to the command logic given in Table I. If the BIT does not detect any malfunction, the VMS shall provide the output pulse train responses given in Table I. Malfunction of the VMS shall be indicated by pulse train responses other than those given in Table I.

TABLE I. BUILT-IN-TEST

DISCRETE INPUT		VMS OUTPUT (PULSES/SEC)	
BIT COMMAND 1	BIT COMMAND 2	FORWARD	REVERSE
1	0	355 ± 53	0
0	1	0	355 ± 53
1	1	0	0
0	0	Normal Operation	

3.3.3.3 Odometer reversal jumper. The VMS shall meet the following requirements.

a. With no jumper between pins 7 and 8 of the connector mating with J1, counterclockwise rotation of the shaft, when viewed from the shaft extension end, shall produce output pulses on pins 3 and 4.

b. With no jumper between pins 7 and 8 of the connector mating with J1, clockwise rotation of the shaft, when viewed from the shaft extension end, shall produce output pulses on pins 5 and 6.

c. With a jumper connected between pins 7 and 8 of connector mating with J1, clockwise rotation of the shaft, when viewed from the shaft extension end, shall produce output on pins 3 and 4.

d. With a jumper connected between pins 7 and 8 of the connector mating with J1, counterclockwise rotation of the shaft, when viewed from the shaft extension end, shall produce output pulses on pins 5 and 6.

3.4 Environmental requirements.

3.4.1 Altitude.

3.4.1.1 Operational Altitude. The VMS shall operate at altitudes from -1300 to +10,000 feet.

3.4.1.2 Non-Operational Altitude. Non-operating, the VMS shall withstand exposure to altitudes from -1300 to +40,000 feet.

3.4.2 Temperature.

3.4.2.1 Operating Temperature. The VMS shall operate in ambient air and mounting surface temperatures ranging from -50°F (-46°C) to +200°F (93°C).

3.4.2.2 Storage Temperature. The VMS shall not be damaged by storage ranging from –60°F (-51°C) to 200°F (93°C).

3.4.3 Humidity. The VMS shall not be damaged by operation, transportation, or storage in environments with ambient relative humidity within the range of 1 to 100 percent across the temperature range defined in 3.4.2.

3.4.4 Submersion. The VMS, when connected to the mating electrical and mechanical drive cables, shall not be adversely affected after submersion in 3 feet of water for a minimum of 1 hour.

3.4.5 Washdown. The VMS, when connected to the mating electrical and mechanical drive cables, shall suffer no damage or leakage due to exposure of all surfaces to washdown using hot water at 140° ± 20°F with a pressure between 50 ± 1 pounds per square inch gauge (psig) and air drying at a temperature not to exceed 145°F.

3.4.6 Fungus. The materials and construction used in the VMS shall be incapable of supporting fungus growth.

3.4.7 Mechanical shock. The VMS shall operate as specified herein and shall not be damaged when subjected to 1/2 sine wave shock impulses of 40 g at 6-9 msec duration.

3.4.8 Temperature shock. The VMS shall not be damaged nor rendered inoperable when subjected to temperature shock between the ranges of -60°F (-51°C) to +200°F (93°C) as defined by MIL-STD-810.

3.4.9 Vibration. The VMS shall operate in accordance with the requirements of this specification during and after being subjected to the vibration exposure described in MIL-STD-810, for general vibration of Ground vehicles.

3.4.10 Electromagnetic interference (EMI). The VMS shall meet emission and susceptibility characteristics as established by MIL-STD-461 for the following: CE102, CS101, CS114, CS115, CS116, RE102, and RS103. The applicable frequency range for RS103 is 30 MHz to 18 GHz.

3.4.11 Electronic discharge (ESD).

3.4.11.1 Helicopter-borne electrostatic discharge (H-ESD). The VMS shall not be damaged and shall operate as specified herein after being subjected to ESD. The VMS shall be charged to potential differences of up to 300,000 volts, with respect to ground potential, across a capacitance of 1,000 pf, and subsequently being discharged to ground potential through a series resistance of 1 ohm.

3.4.11.2 Personnel-borne electrostatic discharge (P-ESD). The VMS electronic components, including but not limited to circuit modules and repair parts, shall not be damaged by electrostatic discharge generated by handling during maintenance. The VMS shall not be damaged and shall operate as specified herein during and after being charged to potential differences of up to 25,000 volts, with respect to ground potential, across a capacitance of 500 pf, and subsequently being discharged to ground potential through a series resistance of 500 ohms.

3.4.12 Sand and Dust. The VMS shall not be degraded by exposure to sand and dust environments as described in the “Sand and Dust” methods within MIL-STD-810.

3.5 Support and Ownership.

3.5.1 Preventative maintenance. The VMS shall not require any preventative maintenance.

3.5.2 Adjustments and calibration. The VMS shall not require any adjustments or calibration in the field.

3.5.3 Standard marking. Unless otherwise stated by this specification or drawing 12927632 all marking on the exterior of the VMS shall be in accordance with MIL-STD-129.

3.5.4 Chemical Agent Resistant Coating (CARC). In order to assure interoperability with existing decontamination equipment and procedures, all painted surfaces shall be cleaned, treated, and coated using a CARC for the applicable material.

3.5.4.1 CARC workmanship. The coating shall be a smooth continuous, adherent film free of imperfections. Surfaces indicated on 12927632 shall not be painted.

3.5.4.2 CARC color. In order to assure compatibility with existing equipment, the finish shall be in accordance with color green 383, NO. 34094 of FED-STD-595.

4. VERIFICATION

TABLE II. REQUIREMENT/VERIFICATION CROSS REFERENCE MATRIX

METHODS OF VERIFICATION			CLASSES OF VERIFICATION		
N/A	–	Not applicable	A	–	Design Verification
1	–	Analysis	B	–	First article test
2	–	Demonstration	C	–	Conformance
3	–	Examination			
4	–	Test			

SECTION 3 REQUIREMENT	SECTION 4 VERIFICATION	TITLE	VERIFICATION METHOD				VERIFICATION CLASS		
			1	2	3	4	A	B	C
3.1	4.2	Design Verification	X	X	X	X	X		
3.2	4.3	First Article	X	X	X	X	X	X	
3.3.1.1	4.5.1.1	Shield grounding				X	X	X	X
3.3.1.2	4.5.1.2	Input power				X	X	X	X
3.3.1.3.1	4.5.1.3.1	Digital				X	X	X	X
3.3.1.3.2	4.5.1.3.2	Logic levels				X	X	X	X
3.3.2.1	4.5.2.1	Breakaway torque				X	X	X	
3.3.2.2	4.5.2.2	Mechanical damping				X	X	X	
3.3.2.3	4.5.2.3	Inertia	X			X	X	X	
3.3.2.4	4.5.2.4	Weight	X			X	X	X	
3.3.2.5	4.5.2.5	Dimensions		X			X	X	X
3.3.2.6	4.5.2.6	Mechanical drive			X		X		
3.3.3.1	4.5.3.1	Operation				X	X	X	X
3.3.3.2	4.5.3.2	BIT				X	X	X	X
3.3.3.3	4.5.3.3	Odometer jumper				X	X	X	X
3.4.1.1	4.6.1.1	Operational altitude				X	X	X	
3.4.1.2	4.6.1.2	Non-operational altitude				X	X	X	
3.4.2.1	4.6.2.1	Operational temperature				X	X	X	
3.4.2.2	4.6.2.2	Storage temperature				X	X	X	
3.4.3	4.6.3	Humidity				X	X		
3.4.4	4.6.4	Submersion				X	X	X	
3.4.5	4.6.5	Washdown				X	X	X	
3.4.6	4.6.6	Fungus				X	X		
3.4.7	4.6.7	Mechanical shock				X	X	X	
3.4.8	4.6.8	Temperature shock				X	X	X	
3.4.9	4.6.9	Vibration				X	X	X	
3.4.10	4.6.10	EMI				X	X		
3.4.11.1	4.6.11.1	H-ESD				X	X		
3.4.11.2	4.6.11.2	P-ESD				X	X		

TABLE II. REQUIREMENT/VERIFICATION CROSS REFERENCE MATRIX

METHODS OF VERIFICATION			CLASSES OF VERIFICATION		
N/A	–	Not applicable	A	–	Design Verification
1	–	Analysis	B	–	First article test
2	–	Demonstration	C	–	Conformance
3	–	Examination			
4	–	Test			

SECTION 3 REQUIREMENT	SECTION 4 VERIFICATION	TITLE	VERIFICATION METHOD				VERIFICATION CLASS		
			1	2	3	4	A	B	C
3.4.12	4.6.12	Sand and dust				X	X	X	
3.5.1	4.7.1	Maintenance	X	X	X		X		
3.5.2	4.7.2	Adjustments	X	X	X		X		
3.5.3	4.7.3	Marking	X	X	X		X	X	X
3.5.4	4.7.4	CARC			X	X	X	X	
3.5.4.1	4.7.4.1	CARC workmanship			X		X	X	X
3.5.4.2	4.7.4.2	CARC color			X		X	X	X

4.1 Classification of Inspections. The inspection requirements specified herein are classified as follows:

a. Design Verification (see 4.2).

b. First article inspection (see 4.3).

c. Conformance inspection (see 4.4).

4.1.1 Verification conditions. Unless otherwise specified, all verifications shall be performed under the following conditions:

a. Ambient temperature +60°F to +90°F.

b. Relative humidity 90% RH maximum.

c. Pressure 28 to 32 inches of Hg (atmospheric)

d. Power voltage +5 ± 0.25 VDC

4.2 Design verification. When specified in the contract, a sample of the VMS shall be subjected to design verification testing.

4.2.1 Design verification quantity. Design verification shall be performed on at least three (3) sample of the VMS.

4.2.2 Verification to be performed. Design verification shall be performed in accordance with Table II.

4.2.3 Design verification rejection. If any item of the sample fails to comply with the design verification requirements, the sample shall be rejected.

4.3 First article. When specified in the contract, a sample of the VMS shall be subjected to first article verification.

4.3.1 First article quantity. First article verification shall be performed on 3 samples of the VMS Assembly.

4.3.2 Inspections to be performed. First article verification shall be performed in accordance with Table II.

4.3.3 First article rejection. If any item of the sample fails to comply with the first article requirements, the sample shall be rejected.

4.4. Conformance verification.

4.4.1 Lot formation. Lot formation shall be in accordance with the lot formation requirement of MIL-STD-1916, paragraph 4.2.

4.4.2 Inspections to be performed. Conformance verification shall be performed in accordance with Tables II.

4.4.3 Classification of characteristics.

a. The definitions of critical, major and minor characteristics shall be as defined in MIL-STD-1916.

b. All conformance tests shall be tested conducted on lot samples as defined by Table III.

c. The definitions of lot sampling levels shall be as defined in MIL-STD-1916.

TABLE III. CLASSIFICATION OF CHARACTERISTICS

SECTION 3 REQUIREMENT	SECTION 4 VERIFICATION	TITLE	LOT SAMPLING LEVEL
MAJOR CHARACTERISTICS			
3.3.1.1	4.5.1.1	Shield grounding	100%
3.3.1.2	4.5.1.2	Input power	100%
3.3.1.3.1	4.5.1.3.1	Digital	100%
3.3.1.3.2	4.5.1.3.2	Logic levels	100%
3.3.3.1	4.5.3.1	Operation	100%
3.3.3.2	4.5.3.2	BIT	100%
3.3.3.3	4.5.3.3	Odometer jumper	100%
MINOR CHARACTERISTICS			
3.3.2.5	4.5.2.5	Dimensions	Level I
3.5.3	4.7.3	Marking	Level II
3.5.4.1	4.7.4.1	CARC workmanship	Level II
3.5.4.2	4.7.4.2	CARC color	Level II

4.4.4 Non-conforming product. If any item of the sample fails to comply with any conformance requirement, production shall be rejected in accordance with MIL-STD-1916. Subsequent actions for the lot are defined in MIL-STD-1916.

4.4.5 Alternative quality conformance procedures. Unless otherwise specified herein or provided for in the contract, alternative quality conformance procedures, methods or equipment, such as statistical process control, tool control, other types of sampling plans, etc., may be used by the contractor when they provide, as a minimum, the level of quality assurance required by the provisions herein. (see 6.4)

4.4.6 Failure. If any item fails to meet the specified test requirements, acceptance of the product shall be suspended until the contractor has made necessary corrections and the Government has approved the corrections.

4.5 Interface inspections.

4.5.1 Electrical Interface.

4.5.1.1 Shield grounding. The connector shall be in accordance with MS27468T15B35P. When the VMS is secured to the conductive mount, verify that the resistance between the connector shell and the mount is less than 0.1 Ohm.

4.5.1.2 Input power. Verify using industry standard equipment that the VMS operates on input power within 5 ± 0.25 VDC power with peak to peak ripple up to 300 mV from DC to 20

MHz. Input to be supplied via J1, pins 28 and 29, per 12927632. The related tests below also apply:

a. Verify that the VMS does not require more than 2.5 watts at 5 VDC.

b. Using standard measuring equipment, verify that the resistance between each of the DC returns, J1, pin 18 and pin 30, per 12927632, and the chasis ground is greater than 100K Ohms.

c. Verify that the VMS maintains all operational capabilities after short circuiting primary power to ground.

d. Verify that the VMS maintains all operational capabilities after power voltages within the range of +5.9 VDC to +6.0 VDC.

4.5.1.3 Signal interfaces.

4.5.1.3.1. Digital. Verify that data is transferred between the VMS and a control device via digital (two-state) signal circuits in accordance with requirements.

4.5.1.3.2 Logic levels. Verify using an oscilloscope or equivalent industry tool that a positive voltage on the "Hi" line with respect to the "Lo" line, in accordance with 12927632, represents a binary "1" or "set" condition. Verify a positive voltage on the "Lo" line with respect to the "Hi" line represents a logic "0" or "reset" condition.

4.5.2 Mechanical interface.

4.5.2.1 Mechanical breakaway torque. Using standard measuring equipment calibrated to within 0.05 inch-ounces of the applicable tolerance, verify the torque required to initiate a movement of the VMS shaft in both directions is in accordance with 3.3.2.1.

4.5.2.2 Mechanical damping. Verify compliance with the requirements by mounting the unit to a vibration table and subjecting the unit to the vibration sweeps specified in 3.4.9. The output shall be monitored for any indications.

4.5.2.3 Inertia. The inertia shall be measured using standard measuring equipment calibrated to within 10% of applicable tolerances in order to verify compliance with 3.3.2.3.

4.5.2.4 Weight. Use standard measuring equipment calibrated to ± 1 ounce to verify the VMS is in compliance with paragraph 3.3.2.4 of this specification.

4.5.2.5 Dimensions. Use standard measuring equipment calibrated to ± 10% of the applicable tolerances to verify that the dimensions of the VMS are in accordance with 12927632.

4.5.2.6 Mechanical drive. Visually verify that the interface to the mechanical drive cable is in accordance with 12927632.

4.5.3 Operational interface.

4.5.3.1 Operation. Verify the compliance with applicable requirement with an oscilloscope. Rotate the VMS shaft in forward and reverse directions. The VMS shall generate 32 output pulses per revolution, 1 pulse per 11.25^{o}. Each pulse shall have an 800 ± 80 microseconds width.

4.5.3.2 Built-In-Test. The built-in-test (BIT) shall be performed by providing signals to the BIT input lines as specified in Table I. For each combination of inputs; monitor the two outputs simultaneously and compare with the values provided in Table I. The normal operating condition mentioned in Table I, refers to the condition were the output of the VMS will produce a train of pulses with a frequency directly proportional to the speed at which the shaft is rotating, while the opposite direction output remains at zero. A BIT indication of a malfunction, when there is no actual malfunction, shall be considered a malfunction.

4.5.3.3 Odometer reversal jumper. Verify conformance as follows using standard measuring equipment:

a. With no jumper between pins 7 and 8, rotate the shaft from 0 to 1400 rpm in the counterclockwise direction. Verify that pulses are output on pins 3 and 4 and that no pulses are output on pins 5 and 6.

b. With no jumper between pins 7 and 8, rotate the shaft from 0 to 1400 rpm in the clockwise direction. Verify that pulses are output on pins 5 and 6 and that no pulses are output on pins 3 and 4.

c. With a jumper connected between pins 7 and 8, rotate the shaft from 0 to 1400 rpm in the clockwise direction. Verify that pulses are output on pins 3 and 4 and that no pulses are output on pins 5 and 6.

d. With a jumper connected between pins 7 and 8, rotate the shaft from 0 to 1400 rpm in the counterclockwise direction. Verify that pulses are output on pins 5 and 6 and that no pulses are output on pins 3 and 4.

4.6 Environmental inspections. Normal operational conditions for the VMS shall be simulated to the maximum practical extent during environmental testing. The VMS may be connected to actual or simulated mechanical and electrical connectors during non-operational exposure to test environments. Simulated connectors shall not have greater sealing capability than actual connectors.

The following characteristics shall be measured/observed and compared to values specified herein:

a. Power consumption within limits (4.5.1.2 a.)

b. Forward and reverse pulse trains correctly generated commensurate with mechanical drive rotational rates (4.5.2.1. and 4.5.3.1)

c. Verification that a direction of travel jumper wire in the mating electrical connector causes VMS pulses to be output on the opposite set of output lines for the same direction of rotation (4.5.2.1).

d. Correct responses to BIT commands (4.5.3.2.)

e. Pre and post testing. Prior to and after each test, a series of tests shall be performed to verify proper operation of the equipment. These tests shall measure the system characteristics listed in 4.6 a - d. The equipment shall be inspected for physical damage, loose hardware, degradation of materials, etc. after each test. Should the system setup remain the same from one major test to the next, the post test verification test may serve as the pretest verification test for the next major test. Failure to meet the specified value of any parameter and/or evidence of physical damage constitute failure to the test.

4.6.1 Altitude.

4.6.1.1 Operational Altitude. This test shall be conducted in accordance with the pressure tests of MIL-STD-810, for operation/air carriage items. Pressure shall be maintained at 10.1 pounds per square foot absolute (psia) for a minimum of 60 minutes. Pressure shall also be maintained at 15.4 pounds per square foot absolute (psia) for a minimum of 60 minutes. During the stabilization period the unit shall be powered. At the conclusion of this time the VMS shall be tested per the verification performance tests specified in 4.7.

4.6.1.2 Non-Operational Altitude. This test shall be conducted in accordance with the pressure tests of MIL-STD-810, for storage/air transport items. Pressure shall be maintained at 2.85 psia for a minimum of 60 minutes. During the stabilization period the unit shall be unpowered. After return to ambient conditions, the VMS shall be tested per the verification performance tests specified in 4.7.

4.6.2 Temperature.

4.6.2.1 Operating temperature. The cold operating temperature shall be conducted in accordance with temperature tests of MIL-STD-810, for operational items and shall include a 24 hour non-operational cold soak at -60°F (-51°C) followed by temperature stabilized at -50°F (-46°C). After stabilization at -50°F, a six hour operational test shall be conducted with power applied to the VMS. The shaft shall be rotated at a simulated vehicle speed of 900 RPM. The shaft shall be rotated clockwise for approximately 50 percent of the time and counterclockwise for the remainder of the operational time. The VMS outputs shall be monitored for accuracy.

Breakaway torque shall also be measured. High temperature tests shall be performed on the VMS in accordance with temperature tests of MIL-STD-810, for operational items for 72 test hours at a temperature of +200°F (93°C). The test cycle shall consist of 18 hours operation of the VMS followed by 6 hours of non-operation. This cycle shall be repeated continuously during the 72 hour test. During the operational cycle, power shall be applied to the VMS and the shaft shall be rotated at a simulated vehicle speed of 900 RPM. The shaft shall be rotated clockwise for approximately 50 percent of the time and counterclockwise for the remainder of the operational time. The VMS outputs shall be monitored for accuracy. Breakaway torque shall also be measured.

4.6.2.2 Storage temperature. The cold storage temperature shall be conducted in accordance with temperature tests of MIL-STD-810, for storage items for 168 hours (7 cycles) at a low temperature of -60°F +5°/-0°F. After exposure, the VMS shall be tested per the verification tests specified in Table II at -50°F +5°/-0°F and at room temperature (75°F ± 25°F).

4.6.3 Humidity. This test shall be conducted in accordance with humidity tests of MIL-STD-810 for five (5) cycles of 48 hours. Total test time shall be 240 hours. The test shall not deviate from the procedure described in MIL-STD-810 except that the temperature shall be cycled from +85°F to +140°F during each 24-hour cycle. During each 24-hour cycle the temperature shall be stabilized at +85°F for a minimum of 4 hours and at +140°F for a minimum of 4 hours. The rate of temperature change during transition periods shall not exceed 8°F/hour. All exterior connectors shall have a mating connector, cover, or equivalent installed prior to exposure. Operational checkouts shall be conducted using the verification tests specified in 4.6 and shall be performed at the end of the third and fifth cycles as a minimum.

4.6.4 Submersion. The VMS shall be tested for three feet submergence watertight in accordance with MIL-STD-108. Visually verify that the unit did not suffer damage or leakage.

4.6.5 Washdown. The VMS shall not be damaged nor leak when exposed to a water hose stream with a pressure of 50 ± 1 psig at +140°F ± 20°F, for a period of 30 minutes. The stream shall be directed onto each face of the equipment, from a distance of three feet, for equal periods. The test shall be conducted at ambient conditions.

4.6.6 Fungus. This test shall be conducted in accordance ASTM G21. All exterior connectors shall have a mating connector, cover, or equivalent installed prior to exposure. After exposure, the VMS shall be tested per the verification performance tests specified in 4.7 at room temperature (75°F ± 25°F).

4.6.7 Mechanical shock. The VMS shall be subjected to the shock tests specified in MIL-STD-810 for functional shock. Three shock pulses shall be applied in each direction along each of the three mutually perpendicular axes, for a total of 18 shock pulses. Peak amplitude shall be 40g with a duration of 6-9 msec.

4.6.8 Temperature shock. This test shall be conducted in accordance with MIL-STD-810 tests of steady state shock from constant temperatures. The VMS shall be tested per the conformance tests specified in Table II.

4.6.9 Vibration. Verify conformance to paragraph 3.4.9 by conducting vibration testing as described in MIL-STD-810 for general vibration aboard ground vehicles. The appropriate table shall be used to determine test levels in accordance with intended vehicle application.

4.6.10 EMI. The VMS shall be subjected to EMI tests in accordance with MIL-STD-461. The tests shall demonstrate compliance with the requirements specified in 3.4.10.

4.6.11 ESD.

4.6.11.1 H-ESD. The VMS shall be connected to an electrostatic generator through a 1000±10% pf capacitance. After being charged to a potential difference of 300,000 volts, the test item shall be discharged through a maximum 1-ohm resistor. The VMS shall be subjected to a total of 30 charge/discharge cycles, using both positive and negative charging polarities and 3 different discharge points. Damage to and/or failure of the equipment to perform as specified, after exposure to the charge/discharge cycles, shall constitute failure of the test. The test procedures of MIL-STD-331 apply.

4.6.11.2 P-ESD. The VMS shall be connected to an electrostatic generator through a 500±5% pf capacitance. After being charged to a potential difference of 25,000 volts, the test item shall be discharged through a 500±5% ohm resistor. The VMS shall be subjected to a total of 30 charge/discharge cycles, using both positive and negative charging polarities and 3 different discharge points. Damage to and/or failure of the equipment to perform as specified, after exposure to the charge/discharge cycles, shall constitute failure of the test. The test procedures of MIL-STD-331 apply.

4.6.12 Sand and Dust. Following exposure in accordance with 3.4.12, the VMS shall be inspected using the applicable verification methods of this specification to ensure the functional capabilities have not been compromised. The VMS shall also be visually inspected before and after exposure to verify the workmanship and physical integrity of the system has not been degraded.

4.7 Support and ownership.

4.7.1 Preventative maintenance. Verify that the VMS has a standard operating procedure that does not include or require any preventative maintenance.

4.7.2 Adjustments/calibration. Verify that the VMS has a standard operating procedure that does not include or require any adjustments or calibration in the field.

4.7.3 Standard marking. Verify that the marking on the VMS is in accordance with MIL-STD-129.

4.7.4 Chemical Agent Resistant Coating (CARC). The material, application procedure and verification methods of MIL-C-53072 shall be used to verify conformance to 3.5.4.

4.7.4.1 CARC workmanship. Visually and tactilely verify that the coating meets the requirements of 3.5.4.1

4.7.4.2 CARC color. Verification of the CARC topcoat color shall be in accordance with FED-STD-595 for color green 383, NO. 34094.

5. PACKAGING

5.1 Packaging. For acquisition purposes, the packaging requirements shall be specified in the contract or order (see 6.2). When actual packaging of materiel is to be performed by DoD personnel, these personnel need to contact the responsible packaging activity to ascertain requisite packaging requirements. Packaging requirements are maintained by the Inventory Control Point's packaging activity within the Military Department or Defense Agency, or within the Military Department's System Command. Packaging data retrieval is available from the managing Military Department's or Defense Agency's automated packaging files, CD-ROM products, or by contacting the responsible packaging activity.

6. NOTES

(This section contains information of a general or explanatory nature that may be helpful, but is not mandatory.)

6.1 Intended use. The VMS is intended for use as a vehicle motion sensor. The electronic components covered by this specification are military unique because they must be able to operate satisfactorily under accelerations of 40 g applied in any direction, and at ambient temperatures ranging from -50°F to +200°F. Commercial electronic components are not designed to withstand such extreme and sudden environmental conditions and would experience catastrophic failure. The VMS supplies pulses, representing incremental distance traveled, to the Dynamic Reference Unit Hybrid (DRUH) or other navigation devices. The DRUH is an inertial navigation system that uses VMS data to damp inertial errors and sense vehicle motion. The DRUH is described by MIL-PRF-71185.

6.2 Acquisition requirements. Acquisition documents must specify the following:

a. Title, number and date of this specification.

b. Issue of DODISS to be cited in the solicitation, and, if required, the specific issue of individual documents referenced (see 2.2.1).

c. Requirements for the submission of first article (see Section 4.).

d. Preservation and packaging (see 5.1).

e. Marking requirements (see 5.1).

f. Special finishing requirements from MIL-C-53072 and MIL-STD-171 (see 3.6.1)

6.3 Drawings. Drawings listed in Section 2 of this specification under the heading U.S. Army Armament, Research, Development and Engineering Center (ARDEC) may also include drawings prepared by, and identified as U.S. Army Armament, Research and Development Command (ARRADCOM), Frankford Arsenal, Rock Island Arsenal or Picatinny Arsenal drawings. Technical data originally prepared by these activities is now under cognizance of ARDEC.

6.4 Submission of alternative quality conformance provisions. Contractor proposed alternative quality conformance provisions may be submitted to the Government for evaluation/approval as directed by the contracting activity.

6.5 Definitions.

6.5.1 Shaft rotation. Positive direction of rotation is defined as counterclockwise rotation of the rotor when viewed from the shaft extension (MS53099 adapter) end.

6.5.2 Signal definition.

a. BIT command 1. VMS input discrete signal used to identify the VMS operating mode or Built-In-Test response desired.

b. BIT command 2. VMS input discrete signal used to identify the VMS operating mode or Built-In-Test response desired.

c. Forward odometer output. VMS output pulse train indicating incremental distance traveled by the vehicle in the forward direction, no pulses being output when the vehicle is traveling in reverse.

d. Reverse odometer output. VMS output pulse train indicating incremental distance traveled by the vehicle in the reverse direction, no pulses being output when the vehicle is moving forward.

6.6 Subject term (key word) listing.

a. DRUH Dynamic Reference Unit Hybrid

b. Odometer

Custodian:
Army-AR

Preparing activity:
Army-AR
(Project 1290-0024)

STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

INSTRUCTIONS

1. The preparing activity must complete blocks 1, 2, 3, and 8. In block 1, both the document number and revision letter should be given.
2. The submitter of this form must complete blocks 4, 5, 6, and 7, and send to preparing activity.
3. The preparing activity must provide a reply within 30 days from receipt of the form.

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I RECOMMEND A CHANGE:	1. DOCUMENT NUMBER	2. DOCUMENT DATE (YYYYMMDD)
	MIL-PRF-71196(AR)	20020124

3. DOCUMENT TITLE

SENSOR, VEHICLE MOTION

4. NATURE OF CHANGE (*Identify paragraph number and include proposed rewrite, if possible. Attach extra sheets as needed.)*

5. REASON FOR RECOMMENDATION

6. SUBMITTER

a. NAME *(Last, First, Middle Initial)*	b. ORGANIZATION	
c. ADDRESS (*Include Zip Code)*	d. TELEPHONE (*Include Area Code)* (1) Commercial (2) DSN (*if applicable)*	7. DATE SUBMITTED (*YYYYMMDD)*

8. PREPARING ACTIVITY

a. NAME	b. TELEPHONE (*Include Area Code)*
US ARMY, TACOM-ARDEC	(1) Commercial: (973)724-6628 (2) DSN: 880-6628
c. ADDRESS (*Include Zip Code)* ATTN: AMSTA-AR-QAW-E, BLDG 12 PICATINNY ARSENAL, NJ 07806-5000	**IF YOU DO NOT RECEIVE A REPLY WITHIN 45 DAYS, CONTACT:** **Defense Standardization Program Office (DLSC-LM)** **8725 John J. Kingman Road, Suite 2533** **Fort Belvoir, Virginia 22060-6221** **Telephone (703) 767-6888 DSN 427-6888**