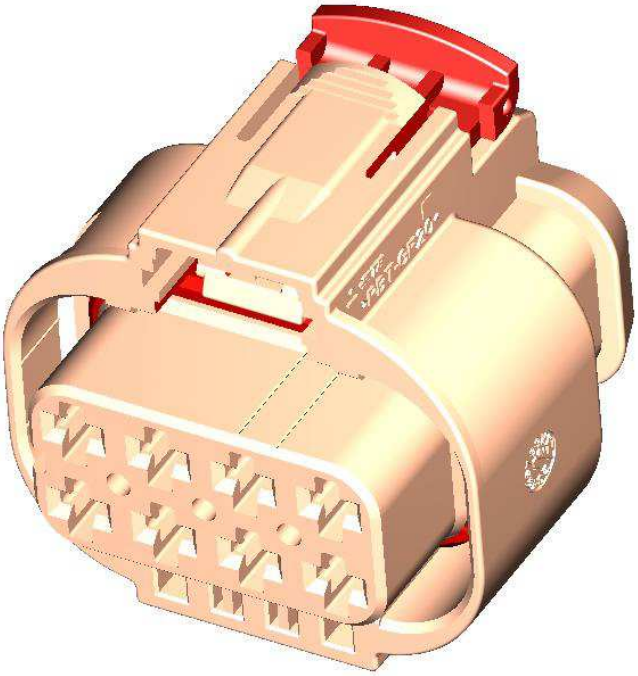
Product Specification

Plug Connector 8-Pin, waterproof
“Connector System for Engine Control Unit”



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A	RELEASE	YH MA/HG CHO	20-SEP-2012
REV.	**DESCRIPTION**	**DR/CHK**	**DATE**

Index

1. SCOPE

1.1 Contents.

This specification covers the requirements for product performance, test methods and quality assurance provisions of 8-Pin Connector.

The applicable product descriptions and part number are as follows:

Part Number	Descriptions
See interface 114-61047	MALE CNNECTOR, 8-Pin
X-2109441-X	ASS'Y 8 POS. CONNECTOR
968882	AMP MCP2.8, SWS, WSR[1] 0.35mm^2
968855	AMP MCP2.8, SWS, WSR[1] 0.5-1.0mm^2
968857	AMP MCP2.8, SWS, WSR[1] 1.0-2.5mm^2
828904-1, 828905-1 828922-1(cavity plug) (various wire cross-section, see the drawing of the individual seal)	SINGLE WIRE SEAL FOR AMP MCP2.8

Ref) 1 Wire size range,

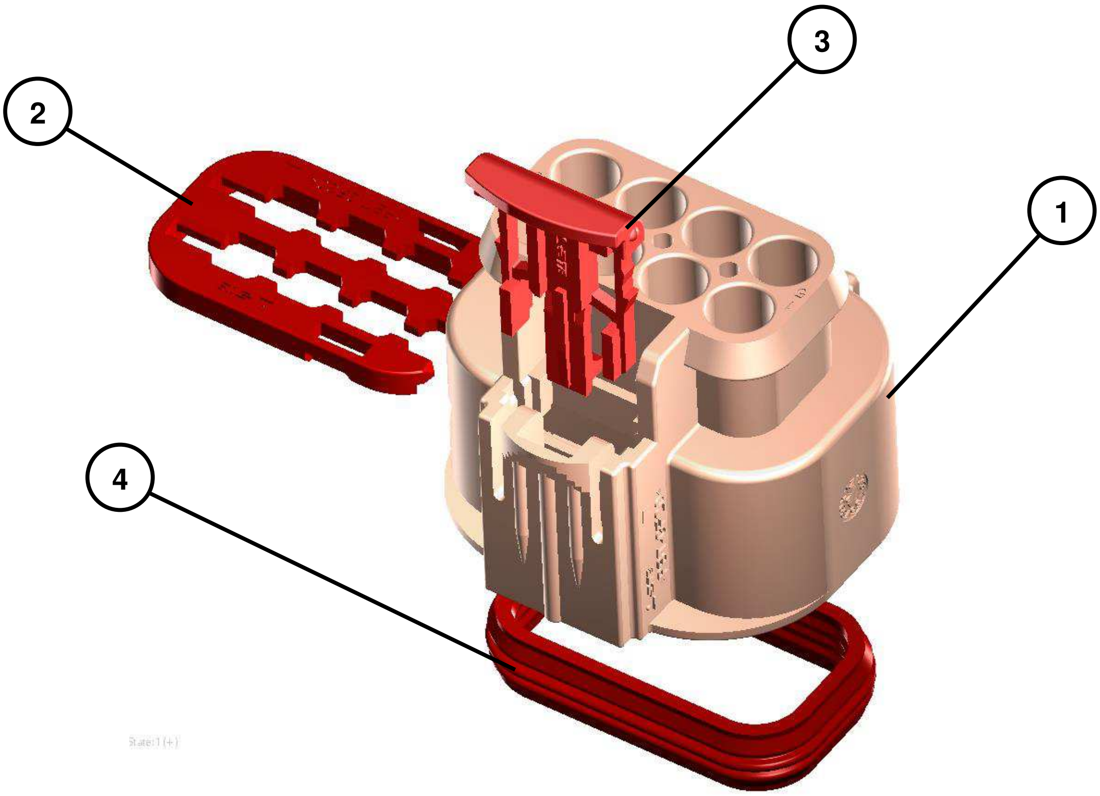
- The 8-Pin plug connector is used for the connection of junction box inside the vehicle and also at various installation locations in the engine compartment. On the cable side, the system has a modular design, permitting the connection of a separate engine and/or vehicle cable harness.

A. MALE CONNECTOR

Contact 8 x2.8mm x 0.8mm

For the dimensional definition of the interface, see drawing 114-61047

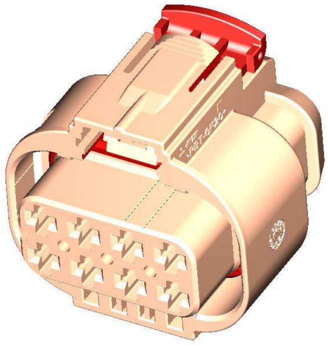
B. ASS`Y 8 POS CONNECTOR



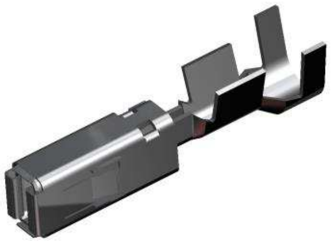
POS. 1 PLUG HOUSING
POS. 2 DBL HOUSING
POS. 3 CPA HOUSING
POS. 4 INNER SEAL

2. DELIVERY CONDITION

2.1 8 POS CONNECTOR

ASSY 8 POS. CONNECTOR	PN X-2109441-X	

2.2 TERMINALS FOR 8 POS CONNECTOR

MCP 2,8 TERMINAL 0.35-2,5 mm^2 FOR 8 POS CONNECTOR	PN SEE CUSTOMER DRAWINGS 1355036 (Single wire seal 828904-1, 828905-1)	

3. APPLICABLE DOCUMENTS

The following documents form a part of this specification to the extent specified herein. In the event of conflict between the requirements of this specification and the product drawing, the product drawing shall take precedence. In the event of conflict between the requirements of this specification and the referenced documents, this specification shall take precedence.

TE Specifications:

A. 109-5000	Test Specification, General Requirements for Test Methods
B. 114-61047	Interface drawing for 8 POS. Plug Ass`y
C. 114-18387	Application Specification for MCP2.8K receptacle
D. 108-18717	Product specification for MCP 2.8k receptacle
E. 411-61012	Instruction Sheet for 8POS. Plug Ass'Y
F. 107-	Packaging Specification.

Reference Documents:

A. GMW 3191

4. REQUIREMENTS

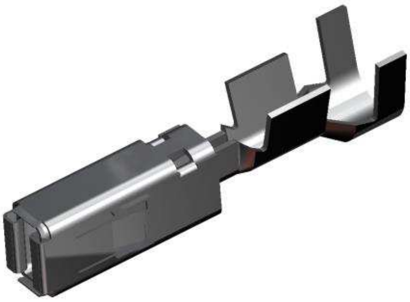
4.1 Design and Construction:

Product shall be of the design, construction and physical dimensions Specified on the applicable product drawing.

4.2 Materials & Finish

A contact

- AMP MCP2.8K



4.3 Ratings

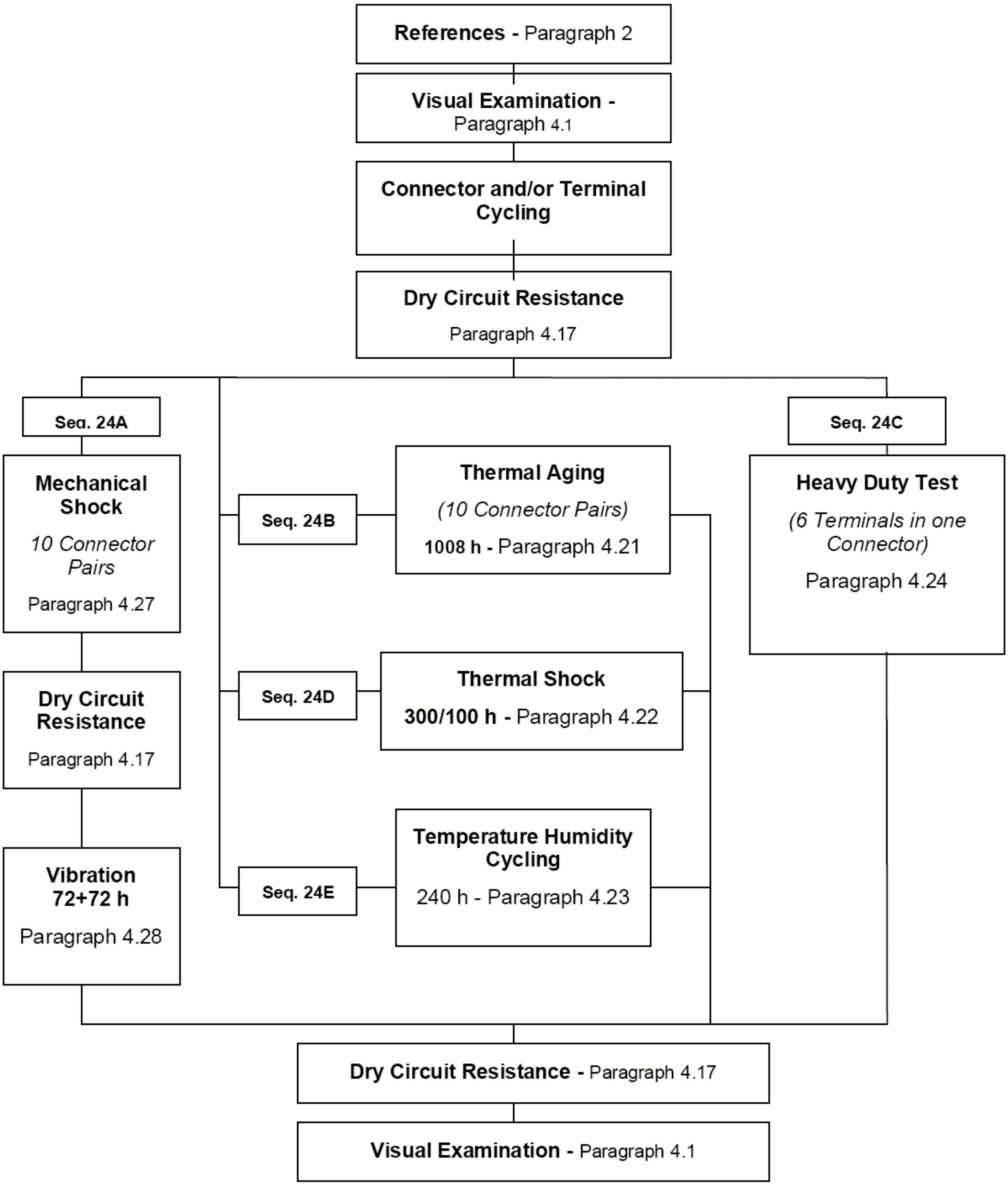
Temperature Rating: −40℃ to + 125℃
(Ambient Temperature + Temperature Rise due to energized current)

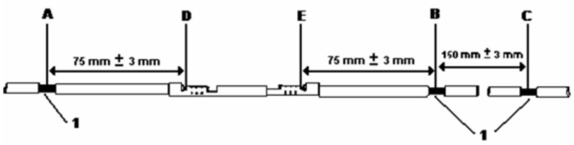
4.4 Performance and Test descriptions:

The product is designed to meet the electrical, mechanical and environmental performance requirements specified in Para. 3.5. All tests are performed at ambient temperature unless otherwise specified.

4.5 Test Requirements and Procedures Summary:

Figure 1: Connector Electrical Tests



Item No.	Procedure Or Standard	Test Description	Acceptance Criteria	Procedure
1	**GMW**	**Mechanical Shock/ Vibration Sequence**	**GM Sequence24A**	
1a	GMW 4.1	Visual Inspection	Inspect for defects.	Visually examine each test specimen before testing and/or conditioning. The test specimens shall not exhibit any evidence of deterioration, cracks and/or other deformities that could affect performance, function and/or appearance. A control sample shall be retained. Photographs and/or video recordings of the samples being tested shall be taken.
1b		Connector and / or Terminal Cycling	10 condition cycle	
1c	GMW 4.17	Dry Circuit Resistance -2.8mm	$R_T \le 5m\Omega$	**1** Attach micro-ohmmeter leads to locations A, B, and C as illustrated in Figure 2, In-Line Circuit Test Lead Location, to the terminated test leads. **2** Measure and record the resistance across (150 ± 3) mm of the new and non-preconditioned terminated leads to be used for the test. **3** Mate the terminated pairs. Measure the resistance across A to B and B to C using instrumentation, which determines resistance by either the offset compensation or current reversal methods. **4** Condition the terminal pairs per GMW 3.3, Conditioning **5** Re-mate the terminated pairs and measure the resistance across A to B and B to C using instrumentation which determines resistance by either the offset compensation or current reversal methods. **6** Calculate the combined resistance of the terminal conductor attachments and the interface with the following formula: $R_{Total\ Connection} = R_{(DE)} = R_{(AB)} - R_{(BC)}$ Figure 2: In-Line Circuit Test Lead Location 

GMW 3.3 Conditioning.
Prior to starting any test procedure specified in this document, the following conditioning procedures shall be followed.

- Crimp wires of appropriate gauge size to terminals. Insert terminated leads into specific connector housings, when required.
- Completely mate and unmate each connector or terminal pair 10 times.
- Store test samples at an ambient temperature of (+23 ± 5) C for 24 h min.

1d	GMW 4.27	Mechanical Shock Wire size : 2.5mm	Resistance >7Ω >1 µs	1) Divide the test samples into two groups of 5. 1-1) The first group shall be set up and monitored continuously. Refer to Figure 3, Series Circuit Monitoring, and the following instructions: **A** Solder the ends of the conductors to each other in the sample set being monitored to form a single series circuit with only two free ends. **B** Solder the end of one of the free conductors to a 2 W (120 ± 1.2) resistor. **C** Solder the power supply negative lead to the free end of the resistor and the positive lead of the power supply to the other free conductor end. **D** Connect the continuity monitoring equipment across the resistor, making sure that the negative lead of the continuity monitoring equipment is connected to the negative side of the resistor. Set the continuity monitoring equipment to monitor the current through the resistor. 2) The second group shall not be monitored. 2-1)Construct a suitable mounting apparatus using the following design criteria: **A** The mounting apparatus shall be constructed and secured to minimize added effects, i.e., harmonics, dampening, resonances, etc. **B** For in-line connectors, mount the mated connector pair directly to the test fixture mounting bracket using the connector feature provided for mounting as shown in Method 1 in Figure 4, Vibration Mounting Fixture. Do not use a "Christmas Tree" or any similar type of mounting feature. Instead, the test fixture mounting bracket itself must be constructed so as to include a direct mounting feature to mate with the clip mount (dovetail) on the mated connector pair. **C** For device (panel mount) connectors, mount the device directly to the test fixture mounting bracket as shown in Method 2 in Figure 4, Vibration Mounting Fixture. Use the normal device mounting feature(s) used to secure the device in its intended vehicle location. The test fixture mounting bracket shall be fabricated to include any features necessary to mount the device directly to the fixture. **D** Secure the conductor bundle (100 ± 5)mm from the rear surface of the conductors under test (CUT) as illustrated in Figure 4, Vibration Mounting.

Figure 3: Series Circuit Monitoring

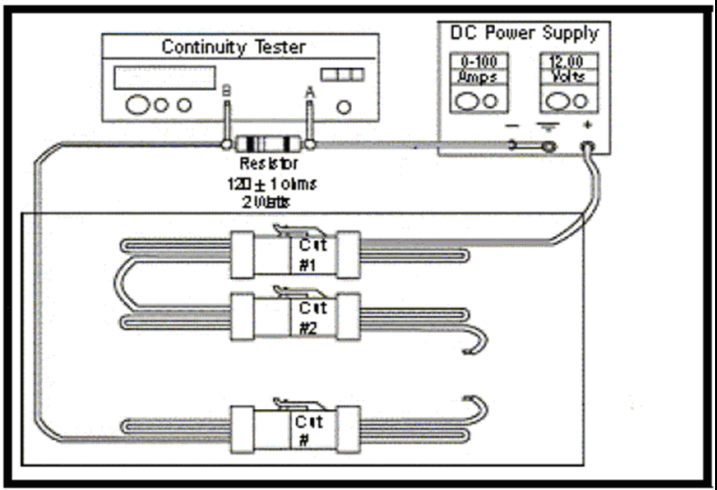
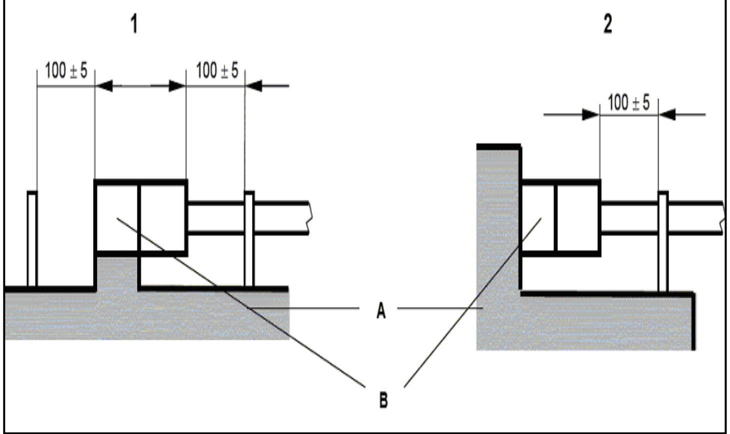
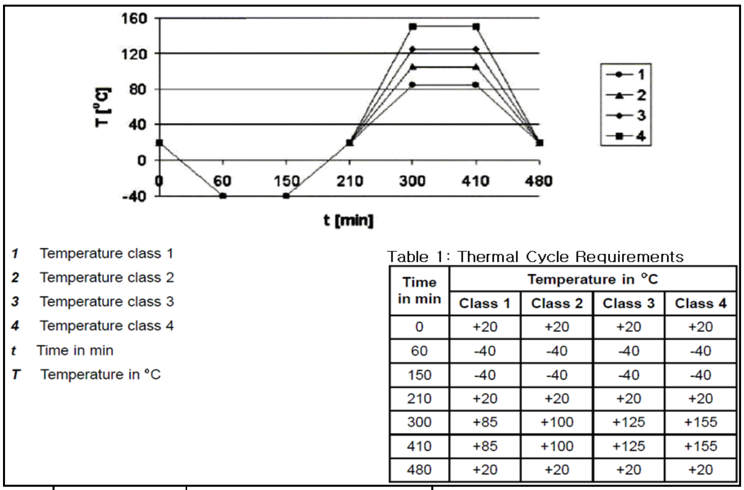


Figure 4: Vibration Mounting Fixture



1e	GMW 4.17	Dry Circuit Resistance -2.8mm	$R_T \leq 5m\Omega$	
1f	GMW 4.28	Vibration with Thermal Cycling -Vibration Class 2 -Temp Class 3 -Circuit Continuity Monitoring Wire size : 2.5mm^2	Resistance >7Ω >1 µs	Using the same test samples and mounting fixtures utilized in the Mechanical Shock Test specified in paragraph 4.27, vibrate the parts per the applicable vibration profiles defined in Figure 6 to Figure 11. Vibration profiles and temperature settings are chosen based on the intended vehicle application. Engine and transmission mounted connector assemblies shall be subjected to both the sine and random vibration profiles. The sine and random vibration schedules may be run in any order. The test samples undergoing the appropriate vibration profile shall be simultaneously subjected to the thermal cycle as defined in Figure 5: Thermal Cycle and Table 1, Thermal Cycle Requirements. Refer to the appropriate vibration profile for specific test procedures, test duration, amplitude and frequency requirements. At the completion of the required vibration cycles, measure the dry circuit resistance per paragraph 4.17. Record the results.

Figure 5: Thermal Cycle

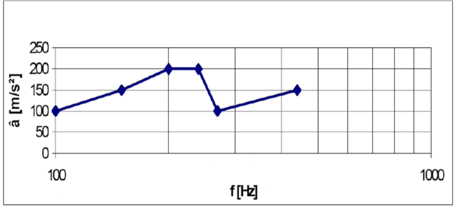


1 Temperature class 1
2 Temperature class 2
3 Temperature class 3
4 Temperature class 4
t Time in min
T Temperature in °C

Table 1: Thermal Cycle Requirements

Time in min	Temperature in °C			
	Class 1	Class 2	Class 3	Class 4
0	+20	+20	+20	+20
60	-40	-40	-40	-40
150	-40	-40	-40	-40
210	+20	+20	+20	+20
300	+85	+100	+125	+155
410	+85	+100	+125	+155
480	+20	+20	+20	+20

A - Mounting Location: Engine, Transmission Figure 6: Engine/Transmission Mount Sinusoidal Vibration Cycle (ISO 16750-3 based)



â Amplitude of acceleration m/s^2

f Frequency in Hz

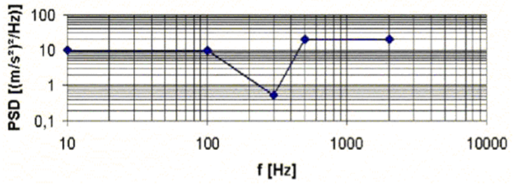
- Test according to EN 60068-2-6
- Frequency sweep: 1 octave/min.
- Test duration = (22...24) h for each X, Y, Z co-ordinate axis of the part.

The specified test profile applies to both gasoline and diesel engines. This test is followed by the Random Vibration Test in Figure 22.

Table 2: Engine/Transmission Mount Sinusoidal Vibration Cycle (ISO 16750-3 based)

Frequency in Hz	Amplitude of acceleration in m/s^2
100	100
150	150
200	200
240	200
270	100
440	150

A-1 Random Vibration Cycle. Figure 7: Engine/Transmission Mount Random Vibration Cycle (ISO 16750-3 based)



PSD Power Spectral Density in (m/s^2)^2/Hz

F Frequency in Hz

Test according to EN 60068-2-64, RMS acceleration.

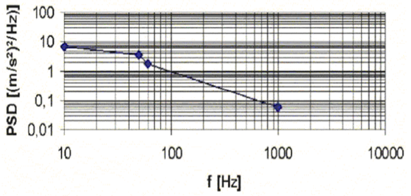
Value = 181 m/s^2

Frequency Sweep: 1 octave/min for each X, Y, Z co-ordinate axis of the part.

Table 3: Engine/Transmission Mount Random Vibration Cycle (ISO 16750-3 based)

Frequency in Hz	Power Spectral Density in (m/s^2)^2/Hz
10	10
100	10
300	0.51
500	20
2000	20

B Mounting Location: Body (Sprung Masses) Figure8: Body (Sprung Masses) Random Vibration Schedule



PSD Power Spectral Density in (m/s^2)^2/Hz

F Frequency in Hz

Test according to EN 60068-2-64

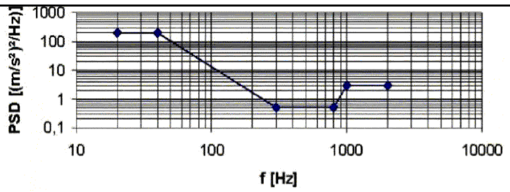
Test Duration = (22...24) h for each X, Y, Z coordinate axis of the parts.

RMS Acceleration = 20.9 m/s^2.

Table 4: Body (Sprung Masses) Random Vibration Schedule

Frequency in Hz	Power Spectral Density in (m/s^2)^2/Hz	Acceleration Power Density in G^2/Hz
10	7	0.073
50	3.5	0.036
60	1.75	0.018
1000	0.06	0.0006

C - Mounting Location: Wheel. Figure9: Wheel Random Vibration Cycle



PSD Power Spectral Density in (m/s^2)^2/Hz

F Frequency in Hz

Test according to EN 60068-2-64.

Test Duration = (22...24) h for each plane.

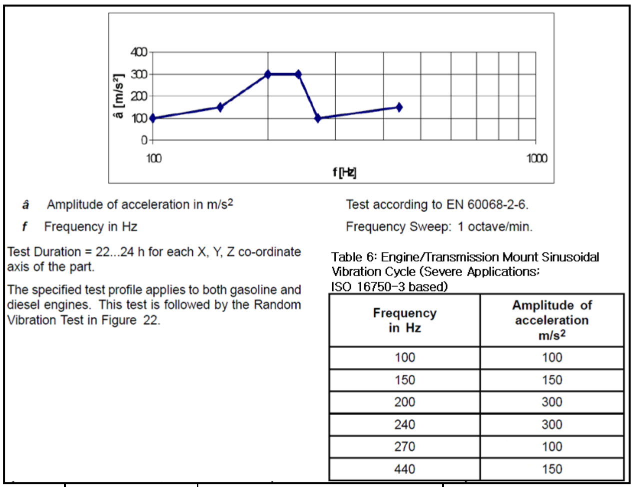
RMS Acceleration = 107.3 m/s^2.

Table 5: Wheel Random Vibration Cycle

Frequency in Hz	Power Spectral Density in (m/s^2)^2/Hz	Acceleration Power Density in G^2/Hz
20	200	2.08
40	200	2.08
300	0.5	0.005
800	0.5	0.005
1000	3	0.031
2000	3	0.031

D - Mounting Location: Severe Engine and Transmission Locations.

Figure10: Engine/Transmission (Severe Applications; ISO 16750-3 based)



â Amplitude of acceleration in m/s^2

f Frequency in Hz

Test Duration = 22...24 h for each X, Y, Z co-ordinate axis of the part.

The specified test profile applies to both gasoline and diesel engines. This test is followed by the Random Vibration Test in Figure 22.

Test according to EN 60068-2-6.

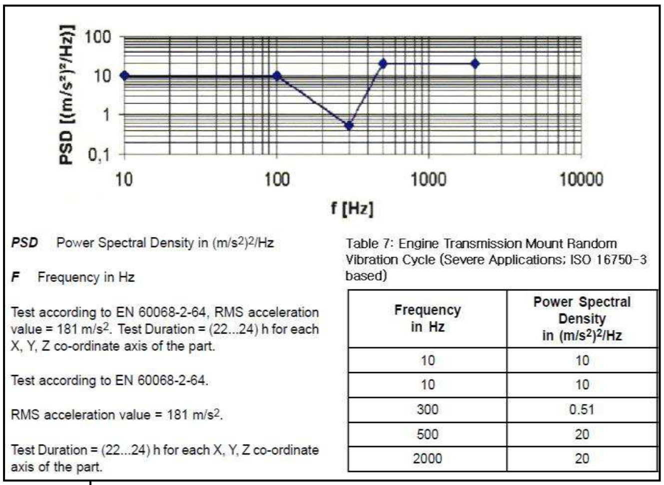
Frequency Sweep: 1 octave/min.

Table 6: Engine/Transmission Mount Sinusoidal Vibration Cycle (Severe Applications; ISO 16750-3 based)

Frequency in Hz	Amplitude of acceleration m/s^2
100	100
150	150
200	300
240	300
270	100
440	150

D-1 Severe Random Vibration Cycle.

Figure 11: Engine/Transmission Mount Random Vibration Cycle (Severe Applications; ISO 16750-3 based)



PSD Power Spectral Density in (m/s^2)^2/Hz

F Frequency in Hz

Test according to EN 60068-2-64, RMS acceleration value = 181 m/s^2. Test Duration = (22...24) h for each X, Y, Z co-ordinate axis of the part.

Test according to EN 60068-2-64.

RMS acceleration value = 181 m/s^2.

Test Duration = (22...24) h for each X, Y, Z co-ordinate axis of the part.

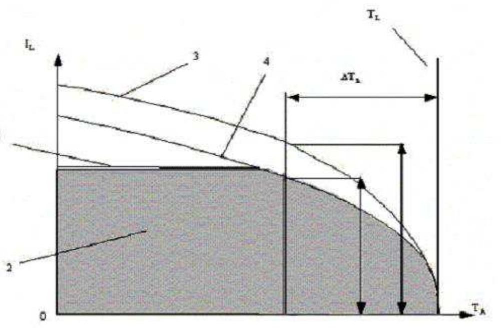
Table 7: Engine Transmission Mount Random Vibration Cycle (Severe Applications; ISO 16750-3 based)

Frequency in Hz	Power Spectral Density in (m/s^2)^2/Hz
10	10
10	10
300	0.51
500	20
2000	20

1g	GMW 4.17	Dry Circuit Resistance -2.8mm	$R_T \leq 5m\Omega$	
1h	GMW 4.1	Visual Inspection	Inspect for defects.	
2	**GMW 4.21**	**Thermal Aging**	**GMW sequence 24B**	
2a	GMW 4.1	Visual Inspection	Inspect for defects.	
2b		Connector and / or Terminal Cycling	10 condition cycle	
2c	GMW 4.17	Dry Circuit Resistance -2.8mm	$R_T \leq 5m\Omega$	
				1 Measure the dry circuit resistance per paragraph 4.17. **2** Set the temperature chamber to the maximum ambient temperature specified in Table 1, Temperature Class, for the class rating of the connector under test. **3** Place the samples in the chamber and heat age for 1008 h. **4** Remove the samples from the chamber and let rest at ambient temperature and humidity for 24 h min. **5** Measure the dry circuit resistance per paragraph4.17.
2e	GMW 4.17	Dry Circuit Resistance -2.8mm	$R_T \leq 5m\Omega$	
2f	GMW 4.1	Visual Inspection	Inspect for defects.	
3	**GMW 4.24**	**Heavy Duty Test**	**GMW sequence 24C**	
3a	GMW 4.1	Visual Inspection	Inspect for defects.	

Table 8: Temperature Class

Class	Ambient Operating Temperature in °C	Typical Installation Position
1	-40...+85	Passenger compartment or trunk
2	-40...+105	Under hood/chassis
3	-40...+125	On engine
4	-40...+155	On engine (hot locations)

3b		Connector and / or Terminal Cycling	10 condition cycle	
3c	GMW 4.17	Dry Circuit Resistance -2.8mm	$R_T \leq 5m\Omega$	
3d	GMW 4.24	Heavy Duty Test -40℃ ~ +80℃ Temp Class3 - Temp Rise **Figure 12: Derating Curve**  **1** Current load capacity of cable used **2** Allowable current load of terminal and cable **3** Base curve **4** Derating curve (80 % of base curve) **IL** Current load **TA** Ambient temperature **TL**	+50℃ Max	**1** Complete the dry circuit test per paragraph 4.17, Dry Circuit, and record the results for each terminal pair. **2** Set the power supply to provide the maximum de-rated current for the terminal and cable taken from the border of Area 2 in Figure 12, Derating Curve, for the largest wire size at the specified test temperature, i.e., +80 C or +100C. **3** Connect the thermocouple leads a data logger. **4** Set the temperature chamber to +80 C for temperature classes (1...3) in Table 1 and +100 C for temperature class 4 in Table 1. **5** Run the maximum de-rated current through the test samples at the respective test temperature for 5 h. **6** Transfer the samples to -40 C and cool for 2 h at 0 A. **7** Repeat the above test procedure for a total of 5 cycles. **8** After 5 cycles, store the samples at (+23 ± 5) C for 24 h min. **9** Perform a dry circuit test per paragraph 4.17, Dry Circuit, and record the results for each terminal pair.
3e	GMW 4.17	Dry Circuit Resistance -2.8mm	$R_T \leq 5m\Omega$	
3f	GMW 4.1	Visual Inspection	Inspect for defects.	
4	**GMW 4.22**	**Thermal Shock**	**GMW sequence 24D**	
4a	GMW 4.1	Visual Inspection	Inspect for defects.	
4b		Connector and / or Terminal Cycling	10 condition cycle	
4c	GMW 4.17	Dry Circuit Resistance -2.8mm	$R_T \leq 5m\Omega$	
4d	GMW 4.22	Thermal Shock -40℃ ~ +125℃ (Temp Class3) For 300h - Circuit Continuity Monitoring	Resistance >7Ω >1 µs	**1** Solder the ends of the conductors to each other in the test sample set being monitored, to form a single series circuit with only two free ends. **2** Solder one of the free conductor ends to a 2 W (120 ± 1.2) resistor. **3** Solder the power supply negative lead to the free end of the resistor and the power supply positive lead to the remaining free conductor end of the test sample.

				4 Preset the power supply to provide 100 mA to the circuit. **5** Connect the continuity monitoring equipment across the resistor, making sure that the negative lead of the continuity monitoring equipment is connected to the negative side of the resistor. Set the continuity monitoring equipment to monitor the current through the resistor. As an option, the continuity monitoring equipment may be used to monitor one or more terminal pairs instead of the resistor. **6** Measure the dry circuit resistance per paragraph 4.17. **7** Place the test samples in the chamber so that there is no substantial air flow obstruction around the test samples. **8** Determine the min. and max. temperatures per the temperature class of the component set being tested. Set the temperature chamber to the minimum ambient temperature for that class. **9** Place the samples in the chamber and allow the Chamber temperature to stabilize. Soak the samples an additional 30 min. **10** Transfer the samples to the high temperature chamber set to the maximum ambient temperature for the class selected. Allow the test samples to soak for 30 min. ***Note:*** Chamber to chamber transfer time shall be < 10 s. **11** For temperature class 1: • Transfer test samples between temperature extremes 100 total times while continuously monitoring for any loss of electrical current level per the set-up described above. **12** Temperature classes 2, 3 and 4: • Transfer test samples between temperature extremes 300 total times while continuously monitoring for any loss of electrical current level per the set-up described above. **13** At the end of the cycling schedule remove the test samples from the chamber and measure the dry circuit resistance per paragraph 4.17.
4e	GMW 4.17	Dry Circuit Resistance -2.8mm	$R_T \le 5m\Omega$	
4f	GMW 4.1	Visual Inspection	Inspect for defects.	
5	**GMW 4.23**	**Temperature/Humidity Cycling**	**GMW sequence 24E**	
5a	GMW 4.1	Visual Inspection	Inspect for defects.	
5b		Connector and / or Terminal Cycling	10 condition cycle	

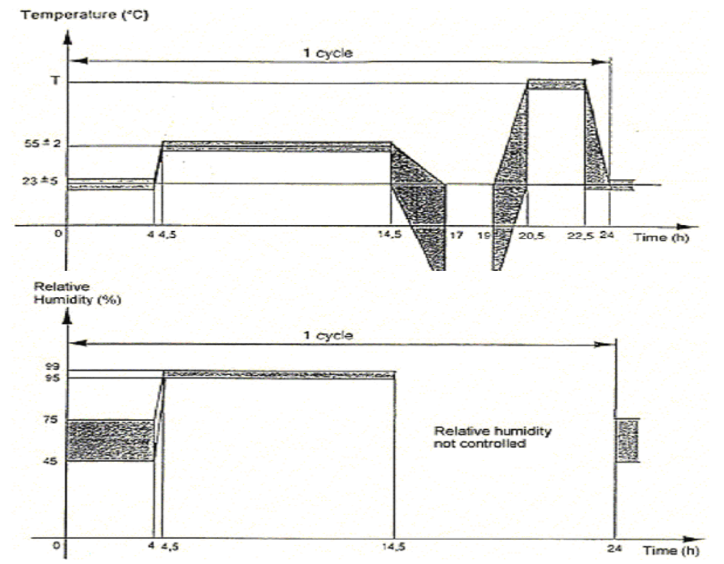
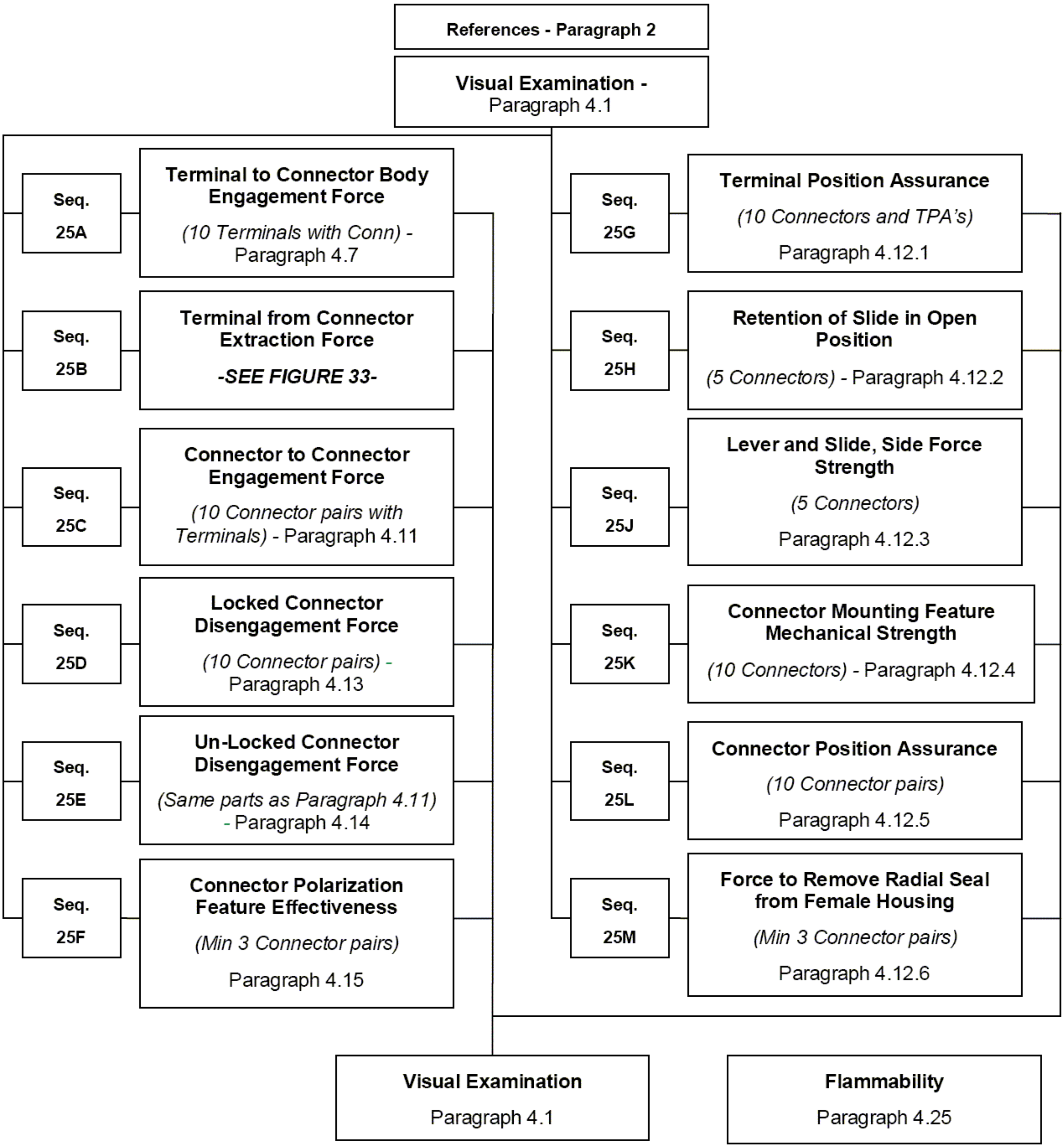
5c	GMW 4.17	Dry Circuit Resistance -2.8mm	$R_T \leq 5m\Omega$	
5d	GMW 4.23	Temperature/ Humidity Cycling for 240h - Temp Class 3 Figure 13: Temperature Humidity Cycle 		**1** Measure the dry circuit resistance per paragraph 4.17. **2** Place the test samples in the chamber ensuring that there is no substantial air flow obstruction around the test samples. **3** Determine the min. and max. temperatures for the temperature class of the component set being tested. Set the temperature chamber to (+23 ± 5) C with the relative humidity between (45...75) %. **4** Place the samples in to the thermal chamber and allow the chamber temperature to stabilize. Soak the test samples for an additional 30 min after temperature stabilization. **5** Cycle the test samples 10 times per the cycling schedule shown in Figure 13, Temperature Humidity Cycle, using the min. and max. ambient operating temperatures for the respective temperature class as specified in Table 1, while continuously monitoring the current level in the test circuit. **6** At the completion of the 10 cycles, measure the dry circuit resistance per paragraph 4.17.
5e	GMW 4.17	Dry Circuit Resistance -2.8mm	$R_T \leq 5m\Omega$	
5f	GMW 4.1	Visual Inspection	Inspect for defects.	

Figure 14: Connector System Mechanical Tests



Item No.	Procedure Or Standard	Test Description	Acceptance Criteria	Procedure
6	**GMW 4.7**	**Terminal-to-Connector Engagement Force**	**GMW sequence 25A**	
6a	GMW 4.1	Visual Inspection	Inspect for defects.	
6b	GMW 4.7	Terminal-to-Connector Engagement Force -Wire Size: 0.35mm^2 - A-TPA In Open Position - B-TPA In Fully Seated Position	-15 N Max -30 N Min	**A-TPA in Open Position:** **1** Mount the connector with the TPA in the “Open” position into a fixture. **2** Secure a terminated lead into a suitable fixture ≈ 20 mm from the back of the terminal or seal. Take special care when securing the terminated lead so that the lead fixture does not interfere with full terminal insertion during the test. **3** Insert terminal into connector at a uniform rate of(50 ± 10) mm/min until fully seated and locked. **4** Record peak force and graph force versus distance from initial contact of terminal to connector body to final engaged position. **B-TPA in Fully Seated Position** **1** Mount a connector with a fully seated TPA into a fixture. **2** Secure a terminated lead into a suitable fixture ≈ 20 mm from the back of the terminal or seal. Take special care when securing the terminated lead so that the lead fixture does not interfere with full terminal insertion during the test. **3** Insert the terminal into the connector at a uniform rate of (50 ± 10) mm/min until it is either fully seated and locked into the cavity or all forward motion of the terminal ceases due to interference between the terminal and the TPA or the test insertion force reaches 75 N max. **4** Record peak force and graph force versus distance from initial contact of terminal to connector body to final engaged position.
6c	GMW 4.1	Visual Inspection	Inspect for defects.	
7	**GMW 4.9**	**Terminal-from-Connector Extraction Force**	**GMW sequence 25B**	
7a	GMW 4.1	Visual Inspection	Inspect for defects.	

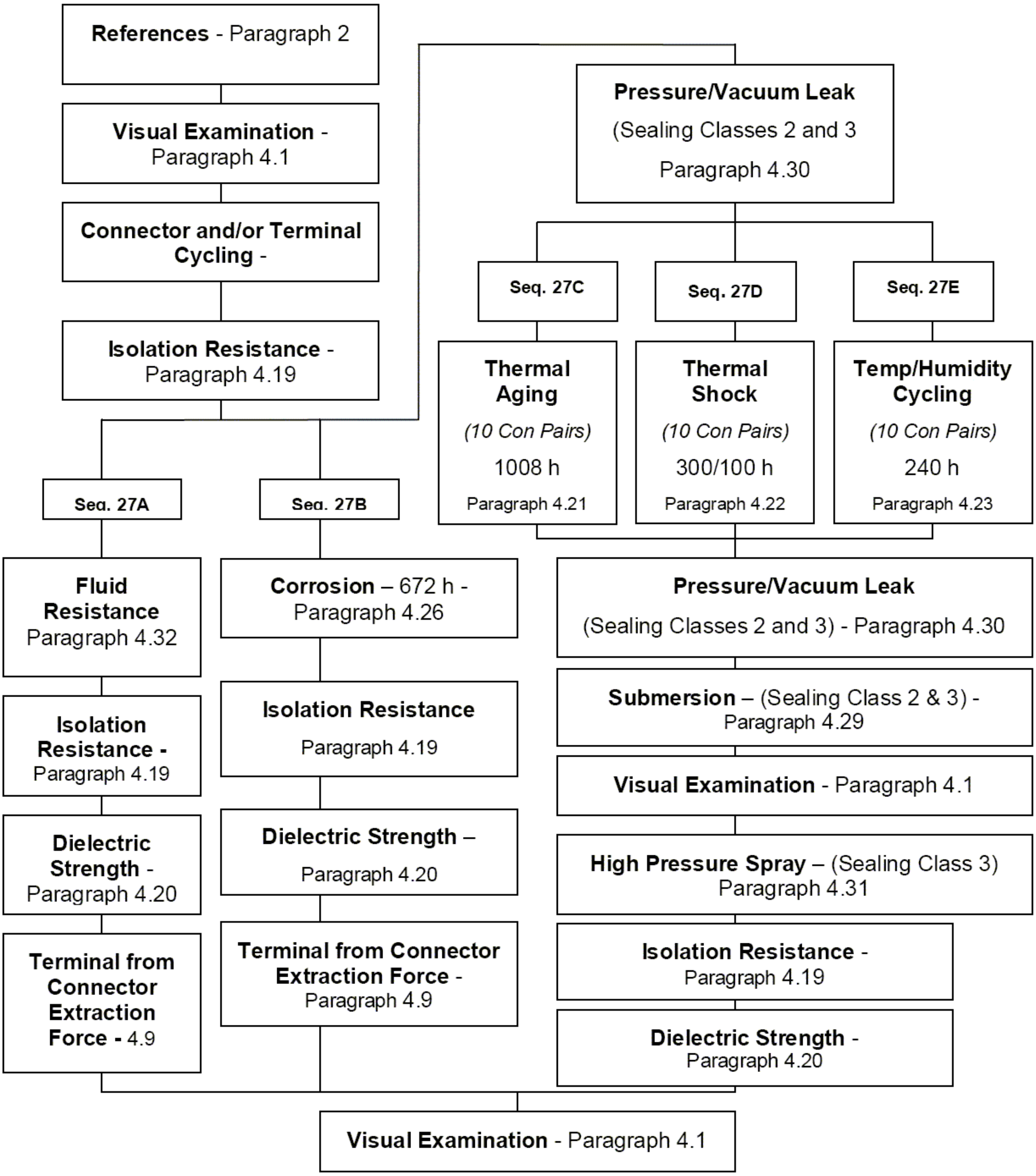
7b	GMW 4.9	Terminal-from-Connector Extraction Force -Wire Size : 2.5 mm^2 - Primary lock only (2.8mm Terminal) - Primary lock & TPA /PLR (2.8mm Terminal) - Post-Moisture Conditioning (2.8mm Terminal)	-60 N Min -100 N Min -100 N Min	**1** Assemble connectors and 10 of the terminals including all seals and other necessary components but without the TPA's. Designs using pre-staged TPA's shall have the TPA in the pre-staged position. **2** Secure the connector into a fixture. **3** Attach the conductor to the pull tester at a point < 100 mm behind the rear of the terminal. **4** Pull the conductor at a uniform rate of (50 ± 10) mm/min until pull-out occurs. Note pull-out value and failure mode. **5** Record peak force required to pull the terminal out of the connector cavity. If the conductor breaks or pulls out of the terminal before the terminal pulls out of the cavity, record this force and note the failure mode. **6** Using new test samples repeat steps 1 to 5 but with all TPA's fully seated. **7** Using new test samples and fully seated TPA's, repeat steps 1 to 5 using connectors that are moisture conditioned by being exposing to (95...98) % Relative Humidity at +40 C for 6 h. The pull test shall be performed immediately following removal of the connectors from the temperature/humidity chamber. **8** Using new test samples and fully seated TPA's, repeat steps 1 to 5 immediately after GMW 4.21, Thermal Aging. See Figure 1 for Test sequence. **9** Using new test samples and fully seated TPA's, repeat steps 1 to 5 immediately after GMW 4.23, Temperature/Humidity Cycling. See Figure 35 for test sequence.
7c	GMW 4.1	Visual Inspection	Inspect for defects.	
8	**GMW 4.11**	**Connector-to-Connector Engagement Force**	**GMW sequence 25C**	
8a	GMW 4.1	Visual Inspection	Inspect for defects.	
8b	GMW 4.11	Connector-to-Connector Engagement Force (50±10mm/min)	75N Max	**1** Secure connector to be mated into fixture. **2** Attach mating connector assembly into fixture. **3** Mate connectors together at a uniform rate of (50 ± 10) mm/min until fully seated and locked. **4** Record peak force and graph force versus distance from initial contact of connectors to final engaged position.

8c	GMW 4.1	Visual Inspection	Inspect for defects.	
9	**GMW 4.13**	**Locked Connector Disengagement Force**	**GMW sequence 25D**	
9a	GMW 4.1	Visual Inspection	Inspect for defects.	
9b	GMW 4.13	Locked Connector Disengagement Force (50±10mm/min) 8Way	120N Min	**1** Make a fixture that will secure the connectors to be tested without distorting any of the parts either before or during the test. **2** Mount the mated connector housings in the fixture with the locking feature engaged. Ensure that all secondary locks and/or CPA's are either removed or disengaged. **3** Pull the mated connectors apart at a rate of (50 ± 10) mm/min. **4** Record the force at which the connectors disengage.
9c	GMW 4.1	Visual Inspection	Inspect for defects.	
10	**GMW 4.14**	**Unlocked Connector Disengagement Force**	**GMW sequence 25E**	
10a	GMW 4.1	Visual Inspection	Inspect for defects.	
10b	GMW 4.14	Disengagement Unlock CONN'R	100N Max	**1** Make a fixture that will secure the connectors to be tested without distorting any of the parts either before or during the test. **2** Mount 5 of the mated connector housings in the fixture with the locking feature disengaged. Ensure that all secondary locks and/or CPA's are either removed or disengaged. **3** Pull the mated connectors apart at a rate of (50 ± 10) mm/min. **4** Record the force at which the connectors disengage. **5** Mount 5 of the mated connector housings in the fixture with the locking feature engaged. **6** Measure the force required to disengage the primary locking feature. **7** Record the force required to disengage the lock.
10c	GMW 4.14	Lock disengagement	100N Max	
10d	GMW 4.1	Visual Inspection	Inspect for defects.	
11	**GMW 4.15**	**Connector Polarization (Coding) Feature Effectiveness**	**GMW sequence 25F**	
11a	GMW 4.1	Visual Inspection	Inspect for defects.	

11b	GMW 4.15	Connector Mated One or more incorrect orientations	No mating >150 N or mating value *3	**1** Using a suitable fixture, orient the connector halves with respect to one another in one or more incorrect orientations specified by the design engineer as most likely to defeat the index feature. **2** Engage the connector halves at a uniform rate of 50 mm/min until the force specified under GMW 4.16.5 is applied. Note whether electrical contact is made. **3** Repeat steps 1 and 2 with every other possible mate within the same connector family.
11c	GMW 4.1	Visual Inspection	Inspect for defects.	
12	**GMW 4.12.1**	**Terminal Position Assurance(TPA)**	**GMW sequence 25G**	
12a	GMW 4.1	Visual Inspection	Inspect for defects.	
12b	GMW 4.12.1	TPA Closing Force with Properly Assembled Terminals	30N Max	**TPA Closing Force with Properly Assembled Terminals.** **1** Insert terminals into all cavities of the connector. **2** Secure connector body and TPA into a holding fixture. **3** Insert TPA into connector body at a uniform rate of (50 ± 10) mm/min. **4** Record peak force and graph force versus distance from initial position of TPA to connector body to final engaged position.
12c	GMW 4.12.1	TPA Closing Force with One Improperly Assembled Terminal	60N Min	**TPA Closing Force with One Improperly Assembled Terminal.** **1** Study the design of the terminal and TPA and determine the position of the terminal where it's most likely that the TPA is possible to close with the lowest force and still provide terminal electrical contact. **2** Insert the terminal into that position. **3** Secure connector body to fixture. **4** Fully insert TPA into connector body at a uniform rate of (50 ± 10) mm/min. **5** Record the peak force and graph force versus distance from initial contact of the TPA to the connector body to the final engaged position.
12d	GMW 4.12.1	Closed TPA Locking Force	25N Min	**Closed TPA Locking Force.** **1** Using a suitable fixture, orient the connector with orientations specified by the design engineer as most likely to defeat the holding feature. **2** Pull or push the TPA from the connector at a uniform rate (50 ± 10) mm/min until a force of 20 N is applied.

12e	GMW 4.1	Visual Inspection	Inspect for defects.	
13	**GMW 4.12.5**	**Connector Position Assurance (CPA)**	**GMW sequence 25L**	
13a	GMW 4.1	Visual Inspection	Inspect for defects.	
13b	GMW 4.12.5	CPA Lock and Unlock Force - locking force -opening force	 22N Max 20~40N	**CPA Lock and Unlock Force.** **1** Using a mated connector pair, close the CPA at a uniform rate of (50 ± 10) mm/min until fully seated and locked. Record the peak force. **2** Open the CPA at a uniform rate of (50 ± 10)mm/min until fully opened. Record the peak force.
13c	GMW 4.12.5	CPA closing force on Unmated Connectors	- 8way :80 N Min	**CPA Closing Force on Unmated Connectors.** Using an unmated connector, close the CPA at a uniform rate of (50 ± 10) mm/min until fully seated and locked. Record the peak force.
13d	GMW 4.12.5	CPA Extraction Force	- 8way :80 N Min	**CPA Extraction Force.** Using an unmated connector, apply a force to the CPA in the opposite direction to the normal closing direction at a uniform rate of (50 ± 10) mm/min until fully detached. Record the peak force.
13e	GMW 4.1	Visual Inspection	Inspect for defects.	
14	**GMW 4.12.6**	**Force to remove Radial Seal from Female Housing**	**GMW sequence 25M**	
14a	GMW 4.1	Visual Inspection	Inspect for defects.	
14b	GMW 4.12.6	Force to remove Radial Seal from Female Housing	9N Min	Pull radial seal using suitable equipment at a rate of (50 ± 10) mm/min and record the force needed to remove the radial seal from the female housing.
14c	GMW 4.1	Visual Inspection	Inspect for defects.	

Figure 15: Sealed Connector Environmental Tests



Item No.	Procedure Or Standard	Test Description	Acceptance Criteria	Procedure
15	**GMW**	**Fluid Resistance Sequence**	**GMW sequence 27A**	
15a	GMW 4.1	Visual Inspection	Inspect for defects.	
15b		Connector and / or Terminal Cycling	10 condition cycle	
15c	GMW 4.19	Isolation Resistance	R > 100 Mohms @ 500 VDC For 15s	**Note:** For sealed connector pairs, complete all measurements in this test procedure within one hour after any previous environmental test. **Note:** For unsealed connector pairs, test samples shall rest at ambient temperature and humidity for 3 h min. prior to measuring isolation resistance after any previous environmental test. **1** Mate connector pairs. **2** Wrap metal foil around the exterior of the connector without contacting any terminals or wires. **3** Remove a minimal amount of insulation from the ends of the wires. **4** Separate wires under test with sufficient distance as to have no influence on isolation resistance between any two wire pairs. **5** Measure the isolation resistance by applying 500 VDC between all adjacent pairs of terminals. **6** Record the resistance after 15 s of stabilized readings. **7** Attach all the terminated wire leads to the positive lead of a Mega-Ohmmeter. Attach the negative lead of the Mega-Ohmmeter to the metal foil. **8** Measure the isolation resistance by applying 500 VDC between the terminals and the metal foil. **9** Record the resistance after 15 s of stabilized readings.
15d	GMW 4.32	Fluid Resistance Sequence		**Caution:** Follow all Federal, state, and local safety regulations, standards, and procedures when performing this test. **1** Prepare a sufficient number of male and female terminal leads using the smallest size wire specified for the respective terminals to fully assemble at least 20 mated connector pairs. These terminated leads shall be built on design intent production crimp machines. ***Note:*** For Header type connectors, prepare samples only for the mating connector.

GMW 3.3 Conditioning.
Prior to starting any test procedure specified in this document, the following conditioning procedures shall be followed.

- Crimp wires of appropriate gauge size to terminals. Insert terminated leads into specific connector housings, when required.
- Completely mate and unmate each connector or terminal pair 10 times.
- Store test samples at an ambient temperature of (+23 ± 5) C for 24 h min.

				2 Assemble a minimum of 20 pairs of fully populated mating connector pairs using the terminals prepared in step 1. Assembly must include all applicable TPA's, seals, etc. Number each mated connector pair. **3** Condition test samples per GMW 3.3, Conditioning. **4** Verify conformance of each mated connector assembly pair to paragraph 4.1, Visual Examination. **5** Perform the Isolation Resistance test, per GMW 4.19. This establishes a reference for the concluding Isolation Resistance test. **6** Completely submerse a minimum of 2 test samples in each fluid listed in Table 20 for 60 min. Fluids are to be stabilized at the temperatures indicated in Table 20, Fluids. ***Note:*** A fresh test sample is to be used for each fluid and each test sample is to be submersed in one fluid only, unless otherwise requested by the authorized person. **7** At the conclusion of the submersion period, remove the sample from the fluid and store the wet test samples in suitable containers for one week. Do not allow test samples submersed in different fluids to touch each other and do not allow any dissimilar fluid drippings to intermingle. **Caution:** Do not shake off any excess fluid. Use care not to splash any fluid on unintended surfaces. **8** After the one week storage period, perform the Isolation Resistance Test in GMW 4.19 on the stored test samples.
15e	GMW 4.19	Isolation Resistance	R > 100 Mohms @ 500 VDC For 15s	
15f	GMW 4.20	Dielectric Strength - AC1000V at 50 or 60Hz - DC 1600V For 60s	No Breakdown No Flash Over	**Note:** For sealed connector pairs, all measurements in this test procedure shall be completed within one hour after any prior environmental test. **Note:** For unsealed connector pairs, test samples shall rest at ambient temperature and humidity for 3 h min. prior to measuring dielectric strength after any previous environmental test. **1** Mate connector pairs. **2** Wrap metal foil around the exterior of the connector without contacting any terminals or wires.

				3 Remove a minimal amount of insulation from the ends of the wires. **4** Separate wires under test with sufficient distance as to have no influence on isolation resistance between any two wire pairs. **5** Using the high potential (hi-pot) tester, apply an AC rms voltage of 1000 V at 50 Hz or 60 Hz or a DC voltage of 1600 V across each adjacent cavity for 60 s min. **6** Record any current leakage. **7** Attach all the terminated wire leads to the positive lead of the hi-pot tester. Attach the negative lead of the hi-pot tester to the metal foil. **8** Apply an AC voltage of 1000 V (rms) at 50 Hz or 60 Hz or a DC voltage of 1600 V between the terminals and the metal foil for 60 s min. **9** Record any current leakage.
15g	GMW 4.9	Terminal-from-Connector Extraction Force (2.8mm Terminal)	90 N Min	**1** Assemble connectors and 10 of the terminals including all seals and other necessary components but without the TPA's. Designs using pre-staged TPA's shall have the TPA in the pre-staged position. **2** Secure the connector into a fixture. **3** Attach the conductor to the pull tester at a point< 100 mm behind the rear of the terminal. **4** Pull the conductor at a uniform rate of (50 ± 10) mm/min until pull-out occurs. Note pull-out value and failure mode. **5** Record peak force required to pull the terminal out of the connector cavity. If the conductor breaks or pulls out of the terminal before the terminal pulls out of the cavity, record this force and note the failure mode. **6** Using new test samples repeat steps 1 to 5 but with all TPA's fully seated. **7** Using new test samples and fully seated TPA's, repeat steps 1 to 5 using connectors that are moisture conditioned by being exposing to (95...98) % Relative Humidity at +40 C for 6 h. The pull test shall be performed immediately following removal of the connectors from the temperature/humidity chamber. **8** Using new test samples and fully seated TPA's, repeat steps 1 to 5 immediately after GMW 4.21, Thermal Aging. **9** Using new test samples and fully seated TPA's, repeat steps 1 to 5 immediately after GMW 4.23, Temperature/Humidity Cycling.

15h	GMW 4.1	Visual Inspection	Inspect for defects.	
16	**GMW 4.21**	**Sealing Sequence With Thermal Aging**	**GMW sequence 27C**	
16a	GMW 4.1	Visual Inspection	Inspect for defects.	
16b		Connector and / or Terminal Cycling	10 condition cycle	
16c	GMW 4.19	Isolation Resistance	R > 100 Mohms @ 500 VDC For 15s	
16d	GMW 4.30	Pressure/Vacuum Leak		**1** Prepare terminated leads using the Smallest conductor size and insulation type appropriate to the terminal and

16e	GMW 4.30	Initial Increase the air pressure until 48KPa	No bubbles	connector under test. Prepare enough samples of male and female terminals to assemble a minimum of 10 pairs of connector assemblies leaving one cavity open for each connector pair. Assembly must include all applicable TPA’s, seals, etc. Number each mated connector pair. ***Note:*** For convenience, and to minimize loose conductor ends, conductor lengths may be terminated on both ends and looped between samples. **2** Insert a loose wire seal into the open cavities of the connector pair. **3** For mat type seals only, select 10 cavities at random among the sample set and record the connector and cavity numbers. Remove and re-insert the terminals in the selected cavities. The purpose of this step is to ensure the terminal does not damage the seal during service operations. **4** Insert a tube of sufficient diameter and wall strength (to prevent leakage between the tube and the conductor seal) into the seal in the open cavity in each connector pair paying special attention that the tube is inserted far enough to engage the full sealing capability of the wire seal. **5** Condition the parts per GMW 3.3 Conditioning. **6** Verify conformance of each mated sample connector assembly to the Isolation Resistance Test specified in GMW 4.19. This establishes a reference for the concluding Isolation Resistance test. **7** After completing steps 5 and 6 connect the free end of the tube to a regulated pressure source.

GMW 3.3 Conditioning.
Prior to starting any test procedure specified in this document, the following conditioning procedures shall be followed.

- Crimp wires of appropriate gauge size to terminals. Insert terminated leads into specific connector housings, when required.
- Completely mate and unmate each connector or terminal pair 10 times.
- Store test samples at an ambient temperature of (+23 ± 5) C for 24 h min.

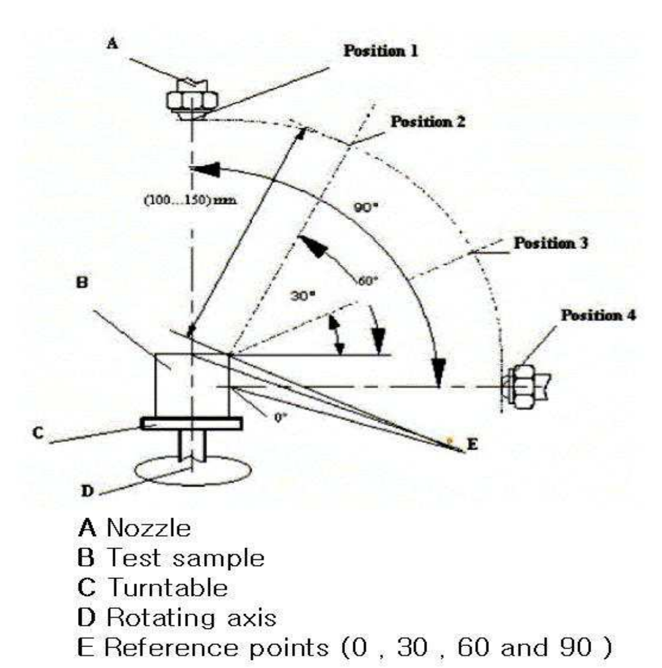
				8 Prepare enough salt water solution to completely submerse all samples to a depth of (300...400) mm below the surface. Use tap water at (+23 ± 5) C and (15...16) g of table salt (NaCl) per liter. Add an appropriate ultraviolet (florescent) dye to aid in the visual inspection for any ingress of solution into the test samples. 10 ml of liquid dish washing soap per liter of water may also be added. Mix well before adding to test apparatus. **9** Bend all conductors in the same direction, 90 to the back of each sample connector half and secure them in this position, using actual conductor dress shields if available. This is to simulate dressing of the conductors as they exit the connector and is intended to stress the conductor seals(s) as in actual applications. If actual production dress shields are not available, simulate production application intent as closely as possible. Ensure that the tube is not kinked, squeezed shut or otherwise obstructed. The tube should be left out of the 900 bend if feasible. Seal all loose conductor ends to eliminate possible leakage through the conductor strands. **10** Completely submerse all samples into the container of salt water solution prepared in step 8 above. Use care to avoid submersing any wire ends or the open end of any tube. **11** Slowly increase the air pressure of the regulated pressure source supplying the tube in each sample until the gauge reads 48 kPa (7psig). **12** Observe samples for 15 s and verify that there are no air bubbles. **13** Switch the regulated source from pressure to vacuum and slowly apply 48 kPa (7psig) of vacuum to the samples for 15 s. **14** Remove the samples from the salt water solution, shake off excess fluid and then carefully dry all exterior surfaces of the sample. **15** Strip 10 mm of insulation from the conductor ends of each terminal in one connector half and repeat the Isolation Resistance test specified in GMW 4.19.

GMW 4.1.7 Post-Test Visual Examination.
After testing, re-examine each test sample and note in detail any observable changes, such as swelling, corrosion, discoloration, physical distortions, cracks, etc. Compare the tested samples to the following items, noting any differences:

- Control samples.
- Videos.
- Photographs.

GMW 4.31.4 Procedure.
Mount the test samples on a turntable with a rotation rate of (5 ± 1) revolutions/min. Subject the connector samples to the high-pressure water spray for in positions 1 to 4 as illustrated in Figure 16, Test Arrangement for 30 s each. Let connectors dry through evaporation in still air at (+23 ± 5) C.
Perform the Isolation Resistance Test specified in GMW 4.19.

Figure 16: Test Arrangement



16 At the completion of the test, visually inspect each mated sample pair for any physical degradation, cracking, etc. per GMW 4.1.7 taking special care not to allow any surface moisture to enter the interior of either connector. Disconnect the mated connectors and carefully inspect the interior of the connectors for any evidence of moisture ingress as evidenced by residue of the florescent dye.

17 Re-connect each sample to its original mate and re-seal all conductor ends. Place the samples in a temperature chamber stabilized at the maximum ambient temperature for the appropriate temperature class from Table 1. Heat Soak all samples for 70 h.

18 After the Heat Soak, remove the samples from the chamber and allow the samples to cool to (+23 ± 5) C. Repeat steps 9 to 15, except limit the pressure in step 11 and the vacuum in step 13 to 28 kPa (4psig).

19 Verify conformance of all test samples to the Acceptance Criteria in GMW 4.31.4.

20 Special test for connectors with mat type conductor seals.

Note: This test is not applicable to single cavity connector designs. This is an additional test and requires use of new samples. Its purpose is to check for seal distortion from extremes of conductor size that may produce a leak.

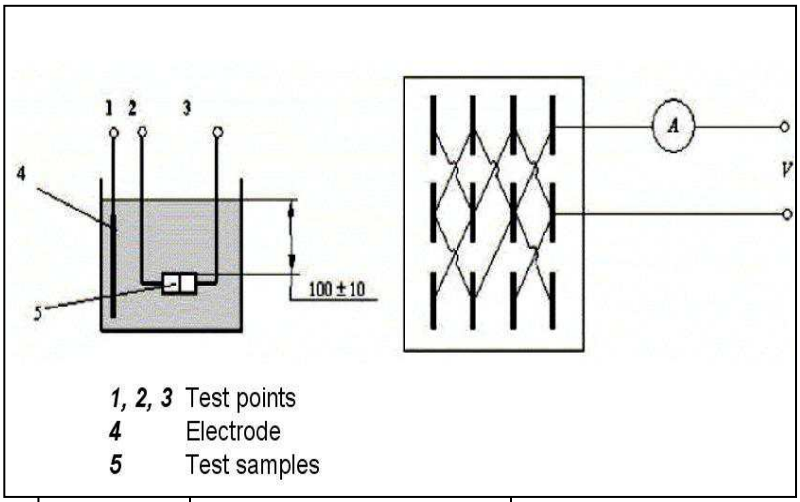
A Repeat step 1, except prepare one male and one female terminated lead using the smallest conductor size for each connector pair to be tested.

B Repeat step 1 except using the largest conductor size and insulation type for the terminals to be used in the intended application. Prepare only enough terminal samples to fully populate all connector pairs, less one cavity for each connector half and less the one cavity left open for the pressure/vacuum tube.

C Prepare a minimum of 10 connector pairs so that all but one randomly selected cavity in each connector half is populated with a terminal crimped to the largest conductor size, prepared in step B above. Leave one cavity in each connector pair open for the pressure/vacuum tube, as directed in step 1.

				Then fill the remaining cavity in each connector half with appropriate terminal crimped to the smallest conductor size, prepared in step A above. Unless the size of the connector makes it impossible, do not place the smallest conductor in a cavity adjacent to the pressure/ vacuum tube. Number each connector pair. **D** Repeat steps (4...19) using the samples prepared in step C above.
16f	GMW 4.1	Visual Inspection	Inspect for defects.	
16g	GMW 4.21	Thermal Aging +125℃for 1008h (Temp Class3)		
16h	GMW 4.30	Pressure/Vacuum Leak -Increase the air pressure Until 28KPa For 15s	No bubbles	
16i	GMW 4.1	Visual Inspection	Inspect for defects.	
16j	GMW 4.29	Submersion (Sealing Class 2 0.35mm² &2.5 mm² Wire) +125℃(Temp Class3) - Leakage Current	5 µA Max	Prepare a water submersion test device per Figure 17. Place mated connector samples into a thermal chamber and heat soak the samples for at least 30 min at the maximum ambient operating temperature for the appropriate temperature class. Remove the heated test samples from the thermal chamber and immediately immerse the heated test sample into (+23 ± 5) C de-ionized water to a depth of 100 mm for 1 h min. With the test samples immersed in the liquid, record any leakage current measurements between each terminal pair and the electrode at 14 VDC. Also, record the leakage current measurements between every two adjacent terminals pairs. At the completion of the test, visually inspect each mated sample pair for any physical degradation, cracking, etc. per GMW 4.1.7 taking special care not to allow any surface moisture to enter the interior of either connector. Disconnect the mated connectors and carefully inspect the interior of the connectors for any evidence of moisture ingress as evidenced by residue of the florescent dye. No evidence of water or florescent dye shall be present in the interior of either mated connector.

Figure 17: Water Submersion Setup



16k	GMW 4.1	Visual Inspection	Inspect for defects.	
16l	GMW 4.19	Isolation Resistance	R > 100 Mohms @ 500 VDC For 15s	
16m	GMW 4.20	Dielectric Strength - AC1000V at 50 or 60Hz For 60s - DC 1600V For 60s	No Breakdown No Flash Over	
16n	GMW 4.9	Terminal-from-Connector Extraction Force (2.8mm Terminal)	90 N Min	
16o	GMW 4.1	Visual Inspection	Inspect for defects.	
17	**GMW 4.22**	**Sealing Sequence With Thermal Shock**	**GMW sequence 27D**	
17a	GMW 4.1	Visual Inspection	Inspect for defects.	
17b		Connector and / or Terminal Cycling	10 condition cycle	
17c	GMW 4.19	Isolation Resistance	R > 100 Mohms @ 500 VDC For 15s	
17d	GMW 4.30	Pressure/Vacuum Leak		
17e	GMW 4.30	Initial Increase the air pressure until 48KPa	No bubbles	
17f	GMW 4.1	Visual Inspection	Inspect for defects.	
17g	GMW 4.21	Thermal Shock -40℃+125℃for 300h (Temp Class3)		
17h	GMW 4.30	Pressure/Vacuum Leak -Increase the air pressure Until 28KPa For 15s	No bubbles	
17i	GMW 4.1	Visual Inspection	Inspect for defects.	
17j	GMW 4.29	Submersion (Sealing Class 2 0.35mm^2 &2.5 mm^2 Wire) +125℃(Temp Class3) -Leakage Current Sealing class 2	5 µA Max	
17k	GMW 4.1	Visual Inspection	Inspect for defects.	
17l	GMW 4.19	Isolation Resistance	R > 100 Mohms @ 500 VDC For 15s	

17m	GMW 4.20	Dielectric Strength - AC1000V at 50 or 60Hz For 60s - DC 1600V For 60s	No Breakdown No Flash Over	
17n	GMW 4.1	Visual Inspection	Inspect for defects.	
18	**GMW 4.23**	**Sealing Sequence With Temp/Humidity Cycling**	**GMW sequence 27E**	
18a	GMW 4.1	Visual Inspection	Inspect for defects.	
18b		Connector and / or Terminal Cycling	10 condition cycle	
18c	GMW 4.19	Isolation Resistance	R > 100 Mohms @ 500 VDC For 15s	
18d	GMW 4.30	Pressure/Vacuum Leak		
18e	GMW 4.30	Initial Increase the air pressure until 48KPa	No bubbles	
18f	GMW 4.1	Visual Inspection	Inspect for defects.	
18g	GMW 4.23	Temperature/Humidity Cycling for 240h - Temp Class 3		
18h	GMW 4.30	Pressure/Vacuum Leak -Increase the air pressure Until 28KPa For 15s	No bubbles	
18i	GMW 4.1	Visual Inspection	Inspect for defects.	
18j	GMW 4.29	Submersion (Sealing Class 2 0.35mm^2 &2.5 mm^2 Wire) +125°C(Temp Class3) - Leakage Current	5 μA Max	
18k	GMW 4.1	Visual Inspection	Inspect for defects.	
18l	GMW 4.19	Isolation Resistance	R > 100 Mohms @ 500 VDC For 15s	
18m	GMW 4.20	Dielectric Strength - AC1000V at 50 or 60Hz For 60s - DC 1600V For 60s	No Breakdown No Flash Over	
18n	GMW 4.9	Terminal-from-Connector Extraction Force (2.8mm Terminal)	90 N Min	
18o	GMW 4.1	Visual Inspection	Inspect for defects.	
19	**GMW 4.23**	**Sealing Sequence With Temp/Humidity Cycling**	**GMW sequence 27E**	
19a	GMW 4.1	Visual Inspection	Inspect for defects.	
19b		Connector and / or Terminal Cycling	10 condition cycle	
19c	GMW 4.19	Isolation Resistance	R > 100 Mohms @ 500 VDC For 15s	

19d	GMW 4.30	Pressure/Vacuum Leak		
19e	GMW 4.30	Initial Increase the air pressure until 48KPa	No bubbles	
19f	GMW 4.30	After leave the heat soak 70h Isolation resistance	R > 100 Mohms @ 500 VDC For 15s	
19g	GMW 4.30	After leave the heat soak 70h Increase the air pressure until 28KPa	No bubbles	
19h	GMW 4.1	Visual Inspection	Inspect for defects.	
20	**GMW 4.25**	**Flammability**		
20a	GMW 4.25	Flammability	100mm / min Max	Perform the flammability test per GMW3232.

Test Sequence from Figure 31 to Figure 35	Para-graph	Name of Test	New Sealed Connector		
			Non GMW3191 Approved Terminal System	GMW3191 Approved Terminal System	Addition of new connector in existing approved series
Terminal–Mechanical tests					
22A	4.2	Crack Corrosion	○		
22B	4.3	Crimp Integrity	○		
22C	4.4	Terminal Wire Attachment Tensile Strength Tests	○		
22D	4.5	Terminal-to-Terminal Engagement Force	○		
22E	4.8	Mechanical Overstress	○		
22F	4.34	Terminal Bend Resistance	○		
Terminal–Electrical tests					
23A		Terminal – Maximum Current Rating	○		
23B		Terminal – Current Cycling Sequence	○		
Connector System Electrical Tests					
24A		Mechanical Shock/Vibration Sequence	○	○	○
24B	4.21	Thermal Aging	○	○	○
24C	4.24	Heavy Duty Test	○	○	○
24D	4.22	Thermal Shock	○	○	○
24E	4.23	Temperature/Humidity Cyc	○	○	○

Test Sequence from Figure 31 to Figure 35	Para-graph	Name of Test	New Sealed Connector		
			Non GMW3191 Approved Terminal System	GMW3191 Approved Terminal System	Addition of new connector in existing approved series
Connector System Mechanical Tests					
25A	4.7	Terminal-to-Connector Engagement Force	○	○	
25B	4.9	Terminal-from-Connector Extraction Force	○	○	○
25C	4.11	Connector-to-Connector Engagement Force	○	○	○
25D	4.13	Locked Connector Disengagement Force	○	○	○
25E	4.14	Unlocked Connector Disengagement Force	○	○	○
25F	4.15	Connector Polarization (Coding) Feature	○	○	○
25G	4.12.1	Terminal Position Assurance (TPA)	○	○	○
25H	4.12.2	Retention of Slide in Open Position	○	○	○
25J	4.12.3	Lever and Slide, Side Force Strength.	○	○	○
25K	4.12.4	Connector Mounting Feature Mechanical Strength	○	○	
25L	4.12.5	Connector Position Assurance (CPA)	○	○	○
25M	4.12.6	Force to remove Radial Seal from Female Housing	○	○	○
Unsealed Connector Environmental Tests					
28A	4.21	Thermal Aging			
28B		Corrosion Sequence			
28C	4.22	Thermal Shock			
28D	4.23	Temperature/Humidity Cycling			
Sealed Connector Environmetal Tests					
27A		Fluid Resistance Sequence	○	○	○
27B		Corrosion Sequence (Only for Connectors with Exposed Metal	○	○	○
27C		Sealing Sequence With Thermal Aging	○	○	○
27D		Sealing Sequence With Thermal Shock	○	○	○
27E		Sealing Sequence With Temp/Humidity Cycling	○	○	○

Test Sequence from Figure 31 to Figure 35	Para–graph	Name of Test	New Sealed Connector		
			Non GMW3191 Approved Terminal System	GMW3191 Approved Terminal System	Addition of new connector in existing approved series
Other Tests					
	4.6	Terminal Normal Force (Not required if test previously	○		
	4.25	Flammability	○	○	○
	4.33	Electrical Resistance of Short Circuit Devices	○	○	○