DEUTSCH* DTM Series Connector System

1. INTRODUCTION

1.1. Purpose

This report summarizes the results of testing performed on DEUTSCH DTM series connector system to determine conformance to the requirements of product specification 108-151010.

1.2. Scope

This report covers the electrical, mechanical, and environmental performance of the DEUTSCH DTM series connector system. Testing was performed at the DEUTSCH Industrial Products Division Laboratory in 1997, 2006, 2015. The test file numbers for this testing are listed in Figure 1. This documentation is on file at, and available from, DEUTSCH Industrial Products Division Laboratory.

Test Group	Test Report
1	970523-01/02
2	970523-03/04
3	970523-05/06
4	970605-01
5	IPD060731-01
6	IPD060731-03
7	IPD060731-05
8	IPD060731-08
9	IPD060731-09
10	IPD060731-10
11	IPD060731-11
12	IPD060731-12
13	IPD060731-13
14	IPD070426-17
15-17	WE-2015-115ACL

Figure 1

1.3. Conclusion

The DEUTSCH DTM series connector system products listed in Paragraph 1.4 conform to the electrical, mechanical, and environmental performance requirements given in product specification 108-151010.

1.4. Test Specimens

Test specimens were representative of normal production lots. Specimens identified with the part numbers given in Figure 2 were used for testing.

1.5. Environmental Conditions

Unless otherwise stated, the following environmental conditions prevailed during testing:

Temperature: 15° to 35°C

Relative humidity: 25 to 75%

DEUTSCH PART NUMBER	DESCRIPTION	TEST GROUP
DTM04-12PA	12-Pin Receptacle, Inline	1-3
DTM06-12SA	12-Pin Plug, Inline	
WM-12P	12-Pin Receptacle Wedge Lock	
WM-12S	12-Pin Plug Wedge Lock	
1060-20-0122	Size 20 S&F Pin, Nickel	
1060-20-0144	Size 20 S&F Pin, Gold	
1062-20-0122	Size 20 S&F Socket, Nickel	
1062-20-0144	Size 20 S&F Socket, Gold	
DTM04-2P	2-Pin Receptacle, Inline	4
DTM06-2S	2-Pin Plug, Inline	
DTM04-12PA	12-Pin Receptacle, Inline	
DTM06-12SA	12-Pin Plug, Inline	
WM-2P	2-Pin Receptacle Wedge Lock	
WM-2S	2-Pin Plug Wedge Lock	
WM-12P	12-Pin Receptacle Wedge Lock	
WM-12S	12-Pin Plug Wedge Lock	
0460-202-20141	Size 20 Solid Pin, Nickel	
0462-201-20141	Size 20 Solid Socket, Nickel	
DTM04-2P	2-Pin Receptacle, Inline	5-14
DTM06-2S	2-Pin Plug, Inline	
DTM04-3P	3-Pin Receptacle, Inline	
DTM06-3S	3-Pin Plug, Inline	
DTM04-4P	4-Pin Receptacle, Inline	
DTM06-4S	4-Pin Plug, Inline	
DTM04-6P	6-Pin Receptacle, Inline	
DTM06-6S	6-Pin Plug, Inline	
DTM04-08PA	8-Pin Receptacle, Inline	
DTM06-08SA	8-Pin Plug, Inline	
DTM04-12PA	12-Pin Receptacle, Inline	
DTM06-12SA	12-Pin Plug, Inline	
WM-2P	2-Pin Receptacle Wedge Lock	
WM-2S	2-Pin Plug Wedge Lock	
WM-3P	3-Pin Receptacle Wedge Lock	
WM-3S	3-Pin Plug Wedge Lock	
WM-4P	4-Pin Receptacle Wedge Lock	
WM-4S	4-Pin Plug Wedge Lock	
WM-6P	6-Pin Receptacle Wedge Lock	
WM-6S	6-Pin Plug Wedge Lock	
WM-8P	8-Pin Receptacle Wedge Lock	
WM-8S	8-Pin Plug Wedge Lock	
WM-12P	12-Pin Receptacle Wedge Lock	
WM-12S	12-Pin Plug Wedge Lock	
1060-20-0122	Size 20 S&F Pin, Nickel	
1060-20-0222	Size 20 S&F Pin, Nickel	
1062-20-0122	Size 20 S&F Socket, Nickel	
1062-20-0222	Size 20 S&F Socket, Nickel	
1062-20-0322	Size 20 S&F Socket, Nickel	

Figure 2 cont

DEUTSCH PART NUMBER	DESCRIPTION	TEST GROUP
DTM04-2P	2-Pin Receptacle, Inline	15-17
DTM06-2S	2-Pin Plug, Inline	
DTM04-3P	3-Pin Receptacle, Inline	
DTM06-3S	3-Pin Plug, Inline	
DTM04-4P	4-Pin Receptacle, Inline	
DTM06-4S	4-Pin Plug, Inline	
DTM04-6P	6-Pin Receptacle, Inline	
DTM06-6S	6-Pin Plug, Inline	
DTM04-08PA	8-Pin Receptacle, Inline	
DTM06-08SA	8-Pin Plug, Inline	
DTM04-12PA	12-Pin Receptacle, Inline	
DTM06-12SA	12-Pin Plug, Inline	
DTM6P-BT	6-Pin Rubber Boot	
DTM8P-BT	8-Pin Rubber Boot	
WM-2P	2-Pin Receptacle Wedge Lock	
WM-2S	2-Pin Plug Wedge Lock	
WM-3P	3-Pin Receptacle Wedge Lock	
WM-3S	3-Pin Plug Wedge Lock	
WM-4P	4-Pin Receptacle Wedge Lock	
WM-4S	4-Pin Plug Wedge Lock	
WM-6P	6-Pin Receptacle Wedge Lock	
WM-6S	6-Pin Plug Wedge Lock	
WM-8P	8-Pin Receptacle Wedge Lock	
WM-8S	8-Pin Plug Wedge Lock	
WM-12P	12-Pin Receptacle Wedge Lock	
WM-12S	12-Pin Plug Wedge Lock	
1028-021-0205	2-Pin Backshell	
1028-024-0305	3-Pin Backshell	
1028-027-0405	4-Pin Backshell	
1028-034-1205	12-Pin Backshell	
1060-20-0122	Size 20 S&F Pin, Nickel	
1062-20-0122	Size 20 S&F Socket, Nickel	

Figure 3 end

1.6. Qualification Test Sequence

TEST OR EXAMINATION	TEST GROUP (a)																
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
	TEST SEQUENCE (b)																
Examination of Product	1	1	1	1	1,5	1,5	1,8	1,3	1,4	1,7	1,6	1,6	1,6	1,15	1,6	1,6	1,6
Low Level Contact Resistance	4	4	4	2,5,8			3.7				3,5			3,6,8, 10,12			
Contact Resistance	3	3	3	3,6,9													
Insulation Resistance 1				11			5			3,6		5	4,6				
Insulation Resistance 2															2,5	2,5	2,5
Withstanding Voltage							6										
Conditioning of Samples					2	2	2		2	2	2	2	2,3	2			
Temperature Life		2		4													
Connection and Disconnection														4			
Tensile Strength of Conductor								2									
Locking Device Strength												4					
Contact Insertion Force					3												
Contact Retention					4												
Water Immersion				10													
Influence of Water and Salt										5			5				
Temperature/Humidity Cycling							4							5			
Thermal Cycle	2																
Thermal Shock 1			2												3	3	3
Thermal Shock 2														13			
Sinusoidal Vibration 1				7													
Sinusoidal Vibration 2														7			
Random Vibration														9			
Mechanical Shock														11			
De-Rating									3								
Drop						4											
Chemical Fluids										4		3					
Plastic Bag Test											4			14			
Durability					3												
Protection Against Dust (IP6KX)															4		
Protection Against Water (IPX8)																4	
Protection Against High Pressure/Steam Jet Cleaning (IPX9K)																	4

(a) Specimens were prepared in accordance production drawings and were selected at random from current production.

- Groups 1 through 3 specimens consisted of 12-position connectors with DEUTSCH solid terminal system size 20 nickel and gold pins and socket contacts with size 18 and 20 AWG wire.
- Group 4 specimens consisted of 2- and 12-position connectors with DEUTSCH solid terminal system size 20 nickel pins and socket contacts with size 20 AWG wire.
- Group 5 through 14 specimens consisted of 2-, 3-, 4-, 6-, 8- and 12-position connectors with DEUTSCH S&F terminal system size 20 nickel pin and socket contacts with sizes 0.50 mm^2, 0.75 mm^2 and 1.50 mm^2.
- Group 15 through 17 specimens consisted of 2-, 3-, 4-, 6-, 8- and 12-position connectors with DEUTSCH S&F terminal system size 20 nickel pin and socket contact with size 20 TXL wire

(b) Numbers indicate sequence that tests were performed.

Figure 4

2. TEST METHODS AND RESULTS

2.1. Examination of Product

Product was visually inspected for correct use of materials, proper construction, correct part number and insert markings, and over-all quality of workmanship. Poor molding fabrication, loose materials, damaged or improperly manufactured contacts, galling of metal parts, nicks and burrs of metal parts, and torn seals or cracked plastic were considered adequate basis for rejection.

2.2. Low Level Contact Resistance

Applied voltage did not exceed 20 mV open circuit, and the test current was limited to 100 mA. The resistance of an equal length of wire (reference wire) was subtracted from the same reel as what was used for the connector wiring.

2.3. Contact Resistance

Test currents are given in Figure 5. The resistance of an equal length wire (reference wire) was subtracted from the actual readings to determine the added resistance of the terminal. The reference wire was taken from the same reel as what was used for the connector wiring.

CONTACT SIZE	WIRE SIZE (AWG, mm^2)	TEST CURRENT (amp)	MAXIMUM VOLTAGE DROP (mV)	
			Solid Contact	S&F Contact
20	16, 1.0	7.5	60	100
	18, 0.08			
	20, 0.05			
	22, 0.35	5		

Figure 5

2.4. Insulation Resistance 1

Each contact was checked to all other contacts and the shell, if the shell is conductive. Test was performed using a 500 VDC ±10% megohmmeter.

2.5. Insulation Resistance 2

Each contact was checked to all other contacts and the shell, if the shell is conductive. Test was performed using a 1000 VDC ±10% megohmmeter.

2.6. Withstanding Voltage

Applied AC voltage was 1000 V (rms) or DC voltage of 1600 V for 1 minute across all terminals connected together and a metal film surrounding the housing. In addition, the voltage was applied with a different test sample to every two adjacent contacts.

2.7. Conditioning of Samples

The test sample was placed in a test chamber for 500 hours at +120°C without current flowing.

2.8. Temperature Life

The wired mated connectors were subjected to 1000 hours at +125°C without current flowing.

2.9. Connection and Disconnection

The connection and disconnection was performed as specified by the connector manufacturer at a constant speed between 25 mm/min and 100 mm/min. The connector was subjected for 10 connections and disconnections. The force was measured at the first connection, the first disconnection, and the tenth disconnection.

2.10. Tensile Strength of Conductor

The tensile strength of the crimped connection was tested by using suitable apparatus at a constant speed within the range of 25 mm/min. If the terminal had a cable insulation crimp, it was rendered mechanically ineffective.

2.11. Locking Devise Strength

The ability of locked connectors were checked to withstand a specific static load. A test force of 100 N was applied in the disconnection direction and held constant for 10 to 12 seconds.

2.12. Contact Insertion Force

The insertion force of the contact into the cavity was tested by using the minimum and maximum size cable, placing it in the insertion direction via a test fixture and positioning it as close to the cable attachment. The contact was locked in place. The performance was measured at constant 25 mm/min.

2.13. Contact Retention

A constant force was applied to the front and/or back of the terminal in an axial direction and held for 10 to 12 seconds.

2.14. Water Immersion

The wired mated connectors were placed in an oven at +125°C for a minimum of 2 hours, then immediately placed in water with a 5% salt by weight content and 0.1 g/L wetting solution to a depth of 914 mm for 4 hours minimum. The free ends of the mated connectors remained out of the water to prevent wicking of the water through the open wires. Water temperature was +23°C.

2.15. Influence of Water and Salt

Samples were placed in an oven at +125°C for 1 hour, then immediately placed in water with 5% salt in weight content and 0.1 g/L wetting agent to a depth of 1 meter for 4 hours.

2.16. Temperature/Humidity Cycling

The sample was subjected to 10 cycles of 24 hours as follows:

1. Held at +23°C at 45% RH for 4 hours
2. Raised to +55°C at 95% RH for 0.5 hours
3. Held at +55°C at 95% RH for 10 hours
4. Lowered to -40°C within 2.5 hours
5. Held at -40°C for 2 hours
6. Raised to +120°C within 1.5 hours
7. Held at +120°C for 2 hours

2.17. Thermal Cycle

Cycled mated connectors from -55° to +125°C. Connectors remained at each temperature extreme for a minimum of 1 hour. Mated connectors were cycled a total of 20 complete cycles.

2.18. Thermal Shock 1

Test samples were subjected to 10 cycles. One cycle consisted of a soak time at -55°C, then transitioned within 2 minutes to an ambient temperature of +125°C with a soak time, and then transitioned back to -55°C within 2 minutes. The soak times were established as the time necessary to bring the internal connector temperature on test to within 5°C of each of the ambient temperatures.

2.19. Thermal Shock 2

Subjected the sample to: (a) 20 minutes at -40°C, (b) ≤ 30-second transition time, (c) 20 minutes at +125°C, (d) ≤ 30-second transition time. Repeated 100 times.

2.20. Sinusoidal Vibration 1

Sine sweep: 10 to 2000 Hz

Initial displacement: 1.78 mm DA

Maximum acceleration: 20 g

Test duration: 12 hours per axes X, Y, Z (test current first 3 hours each axis)

CONTACT SIZE	WIRE SIZE (AWG, mm^2)	TEST CURRENT (Amp)
20	16, 1.0	5
	18, 0.08	
	20, 0.50	
	22, 0.35	3

Figure 6

2.21. Sinusoidal Vibration 2

Low frequency/amplitude: 10 Hz to 100 Hz/0.75 mm

High frequency/acceleration: >100 Hz to 500 Hz/30 g and >500 Hz to 2000 Hz/20g

Test duration: 16 hours per axis

No current applied.

2.22. Random Vibration

Test duration was 94 hours per axis. The rms acceleration value was 177 m/s^2.

FREQUENCY (Hz)	PSD (m/s^2) s^2/Hz
10	14
20	28
30	28
180	0.75
300	0.75
600	20
2000	20

Figure 7

2.23. Mechanical Shock

Three shocks were applied along the 3 mutually perpendicular axes for a total of 18 shock. The pulse was approximately a half-sine wave of 300 g magnitude with a duration of 3 ms.

2.24. De-Rating

Measurement was carried out in air as undisturbed as possible. The test samples were mounted in an enclosure, which protects the immediate environment from external air movement. The thermocouple probes were assembled to the test sample to measure temperature increase at the contact as the current increases. The current was increased in 1-amp steps. The current was maintained for 1 hour after thermal stability at each current level. Temperature was recorded at each current level.

2.25. Drop

The length of the cable was 1250 mm long. The cable was attached to a fixed point 1000 mm above the floor. A free swinging of the test sample was allowed. The test sample was held horizontal and allowed to swing down to hit a steel plate. This was repeated 5 times.

2.26. Chemical Fluids

One fluid was applied to each test sample. Chemicals were dipped, sprayed, or brushed on the sample, depending on the most convenient application system. Any excess fluid was allowed to drip off the specimen. The sample was stored for 24 hours in accordance with the aging temperature. See Figure 8.

FLUID	AGING TEMPERATURE
Diesel Fuel	120°C
Bio Diesel Fuel	
Unleaded Gasoline	26°C
Battery Fluid	80°C
Methanol	26°C
Engine Oil	120°C
Transmission Fluid	
Hydraulic Fluid	

Figure 8

2.27. Plastic Bag Test

The sample was placed on a support inside an airtight container. Beneath the support was a saline solution of H^2O with 3% NaCl and volume of approximately 2% of the total volume of the airtight container. The sample was placed in a thermal shock chamber. The 3 chambers were set to 3 different temperatures: -20°C, +5°C, and +85°C. Time exposed at each temperature was 20 minutes. Transition time was less than 60 seconds. This was repeated 200 times.

2.28. Durability

Test samples were mated and unmated 20 complete cycles at room temperature.

2.29. Protection Against Dust (IP6KX)

Test samples were subjected to 20 cycles of 6 second movement of air/dust mixture, paused for 15 minutes.

2.30. Protection Against Water (IPX8)

Test samples were subjected to immersion in water, 1m for 4 hours.

2.31. Protection Against High Pressure/Steam Jet Cleaning (IPX9K)

Test samples were subjected to water fan with rotational speed 5±1°/min, water flow 14- 16 l/min, water pressure 800-1000 kP, water temperature 80±5 °C for 30 seconds per position. Spray positions: 0°, 30°, 60°, 90°

3. SUMMARY OF TESTING

3.1. Examination of Product—All Test Groups

Specimens were visually inspected and no evidence of physical damage detrimental to product performance was observed.

3.2. Low Level Contact Resistance—Test Groups 1, 2, 3, 4, 7, 11, and 14

All low level contact resistance measurements were equal to or less than 12.5 mΩ for 1.5mm^2, 18 AWG, 0.75 mm^2, 20 AWG, and 0.50 mm^2.

3.3. Contact Resistance—Test Groups 1, 2, 3, and 4

All contact resistance measurements were less than 100 mV.

3.4. Insulation Resistance 1—Test Groups 4, 7, 10, 12, and 13

All insulation resistance measurements were greater than 1000 MΩ.

3.5. Insulation Resistance 2—Test Groups 15-17

All insulation resistance measurements were greater than 20 MΩ.

3.6. Withstanding Voltage—Test Group 7

All withstanding voltage measurements had current leakage less than 2.0 mA.

3.7. Conditioning of Samples—Test Groups 5, 6, 7, 9, 10, 11, 12, 13, and 14

No evidence of physical damage was visible as a result of conditioning of sample testing.

3.8. Temperature Life—Test Groups 2 and 4

No evidence of physical damage was visible as a result of temperature life testing.

3.9. Connection and Disconnection—Test Group 14

All connection measurements were less than 135 N.

3.10. Tensile Strength of Conductor—Test Group 8

All tensile strength measurements were greater than 70 N for 0.5 mm^2, 90 N for 0.75 mm^2, and 155 N for 1.50 mm^2.

3.11. Locking Devise Strength—Test Group 12

All locking devise strength measurements withstood 100 N for 10 to 12 seconds.

3.12. Contact Insertion Force—Test Group 5

All contact insertion force measurements were equal to or less than 30 N for 1.50 mm^2 and 15 N for 0.75 mm^2 and 0.50 mm^2.

3.13. Contact Retention—Test Group 5

All contact retention force measurements withstood 60 N for 10 to 12 seconds.

3.14. Water Immersion—Test Group 4

All test sample insulation resistance measurements were greater than 1000 MΩ.

3.15. Influence of Water and Salt—Test Groups 10 and 13

All test sample insulation resistance measurements were greater than 100 MΩ.

3.16. Temperature/Humidity Cycling—Test Groups 7 and 14

No evidence of physical damage was visible as a result of temperature/humidity cycle testing.

3.17. Thermal Cycle—Test Group 1

No evidence of physical damage was visible as a result of thermal cycle testing.

3.18. Thermal Shock 1—Test Group 3

No evidence of physical damage was visible as a result of thermal shock testing.

3.19. Thermal Shock 2—Test Group 14

No evidence of physical damage was visible as a result of thermal shock testing.

3.20. Sinusoidal Vibration 1—Test Group 4

No discontinuities were detected during vibration testing. Following vibration testing, no cracks, breaks, or loose parts on the specimens were visible.

3.21. Sinusoidal Vibration 2—Test Group 14

No discontinuities were detected during vibration testing. Following vibration testing, no cracks, breaks, or loose parts on the specimens were visible.

3.22. Random Vibration—Test Group 14

No discontinuities were detected during vibration testing. Following vibration testing, no cracks, breaks, or loose parts on the specimens were visible.

3.23. Mechanical Shock—Test Group 14

No discontinuities were detected during mechanical shock testing. Following mechanical shock testing, no cracks, breaks, or loose parts on the specimens were visible.

3.24. De-Rating—Test Group 9

De-rating curves were generated with a 40°C increase in temperature. See Figure 9.

3.25. Drop—Test Group 6

All test samples showed no detrimental damage following the test.

3.26. Chemical Fluids—Test Groups 10 and 12

No evidence of physical damage was visible as a result of exposure to chemicals.

3.27. Plastic Bag Test—Test Groups 11 and 14

All test samples did not have moisture inside or any detrimental damage following the test.

3.28. Durability—Test Group 6

No physical damage occurred as a result of manually mating and unmating the test samples 20 times.

3.29. Protection Against Dust (IP6KX) – Test Group 15

All test sample insulation resistance measurements were greater than 20 MΩ. Also, no signs of moisture inside the connector.

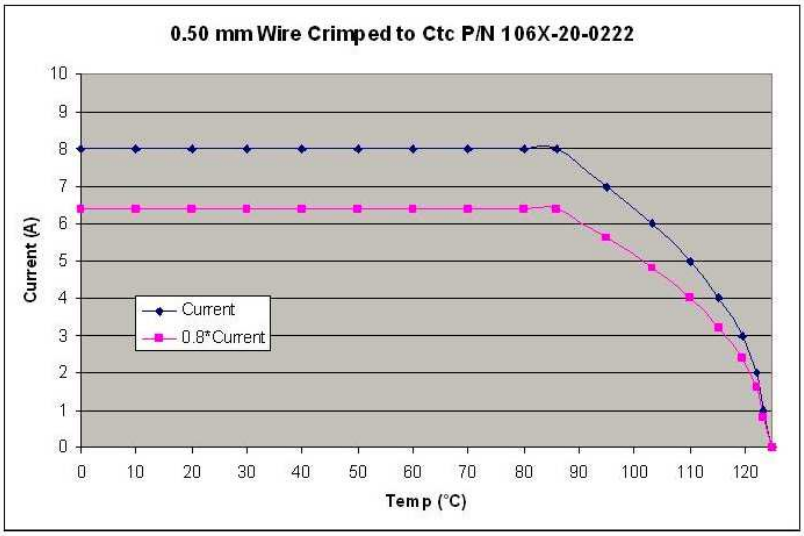
3.30. Protection Against Water (IPX8) – Test Group 16

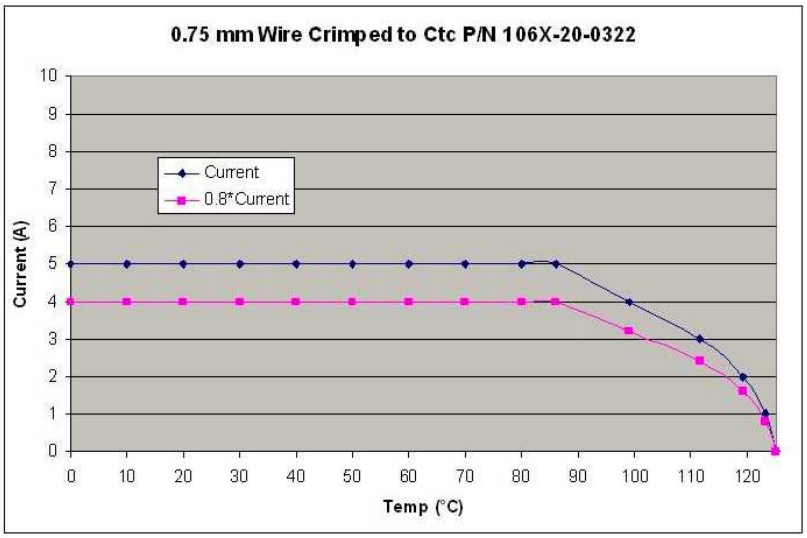
All test sample insulation resistance measurements were greater than 20 MΩ. Also, no signs of moisture inside the connector.

3.31. Protection Against High Pressure/Steam Jet Cleaning (IPX9K) – Test Group 17

All test sample insulation resistance measurements were greater than 20 MΩ. Also, no signs of moisture inside the connector.

De-Rating Curves





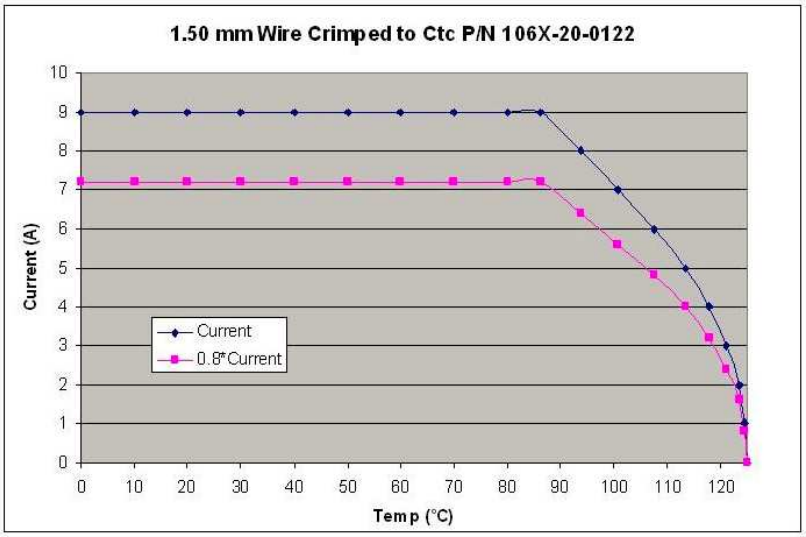


Figure 9