PRODUCT TESTING SUMMARY

Intellitec Battery Disconnect

Part number: 00-00055-XYZ

Intellitec's Battery Disconnects provide a simple, reliable, and cost effective means of remotely disconnecting the battery of larger vehicles or boats. Rather than having to install long runs of heavy, unprotected battery cable to a large cumbersome switch, the Disconnect can be located near the battery, out of normal reach. It is connected to a low current switch conveniently located for the driver by a low current cable. The concern of long battery cables shorting to the chassis is all but gone.

The Battery Disconnect is designed incorporating Intellitec's patent No. 4,628,289, of a simple magnetic mechanism. It operates as a latching relay, drawing NO current to keep it closed or open. This latching feature allows the Disconnect to operate without discharging the battery.

The following document is a compilation of tests performed on the Intellitec Battery Disconnect 01-00055-XYZ as well as the characterization of its primary function. 2+ million units have been sold across multiple industries since introduction.

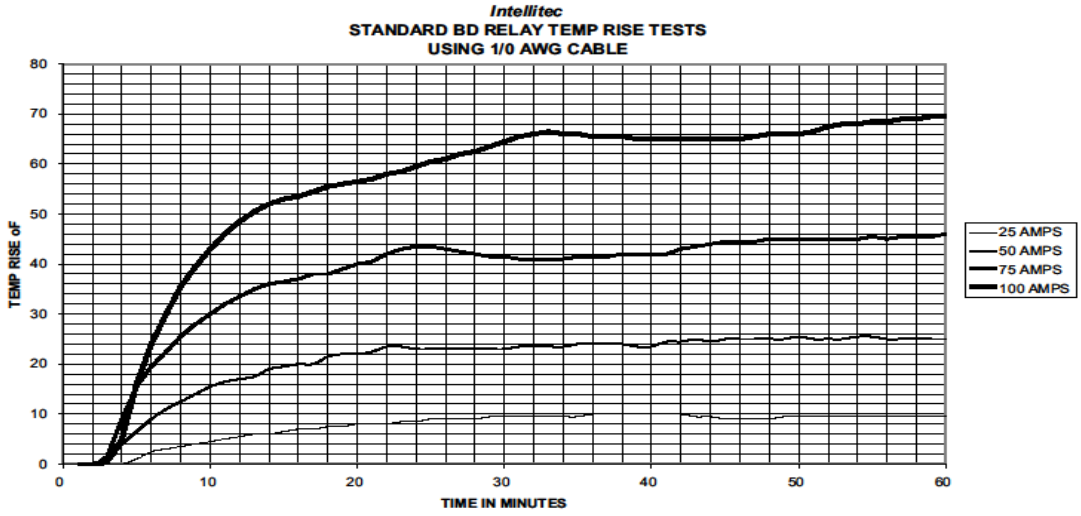
Part Number:	01-00055-000	01-00055-002	01-00055-003
Feature:	W/ Fuses	Standard	Waterproof
Continuous Current Rating:	100 A	100 A	100 A
Nominal Voltage:	12.0 V	12.0 V	12.0 V
Contact Life at Full Load:	20,000 Cycles	20,000 Cycles	20,000 Cycles
Min Actuation Voltage: (Recommended)	9.0 V	9.0 V	9.0 V

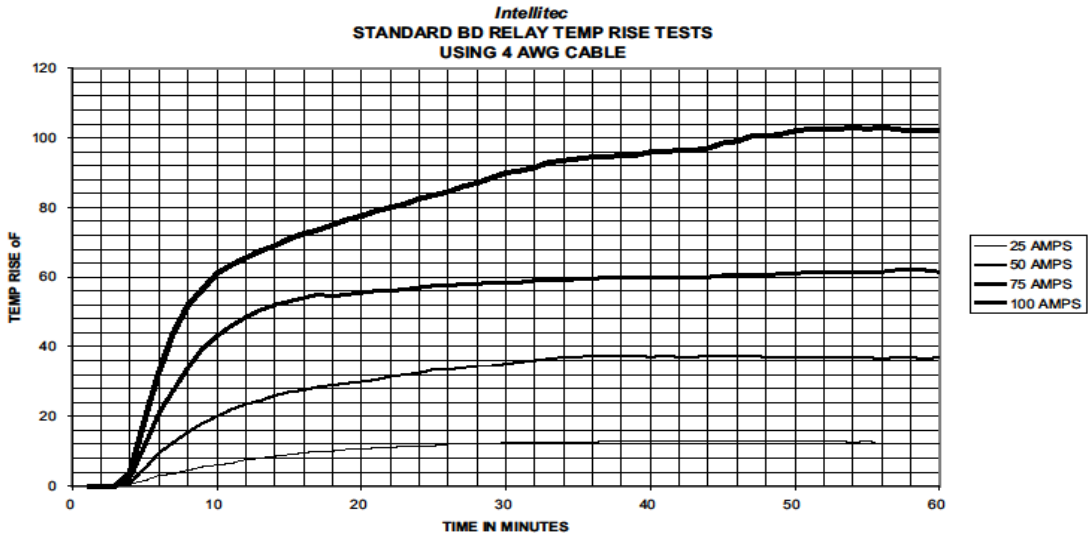
01-00055-000

01-00055-002

Thermal Characterization and Testing

The following graphs illustrate the temperature rise over ambient of the battery disconnect's contacts. The test procedure used resistive loads of various amperage and measured the temperature at each of the contact points using a temperature monitor device. The recorded data used the highest read temperature point during the test. The two graphs reflect the use of different wire gauge and how it impacts the rise in temperature over ambient.





Electrical characterization and testing

Evaluation of (3) battery disconnects for minimum pull-in voltage, measure coil current at pull-in, minimum time to pull in (at nominal voltage), and coil resistance (using 4-wire measurement). The contacts were loaded with currents of 0.5A and 6A during pull-in at the following temperatures: -20°C, +25°C, +85°C.

	Relay Test Procedure 30121	Nominal Voltage 12V					
	DUT Temp	-20	°C	25	°C	85	°C
1	Verify Relay Contacts are open. If not change to open position						
2	Measure Coil Resistance (4 wire)	1.55	Ω	1.92	Ω	2.3	Ω
3	Set load to **500mA**						
4	Set Voltage to Nominal Voltage for the relay.						
5	Using Min/Min procedure find minimum pulse						
6	Record Minimum Pulse	40	mS	40	mS	60	mS
7	Measure Coil Current from Scope	3.9	A	3.6	A	3.6	A
8	Measure voltage drop across contact sense leads using DMM	27.6	mV	28.3	mV	29.3	mV
9	Use minimum pulse to open relay						
10	Measure Coil Current from Scope	3.1	A	2.9	A	3.2	A
11	Measure voltage drop across contact sense leads using DMM	11.8	V	11.8	V	11.8	V
12	Set Power Supply to **Nominal Voltage**						
13	Use 200mS pulse to close relay.						
14	Measure Coil Current from Scope	7.4	A	6.2	A	5.3	A
15	Measure voltage drop across contact sense leads using DMM	27.3	mV	27.3	mV	23.9	mV
16	Use 200mS pulse to open relay						
17	Measure Coil Current from Scope	8.9	A	6.1	A	5.5	A
18	Measure voltage drop across contact sense leads using DMM	10.3	V	11.8	V	11.8	V
19	Using Min/Min procedure find lowest Voltage with 200mS pulse						
20	Record **Minimum Voltage**	5.5	V	6.2	V	8.4	V
21	Use 200mS pulse to close relay.						
22	Measure Coil Current from Scope	3.4	A	3.1	A	3.6	A
23	Measure voltage drop across contact sense leads using DMM	27.3	mV	27	mV	29.3	mV
24	Use 200mS pulse to open relay						
25	Measure Coil Current from Scope	3.1	A	3	A	3.6	A
26	Measure voltage drop across contact sense leads using DMM	11.8	V	11.8	V	11.8	V
27	Set load to **6A**						
28	Using Min/Min procedure find lowest Voltage with 200mS pulse						
29	Record **Minimum Voltage**	5.5	V	6.3	V	8.2	V

30	Use 200mS pulse to close relay.						
31	Measure Coil Current from Scope	3.4	A	3.3	A	3.8	A
32	Measure voltage drop across contact sense leads using DMM	318	mV	320	mV	346	mV
33	Use 200mS pulse to open relay						
34	Measure Coil Current from Scope	2.9	A	3.1	A	3.6	A
35	Measure voltage drop across contact sense leads using DMM	11.8	V	11.8	V	11.8	V
36	Set Power Supply to **Nominal Voltage**						
37	Use 200mS pulse to close relay.						
38	Measure Coil Current from Scope	7.4	A	6.2	A	5.3	A
39	Measure voltage drop across contact sense leads using DMM	3.14	mV	321	mV	347	mV
40	Use 200mS pulse to open relay						
41	Measure Coil Current from Scope	7.4	A	6.1	A	5.3	A
42	Measure voltage drop across contact sense leads using DMM	11.8	V	11.8	V	11.8	V
End of Test							

*Results in table are based on the average of the 3 units under test

Environmental Testing

(Report 13217)

Ignition Test

Ignition testing was performed by a third-party testing house. Units were tested for compliance with the ignition protection requirements of the SAE J-1171 for fuel and electrical components that could be mounted in a compartment which could have gasoline vapors.

Water Submergence Test

The 01-00055-000 relay housing showed signs of air bubbles escaping from the contactor studs during the submergence test. Water droplets were found inside the units after 15-minute submergence however the surrounding explosive vapor did not ignite when the relay was electrically operated in the atmosphere which was maintained at an explosive mixture of propane and air. Additionally, none of the 50 induced explosions caused the explosive atmosphere surrounding the units to ignite when the induced explosion test was performed.

The 01-00055-003 relay housing did not show any signs of air bubbles escaping during the water submergence test. Additionally, the relays did not ignite the surrounding explosive atmosphere during the explosive mixture exposure test or during the induced explosion test.

High Temperature Test

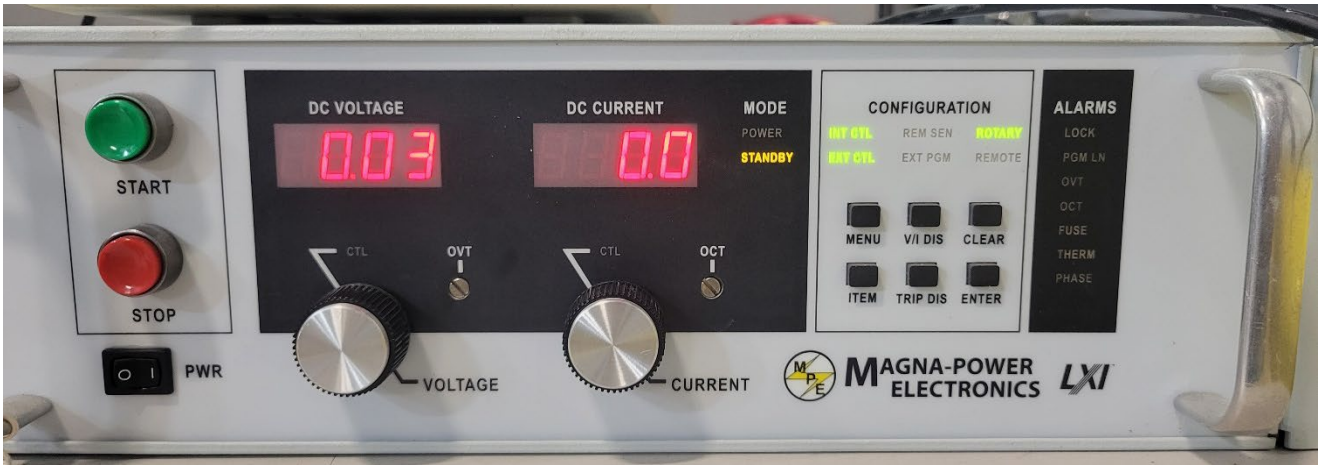
The units were subjected to an ambient temperature of 60° C during the high temperature test. Nominal voltage used during the test was 12V and the resistive load of 100A with a 10% duty cycle. During this test the highest temperature indicated on any surface was 69° C. 4.8% of the surrounding air was composed of propane with no ignition detected.

The results of the tests performed indicated that all the test units meet the requirements of the SAE J-1171, as well as the USCG requirements specified in Title 33 CFR 183.410, and the NMMA requirements for ignition protection.

Life Cycle Testing

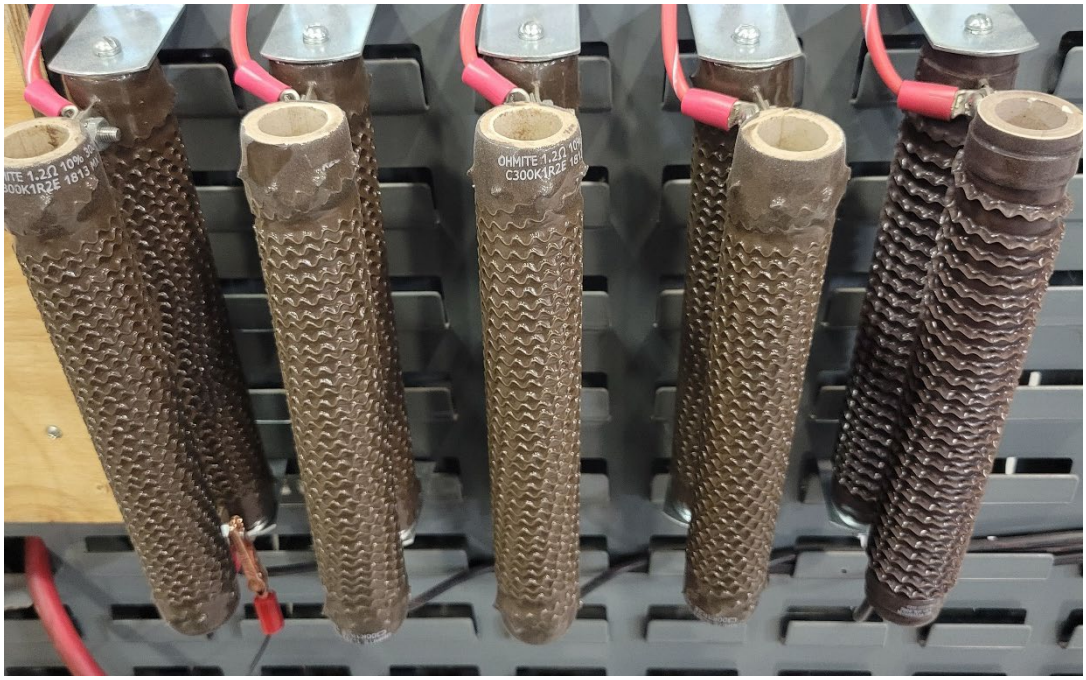
Life cycle testing performed on the battery disconnect consisted of full load latching and unlatching of the solenoid under full resistive load. Testing was performed in a climate-controlled environment with an ambient temperature of 25° C. 1 cycle is considered a closing and opening of the solenoid. This was performed at a rate of 10 seconds per cycle where 5 second delay between opening and closing of the solenoid was used. To maintain a consistent duty cycle, a function generator was used to trigger the switching of the solenoid state. A Magna-Power TS50-200 Power supply was used to provide the sufficient voltage and current sourcing needed to perform testing. With the power supply set to approximately 13.3V to achieve the 100A full load rating used during testing, a consistent and accurate load and current supply was applied during each cycle. The test was performed on 4 individual units and ran until 20,000 cycles or the unit failed. A failure is considered true when either the solenoid does not open/close or the mV drop across the contacts exceeds 80 mV.

Sample Units used for cycle testing



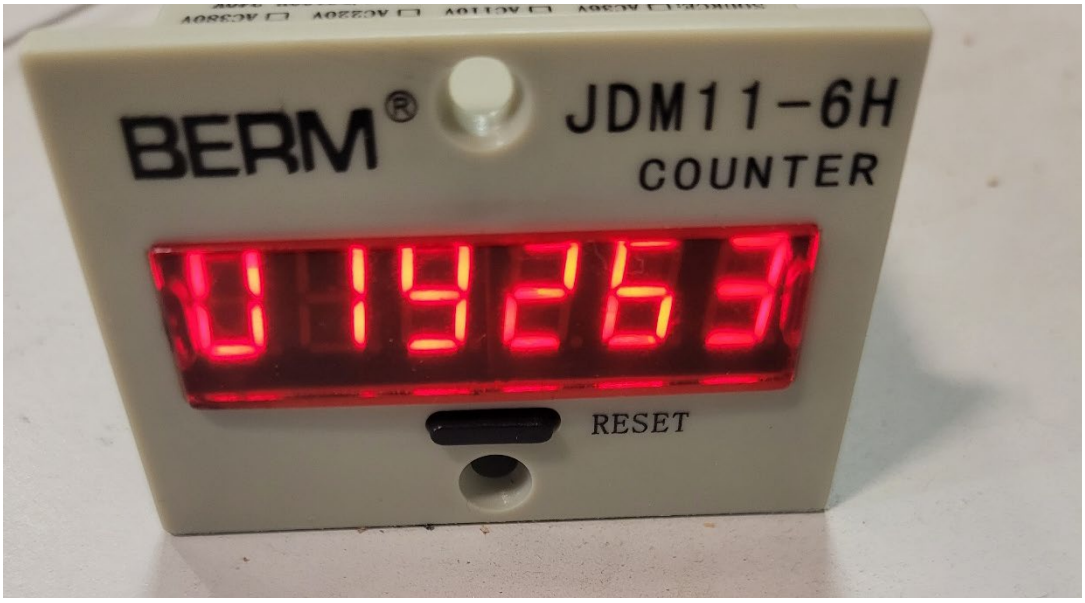
Magna-Power TS50-200 Power supply

Function Generator



Resistive Load Bank

PRODUCT TESTING SUMMARY



Cycle Counter

Test Results							
UUT 1		**UUT 2**		**UUT 3**		**UUT 4**	
Cycles	Voltage Drop (mV)	Cycles	Voltage Drop (mV)	Cycles	Voltage Drop (mV)	Cycles	Voltage Drop (mV)
0001	19	0001	32	0001	26	0001	38
1033	20	975	31	1360	25	1225	37
2113	24	2051	34	2085	28	2287	36
3077	29	3150	36	3122	29	3190	34
4029	29	4072	38	4003	30	4030	34
5165	27	5088	32	5082	29	5160	34
5980	26	6000	37	6333	33	6970	47
7009	33	7002	41	7177	38	7028	30
8145	29	8043	42	8277	35	8064	27
9105	32	9150	67	9021	36	9041	27
10031	31	10001	51	10040	31	10022	31
11181	29	11111	34	10930	31	11015	25
12243	34	12000	34	12108	42	12150	33
13062	35	12976	37	13260	32	13045	34
14400	33	13985	60	14118	34	13988	36
15217	37	15192	33	15000	35	15028	38
16011	37	16141	31	16161	36	15976	28
17360	28	16967	31	17033	33	16965	33
18006	31	17940	36	17930	36	18099	37
19231	32	19354	28	19045	36	19036	35
20040	33	19985	38	20031	33	20011	46

Conclusion

All units passed the initial 20,000 Cycles without failing to open/close. The mV drop across the contacts shows a trend over cycles of increasing slightly but well within the acceptable range of the solenoid specification.