SAE International™

SURFACE VEHICLE STANDARD

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Superseding J563 MAR1990

(R) Standard for 12 Volt Cigarette Lighters, Power Outlets, and Accessory Plugs

RATIONALE

This revision to the specification incorporates dimensional and performance additions to accommodate known and anticipated usages and installations, and adds more detailed testing requirements. It adds requirements for power outlets based on the lighter receptacle. It also adds requirements for aftermarket devices and plugs designed to be inserted into the lighter or power outlet receptacle. This revision is also intended to supersede SAE/USCAR-4, November 1997.

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1. SCOPE

This standard is intended to cover cigar or cigarette lighters as well as power outlets based on the form and dimensions of the cigar lighter, and accessory plugs for use in these devices. Components covered herein are designed to work in nominal 12 VDC systems. This standard is a full performance specification. It includes dimensional and operational parameters as well as performance characteristics which must be met when submitting a cigar lighter assembly, power outlet assembly, or plug for production approval. This standard constitutes an acceptance specification for these devices.

This standard covers the operational, reliability, durability, acceptance, and testing requirements for a cigar lighter (also referred to as just “lighter”) for installation in the passenger compartment of production vehicles. This standard covers power outlets that are based on the form and dimensions of the lighter receptacle intended for installation in the passenger compartment of production vehicles. This standard also covers plugs designed for insertion into the power outlet. Associated components supplied as part of, or with the lighter or outlet are also covered. Additional requirements may be added for these devices when mounted outside the passenger compartment of production vehicles.

Testing shall be done on part families (i.e. lighter receptacles and related knob-elements), as opposed to separate piece-parts, as directed by the appropriate purchasing agreement. Lighter knob-elements and lighter receptacles are not intended to be interchangeable when manufactured by different suppliers.

2. REFERENCES

Resolution of document precedence in the event of a conflict between performance standards, part drawings, and related standards or specifications shall be as follows unless otherwise specified in a specific contract or purchase order:

- 1st – Applicable Part Drawing(s)
- 2nd – This Standard
- 3rd – Other SAE and SAE-USCAR published Standards and Specifications
- 4th – Other related standards

Nothing in this specification, however, supersedes applicable laws and regulations unless specific exemption has been obtained. Suppliers are expected to be aware of, and comply with, worldwide vehicle and component requirements.

2.1 Part Drawing

The component part drawing shall contain, at a minimum, the following information:

- A reference to this specification for interface and testing requirements.
- All part dimensional requirements not covered herein, including any orientation (keying) requirements.
- Performance requirements not covered herein, such as material standards and component specifications.
- Conformance requirements not covered herein, such as corporate or industry standards.
- Typical mating connector, terminal, and illumination requirements (including dimensions where required).

2.2 Applicable Publications

The following publications form a part of this specification to the extent specified herein. Unless otherwise indicated, the latest version of SAE publications shall apply.

2.2.1 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or 724-776-4970 (outside USA), www.sae.org.

SAE J1885 Accelerated Exposure of Automotive Interior Trim Components Using a Controlled Irradiance Water Cooled Xenon-Arc Apparatus

2.2.2 ISO Publications

Available from ANSI, 25 West 43rd Street, New York, NY 10036-8002, Tel: 212-642-4900, www.ansi.org.

ISO 16750-3 Road vehicles—Environmental conditions and testing for electrical and electronic equipment—Part 3: Mechanical loads

ISO 16750-4 Road vehicles—Environmental conditions and testing for electrical and electronic equipment—Part 4: Climatic loads

ISO 9001 Quality management systems—Requirements

3. DEFINITIONS

Throughout this standard, descriptions will be employed to reference various components. Special names/terms will be defined at first usage in the text, or below, with the usage name/term shown in parentheses immediately following. The usage name/term will be continued in text thereafter. For the purposes of this document, the following will be used:

3.1 Lighter Knob-Element (knob-element)

An assembly containing a heating element and knob for gripping the element, a shield or ash guard, and other internal components. Also referred to as the popout or knob-element assembly.

3.2 Lighter Receptacle (receptacle)

That portion of the system constituting the element receptacle, the electrical connections to the vehicle, the thermal release mechanism, and the over-temperature device. Usually installed in the passenger compartment of the vehicle, this device receives and holds the knob-element when not in use, and provides electrical connections to operate the element. Also referred to as the housing, switch-base, barrel, or socket.

3.3 Lighter

This term refers to the combined assembly of a lighter receptacle and a lighter knob-element.

3.4 Mounting Ring

This mounting ring, usually molded of plastic, serves to position and mount the receptacle to the parent panel of the vehicle.

3.5 Light Ring

This is identical with the mounting ring, but is of a translucent, usually colored, material and usually contains the light source or a place for light to enter the ring. The light source can be included as part of the ring or can be separate. Also referred to as a Glow Ring.

3.6 Power Outlet Receptacle (power outlet)

This device is similar in appearance to the lighter receptacle, but without a thermal release for the knob-element, and without thermal over-temperature provisions. Also referred to as Power Point Receptacle.

3.7 Receptacle

When used by itself, the word receptacle shall mean either the lighter receptacle or the power outlet receptacle as appropriate

3.8 Accessory Plug (plug)

A plug specifically designed to insert into a Power Outlet Receptacle making contact with the receptacle shell for the ground connection, and to the B+ contact in the center bottom of the receptacle.

4. GENERAL

4.1 Intended Usage

The lighter is provided as a convenience, for use in lighting cigars and cigarettes. The intent is to provide a lighter which is usable with as little distraction as possible to the primary function of safe vehicle operation, and which is relatively safe, considering this device may reach functional temperatures in excess of safe human contact. There is no intention that this device be incapable of making damaging contact with people or materials if dropped or misused after heating.

The power outlet is provided as a convenience, for connection of electrical devices to the vehicle's electrical supply. The power outlet is exposed to insertion of a variety of devices beyond the automotive industry's control. Principal among these is the plug provided as part of the customer's device. This document provides requirements for the design of these plugs.

The lighter receptacle is not intended to be used for a power outlet, since it has components related to the heating and pop-out function. However, it is recommended that power outlet plugs be designed so that if inserted in a lighter receptacle, no damage will occur to the internal components of the lighter receptacle. The power outlet is not expected to function with plugs not meeting the requirements of this specification.

Devices intended for mounting outside the passenger compartment should meet these requirements as a minimum, with other requirements added by the purchasing documents.

4.2 Life Expectancy

The objective of this standard is to develop components that are capable of operating in their intended environment and application for a minimum period of 10 years / 240 000 Km. The performance objective for the lighter is 10 000 heating cycles, under various conditions, with no failures. The performance objective for the power outlet is also 10 000 cycles, combining insertion/extraction with powered operation. The tests described in this standard are intended to verify this capability.

5. TEST ENVIRONMENTS

5.1 Component Level

5.1.1 Test Equipment Defaults

Test tolerances, in all cases, shall be as stated in the appropriate paragraph(s). Any deviations from these tolerances shall be cause for test failure.

Test equipment calibration must meet ISO standards.

Measurement Precision: Measuring devices used for purposes of this standard shall be capable of one order of magnitude greater than the stated value. For example, if a dimension is two decimal places (x.xx), the measuring device must be capable of three decimal (x.xxx) place readings.

Measurement Accuracy: Measuring devices shall be accurate to at least ±5%.

5.1.2 Test Environment Defaults

Unless otherwise specified, the tests shall be conducted at room temperature (23 °C ± 5 °C). No relative humidity is specified.

All testing is to be done with 1.0 mm^2 wire as short as possible

5.1.3 Test Voltage Default

Unless otherwise specified, tests shall be run at 14.0 ± 0.2 VDC as measured at the harness connector terminals.

5.1.4 Test Plug

Plugs used to test the power outlet receptacle shall meet the design requirements of 7.4.1. Maximum current rating of the test plug shall be 20 amperes. For vibration testing, test plug mass shall be 250 g with center of gravity located at 25 mm from the face of the panel when installed in a receptacle.

For testing lighters the Lighter Receptacle and Knob/Element assembly shall be from the same supplier

5.2 Test Samples

5.2.1 Sample Identification

Engineering test samples shall be uniquely identified, such that related data, and subsequent testing and examination can be correlated.

5.2.2 Sample Selection

Samples for testing shall be taken from the latest level of the parts stream. Random selection shall be a prime consideration unless a specific cross-section of production processes is required, such as multiple mold cavities, etc. Samples shall have been subjected to all normal processing and handling up to final packing.

5.2.3 Performance

Test samples shall be evaluated immediately before testing, after each phase (if appropriate), and at the conclusion of testing. For Lighters, performance evaluation shall be 5 actuations at 5 minutes intervals monitoring current draw and release time. Shorter intervals are allowed provided equivalent cooling to ambient is accomplished. Current draw and release time shall not vary more than 20% from their initial values. For power outlet receptacles, voltage drop shall not vary more than 15% from their initial values.

5.2.4 Sample Disposition

When samples have completed testing they shall not be returned to the production stream. The only exception shall be for production audit samples that are not subjected to any intrusive examination or testing, have accumulated less than 10 cycles of actuation, and can be returned to the same production lot they have been selected from.

5.3 Duty Cycle Definitions

Unless otherwise specified for a specific test the following duty cycles will be used.

5.3.1 Lighter

A lighter cycle consists of the following:

- Knob-Element inserted and ready to be engaged,
- Engaged and heating,
- Released,
- Withdrawn, allow to cool to less than 40 °C (forced air cooling allowed) and reinserted,
- Rotated to a different position,
- Repeat.

5.3.2 Power Outlet

A power outlet cycle consists of:

- Insertion of an accessory plug with a load connected,
- Pause for required time,
- Withdrawal with the load still connected,
- Cool, if required, to less than 40 °C (forced air cooling allowed),
- Rotate to a different position,
- Pause for required time,
- Repeat.

The load shall be a mixture of 25% of the cycles at 20 ± 2 amperes for 15 seconds, and 75% of the cycles at 5 ± 0.5 amperes for 5 seconds, pausing 1 minute between cycles. Loads shall be resistive.

5.3.3 Accessory Plug

A accessory plug cycle consists of:

- Insertion into a power outlet with a load connected,
- Pause for required time,
- Withdrawal with the load still connected,
- Cool, if required, to less than 40 °C (forced air cooling allowed),
- Rotate to a different position,
- Pause for required time,
- Repeat.

The load shall be a mixture of 25% of the cycles at full rated current for 15 seconds, and 75% of the cycles at 25% of full rated current for 5 seconds, pausing 1 minute between cycles. Loads shall be resistive.

Test times may be accelerated with the concurrence of the customer's engineer.

5.4 Failure Determination (definition)

When lighters are tested on an automated fixture, the following shall be checked at each cycle or as noted:

a. Insertion force (prior to and at end of test)

b. Excessive engagement force

c. Failure to engage or to remain engaged

d. Failure to release within the time limit

e. Withdraw force (prior to and at end of test)

f. Temperature Profile (prior to and at end of test)

If any lighter fails to engage within the maximum force, fails to remain engaged, fails to release as specified, or fails the temperature profile, the test should be paused, and the cause determined before continuing with the unfailed samples. If any device exceeds the insertion or withdraw forces, the cause should be determined and the offending component removed form test. A replacement device may be installed in place of a failed unit in order to continue testing a mating component or to balance the forces within the test fixture, however the replacement unit is not to be included in the sample size or calculations.

When power outlets are tested on an automated fixture, the following shall be checked at each cycle or as noted:

a. Current continuity without interruption

b. Insertion force (prior to and at end of test)

c. Withdrawal force (prior to and at end of test)

Power outlet receptacles shall be tested as above comparing insertion and removal forces before and after testing.

When testing accessory plugs the plug shall be inserted into a qualified receptacle and checked for changes in insertion and withdrawal force between the beginning of the test(s) and the end of the test(s). The plug shall be tested at 110% of its rated current carrying capacity and shall carry that current without interruption or over-heating.

If any component fails, a replacement device may be installed in place of a failed unit in order to continue testing a mating component or to balance the forces within the test fixture, however the replacement unit is not to be included in the sample size or calculations.

If portions of these test sequences are done as separate tests, the results shall be combined statistically to indicate the total reliability value of the lighter assembly.

6. TEST MATRIX

The test sequence and allocation of test samples among the tests is shown in Appendix A, Validation Test Schedule.

Some tests are by nature destructive, and will render a sample unfit for further evaluation. These tests have been scheduled last in each sequence.

7. COMPONENT MECHANICAL REQUIREMENTS

7.1 General Inspection

Components shall be examined for defects. General inspections shall include, but are not limited to: discolorations, die shift on molded parts, loose fits, buzz, squeaks, rattles, mismatched component parts, flash, burrs, rough edges, deformed parts, binding, and subtle subjective changes in operation or appearance. General inspection is a requirement at every stage of testing, whether explicitly stated or not.

Components shall be manufactured free of any contamination that could affect the form, fit, function, and appearance. All metal stampings are to be free of burrs, and finished assemblies and components shall be free of sharp edges.

The knob, the element, the shield, the receptacle assembly, and all mating parts shall be uniformly concentric to eliminate any chance of the coil holder shorting between the receptacle shell and the positive contacts, and to assure proper appearance regardless of element/knob orientation.

7.2 Receptacle Dimensional

7.2.1 Mechanical Requirements

The receptacle shall be checked dimensionally for the following:

a. Dimensions, features, and clearances in accordance with Appendix C, Receptacle Dimensions.

b. Other dimensions as specified by the governing drawing.

7.2.2 Voltage Identification

If the receptacle is designed to work at only one voltage, it shall be so identified on the exterior, cylindrical surface.

7.2.3 Orientation

Receptacles shall be designed so that they can operate in all orientations.

7.2.4 Power Outlet Contact Design

The receptacle of power outlets shall have the positive contact recessed a minimum of 1.0 mm or otherwise designed in such a manner that a coin, dropped flat into the receptacle, will not short the device. It shall also be designed such that a lighter knob-element assembly cannot make contact with the positive terminal when pressed into the receptacle with a force of 110 N.

7.3 Heating Element Dimensional and Unit Forces

7.3.1 Element Shield

An element shield (also called ash guard) shall be provided such that the heated element (e.g. coil) cannot make contact with any surface of a spherical radius of 75 mm or greater. If this is accomplished with a retractable or sliding device, the force to move the shield shall not be less than 2.2 N nor greater than 8.4 N. At no time shall the efforts for moving the shield exceed the forces required for insertion or removal of the element from the receptacle.

7.3.2 Voltage Identification

Heating elements shall be plainly identified with their intended operating voltage. Identification shall be affixed to the outer surface of the element shield.

7.3.3 Actuation Forces

The forces required to insert, engage, disengage, and remove the knob/element to/from the lighter receptacle shall be as follows:

Insertion to Receptacle	Less than 27 N
Engage to Heat	13 N to 36 N
Remove from Receptacle	10 N to 36 N
Disengage without heating at ambient temperature	less than 45 N

Unless otherwise specified, these forces shall be the average of 3 readings taken with the element rotated from 60° to 90° between each reading. Forces are measured along the axis of insertion.

The forces required to insert and remove a plug shall be as follows:

Insertion to point of first contact of B+ contact	Less than 36 N
Removal from receptacle	10 N to 40 N

7.3.4 Off Axis Forces

The knob/element may be engaged in normal practice by forces that are not along the axis of the receptacle. The knob/element shall properly engage from the inserted position and function when depressed with a force applied “off-axis”. The actuation force for this requirement shall be the resultant of the Insertion force measured above plus a normal component of force equal to one-third of that force. This force shall be applied at 60° increments around the axis for a total of 6 readings. At no position shall there be contact between the B+ and ground except through the heating element.

7.3.5 Excessive Force

No component shall be damaged by the application of 200 N of “excessive” force applied in the direction of engagement

7.3.6 Side Loading

Side loading of the knob/element or the plug may occur during normal use.

For lighters, with the knob/element fully inserted but not engaged to the heating position, the knob/element and lighter receptacle shall withstand a radial load of 110 N applied at a distance of 12.7 mm from the mating face of the knob and element (or at the end of the knob if knob is not long enough), and at 60° increments around the axis of the lighter. There shall be no degradation of mechanical or electrical function following this test.

For lighters, with the element fully engaged to the heat position, but without power applied, a force of 50 N shall be applied to the knob in line with each bi-metal finger. The side force shall not cause an electrical short between the positive components and the ground shell.

7.3.7 Knob Retention

The knob shall withstand an axial pull of 222 N at ambient temperature in a direction to separate the knob from the element.

The knob shall withstand an axial pull of 90 N applied 15 seconds after release from heating in a direction to separate the knob from the element.

7.4 Accessory Plug Characteristics

7.4.1 Dimensional requirements.

The dimensional requirements of a qualified plug shall be as shown in Appendix B.

Design of plugs should be such that rotation of plug, in power outlet or lighter receptacle, shall not cause locking or interference with lighter retention fingers or openings in sidewall.

7.4.2 B+ Contact Force

The retention forces shall be such as to maintain a minimum B+ contact force capable of a current carrying capacity of 15% over its rated current capacity when subjected to the vibration and shock loading specified herein (9.4 and 9.5). Testing will be by subjecting a mated plug and power outlet receptacle to the specified vibration profile in 9.4 for 4 hours and noting any changes in current draw or voltage drop across the plug terminals

7.4.3 B+ Contact Side Movement

With the ground contact removed from the plug, the B+ contact shall not be capable of contacting the thermostat of a lighter receptacle to the extent of deforming or changing the characteristics of the thermostat.

7.4.4 Plug Extensions and Mechanical Loads

Plugs are not intended to support mechanical loads. Such loads could damage the receptacle and/or the panel to which the receptacle is mounted. The plug should not be used to support other equipment whether that equipment uses receptacle power or not. The maximum mass of components incorporated in the plug shall not exceed 250 g and the center of gravity of that mass must not be located further than 25 mm from the front of the panel containing the receptacle when the plug is fully inserted.

7.4.5 Plug Thermal Characteristics

Plugs must be so designed that the temperature of exposed surfaces does not exceed 35 °C, when inserted fully into the receptacle and while carrying rated current. Upon removal from carrying its rated current, no other surface shall exceed 60 °C. The measurement shall be made within 5 seconds of removal.

7.4.6 Plug Current Rating and Fusing

The vehicle circuits may be wired and fused at up to 20 amperes. Plugs that are permanently connected to wiring or external circuitry rated for less than 20 amperes must include a fuse for that lower rating. Plugs that contain internal circuitry must be limited by a fuse or by the circuitry itself. Plugs that are marketed for other uses must contain a fuse.

7.4.7 Plug Labeling

Plugs containing fuses must be labeled with the maximum fuse rating to be installed.

7.5 Mounting

The recommended method of mounting lighter or power outlet receptacles in a panel is with a mounting ring as shown in Appendix F.

The mounting assembly (mounting ring) is intended to provide the interface between the lighter or the power outlet receptacle to the vehicle panel. Mounting rings with caps are intended to be used with power outlet receptacle and are not recommended to be used with the lighter receptacle.

The mounting ring shall lock (snap fit) into a circular hole in the parent panel of 27.8 (+0.25, –0.00) mm diameter. The lighter or power outlet receptacle shall lock (snap fit) into the mounting ring. The panel shall be flat and uniform 2.50 to 3.00 mm thick at the mounting hole and for a distance of 5.0 mm around the hole. It is recommended that the mounting hole and its edges shall be normal to the panel. If keying is required it shall be as shown in the appendix. To meet installation ergonomics for hand assembly/installation, the installation force for any component or the entire assembly should not exceed 50 N. (Note: For higher forces, ergonomic requirements may require an installation tool.)

The mounting assembly should be designed to withstand a minimum retention force of 200 N applied along the axis of the receptacle in either direction. Testing shall be on 5 samples, as described below.

For purposes of certifying components compatible with this recommended mounting, testing shall use flat polypropylene test panels of at least 100 x 100 mm. Panels of both 2.5 and 3.0 mm thickness and at both limits of 27.8 (+0.25, -0.00) mm diameter shall be included. Use of other materials, when desired, shall be specified by the purchasing document. With a receptacle installed into a test panel mounting ring, exert a force of 200 N in the direction to remove the receptacle from the panel. The receptacle shall not loosen from the panel.

In this recommended mounting, where an illuminated ring is used, the panel mounting hole size, retention features, and force requirements shall remain the same as for a non-illuminated mounting. Lamp connection(s) shall be automatically made through an auxiliary terminal provided in the recommended device connector.

7.6 Terminations

The recommended connection method is a three terminal connector housing as shown in Appendix D. This connector consists of a Primary B+ contact providing current for the primary function (lighter or outlet); a Ground contact providing a return path for all functions; and, if illumination is included, an optional Secondary B+ contact providing current for the illumination device. Detail dimensional requirements and Terminal locations are defined in the Appendix.

NOTE: All Primary lighter and power outlet circuits are intended to be wired and fused or current limited at a minimum of 15 A and a maximum of 20 A. Secondary (illumination) circuit requirements are defined by the application. The circuit resistance of the entire primary circuit shall be no greater than 100 milli-Ohms.

All electrical testing shall be done with production approved wiring and terminals. For testing purposes, wiring shall be with 1.0 mm^2 leads of proper length to provide 100 milli-Ohms of total resistance, fused at both 15 A and at 20 A.

When assembled to the receptacle, the electrical terminations must withstand a steady, right angle pull of 50 N applied to the wires with no loosening, grounding, or reduction in performance of the device. The pull shall be applied at 30° increments around the connector.

7.7 Regulatory Compliance

Products furnished under the authority of this document and products and processes used by suppliers to manufacture those products must conform to the applicable rules and regulations of the countries where the vehicle or product containing this device is intended to be sold. This includes, but is not limited to, restrictions on flammability and restricted materials, and form factors or shapes. Certifications by suppliers of raw materials shall be acceptable in meeting these requirements.

7.8 Recyclability

Products furnished under the authority of this document shall conform to requirements for material recycling as applicable in the country of manufacture and countries of sale of the product containing this device.

7.9 Serviceability / Adjustments

Lighters shall not contain destructive devices, such as fusible links. Over-temperature protection devices shall be self-resetting.

The design of the device (lighter or outlet) shall be such that removal and replacement can be done without deformation or damage either to the receptacle, or the mounting panel or component. Replacement may require an appropriate tool. It is recommended that the harness be extendable such that the connection is accessible from the front of the panel.

7.10 Identification

Unless otherwise specified by the purchaser, the following information shall be affixed to the part in such a way that it is readable under ordinary lighting over a reasonable period of time as defined by the customer.

7.10.1 Logo or Symbol

Any logo or symbol applied to the knob or plug shall be configured to meet ISO requirements.

7.10.2 Part Number

A part number shall be applied as specified by the customer. Additional manufacturer's designations may be included if allowed by the customer, but shall not be applied in a way as to be confused with the final part number. In particular, manufacturer's identification of piece parts or subassemblies should be concealed or on less visible surfaces.

7.10.3 Date of Manufacture

A "date code" shall be applied as a final operation indicating successful completion of tests. The date code shall include the year and day, shift, manufacturing line, and facility location as applicable. The date code may be in any format, but such format shall be publicly available.

8. COMPONENT ELECTRICAL AND THERMAL REQUIREMENTS

8.1 Polarity

The lighter or power outlet shall be wired such that receptacle shell is at ground potential. The central contact shall be B+ at a nominal voltage of 12 volts.

8.2 Operating Voltage Range

Normal Voltage: Electrical parameters of the automobile require that electrical devices operate on a voltage range of 9.0 to 16.0 VDC. The Lighter is expected to function reliably within this range and specifically at the voltage ranges shown below.

9.0 – 11.5	Some degradation* of performance allowed but no damage or permanent degradation allowed.
11.5 – 15.0	Must meet all specifications
15.0 – 16.0	Some degradation* of performance allowed but no damage or permanent degradation allowed.
* Performance degradation shall be limited to variations in pop-out timing and/or element temperatures.	

Testing shall be accomplished under the Initial Release paragraph (8.6.1)

8.2.1 Reverse Voltage

Lighter assemblies shall not be damaged by an application of reverse voltage of –14.0 ± 0.2 VDC for 60 seconds with the element engaged. Release from the engaged position is allowed at any time while meeting this requirement. The lighter shall not be permanently damaged or cause secondary damage as a result of this reverse voltage application.

Aftermarket devices should be aware of the potential for reverse voltages during the life of the vehicle, primarily as a result of jump start techniques that may be used. Protection against such effects are the responsibility of the aftermarket device supplier.

8.2.2 Over Voltage

Vehicles are occasionally subjected to over-voltage conditions. Lighter assemblies shall not be damaged by an over-voltage of 24.0 ± 0.5 VDC applied for 30 seconds with the element inserted but not engaged, and again with the element removed. The lighter assembly and/or receptacle shall not be permanently damaged or cause secondary damage as a result of this over voltage application. Lighting included as part of the assembly may fail so long as the failure can be corrected by replacement of the lighting element.

Aftermarket devices should be aware of the potential for over voltages during the life of the vehicle, primarily as a result of jump start techniques that may be used, or load-dump characteristics of the alternator during a battery disconnect. Protection against such effects are the responsibility of the aftermarket device supplier.

8.3 Isolation Resistance

Receptacles shall withstand 500 VDC (alternative 440 VAC 50/60 Hz) for one minute with no arcing or voltage breakdown. Isolation resistance between terminals shall be a minimum of 20 Megohms. For lighters, these tests shall be conducted with the element in the inserted but not engaged position, and again with the element removed. For outlets these tests shall be conducted with no plug inserted.

8.4 Current Draw

Current draw for a properly operating lighter assembly shall be no more than 10.0 A at 14.0 VDC. Current shall be monitored throughout testing. The power outlet and the lighter receptacle shall be rated at 20 A.

As a development test (ref 10.1), both power outlets and lighter receptacles shall be tested for long duration (1 hour) power outlet over-currents of 30 A using a plug meeting the requirements shown in 7.4.

Neither the lighter assembly nor the power outlet receptacle shall draw any current in the de-energized state.

8.5 Power Outlet Voltage Drop

The power outlet shall not include a voltage drop of more than 200 mV at 20 A. The voltage drop shall be the sum of the voltage drop measured at 20 A between the male blade B+ terminal at the harness connection and the B+ contact in the center of the receptacle, plus the voltage drop measured between the male blade ground terminal at the harness connection and the Receptacle housing. Neither measurement shall constitute more than 70% of the total. Measurements shall be taken by a 4 terminal method.

8.6 Heating Element Thermal Performance

8.6.1 Initial Release

The release time shall not exceed 25 seconds at any stabilized ambient temperature from –20 °C to +55 °C. An average of three readings shall be used to determine compliance.

8.6.2 Heat Profile

The heated element will provide an essentially uniform heat pattern across the surface of the element. Minimum temperatures at release shall be as follows:

After 10 seconds	480 °C
After 20 seconds	380 °C

8.6.3 Reenergizing

After initial release and removal for at least 60 seconds, the element assembly shall be capable of re-engagement to the thermostat. On re-engagement, the element shall be capable of being reheated to a minimum temperature of 400 °C at 10 seconds after release.

8.6.4 Knob Temperature

Knob temperature at initial release shall remain below 35 °C, when tested at ambient temperature. Re-engagement three times, with 60 second intervals between release and re-engagement, knob temperature shall remain below 60 °C.

8.6.5 Inadvertent Ejection from Receptacle

The heated element shall not be ejected from the receptacle after the element has heated and been released by the thermostat. Verification shall be made at the beginning of all testing for each test sample and at the end of testing for each test sample.

8.7 Receptacle Over-temperature Protection

Thermal protection is to be provided in the lighter receptacle. Thermal protection is to be accomplished with a shorting device, activated by thermal (overheat) conditions. At actuation, the shorting device will short the supply (B+) line to ground with a maximum resistance of 50 milli-Ohms. The over-temperature device shall not weld shorted when subjected to five successive over temperature cycles, and with a 15 A fuse replaced between each cycle. Temporary welds that self-clear upon fuse replacement are allowed. The over-temperature device shall activate within 60 seconds at 14.0 ± 0.2 VDC after engaging, when holding the element in the engaged position.

Over-temperature source for this test may be obtained by holding an element assembly in the engaged position or by use of an alternative heat source that replicates the element in heat profile and location. The receptacle shall be horizontally mounted in an enclosed or baffled space of approximately 1000 cc. essentially free of air circulation.

Power outlet receptacles that are not capable of energizing a lighter heating element are not required to have an over-temperature protection device.

9. COMPONENT ENVIRONMENTAL REQUIREMENTS

9.1 Temperature

9.1.1 Operating Temperature

These devices are expected to operate within the typical automotive temperature range of –40 °C to +85 °C with no damage or degradation to performance of the component.

For lighters, test samples shall be mounted to a suitable test panel, and the temperature raised to 85 °C until temperature of the device stabilizes. Operate lighter 5 times at 3 minute intervals, checking release time and maximum current. Reduce temperature to +50 °C and allow temperature of device to stabilize. Operate lighter 5 times at 3 minutes intervals, checking release time and maximum current. Reduce temperature to –18 °C and allow temperature of device to stabilize. Operate lighter 5 times at 3 minutes intervals, checking release time and maximum current. Reduce temperature to –40 °C and allow to stabilize. Operate lighter 5 times at 3 minutes intervals, checking release time and maximum current. Low temperature (below ambient) tests need not follow immediately after high temperature tests. Performance shall be as follows:

At +85 °C	Lighter shall not malfunction or be damaged. Performance degradation* is allowed.
At +50 °C	Lighter shall meet requirements.
At –18 °C	Lighter shall meet requirements.
At –40 °C	Lighter shall not malfunction or be damaged. Performance degradation* is allowed
* Performance degradation shall be limited to change in release time and/or element temperature.	

9.1.2 Storage and Shipping Temperature

These devices shall be subjected to a shipping and storage temperature test. Raise temperature to +95 °C and hold for 48 hours; Reduce temperature to –40 °C and hold for 48 hours. Return to ambient temperature. For lighters, check function by operating lighter 5 times at 3 minutes intervals, checking release time and maximum current. For all devices, check functionality and for any degradation in materials, or changes in shape.

9.2 Thermal Shock

These devices shall not be damaged by exposure to thermal shocks. Thermal shock resistance shall be tested by exposing the device to 10 thermal shock cycles of +85 °C to –40 °C to +85 °C with a maximum transition time of 2 minutes and a minimum dwell time of 30 minutes at each temperature. For lighters, check function by operating lighter 5 times at 3 minutes intervals, checking release time and maximum current. For all devices, check functionality and for any degradation in materials, or changes in shape.

9.3 Humidity

Humidity testing shall consist of 100 hours of 98% RH condensing humidity at 65 °C. During this test the assemblies shall continue to meet functional requirements for current draw and/or trip times when cycled at the rate of once per hour during the first and last 7 hours.

9.4 Vibration

Subject eleven (11) lighter assemblies to random vibration tests in accordance with ISO 16750-3 Test IV for sprung masses. Each test shall be for a minimum of 4 hours and shall be run at an ambient temperature of 23 °C ± 5 °C. Samples shall be mounted with at least two samples mounted in each of three mutually perpendicular axes, one with the lighter element inserted but not engaged with power applied, and one with the lighter fully engaged but without power applied. The mounting orientation of the remaining 5 samples shall be at the supplier's discretion. The three axes shall be defined as a) the axis of the receptacle parallel with the vibration axis; b) the axis of the receptacle normal to the vibration axis and the bi-metal release element in line with the axis of vibration; and c) the axis of the receptacle normal to the vibration axis and the bi-metal release element normal to the axis of vibration.

Subject eleven (11) power outlet receptacles to random vibration tests in accordance with ISO 16750-3 Test IV for sprung masses. Each test shall be for a minimum of 4 hours and shall be run at an ambient temperature of 23 °C ± 5 °C. Samples shall be mounted with at least two samples mounted in each of three mutually perpendicular axes. The test plug shall be as specified in 5.1.4. . The mounting orientation of the remaining 5 samples shall be at the supplier's discretion. The axes definitions shall be similar to those described for the lighter.

9.5 Mechanical Shock/Drop

The lighter shall withstand mechanical shocks and drops.

a. Shock Test: Test in accordance with ISO 16750-3, paragraph 4.2 for a total of 3000 cycles. In all of these tests, no dents, bending, scratches, cracks, or other damage shall be allowed.

2400 cycles shall be performed with the lighter powered, lighter element inserted but not engaged. The lighter must not latch into the engaged position. 400 of these shocks shall be applied in each direction of 3 mutually perpendicular axes.

600 cycles shall be performed as a development test, and the results provided to the customer for evaluation. These 600 cycles shall be performed with the lighter element inserted and engaged but not powered. One half of these shall be performed in each of two perpendicular axes normal to the longitudinal axis of the lighter assembly. The lighter may release from the engaged position, but shall be reengaged prior to the next shock. Any release from the engaged position shall not result in ejection of the lighter element from the receptacle.

b. Drop Test: Test in accordance with ISO 16750-3, paragraph 4.3. 3 devices shall be tested with 2 falls per axis. In all of these tests, no dents, bending, scratches, cracks, or other damage shall be allowed.

9.6 Ultraviolet Stability

Lighters are installed in a variety of positions, some of which are subject to ultraviolet radiation. Color fastness and ultraviolet stability shall be tested in accordance with SAE J1885. This is a development test and results shall be evaluated if appropriate by the customer for determination.

9.7 Contaminants

Contaminants come in contact with lighter and power outlet components both as a result of spills and from handling.

Position four receptacles (two for each contaminant material, one with and one without an element or plug) in a vertical position (opening up), at ambient room temperature and humidity. Connect to power supply set for 14.0 ± 0.2 VDC. For lighters, element is to be fully inserted but not engaged. Spill 60 ml of each of the materials listed below onto each device. Air dry at room temperature for one hour. Insert lighter elements (or plugs for power outlets) into the open 5 receptacles. Check for component function by attempting to cycle. Repeat functional check after 11 more hours of drying time and again after 24 hours. Record any changes from “design condition” at the end of 24 hours. This test does not require full functionality to all requirements for a successful completion. However, the over-temperature protection of lighters shall function as specified at the end of the 24 hour drying time. A functional check shall be attempted by holding the element engaged for one over-temperature activation. Failure of the element to engage will constitute success by default. The mechanical parts shall be checked for mechanical integrity. No cracking or loss of mechanical form is allowed.

Contaminant	Test Solution	Notes
Coffee	Commercial	
Cola	Commercial	
Alcohol Base Cleaner	Commercial	10% by volume
Ammonia Base Cleaner	Commercial	10% by volume

9.8 Corrosion

Many areas of the world, such as coastal areas, have high levels of corrosive atmospheric contaminants. Additionally, many areas of the world use corrosive materials on their roads to control ice and snow. These materials become airborn as well as splash on vehicle surfaces. The purpose of this test is to evaluate the resistance of surface materials and coatings to corrosion, and to evaluate the long-term functionality of the devices under such exposures.

9.8.1 Operating Conditions

Operating Mode – The device under test is electrically connected to a power supply as in vehicle with all electrical connections made.
Durability profile per ISO 16750-4 (use Figure 7 “Test cycle for salt spray test”).
The device does not need to be operated during the 4th and 5th hour of each 24 hour cycle.
Test chamber and setup condition per IEC 60068-2-52.
Duration: 6 cycles (6 days).
Sample Size: 7 devices.

9.8.2 Lighter Assembly

Lighters shall be tested as an assembly of the receptacle and element. The lighter assembly shall be mounted horizontally in the chamber and shall be tested with the element installed but not engaged.

At the conclusion of the first 8 hour period, one sample shall be removed from the test chamber. The assembly may be gently rinsed in slowly running clear, warm (38 °C max.) water and then dried with clean, low pressure (275 kPa max.) compressed air, or allowed to dry at room temperature before examination and testing. There shall be no visible evidence of corrosion. Specific internal components may be exempt from the visible corrosion requirement only on approval of the customer’s responsible engineer.

Continue testing the remaining 6 samples for the total of 6 days. At the conclusion of the test, the samples may be rinsed and cleaned as described above. The units shall be tested for Isolation Resistance (8.3). The unit shall also be operated through 25 cycles. Failure to engage, disengage, increase in effort to remove the element of greater than 5%, or failure of the over-temperature device shall constitute failure.

9.8.3 Power Outlet Receptacle

For the Power Outlet Receptacle, one half of the samples shall be tested without a cap or other aesthetic cover and with no plug installed. The other half of the samples shall be tested with a test plug inserted.

At the conclusion of the first 8 hour period, one sample shall be removed from the test chamber and inspected as described above.

Continue testing the remaining 6 samples for the total of 6 days. At the conclusion of the test, the samples may be rinsed and cleaned as described above. The units shall be tested for Isolation Resistance (8.3). The receptacles with no test plugs shall have one added. The samples shall be operating through 25 cycles. Failure to provide contact shall constitute failure.

9.8.4 Accessory Plug

For the Accessory Plug, one half of the samples shall be tested without being inserted in a receptacle. The other half of the samples shall be tested inserted into a Power Outlet Receptacle.

At the conclusion of the first 8 hour period, one sample shall be removed from the test chamber and inspected as described above.

Continue testing the remaining 6 samples for the total of 6 days. At the conclusion of the test the samples may be rinsed and cleaned as described above. The unit shall be tested for Isolation Resistance (8.3) and Voltage Drop (8.5). Failure to pass either test shall constitute a failure.

10. VALIDATION

10.1 Development Testing

10.1.1 Purpose

Development tests are tests used to evaluate specific areas of design. They are a tool for evaluating original designs, design alternatives, proposed improvements, cost reduction proposals, or for field problem analysis. Development tests may be severe. Development tests often accelerate testing by exaggerating specific environments. Failures under a development test are expected. Such failure does not necessarily indicate inadequacy of design. Any failures must be evaluated and the results and any action documented to the customer. Any development tests included herein are for reference only and are not a part of the part approval. Additional development test requirements will vary from customer to customer.

10.2 Design Validation and Durability Testing

Validation tests are those tests required to demonstrate that the component or system of components can meet the requirements of this specification for the life of the component. These validation tests must be satisfactorily completed before use on a production vehicle.

Durability testing shall consist of cycling the part(s) for 10 000 cycles in accordance with the duty cycles specified as follows:

a. Insert the element or plug into the receptacle (the knob may be modified for attachment to the test equipment, and a guide at the receptacle entry may be used (for outlets) A resistive load shall be continuously connected to the plug for these tests. The load shall be a pseudo-random mixture of 20A for approximately 25% of the cycles, and 5A for 75% of the cycles.

b. (for lighters) Engage the lighter and then remove the force in such a manner that release from engagement is unrestricted. Measure current and release time for each cycle.

c. (for lighters) After 20 seconds following release, remove the lighter from the receptacle.
(for outlets) After 20 seconds, remove the plug from the receptacle.

d. (for lighters) Allow to cool to less than 40 °C (forced air cooling is allowed).

e. Begin next cycle. The element or plug shall be rotated between each insertion so that engagement position is varied.

f. (for lighters) At the start and after each 25% of the test, the test shall be paused and the heat profile of the element shall be measured.

A failure of the lighter will be counted if current, release time, or heat profile are out of specification. A failure of a power outlet will be the inability to carry the required current.

Design validation shall consist, unless otherwise specified, of the tests stated in this specification. Sample sizes and test sequence shall be in accordance with the test matrix of Appendix A.

Where a basic device family has been validated as separate components, the test schedule for assemblies consisting of those validated components, together with brackets and/or jumper harnesses may be abbreviated to include only those parameters related to the assembly differences.

When new parts differ from parts previously tested and fully qualified under this specification by details that affect only mounting and orientation, and which can be shown analytically to not affect performance, re-testing under this paragraph may be modified or waived at the option of the customer.

11. RELIABILITY

The Reliability requirements have been incorporated in the testing specified above. No additional testing is required.

12. QUALITY ASSURANCE

The supplier shall be certified to a system recognized and accepted by the customer (e.g. ISO 9001).

13. NOTES

13.1 Marginal Indicia

A change bar (I) located in the left margin is for the convenience of the user in locating areas where technical revisions, not editorial changes, have been made to the previous issue of this document. An (R) symbol to the left of the document title indicates a complete revision of the document, including technical revisions. Change bars and (R) are not used in original publications, nor in documents that contain editorial changes only.

PREPARED BY THE SAE LIGHTER AND POWER OUTLET SUBCOMMITTEE
OF THE CIRCUIT PROTECTION & SWITCH DEVICES STANDARDS COMMITTEE

APPENDIX A - TEST MATRIX

{PRIVATE }

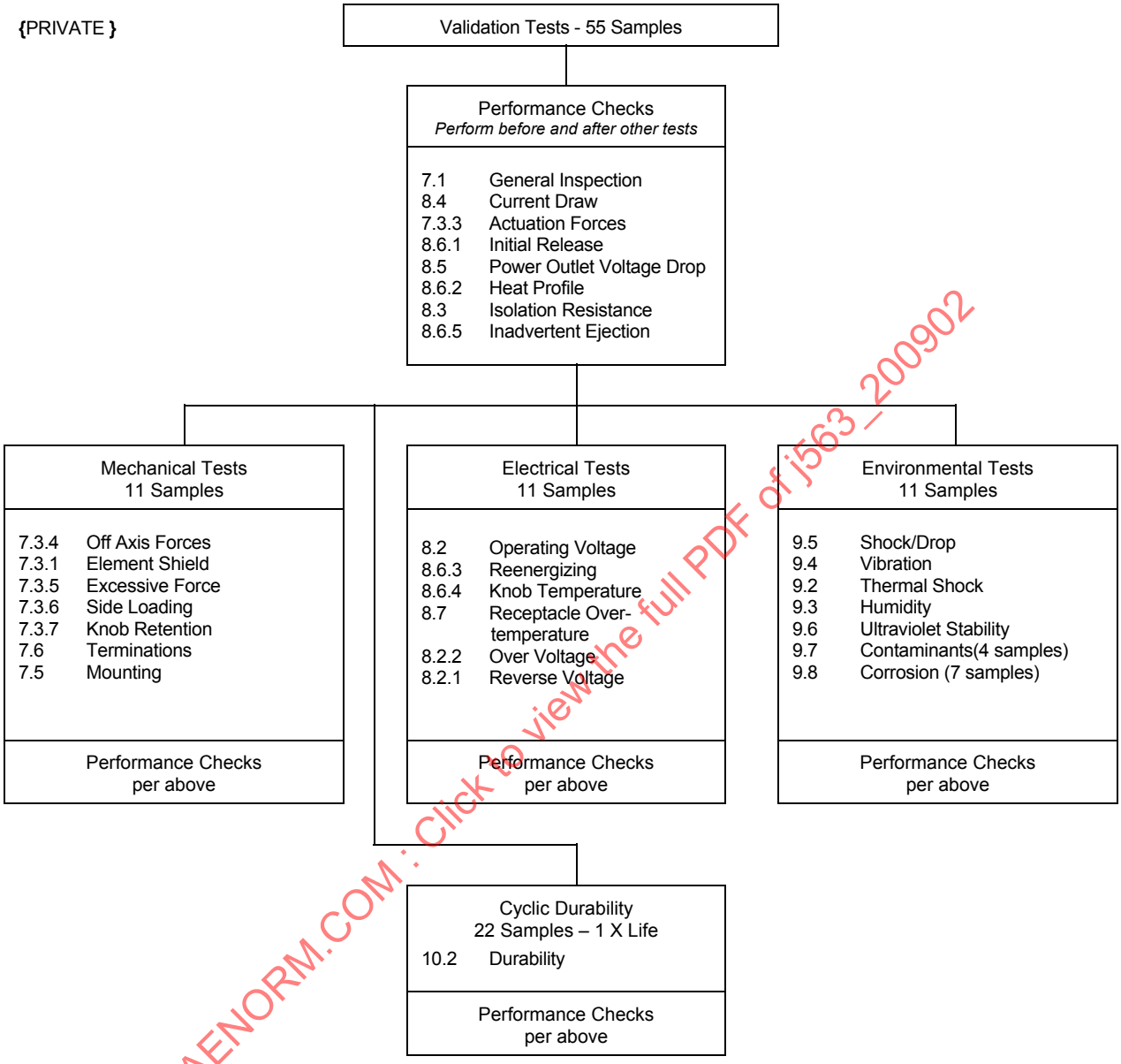
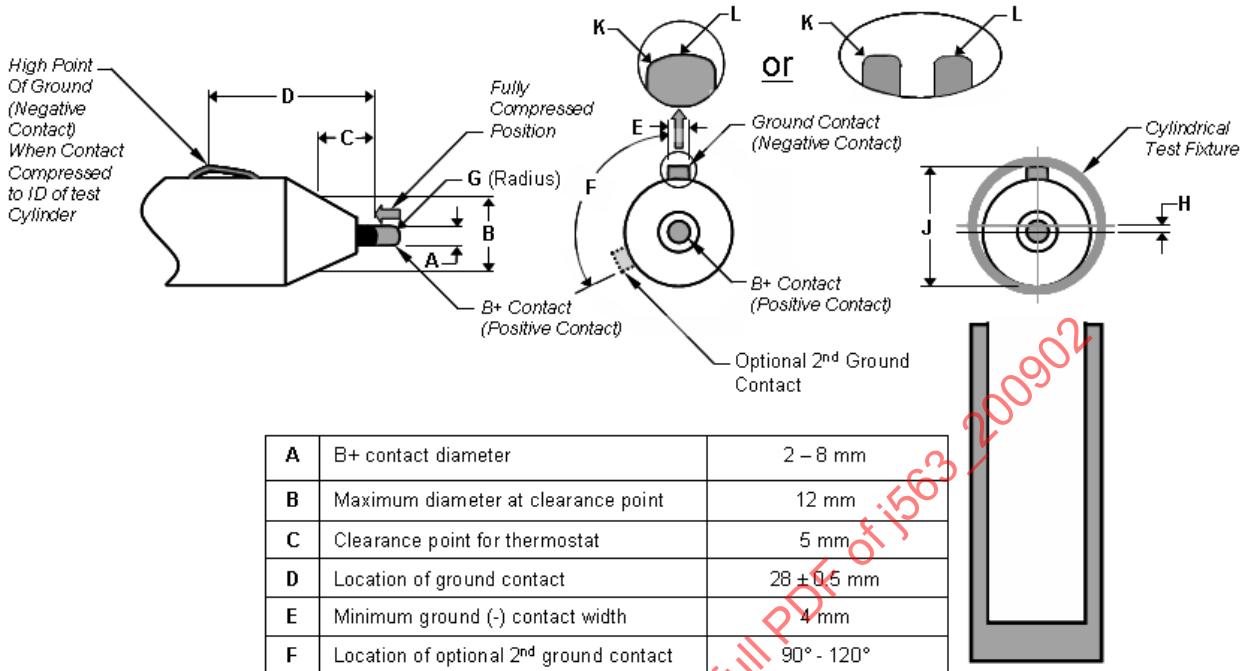


FIGURE A1 - TEST MATRIX

APPENDIX B - ACCESSORY PLUG DIMENSIONAL REQUIREMENTS



A	B+ contact diameter	2 – 8 mm
B	Maximum diameter at clearance point	12 mm
C	Clearance point for thermostat	5 mm
D	Location of ground contact	28 ± 0.5 mm
E	Minimum ground (-) contact width	4 mm
F	Location of optional 2nd ground contact	90° - 120°
G	Minimum radius of tip	0.5 mm min.
H	Maximum B+ eccentricity	0.5 mm max.
J	ID of test cylinder	21.01 mm
K	Ground contact edge radius	0.5 mm min.
L	Ground contact radius	20.0 mm max.

FIGURE B1 - ACCESSORY PLUG DIMENSIONAL REQUIREMENTS

APPENDIX C - RECEPTACLE-DIMENSIONS

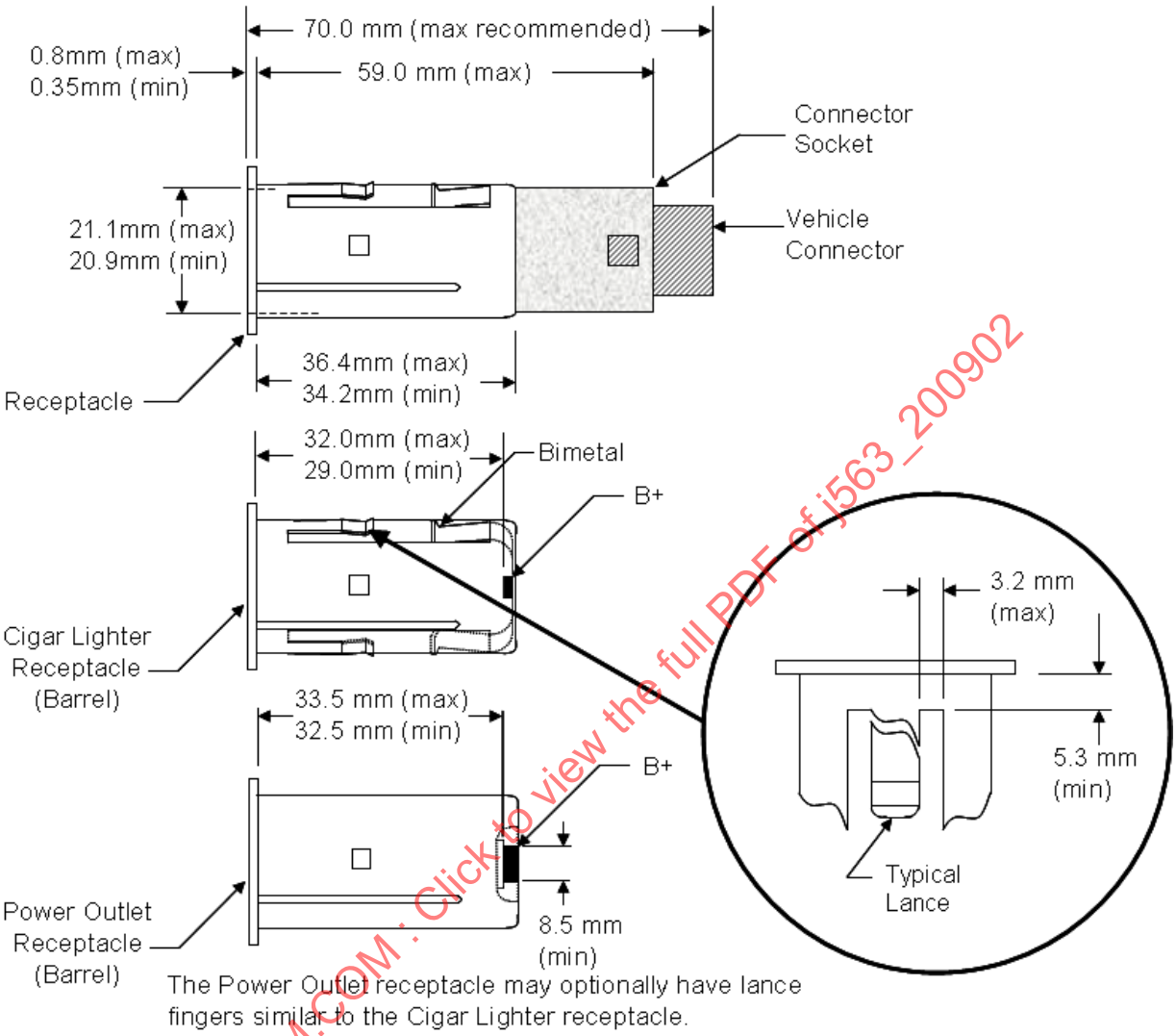


FIGURE C1 - RECEPTACLE DIMENSIONS