

# Technical Reference

## General Application Notes

There are common considerations when using our connectors. Additional considerations may apply based on the particular connector being used, the application, and conditions in which it's being used. This information is intended to provide a basic understanding and is provided for reference only. Connectors should be assembled and used according to the equipment and the manufacturer's instructions, as well as in compliance with local and international electrical codes.

The maximum amperage ratings provided in the specifications are based on use of our recommended assembly tooling and the maximum wire size for the connector being used. Amperage ratings are based on not exceeding the maximum operating temperature of the connector housing, factoring in an ambient temperature of 25°C or 77°F. A wire with an appropriate insulation temperature rating should be selected to meet or exceed the total connector temperature (heat rise + ambient).

As an example: if the maximum operating temperature for a connector operation is 105°C and the ambient temperature is 25°C, the maximum heat rise attributable to the connector is 105°C - 25°C = 80°C. The expected heat rise based on the connector and wire size used can be estimated using the heat rise charts, but should be confirmed by testing in the specific application with the specific wire to be used.

Connector devices are rated or derated by the wiring configuration and the environment. Factors to be considered include: enclosure characteristics, connector housing and wire insulation characteristics, number of wires in an enclosed area such as a raceway or conduit, as well as the ambient temperature.

Underwriter Laboratories Inc. amperage ratings are based on not exceeding the maximum operating temperature of the connector housing. This means connectors can be extremely hot when used at the UL amperage ratings. For this reason UL amperage ratings should only be applied to connectors when they are used inside an enclosure not accessible to untrained persons. Canadian Standards Association ratings are based on not exceeding a 30°C temperature rise above ambient temperatures. For this reason CSA amp ratings are a good point of reference for connectors that are user operated. APP® does not recommend exceeding a 30°C temperature rise above ambient temperatures for connections accessible during operation to untrained persons.

## How to Read Temperature Charts

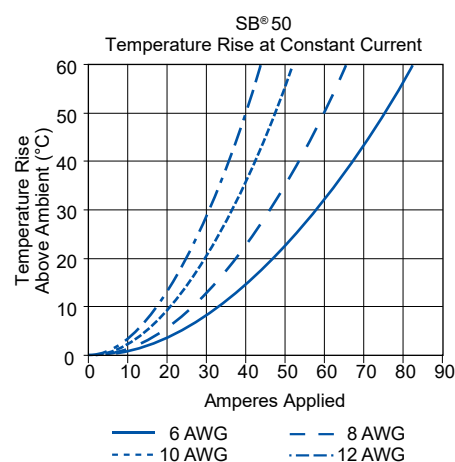
### Temperature Rise Charts are Based on a 25° Ambient Temperature

Temperature Rise at Constant Current charts show the associated heat rise as a result of applied current to the connector. An example of the SB® 50 connector Temperature Rise chart is included to follow along with this explanation.

The chart is based on an ambient temperature of 25°C (77°F room temperature). Accordingly if the temperature °C on the Y axis of the chart is at 30°C, the expected total connector temperature would be 55°C.

Separate curves are shown for 6, 8, 10, and 12 AWG wire. Interpreting the curves, if 50 amps are applied continuously to the connector, the heat rise will be 23°C for 6 AWG, 35°C for 8 AWG, 55°C for 10, and 12 AWG wire is not suitable for this amperage.

Where T = Temperature, heat rise is expressed as a  $\Delta T^{\circ}\text{C}$ .  
 $T_{\text{ambient}} - T_{\text{ambient}} + \text{heat from applied current} = \Delta T^{\circ}\text{C}$ .

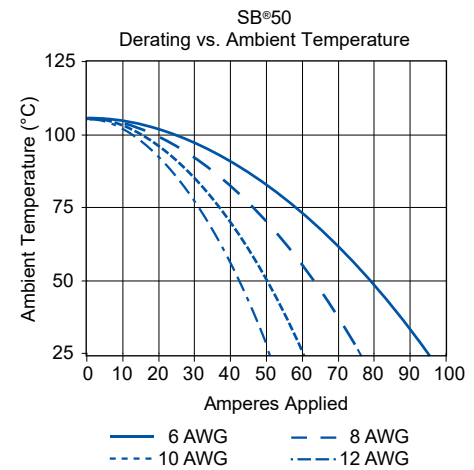


## Derating vs. Ambient Temperature Charts

Derating vs. Ambient Temperature charts show the maximum amperage capability of a connector at a given ambient temperature. An example of the SB® 50 connector chart is included to follow along with this explanation.

All data points are based on the maximum operating temperature of the connector, most often 105°C or 221°F. Accordingly if the temperature °C on the Y axis of the chart is at 105°C, there is no amperage capability because the connector housing is already at the maximum operating temperature.

Separate curves are shown for 6, 8, 10, and 12 AWG wire. Interpreting the curves, at a 75°C ambient temperature the maximum amperage capability that can be applied continuously to the connector is: 58A for 6, 46A for 8, 37A for 10, and 31A for 12 AWG.

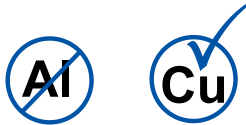


## Notes on Temperature Rise Charts

Note that these charts are constructed using calculations based on actual test data. For this reason the chart information may vary slightly from the safety agency ratings. Safety agency ratings and compliance with electrical codes take precedent over these charts. The charts are designed to provide a guideline as to the connectors' capability. Actual results can vary based on the specific wire used, crimp tooling and assembly, as well as the environment the connector is used in.

CSA ratings are based on not exceeding a 30°C temperature rise above ambient or a total temperature of 55°C. This is considered the maximum temperature to safely handle a connector at. UL ratings can be based on the operating temperature limit of the connector. Often for our connectors this is 105°C or an 80°C temperature rise above an ambient temperature of 25°C. To provide a margin of safety, the heat rise charts are limited to a 60°C temperature rise.

## Compatible Wires



Our connectors are designed to be crimped or soldered to multi-stranded copper conductor wires only. Alternate conductor materials including aluminum should not be used. Aluminum conductors crimped into our contacts can result in a galvanic reaction occurring between the aluminum wire and the more cathodic metals used in our contacts including copper, tin, silver, and gold. Additionally softer metals like aluminum flow or loosen from crimps much easier than copper.

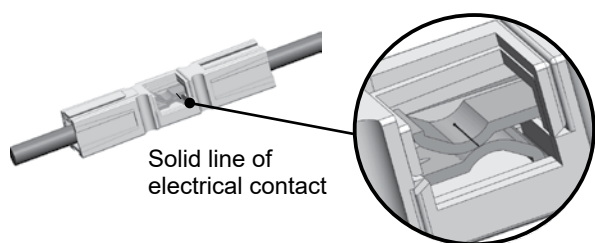
Multi-stranded wire is recommended for all our connectors and is required when crimp terminating wires or when a connector with flat wiping contact technology is used (such as Powerpole® and SB®). Solid wires do not adequately compress and retain in crimp barrels after being crimped. For this reason if solid wire is used, it should be with solder termination only.

Solid wires also do not flex and bend as easily as multi-stranded equivalents and can act as a lever arm and impede or alter the natural state of a flat wiping contact in the housing. This impediment or alteration to the flat wiping contact's natural state can cause intermittency and shorts as well as higher resistance and temperature at a given amperage than is shown in the specifications. Mating and unmating forces may also be impacted.

# Different Contact Technologies

## Flat Wiping

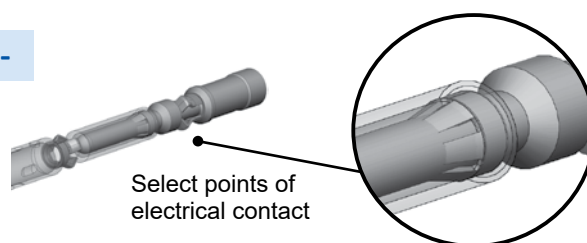
- Same contacts on the “male” and “female” side reduce inventory costs and increase ease of assembly.
- Low resistance connection has a large conducting surface and a high normal force in comparison to typical pin and socket contacts.
- Sacrificial tip confines damage to non-conducting area when mating or breaking under load.
- Raised surface on the mating side of the contacts secures the connector in the mated condition, limiting the need for latching on outer housings.
- Over wiping design cleans the mating surface when mating and unmating.



**Flat Wiping Technology**

**Altered Housing  
for Reference Only**

**- VS -**



**Pin & Socket Technology**

**Good Condition**

## Pin & Socket

- Different contacts on male and female sides. Female socket contacts are typically more expensive than the simple geometries of the pin contacts.
- Often higher resistance than flat wiping connectors of the same wire size and plating due to the reduced mating surface area and lower normal force. Gold plating often used to compensate and minimize resistance.
- Best for compact connection needs such as signal and low power due to static position in housings and symmetrical shape.
- Socket contacts can catch and hold debris inside the socket body causing mating problems.

## Use of Anderson™ Connectors in Applications Exceeding 600V

The approved voltage ratings for our connectors are usually limited by the category under which a safety agency such as UL approves our connector for use. UL typically defers to National Electric Code (NEC) on the voltage limitations for any given device our connector could be used in. For most common applications NEC restricts voltage to a maximum of 600V AC/DC which is what our connector voltage ratings are based on.

To achieve UL 1977 approval for a 600V rating, we test our connectors for dielectric withstanding voltage. The connector is tested at 2 times the rated voltage of 600V plus 1000V or 2200VAC for 1 minute. For applications exceeding 600V, UL / NEC / IEC may require application specific review for creepage and clearance resistance.

# Touch Safety & Ingress Protection (IP68)

## UL 1977 Section 10.2

Typically required for applications where the connector is external to the end device and operating over 30V or 200A, where wet conditions may be present (600V category).

Testing is performed using a probe that mimics a child’s finger. All features of the connector are tested for live parts in the unmated state (no pressure applied). A smaller 3 mm probe is then applied in the mated state to test for live parts. Note that some applications may require the connector to not expose live parts to the 3 mm probe in the mating interface.

## IEC 60950

From the standard for Information Technology Equipment Safety, the requirements are harmonized with UL1950. Typically required for commercial and industrial applications where operators may need some degree of protection while accessing or servicing equipment.

Testing is performed using a probe that mimics an adult finger. All features of the connector are tested for live parts in the unmated state with 30 N of force applied to the probe.

## IEC 60529

Standard for Degrees of Protection Provided by Enclosures is harmonized with EN 60529.

Protection degree number is assigned to both solids and liquids in that order. For example: a connector with an IP20 rating is protected against fingers, but has no protection against ingress of liquids. We take a conservative approach in rating our connectors against liquid ingress and consider any meaningful water ingress to have a harmful effect.

Protection Degree	Solids (first digit)		Liquids (second digit)	
	Description	Protected Against	Description	Protected Against
0	Not Protected		Not Protected	
1	> 50 mm	Large body part such as back of hand	Vertically dripping water (no harmful effect)	<b>Duration:</b> 10 minute <b>Water:</b> 1 mm / minute rainfall <b>Pressure:</b> N/A
2	> 12.5 mm	Adult fingers or similarly sized objects	Tilted 15 degrees up dripping water (no harmful effect)	<b>Duration:</b> 10 minute <b>Water:</b> 3 mm / minute rainfall <b>Pressure:</b> N/A
3	> 2.5 mm	Typical screw drivers or large wires	Water spray up to 60 degree angle (no harmful effect)	<b>Duration:</b> 5 minute <b>Water:</b> 0.7 liter / minute <b>Pressure:</b> 80 - 100 kN/m <sup>2</sup>
4	> 1 mm	Small pointy tools and small wires	Water splash from any direction (no harmful effect)	<b>Duration:</b> 5 minute <b>Water:</b> 10 liter / minute <b>Pressure:</b> 80 - 100 kN/m <sup>2</sup>
5	Dust Protected	Complete physical protection, no functional interference from dust	Water jet from any direction (no harmful effect)	<b>Duration:</b> 3+ minute <b>Water:</b> 12.5 liter / minute <b>Pressure:</b> 30 kN/m <sup>2</sup> @ 3 m distance
6	Dust Sealed	Complete physical protection and sealed from dust ingress	Strong water jet from any direction (no harmful effect)	<b>Duration:</b> 3+ minute <b>Water:</b> 100 liter / minute <b>Pressure:</b> 100 kN/m <sup>2</sup> @ 3 m distance
7	N/A		No ingress of water in harmful quantity when immersed up to 1 m depth	<b>Duration:</b> 30 minute <b>Water:</b> Immersion <b>Pressure:</b> 1 m depth
8			No ingress of water in harmful quantity when subject to tests in excess of condition 7	<b>Duration:</b> Mfg. specified <b>Water:</b> Immersion <b>Pressure:</b> 1 + m depth, Mfg. specified

# Preventative Maintenance

Damaged connectors, contacts and cables may present hazards, resulting in inefficient battery and charger operation. To avoid these problems, conduct the following maintenance checks at least once annually. If you see any of the following problems, take corrective action immediately.

## 1. Dirty Connectors

When engaged and disengaged, the contact surfaces of Anderson™ flat wiping connectors “over wipe,” thus providing self cleaning action. To ensure the continued benefit of this feature, clean the contact surfaces and lubricate the connectors. Use a “white” lithium grease, which may be obtained from hardware stores and automotive parts suppliers.

## 2. Melting Connectors

Connector housings overheat and melt for many reasons. To prevent this:

- A. Examine the crimp between cable and contact. Ensure the crimp tooling recommended by Anderson™ has been used. Improper crimping, corrosion, and broken wires result in unnecessary resistance causing the contact to heat up.
- B. Check contact surfaces for signs of “pitting” caused by dirt or disengaging connectors under load. One badly pitted contact, particularly in a connector attached to a battery charger, can lead to pitting on surfaces of other contacts. If not corrected, this can result in an epidemic of bad connectors throughout a fleet of electric vehicles and in chargers and batteries.
- C. Check to see if batteries are being disconnected while the charger is still on. This causes the contacts to arc at the tips, resulting in progressive pitting and silver removal from tip to crown. If this practice is occurring, it should be discontinued to avoid major repairs in the future.

## 3. Other Conditions

If any of the following conditions exist, the connector housing, contact and / or cable should be replaced immediately.

- A. Housing - Cracks, missing pieces, evidence of excessive heat, discoloration. You may consider replacing the existing housing with a Chemical Resistant equivalent for improved durability against UV rays and common solvents and hydrocarbons.
- B. Contacts - Pitting, burns, corrosion, excessive wear and cracked crimp barrels, as shown in image “B”.
- C. Cable - Exposed copper near housing, cracked cable, peeling or frayed insulation.
- D. Handles - Loose attachment and signs of damage as missing or loose hardware and cracked or broken plastic (Handles should be used for connectors that are hard to reach or move).
- E. Cable Clamps - Loose attachments, signs of abraded cable jacket, missing or loose hardware. (Cable clamps should be used to relieve strain on unmounted cable).



## Your Best Connection™

2020-0055 Technical Reference REV C7

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