Cable and Connector Selection Guidelines

courtesy of Rebling.com March 3, 2021

Product Category	Industry Standard or Test Results	Product			Tool Required for Mating & Un-mating	Cross Sectional Area of Conductor mm^2 (in^2)	30° C Rise 55° total	60° Touch Safe Metal	45° C Rise 70° total	77° Brewed Coffee	60° C Rise 85° total	85° Touch Safe Plastic	100° Boiling Water	90° C Rise 115° total
Connector	Test Results	Rebling	BFT or XFT	1,000 amp rating with one 750 MCM cable per terminal	Wrench	390 (.601)	1,020		1,270		1,470			1,690
Connector	Test Results	Rebling	BFT or XFT	750 amp rating with one 750 MCM cable per terminal	Wrench	390 (.601)	900		1,100		1,250			1,440
Connector	Test Results	Rebling	MFT	500 amp rating with one 450 MCM cable per terminal	Wrench	240 (.372)	520		630		730			840
Connector	Test Results	Rebling	LFT or SFT	250 amp rating with one 4/0 cable per terminal	Wrench	130 (.196)	280		340		390			450
Connector	Test Results	Anderson	SB350	with one 4/0 cable per terminal	None	130 (.196)	280		340		390			450
Connector	Test Results	Rebling	7010+7020	with one 4/0 cable per terminal	None	75 (.110)	270		330		380			430
Cable	Test Results	750 MCM	Cable	7,600 strands of 30 gauge wire		380 (.597)	1,010		1,250		1,430			
Cable	Test Results	500 MCM	Cable	5,000 strands of 30 gauge wire		250 (.393)	690		850		970			
Cable	Test Results	450 MCM	Cable	4,500 strands of 30 gauge wire		230 (.353)	550		660		770			
Cable	Test Results	250 MCM	Cable	2,500 strands of 30 gauge wire		130 (.196)	360		450		520			
Cable	Test Results	4/0	Cable	2,060 strands of 30 gauge wire		105 (.162)	290		350		400			
Cable	Test Results	3/0	Cable	1,590 strands of 30 gauge wire		80 (.125)	260		310		350			
Cable	Test Results	2/0	Cable	1,280 strands of 30 gauge wire		65 (.101)	240		290		335			
Cable	Test Results	1/0	Cable	1,000 strands of 30 gauge wire		50 (.079)	230		270		315			
Cable	Test Results	2 AWG	Cable	600 strands of 30 gauge wire		30 (.047)	160		190		220			
Cable	Test Results	6 AWG	Cable	250 strands of 30 gauge wire		13 (.020)	90		110		125			
Cable	NEC/UL Standard	1,000 MCM	Cable	10,300 strands of 30 gauge wire		520 (.809)	455		545		615			
Cable	NEC/UL Standard	750 MCM	Cable	7,600 strands of 30 gauge wire		380 (.597)	400		475		535			
Cable	NEC/UL Standard	500 MCM	Cable	5,000 strands of 30 gauge wire		250 (.393)	320		380		430			
Cable	NEC/UL Standard	450 MCM	Cable	4,500 strands of 30 gauge wire		230 (.353)	300		355		405			
Cable	NEC/UL Standard	4/0	Cable	2,060 strands of 30 gauge wire		105 (.162)	195		230		260			
Cable	NEC/UL Standard	2/0	Cable	1,280 strands of 30 gauge wire		65 (.101)	145		175		195			
Cable	NEC/UL Standard	1/0	Cable	1,000 strands of 30 gauge wire		50 (.079)	125		150		170			
Cable	NEC/UL Standard	1 AWG	Cable	800 strands of 30 gauge wire		40 (.063)	110		130		145			
Cable	NEC/UL Standard	2 AWG	Cable	600 strands of 30 gauge wire		30 (.047)	95		115		130			
Cable	NEC/UL Standard	6 AWG	Cable	250 strands of 30 gauge wire		13 (.020)	55		65		75			

Cable and Connector Selection Guidelines: **The cross sectional areas of the terminal and the cable attached to the terminal should be the same.** Attaching a small cable to a large terminal is like attaching a 1 inch pipe to a 4 inch fitting, the size of the cable will limit the system's electrical and thermal performance, not the terminal. To select the optimal connector, follow the steps below:

Step 1: determine the temperature rise your equipment design can tolerate. The higher the temperature rise your equipment can tolerate, the lower the cost of cable and connectors.

Step 2: determine if your equipment needs to comply with UL, NEC, IEC or other standards

Step 3: determine the steady state current which your equipment must handle. If there are frequent or extended peaks of higher currents, use these peaks to estimate an average steady state current.

Step 4: select the smallest cable which can carry your steady state current which does not exceed the temperature rise you can tolerate and which conforms to the standard with which you wish to comply.

Step 5: determine if your equipment needs a separable electrical connection. Separable connections are more expensive and less reliable than permanent (soldered or welded) connections.

Step 6: determine if it is acceptable to use a tool to un-mate your electrical connection. Toolless connectors are more expensive and less reliable than connectors which require tools but might be justifiable if: frequent un-matings occur, the installer is unskilled, a 20 second reduction in maintenance time is critical or lowered assembly labor costs offset the increased cost of the toolless connector.

Step 7: select the lowest cost connector which: does not exceed the temperature rise your equipment can tolerate at your steady state current and meets your un-mating tool requirements.

Temperature Rise Values: the NEC (National Electrical Code) values are NEC's recommendations for typical thermoplastic insulated cables enclosed in a conduit which are close to other cables. UL has adopted NEC's 45° C rise values as their recommendations for current levels per cable size in UL 98. The values labeled "Test Results" were obtained from current vs temperature rise testing of individual cables and connectors suspended in air inside an 18" x 18" x 18" test chamber. Lithium battery system designers usually select components which keep the temperature rise to a maximum of 30° C due the sensitivity of lithium cells. It is wise to compare connectors based upon temperature rise test results since the rated currents and total allowable temperatures defined by standards like UL1977 and IEC 61984 can vary by a factor of 2.5. The current vs temperature rise characteristics of your application may be significantly different than the assumptions used in NEC, UL or IEC standards.

Touch Safe Temperatures: IEC/UL 60950-1 defines the maximum allowable temperature for 3 seconds of contact between a metal component and the human body as 60° C; for plastic it's 85° C.

Cross Sectional Area of Conductor: the cross sectional areas of the stranded cables shown above were calculated using the diameter of one 30 gauge wire = 0.01000 inches