



US Army Corps
of Engineers
Afghanistan Engineer District

AED Design Requirements: Breaker and Conductor Sizing

Various Locations,
Afghanistan

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AED DESIGN REQUIREMENTS - CABLE AND BREAKERS SIZING

Overcurrent protection for conductors and equipment is provided to open the circuit if the current reaches a value that will cause an excessive or dangerous temperature in the **conductors or conductor insulation**.

It is very important that the capacity of the breaker can properly protect the conductors. Conductors enclosed in raceways can not dissipate heat as easy as in free air. So the capacity of the conductor is less than what it is in free air. When sizing conductors you have to determine the weakest link in the system. The National Electric Code (NEC) has a number of tables (NEC Tables 310.16 – 310.21) based on whether the conductors are in raceways, free air, insulation temperatures and ambient temperatures. All of these factors play a part in the proper sizing. Equipment and connection are rated in temperatures. You may use a conductor rated at 90 degrees, but the breaker or panel the conductor is being installed in is only rated for 75 degrees. So the weakest link is the 75 degrees (NEC 110.14.1.b).

Example: The lighting load is continuous at 100 kW, 3 phase, 380/220 volts. The ambient temperature is 40 degrees. For simplicity voltage drop will not be a factor.

$100 \text{ kW} / (380 \text{ volt} \times 1.73) = 152 \text{ amps}$

$152 \text{ amps} \times 125\% \text{ (NEC 219.A.1)} = 190 \text{ amps}$

The nearest breaker size would be 200 amps. You would need to size the wire based on the 200 amps. The 200 amp breaker is rated at 75 degrees and is in a panel rated at 75 degrees. The conductor is rated at 90 degrees. The lowest temperature rating would be the determining factor. Using Table 310.16, 75 degree column it will take a 95mm² copper conductor.

A 50mm² copper conductor has a capacity of 150 amps. If it was fed by a 200 amp breaker the conductor could heat up above its capacity causing possibly damage to the conductor or its insulation. The breaker would not open until the 200 amp level was reached.

The following table can be used to properly size breakers and conductors when the conductors are enclosed in conduit, cabinets, vaults, etc...

The other part of the table can be used to size the equipment grounding conductor. It is based on the size of the Overcurrent device. First size the Overcurrent device and then look in the adjacent columns for either the AWG or metric conductor size.

		Minimum Size of Equipment Grounding Conductors for Grounding Raceways and equipment. (Sizes are based on copper conductors)			
		Amps Table 310-16 75 degree in Raceway			Rating of Overcurrent Device
AWG	Metric		AWG	Metric	
14	2.5mm ²	15	14	2.5mm ²	15
12	4mm ²	25	12	4mm ²	20
10	6mm ²	35	10	6mm ²	30
10	6mm ²	35	10	6mm ²	40
10	6mm ²	35	10	6mm ²	60
8	10mm ²	50	8	10mm ²	100
6	16mm ²	65	6	16mm ²	200
4	25mm ²	85	4	25mm ²	300
3	25mm ²	100	3	25mm ²	400
2	35mm ²	115	2	35mm ²	500
1	50mm ²	130	1	50mm ²	600
1/0	50mm ²	150	1/0	50mm ²	800
2/0	70mm ²	175	2/0	70mm ²	1000
3/0	95mm ²	200	3/0	95mm ²	1200
4/0	120mm ²	230	4/0	120mm ²	1600
250	120mm ²	255	250	120mm ²	2000
300	150mm ²	285	300	150mm ²	2500
350	185mm ²	310	350	185mm ²	2500
400	240mm ²	335	400	240mm ²	3000
500	240mm ²	380	500	240mm ²	4000
600	300mm ²	420	600	300mm ²	5000
700	400mm ²	460	700	400mm ²	5000
800	400mm ²	490	800	400mm ²	6000