ABYC Excerpts

Ground Fault Circuit Interrupter (GFCI) Explained:

Boaters and home owners may be familiar with Ground Fault Circuit Interrupters (GFCI) monted in AC outlet receptacles. A GFCI is a Residual Current Device (RCD) that trips at very low current levels. GFCIs are recommended for circuits supplying AC electrical receptacles in heads, galleys, machinery space, and weather decks.*

*E-11.13.3.5. If installed in a head, galley, machinery space, or on a weather deck, the receptacle shall be protected by a Type A (nominal 5 milliamperes) Ground Fault Circuit Interrupter (GFCI).

Considerations for DC Main Circuit Protection

11.10.1.1.1. OVERCURRENT PROTECTION DEVICE LOCATION: Undergrounded conductors shall be provided with overcurrent protection within a distance of seven inches (175 mm) of the point at which the conductor is connected to the source of power measured along the conductor.

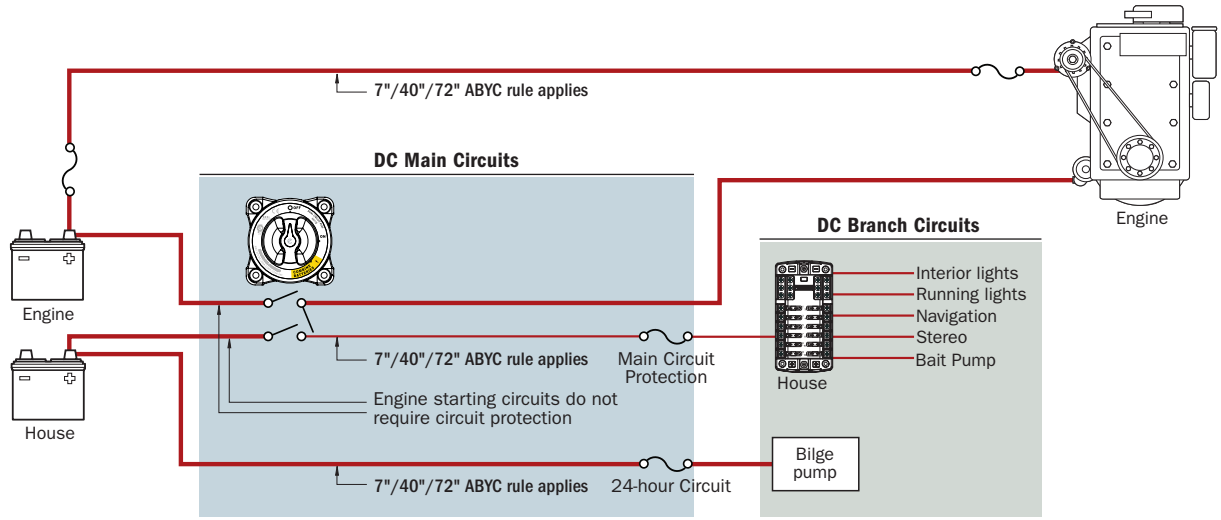
11.6.1.2.1. A battery switch shall be installed in the positive conductor(s) from each battery or battery bank with a CCA rating greater than 800 Amperes.

11.6.1.2.3. BATTERY SWITCH RATINGS: The intermittent rating of a battery switch shall not be less than the maximum cranking current of the largest engine cranking motor that it serves. The minimum continuous rating of a battery switch shall be the total of the ampacities of the main overcurrent protection devices connected to the battery switch, or the ampacity of the feeder cable to the switch, whichever is less.

ABYC Standards for battery switches are currently under review by the ABYC Project Technical Committee for battery switches. The two major changes likely to be made are that allowable temperature rise will decrease, thereby lowering the amperage ratings that switches currently carry, and an Engine Starting Standard similar to that developed by Blue Sea Systems will be incorporated into the standard.

MOUNTING PLACEMENT, DISTANCE FROM POWER SOURCE: The DC Main circuit protection system uses circuit breakers or fuses to protect the wires of the DC Main distribution system. The American Boat and Yacht Council (ABYC) publishes voluntary standards for the type and placement of the fuse or circuit breaker to be used as a DC Main circuit protection device. The diagram below shows the required placement of main circuit protection devices. Note that wire intended to carry engine starting currents between the batteries, the switch, and the starter, is not required to have main circuit protection devices installed.

Mounting placement dimensions for a fuse or circuit breaker (7"/40"/72" ABYC rule): 7 inch maximum if the conductor is not housed in a sheath or enclosure in addition to the wire insulation, 40 inch maximum if the conductor is housed in a sheath or enclosure in addition to the wire insulation, 72 inch maximum if the conductor is connected directly to the battery and housed in a sheath or enclosure in addition to the wire insulation.



ABYC Ampere Interrupt Capacity (AIC) Rating Table

Battery Type	Total Connected Battery Cold Cranking Amperes (CCA) *	Total Connected Battery Marine Cranking Amperes (MCA) *	DC Main	DC Branch
12 or 24 Volts				
One G24 Battery or one G27 Battery	650 CCA	800 MCA or Less	1500 AIC	750 AIC
Two G24 batteries, two G27 batteries, or one 4D battery	651-1100 CCA	800-1375 MCA	3000 AIC	1500 AIC
One Golf Cart battery, one 8D battery, or two 4D batteries	Over 1100 CCA	1375 MCA	5000 AIC	2500 AIC
32 Volts				
	1250 CCA	1550 MCA or Less	3000 AIC	1500 AIC
	Over 1250 CCA	1550 MCA	5000 AIC	2500 AIC

* Battery cold cranking performance rating at -17.8°C (0°F) The discharge load in amperes that a battery at -17.8°C (0°F) can deliver for 30 seconds, and maintain a voltage of 1.2 Volts per cell or higher. e.g. 7.2 Volts for a 12 Volt battery. The CCA for the battery icons above is an approximation and could be slightly higher or lower. Consult the battery manufacturer's specifications for precise CCA ratings.
Many batteries are rated in MCA values. MCA ratings are similar to CCA ratings but taken with the battery at 0°C or 32°F. MCA rating is typically 125% of the CCA rating so this guideline can be used where CCA is not indicated.

E-11 requires the use of circuit breakers that can be reused and reset and that they be applied as per the table above. The standard does not strictly require that fuses be applied in the same way, but it is an issue to consider, especially with high amperage fuses used to protect panel feeders or inverters. Fuses under 10 Ampere rating generally have such a high internal resistance they prevent fault currents from reaching 1000 Amperes in 12 Volt circuits. The apparent contradiction when using these fuses for bilge pumps and other circuits directly off the battery is less of an issue than it might seem. If a fuse blows, and the case appears to be cracked or metal has been ejected, the fuse holder should be replaced.

E-11.5.1.3 and US Coast Guard regulations require that electrical sources of ignition located in spaces containing gasoline powered machinery, gasoline fuel tanks, locations where fumes from gasoline or LP gas fumes can accumulate, comply with standards for ignition protection. To be ignition protected, these devices must have any spark producing mechanisms sealed and low enough surface temperatures that they will not ignite gas fumes. Even diesel powered vessels have suffered major fires and explosions as a result of fumes from dinghy fuel or stored painting supplies. Switches, circuit breakers, and fuses are all considered to be potential sources of ignition. Many of the circuit protection devices offered by Blue Sea Systems comply with ignition protection standards.

ABYC Ampacity Rating Table at 30°C

Wire Size		Temperature Rating of Conductor Insulation												Reference Data		
		75°C		90°C		105°C		75°C		90°C		105°C			Ohms	Ohms
US AWG	Metric mm^2		EngRm		EngRm		EngRm		EngRm		EngRm		EngRm	mm dia	/1000ft	/1000m
	0.75	9.5	7	19	15.5	19	16	6.6	5.0	13	11	13	11	0.98	7.29	23.92
18	0.82	10	8	20	16	20	17	7	5	14	12	14	12	1.02	6.67	21.88
	1.0	13	10	21	17	21	18	9	7	15	12	15	13	1.13	5.47	17.94
16	1.3	15	11	25	21	25	21	11	8	18	14	18	15	1.29	4.17	13.70
	1.5	16	12	24	20	29	24	11	9	17	14	20	17	1.38	3.65	11.96
14	2.1	20	15	30	25	35	30	14	11	21	17	25	21	1.63	2.63	8.63
	2.5	21	16	34	28	38	32	15	11	23	19	26	22	1.78	2.19	7.18
12	3.3	25	19	40	33	45	38	18	13	28	23	32	27	2.05	1.65	5.42
	4.0	34	25	46	38	51	43	24	18	32	27	35	30	2.26	1.37	4.49
10	5.3	40	30	55	45	60	51	28	21	39	32	42	36	2.59	1.04	3.41
	6.0	53	40	57	47	65	55	37	28	40	33	45	39	2.76	0.91	2.99
8	8.4	65	49	70	57	80	68	46	34	49	40	56	48	3.27	0.65	2.14
	10.0	79	60	84	69	100	85	56	42	59	48	70	60	3.6	0.55	1.79
6	13.3	95	71	100	82	120	102	67	50	70	57	84	71	4.1	0.41	1.35
	16.0	105	79	113	93	134	114	73	55	79	65	94	80	4.5	0.34	1.12
4	21	125	94	135	111	160	136	88	66	95	78	112	95	5.2	0.26	0.85
	25	141	106	150	123	175	148	99	74	105	86	122	104	5.6	0.22	0.72
3	27	145	109	155	127	180	153	102	76	109	89	126	107	5.8	0.21	0.67
2	34	170	128	180	148	210	179	119	89	126	103	147	125	6.5	0.16	0.53
	35	173	130	186	153	217	185	121	91	130	107	152	129	6.7	0.16	0.51
1	42	195	146	210	172	245	208	137	102	147	121	172	146	7.3	0.13	0.42
	50	220	165	235	193	273	232	154	116	164	135	191	163	8.0	0.109	0.36
0	54	230	173	245	201	285	242	161	121	172	141	200	170	8.3	0.102	0.34
00	68	265	199	285	234	330	281	186	139	200	164	231	196	9.3	0.081	0.27
	70	274	206	292	239	341	289	192	144	204	168	238	203	9.4	0.078	0.26
000	85	310	233	330	271	385	327	217	163	231	189	270	229	10.4	0.064	0.21
	95	334	251	357	293	413	351	234	175	250	205	289	246	11.0	0.058	0.19
0000	107	360	270	385	316	445	378	252	189	270	221	312	265	11.7	0.051	0.17
	120	387	290	414	339	478	406	271	203	290	237	335	284	12.4	0.046	0.15
	150	445	333	476	390	550	467	311	233	333	273	385	327	13.8	0.036	0.12

Data based on E-11 Table VI-A
(Single Conductors in Free Air)

Data based on E-11 Table VI-B
(Up to three conductors in a sheath, conduit or bundle)

- For bundles of 4 to 6 conductors multiply by 0.857
- For bundles of 7 to 24 conductors multiply by 0.714
- For bundles of 25 or more, conductors multiply by 0.571

SAE conductors are smaller than equivalent AWG by 5% to 12% with current capacity typically less by 7%. ISO Ratings for metric wire are slightly less than these values derived from ABYC VI-A ratings.

Wires counted in bundles need not include:

1. Wires carrying intermittent currents no more than rating per VI-A and for less than one minute per mm of diameter, and not repeating more often than a delay of 5 times active duration.
2. Wires carrying load currents at less than 50% of the wire rating per table VI-B.

Wire selection for DC applications on boats is usually based on voltage drop requirements. However, there is a maximum continuous current that the wire can withstand without overheating. Higher grade marine wires are rated for service up to 105°C (221°F)—the ABYC wire capacity table for 105°C is most frequently quoted. Table VI-A accurately reflects the capacity of single conductors exposed to freely circulating cooling air. However, other factors, such as covering bundles of wire in outer jackets to form a cable, or use of conduits or structural voids to protect wires, can reduce the cooling and reduce the safe capacity of the wire. Tables VI-B, C, and D take into account sheathing and bundling of conductors which reduces the available capacity to carry current without over heating.

A more conservative strategy is to use the 105°C wire, but treat it according to the 75°C column when selecting circuit protection unless the wire is openly exposed for cooling.

ABYC Interrupt Rating Table

AC Shore Power Source	Main Circuit Breaker	Branch Circuit Breaker
120V - 30A	3,000	3,000
120V - 50A	3,000	3,000
120/240V - 50A	5,000	3,000
240V - 50A	5,000	3,000

Corporate Office
425 Sequoia Drive
Bellingham, WA 98226 USA

p 360.738.8230
p 800.222.7617 toll free
f 360.734.4195

www.bluesea.com
conductor@bluesea.com