SAE The Engineering Society For Advancing Mobility Land Sea Air and Space®
INTERNATIONAL
400 Commonwealth Drive, Warrendale, PA 15096-0001

SURFACE VEHICLE RECOMMENDED PRACTICE

SAE J2120

REAF. JUL97

Issued 1992-07
Reaffirmed 1997-07

Superseding J2120 JUL92

Submitted for recognition as an American National Standard

PERSONAL WATERCRAFT—ELECTRICAL SYSTEMS

Foreword—This document has not changed other than to put it into the new SAE Technical Standards Board Format. This consisted of changing the Definition section to Section 3, all other section numbers have changed. This also complies with the ISO format. The first paragraph in the Rationale has also changed.

1. Scope—This SAE Recommended Practice applies to personal watercraft as defined in Section 3. With the exception of Sections 5 and 6, this document does not apply to electronic circuits having a current flow of less than 1 A; conductors which are totally inside an equipment housing; resistance conductors that control circuit amperage; high-voltage secondary conductors and terminations that are in ignition systems; pigtails of less than 180 mm of exposed length; and cranking motor conductors.

1.1 Purpose—This document specifies construction and performance guidelines for electrical systems of personal watercraft. It is intended as a guide toward standard practice and is subject to change to keep pace with experience and technical advances.

2. References

2.1 Applicable Documents—The following publications form a part of this specification to the extent specified herein. The latest issue of SAE publications shall apply.

2.1.1 SAE PUBLICATIONS—Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

SAE J378b—Marine Engine Wiring
SAE J1127—Battery Cable
SAE J1128—Low Tension Primary Cable
SAE J2031—High Tension Ignition Cable

3. Definitions

3.1 AWG—American Wire Gauge.

3.2 Conduit—Any type of rigid plastic or metal piping or tubing which supports the conductors contained within.

3.3 Electrical Component—Electrical equipment such as, but not limited to, conductors, solenoids, motors, alternators, distributors, resistors, and electrical control devices.

3.4 High Voltage Circuit—A nominal voltage of 50 V or more.

SAENORM.COM : Click to view the full PDF of j2120_199707

SAE Technical Standards Board Rules provide that: "This report is published by SAE to advance the state of technical and engineering sciences. The use of this report is entirely voluntary, and its applicability and suitability for any particular use, including any patent infringement arising therefrom, is the sole responsibility of the user."

SAE reviews each technical report at least every five years at which time it may be reaffirmed, revised, or cancelled. SAE invites your written comments and suggestions.

QUESTIONS REGARDING THIS DOCUMENT: (412) 772-8512 FAX: (412) 776-0243
TO PLACE A DOCUMENT ORDER; (412) 776-4970 FAX: (412) 776-0790
SAE WEB ADDRESS http://www.sae.org

Copyright 1997 Society of Automotive Engineers, Inc.
All rights reserved.

Printed in U.S.A.

3.5 **Ignition Protection—**The design and construction of a device such that under design operation conditions it will not ignite a flammable hydrocarbon mixture surrounding the device when an ignition source causes an internal explosion, or it is incapable of releasing sufficient electrical or thermal energy to ignite a hydrocarbon mixture, or the source of ignition is hermetically sealed.

3.6 **Low Voltage Circuit—**A nominal voltage of less than 50 V.

3.7 **Personal Watercraft—**A vessel less than 4 m (13 ft) in length which uses an internal combustion engine powering a water jet pump as its primary source of propulsion, and is designed to be operated by a person or persons sitting, standing, or kneeling on rather than within the confines of a hull.

3.8 **Pigtail—**External power conductors or wires that are part of electrical components such as bilge pumps, blowers, switches, solenoids, and fuses.

3.9 **Sheath—**A material used as a continuous protective covering, such as electrical tape, molded rubber, molded plastic, or flexible tubing, around one or more insulated conductors.

4. Conductor Type, Size, and Identification

4.1 Each conductor must be insulated, stranded copper.

4.2 Low-voltage conductors shall comply with SAE J378b, SAE J1127, SAE J1128, or equivalent standards.

4.3 No conductor shall be used to carry an amperage greater than that specified in Table 1 for its gauge. The ampacity of conductors in an engine compartment must be corrected by the appropriate factor indicated in Table 1.

4.4 A means of identification shall be used to distinguish individual conductors.

5. Conductor Support and Protection

5.1 Each conductor shall be installed so that it is protected from physical damage. Except for the first 500 mm of battery cables, conductors shall be supported by clamps or straps not more than 400 mm apart unless the conductor(s) is contained in a conduit.

5.2 Clamps, straps, or conduits shall be designed to prevent damage to the conductor insulation.

5.3 Conductors connecting components that can move with relation to each other shall be protected from stress.

5.4 Conductors passing through bulkheads, junction boxes, or other rigid surfaces shall be bushed with conduit or grommets, or the conductor shall be protected by a sheath.

6. External Ignition Protection—A representative electrical system as installed in the watercraft, or in an enclosure simulating the watercraft, must not ignite a propane gas and air mixture that is 4.25 to 5.25% propane gas by volume surrounding the electrical system when it is operated in the mode in which it draws its maximum current. The test voltage supply shall be adjusted to 120% of the nominal system voltage except magneto ignition systems.

SAENORM.COM : Click to view the full PDF of j2120_199707

TABLE 1—MAXIMUM CURRENT OF CONDUCTORS (AMPERAGE)
TEMPERATURE RATING OF CONDUCTOR INSULATION

(AWG) Wire Size	60 °C (140 °F)	75 °C (167 °F)	80 °C (178 °F)	90 °C (194 °F)	105 °C (221 °F)	125 °C (257 °F)	200 °C (392 °F)
18	10	10	15	20	20	25	25
16	15	15	20	25	25	30	35
14	20	20	25	30	35	40	45
12	25	25	35	40	45	50	55
10	40	40	50	55	60	70	70
8	55	65	70	70	80	90	100
6	80	95	100	100	120	125	135
4	105	125	130	135	160	170	180
3	120	145	150	155	180	195	210
2	140	170	175	180	210	225	240
1	165	195	210	210	245	265	280
0	195	230	245	245	285	305	325
10	225	265	285	285	330	355	370
100	260	310	330	330	385	410	430
1000	300	360	385	385	445	475	510
ENGINE COMPARTMENT CORRECTION FACTORS							
	0.56	0.75	0.78	0.82	0.85	0.89	1.00

SAENORM.COM : Click to view the full PDF of j2120_199707

7. Overcurrent Protection

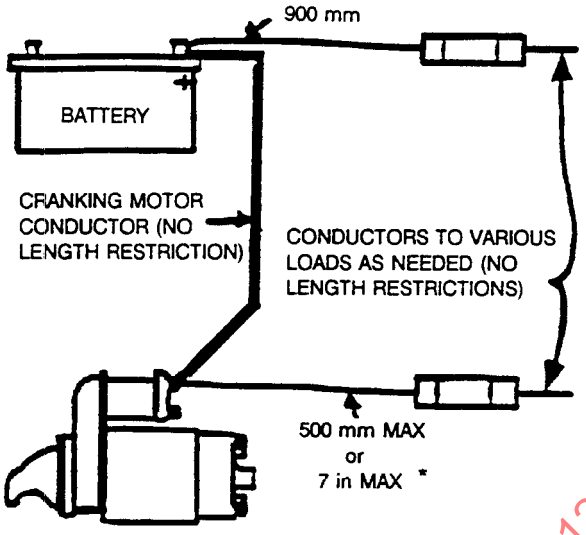
7.1 Except for conductors from self-limiting generators or alternators, each ungrounded current-carrying conductor shall be protected by a manually reset, trip-free circuit breaker or fuse. The fuse or breaker shall be within 180 mm of the origin of the conductor to be protected so long as the fuse or breaker is sized for the smallest conductor in the circuit.

7.1.1 EXCEPTION 1—If a conductor is continuously protected from physical damage by a sheath or enclosure between its terminal ends, the maximum distance to its protecting fuse or breaker may be increased to 500 mm from the power source measured along the conductor.

7.1.2 EXCEPTION 2—An ungrounded supply conductor starting at a storage battery must have its breaker or fuse within 900 mm of the battery measured along the conductor Figure 1.

7.2 The voltage rating of each circuit breaker or fuse shall not be less than the nominal voltage of the circuit it is protecting.

7.3 The current ratings of the circuit breaker or fuse shall not be more than 150% of the value in Table 1 for the conductor it is protecting including the correction factor if any part of the conductor is in an engine compartment.



*** NOTE: Up to 500 mm max is allowed if the conductor, throughout this distance, is contained in a sheath of enclosure such as a junction box, control box, or enclosed panel.**

FIGURE 1—BREAKER/FUSE LOCATION FOR AN UNGROUNDED SUPPLY CONDUCTOR STARTING AT A STORAGE BATTERY

7.4 Circuit breakers or fuses for non-self-limiting generators and alternators shall have a current rating not exceeding 120% of the maximum rated output at 60 °C.

8. Conductor Terminations

8.1 All connections outside of junction boxes or enclosures shall be made with closed ring, eyelet, captive spade, or mechanical or spring lock type connectors. Wire nuts shall not be used on any connection.

8.2 Single or multi-connector plugs outside of junction boxes or enclosures shall not separate under an axial load of 2.7 kg applied for 1 min.

8.3 A soldered joint must not be the sole means of connection to any conductor except for battery terminal connectors with soldered joints at least 1.5 times longer than the diameter of the conductor strands.

8.4 Conductor splices and joints to connectors outside of junction boxes or enclosures shall not break when subjected for 1 min to the load shown in Table 2 for the smallest conductor in the connection.

8.5 Ungrounded terminal fittings and conductors shall be protected from accidental short circuiting with grounded metal or other ungrounded circuits in the event a termination should loosen. Continuously energized terminations without circuit protection must be covered with boots or equivalently protected.

9. Batteries

9.1 Each installed battery must not move more than 25 mm in any direction when a pulling force of twice the battery weight is applied through the center of gravity of the battery as follows:

9.1.1 Vertically in both directions for a duration of 1 min.

9.1.2 Horizontally and parallel to the watercraft's centerline for a duration of 1 min fore and 1 min aft.

SAENORM.COM : Click to view the full PDF of j2120_199707

TABLE 2—TENSILE TEST VALUES FOR WIRE SPLICES (CONDUCTOR-CONDUCTOR AND CONDUCTOR-CONNECTOR JOINTS)

Wire Size (AWG)	Tensile Force (kilograms)
18	4.5
16	6.5
14	13.5
12	16
10	18
8	20.5
6	22.5
5	27
4	32
3	36
2	41
1	45.5

9.1.3 Horizontally and perpendicular to the watercraft's centerline for a duration of 1 min to starboard and 1 min to port.

9.2 Each battery must be installed so that metallic objects cannot come in contact with the ungrounded battery terminals.

9.3 Each metallic fuel line and fuel system component within 100 mm and above the horizontal plane of the battery top surface as installed must be shielded with dielectric material.

9.4 Each battery must not be directly above or below a fuel tank, fuel filter, or fitting in a fuel line.

9.5 A vent system or other means must be provided to permit the discharge from the watercraft of hydrogen gas released by the battery.

9.6 Each battery terminal connector must not depend on spring tension for its mechanical connection to the terminal.

10. Secondary Circuits of Ignition Systems

10.1 Each conductor in a secondary circuit of an ignition system shall meet SAE J2031 or equivalent standards.

10.2 The connection of each ignition conductor to a spark plug, coil, or distributor must have a tight fitting cap, boot, or nipple.

SAENORM.COM : Click to view the full PDF of j2120_199707

PREPARED BY THE SAE PERSONAL WATERCRAFT SUBCOMMITTEE OF THE
SAE MARINE TECHNICAL COMMITTEE