SURFACE VEHICLE STANDARD

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Hydraulic Hose Fitting for Marine Applications

RATIONALE

The technical report covers technology, products, or processes which are mature and not likely to change in the foreseeable future.

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1. ***Scope—***This SAE Standard covers general and performance specifications for hydraulic hose fittings of the styles, types, and classes defined in Section 3 and used in conjunction with nonmetallic flexible hoses for marine applications. This document does not ensure compatibility between manufacturers of hydraulic hose and hydraulic hose fittings. Compatibility is the responsibility of the hydraulic hose assembly manufacturer.

2. ***References***

2.1 **Applicable Publications—**The following publications form a part of this specification to the extent specified herein. Unless otherwise specified, the latest issue of SAE publications shall apply.

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

SAE J516—Hydraulic Hose Fittings
SAE J518—Hydraulic Flanged Tube, Pipe and Hose Connections, Four-Bolt Split Flange Type

2.1.2 ASTM PUBLICATIONS—Available from ASTM, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959.

ASTM A 370—Test Methods and Definitions for Mechanical Testing of Steel Products
ASTM A 450—Specification for General Requirements for Carbon, Ferritic Alloy and Austenitic Alloy Steel Tubes
ASTM A 751—Test Methods, Practices and Terminology for Chemical Analysis of Steel Products

2.1.3 ASME PUBLICATIONS—Available from ASME, 345 East 47th Street, New York, NY 10017.

American Society of Mechanical Engineers Boiler and Pressure Vessel Code Section IX, Welding and Brazing Qualifications

2.1.4 ISO PUBLICATIONS—Available from ANSI, 25 West 43rd Street, New York, NY 10036-8002.

ISO 898-1—Mechanical properties of fasteners—Part 1: Bolts, screws and studs
ISO 6162—Hydraulic Fluid power—Four-screw spilt-flange connections for use at pressure of 2,5 MPa to 40 MPa (25 bar to 400 bar)—Type I metric series and type II inch series

3. Definitions

3.1 Series—A family of fittings designed for use with one or more hoses of different constructions. The series shall consist of one style of fitting, but may contain more than one type and class of fitting.

3.2 Style—Fittings shall be of one of the following three styles: permanently attached style, field attachable screw style, or field attachable segment clamp style. A fitting style may consist of more than one type and class of fitting.

3.3 Type—Fittings shall be of one of the following types: male dryseal pipe thread, male SAE straight thread O-ring boss, male 37 degree flared, female 37 degree flared, male 45 degree flared, female 45 degree flared, male flareless, female flareless, male metric straight thread O-ring boss, face seal, or 4-bolt split flange connections. A fitting type may consist of more than one class of fitting.

The use of split flange clamp halves is limited to the connection of hose fittings to solid threaded flanges or ports. These solid flanges or ports can be in equipment, pipe, or tube. Split flange type fittings shall not be used to connect hose to hose.

3.4 Class—Fittings shall be of one of the following classes: straight or bent. A class may consist of more than one size of fitting.

4. Requirements

4.1 Dimensions—In addition to the requirements of this document, the hose fittings shall meet the general and dimensional requirements of SAE J516 and ISO 6162 (SAE J518), as amended by this document. Other styles, types, and classes of fittings may be used provided they meet the general requirements of 4.2 through 5.7.

4.2 Material—For bars, forgings, tube, and pipe, material shall be steel. Elongation in 50 mm shall be no less than 10%. Split flange clamp halves shall be made of a ferrous material with a tensile strength of at least 310 N/mm^2 and an elongation in 50 mm of no less than 6%. Castings may be used only for clamps and split flange clamp halves.

4.3 Manufacture—Material for bars, forgings, tube, and pipe shall be made by the open hearth, basic oxygen, or electric furnace process. Hot-rolled bar stock shall be of special quality. Cold-rolled bar stock shall be of standard quality. Pipe and tube may be seamless or welded.

4.4 Certification—A certificate of compliance shall be obtained from the material supplier. This certificate shall state that all applicable requirements of the material specification are met. As a minimum, the material specification shall specify the chemical and mechanical requirements of the material.

4.5 Welding—For welded fittings, welding procedures and welders shall be qualified in accordance with the American Society of Mechanical Engineers Boiler and Pressure Vessel Code Section IX, Welding and Brazing Qualifications.

4.6 Bolting—Bolts for use with ISO 6162 (SAE J518) connections shall be of the sizes and lengths indicated in that standard. They shall be of ISO property class 10.9 (SAE Grade 8) material as specified in ISO 898-1. Socket head cap screws of ISO property class 10.9 (SAE Grade 8) material are acceptable

4.7 Design Qualification

4.7.1 MAXIMUM ALLOWABLE WORKING PRESSURE—The maximum allowable working pressures for four-bolt split flanges designed in accordance with SAE J518 shall be 35 MPa for 40 MPa Series (SAE Code 62) flanges and as listed in Table 1 for 2.5 to 35 MPa Series (SAE Code 61) flanges.

TABLE 1—MAXIMUM ALLOWABLE WORKING PRESSURES FOR 2.5 MPA TO 35 MPA SERIES (SAE CODE 61) SPLIT FLANGE TYPE FITTINGS USED IN MARINE APPLICATIONS

TABLE 1—

SAE J518 Flange Dash Size	ISO 6162 Nominal Flange Size (DN)	Maximum Allowable Working Pressure (MPa)
–8	13	31.5
–12	19	31.5
–16	25	25
–20	32	20
–24	38	20
–32	51	16
–40	64	10
–48	76	10
–56	89	2.5
–64	102	2.5
–80	127	2.5

4.7.2 MINIMUM BURST PRESSURE—Except as noted in 4.7.3, the initial fitting design shall be shown by calculation, test, or comparison to be capable of withstanding a burst pressure of four times its maximum allowable working pressure (MAWP) at the minimum expected tensile strength of the materials.

4.7.3 SIMILAR APPLICATIONS—In lieu of the requirement in 4.7.2, but not 5.6, the fittings shall have performed satisfactorily in similar applications for a period of at least five years. Similar applications are those applications where the pressure, temperature, service, and loadings are within the range for which the fitting is rated and will experience in the marine application. Similar applications include, but are not necessarily limited to:

a. Industrial equipment, e.g., mining and manufacturing
b. Off-highway vehicles
c. Aircraft
d. Oil drilling equipment
e. Military equipment

5. Inspection Tests

5.1 Flattening Test—A flattening test shall be made on seamless and welded pipe and tube as follows:

5.1.1 SEAMLESS PIPE—The flattening test shall be made on pipe over 50 mm in nominal diameter. A section not less than 63 mm in length shall be flattened cold between parallel plates in two steps.

During the first step, which is a test for ductility, no cracks or breaks on the inside, outside, or end surfaces shall occur until the distance between the plates is less than the value H calculated in Equation 1.

$$H = \frac{(1+e)t}{(e+t/D)} \qquad \text{(Eq. 1)}$$

where:

H = distance between flattening plates (mm)
t = specified wall thickness (mm)
D = specified outside diameter (mm)
e = deformation per unit length [constant for a given grade of steel: 0.07 for medium carbon steel (0.19 minimum carbon), 0.08 for ferritic alloy steel, 0.09 for austenitic steel and 0.09 for low carbon steel (0.18 maximum carbon)]

During the second step, which is a test for soundness, the flattening shall be continued until the specimen breaks or until the opposite walls of the pipe meet. Evidence of laminated or unsound material that is revealed during the entire flattening test shall be cause for rejection.

5.1.2 ELECTRIC RESISTANCE WELDED PIPE—The flattening test shall be made on pipe over 50 mm in nominal diameter. A specimen at least 100 mm in length shall be flattened cold between parallel plates in three steps with the weld located either 0 or 90 degrees from the line of direction of force.

During the first step, which is a test for ductility of the weld, no cracks or breaks on the inside or outside surfaces shall occur until the distance between the plates is less than 67% of the original outside diameter of the pipe.

As a second step, the flattening shall be continued. During the second step, which is a test for ductility exclusive of the weld, no cracks or breaks on the inside or outside surfaces shall occur until the distance between the plates is less than 33% of the original outside diameter of the pipe, but is not less than five times the wall thickness of the pipe.

During the third step, which is a test for soundness, the flattening shall be continued until the specimen breaks or until the opposite walls of the pipe meet. Evidence of laminated or unsound material, or of incomplete weld that is revealed during the entire flattening test shall be cause for rejection.

5.1.3 BUTT WELDED PIPE—For butt welded pipe over 50 mm in nominal diameter, a specimen at least 100 mm in length shall be flattened cold between parallel plates in three steps with the weld located 90 degrees from the line of direction of force.

During the first step, which is a test for quality of the weld, no cracks or breaks on the inside, outside, or end surfaces shall occur until the distance between the plates is less than 75% of the original outside diameter for butt welded pipe.

As a second step, the flattening shall be continued. During the second step, which is a test for ductility exclusive of the weld, no cracks or breaks on the inside, outside, or end surfaces shall occur until the distance between the plates is less than 60% of the original outside diameter for butt welded pipe.

During the third step, which is a test for soundness, the flattening shall be continued until the specimen breaks or until the opposite walls of the pipe meet. Evidence of laminated or unsound material, or of incomplete weld that is revealed during the entire flattening test shall be cause for rejection

5.1.4 SEAMLESS AND WELDED TUBE—A section approximately 75 mm in length, cut from the finished tubing, shall not crack or show any flaws when flattened between parallel plates to a distance equal to three times the wall thickness of the section under test. For welded tubes, the weld shall be placed 90 degrees from the direction of the applied force. Superficial ruptures as a result of surface imperfections shall not be cause for rejection.

A flattening test in accordance with ASTM A 450 may be performed in lieu of the flattening test described in 5.1.4.

5.2 Reverse Flattening Test—A section 100 mm in length shall be taken from every shipment or every 460 m, whichever is smaller, of finished welded tubing and split longitudinally 90 degrees on each side of the weld. The section containing the weld shall be opened and flattened with the weld at the point of maximum bend. There shall be no evidence of cracks or lack of penetration or overlaps resulting from flash removal in the weld.

5.3 Bend Test—For welded and seamless pipe 50 mm and under in nominal diameter, a sufficient length of pipe shall be capable of being bent cold through 90 degrees around a cylindrical mandrel, the diameter of which is twelve times the nominal diameter of the pipe, without developing cracks at any portion and without opening the weld.

5.4 Welded Fittings

5.4.1 GENERAL—A minimum of two samples shall be taken from each lot of welded fittings and receive (a) a fracture test and (b) either a crush test or a macro-examination. A sample shall consist of a welded fitting. If both the fracture test and the crush test are performed, a minimum of four samples are required. For automatic welding processes, a lot shall consist of a single class of fitting and no more than 1000 units or one continuous production run, whichever is smaller. For manual and semi-automatic welding processes, a lot shall consist of a single day's production per operator, for a single class of fitting.

5.4.2 VISUAL INSPECTION—In addition to the general requirements in 5.4.1, welds employing the use of filler metal shall receive 100% visual inspection. The welds shall show no visible cracks, surface porosity, or entrapped slag. Undercut shall not exceed 0.8 mm in depth, nor shall the total length or undercut greater than 0.4 mm in depth exceed 10% of the length of the weld.

5.4.3 FRACTURE TEST—One or more sections shall be taken from each sample. The sections shall be taken so that the weld is perpendicular to the longitudinal axis of the section. The total width of the section(s) taken from each sample shall equal or exceed 25% of the circumference of the sample. Each section shall be loaded laterally in such a way that the root of the weld is in tension.

The section shall be bent until it fractures or is bent 90 degrees. If the specimen fractures, the fractured surface shall show no evidence of cracks or incomplete fusion, and the sum of the lengths of inclusions and porosity visible on the fractured surface shall not exceed 10% of the total area. Cracking or tearing of the parent metals is acceptable.

5.4.4 CRUSH TEST—Each sample shall be positioned between two parallel plates in a manual or hydraulic press or between the jaws of a multiple jaw hydraulic press. The weld shall be located 3.2 mm from the face of the plates or jaws. The sample shall be either flattened against itself between the parallel plates or be crushed to within 50% of its original diameter between the multiple jaws. There shall be no indication of cracking or tearing in the weld joint. Cracking or tearing of the parent metals is acceptable.

5.4.5 MACRO-EXAMINATION—A cross section of the weld shall be taken from each sample. One face of each cross section shall be smoothed and etched with a suitable etchant to give a clear definition of the weld metal and heat-affected zone. The weld and heat-affected zone shall show complete fusion and freedom from cracks. Fillet welds shall show 100% fusion at the root of the weld, but not necessarily beyond the root.