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HYDRAULIC HOSE FITTINGS FOR MARINE APPLICATIONS—SAE J1475 JUN84

SAE Standard

Report of the Fluid Conductors and Connectors Technical Committee, Hydraulic Hose and Hose Fittings Subcommittee, approved June 1984.

1. Scope—This standard covers general and performance specifications for hydraulic hose fittings of the styles, types, and classes defined below and used in conjunction with nonmetallic flexible hose used in marine applications. In addition to the requirements of this standard, the hose fittings shall meet the general and dimensional requirements of SAE J516. Other styles, types, and classes of fittings may be used provided they meet the general requirements of Sections 3 thru 9. Four-bolt split flange type clamp halves are not within the scope of this standard and are covered under SAE J518c. This standard does not insure compatibility between manufacturers of hydraulic hose and hydraulic hose fittings. Compatibility is the responsibility of the hydraulic hose assembly manufacturer.

2. Definitions

2.1 Series—A family of fittings designed for use with one or more hoses of different construction. The series shall consist of one style of fitting but may contain more than one type.

2.2 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 of fitting.

2.3 Type—Fittings shall be of one of the following types: male dryseal pipe thread, male straight thread 0-ring boss, male 37 deg flared, female 37 deg flared, male 45 deg flared, female 45 deg flared, male flareless, female flareless, or, 4-bolt split flange head. A fitting type may consist of more than one class of fitting.

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

3. Material—For bars, forgings, tube and pipe, the material shall be steel. For castings, the material shall be steel, malleable iron, or ductile iron. Elongation in 2 in (50 mm) shall be no less than 10%. Castings may only be used for clamps and flanges.

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

5. 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.

6. 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.*

7. Qualification Tests

7.1 Except as noted in paragraph 7.2, 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 at the minimum expected tensile strength of the materials.

7.2 In lieu of the requirement in paragraph 7.1, 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; and
(e) Military equipment.

8. Inspection Tests

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

8.1.1 SEAMLESS PIPE—The flattening test shall be made on pipe over 2 in (50 mm) in nominal diameter. A section not less than 2½ in (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, except as provided for below, shall occur until the distance between the plates is less than the value H calculated as follows:

$$H = (1 + e)t/(e + t/D)$$

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

During the second step, which is a test for soundness, the flattening shall be continued until the specimen breaks or 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.

8.1.2 Electric-Resistance-Welded Pipe—The flattening test shall be made on pipe over 2 in (50 mm) in nominal diameter. A specimen at least 4 in (100 mm) in length shall be flattened cold between parallel plates in three steps with the weld located either 0 or 90 deg 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 two thirds 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 sufaces, except as provided for below, shall occur until the distance between the plates is less than one-third 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.

8.1.3 Bull-Welded Pipe—For butt-welded pipe over 2 in (50 mm) in nominal diameter, a specimen not less than 4 in (100 mm) in length shall be flattened cold between parallel plates in three steps. The weld shall be located 90 deg 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 three-fourths 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, except as provided for below, 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 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.

8.1.4 Seamless and Welded Tube—A section approximately 3 in (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 deg 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 A450 may be performed in lieu of the above flattening test.

8.2 Reverse Flattening Test—A section 4 in (100 mm) in length shall be taken from every shipment or every 1500 ft (460 m), whichever is smaller, of finished welded tubing and split longitudinally 90 deg 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.

8.3 Bend Test—For welded and seamless pipe 2 in (50 mm) and under in nominal diameter, a sufficient length of pipe shall be capable of being bent cold through 90 deg 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.

8.4 Welded Fittings

8.4.1 General—A minimum of two samples shall be taken from each lot of welded fittings and receive (1) a fracture test and (2) either a crush test or a macro-examination. A sample shall consist of a welded fitting. If both the fracture test and 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.

8.4.2 Visual Inspection—In addition to the general requirements above, 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 $\frac{1}{32}$ in (0.8 mm) in depth, nor shall the total length or undercut greater than $\frac{1}{64}$ in (0.4 mm) in depth exceed 10% of the length of the weld.

8.4.3 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 ¼ 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 deg. 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.

8.4.4 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 ⅛ in (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 parent metals is acceptable.

8.4.5 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.

8.5 Brazed Fittings

8.5.1 Peel Test—A peel test shall be conducted for each lot of brazed fittings. A lot shall consist of a single batch for batch brazing operations, a single day's production for continuous brazing operations, or a single day's production per operator for manual brazing operations. The peel test shall consist of two fittings for batch and continuous brazing operations and one fitting for manual brazing operations. If a fitting has more than one brazed joint, each brazed joint shall be tested. Additional fittings may be used if necessary. The fitting(s) shall be cut lengthwise into sections with longitudinal axes which are parallel to the longitudinal axis of the fitting and perpendicular to the joint to be tested. The number of sections, usually four or six, depends on the diameter of the joint. Except for the saw cuts, 100% of the joint shall be tested. The sections shall show evidence of brazing filler metal along each edge of the joint(s). Each section shall be separated or peeled either by clamping one end in a vise and striking the fulcrum point with a suitable tool, or by clamping both ends in a machine suitable for separating the sections under tension. Heat may be applied if difficulty is experienced. The total heat applied shall neither cause re-melting of the braze material, nor raise the temperature of the joint above 1000°F (535°C). The separated faying surfaces of the joint(s) shall meet the following criteria:

(a) The total area of defects (unbrazed areas, flux inclusions, etc.) shall not exceed 30% of the total area of any individual faying surface. Tearing of the base material is acceptable;

(b) The sum of the lengths of the defects measured on any one line in the direction of the lap shall not exceed 25% of the lap for copper brazed joints and 45% for silver brazed joints; and

(c) No defect shall extend continuously from one edge of the joint to the other edge, irrespective of the direction of the defect.

8.6 Burst Test—The manufacturer shall randomly[1] test each series of hose fittings two times per year to insure that the burst pressure requirement of four times maximum allowable working pressure is met. The fittings shall be tested with proper hoses. When a fitting series consists of more than one type, class, and size, then only two sizes of the same class and type of fitting need to be tested. For bent tube fittings of the same type and style, a fitting of one angle may qualify a fitting of a lessor angle, provided their material and wall thicknesses are identical. A male dryseal pipe thread fitting will qualify a male straight thread 0-ring fitting of the same series, style, and class, provided they are made of identical

[1] The burst tests shall be randomized to assure that fittings with identical part numbers are not tested each time.

materials. A 37 deg flare male (female) fitting will qualify a 45 deg flare male (female) fitting of the same series, style, and class, provided they are made of identical materials.

If a fitting is used for more than one type of hose, the burst pressure achieved with one type of hose is sufficient to qualify the fitting for use with other hoses of the same or lower pressure rating provided:

(a) All other parts, except for the ferrule or clamp, of the fitting used with both hoses are of identical material and construction;

(b) The fittings are of the same style, type, class, and size; and

(c) The ferrules or clamps are of identical material and similar construction.

8.7 Chemical and Mechanical Tests—Bar stock materials shall be tested every three months to insure their chemical and mechanical requirements are met. The tests shall be conducted as follows:

(a) The chemical and mechanical tests shall be conducted in accordance with ASTM A 751 and A 370 respectively;

(b) Each bar stock specification and grade shall be tested; and

(c) The bar stock shall be divided into three size groups, sizes less than ¾ in (19 mm), sizes ¾ in to 1-1/2 in (19 to 38 mm), and sizes greater than 1-1/2 in (38 mm). Only one test per each size group need be performed for bars of the same specification and grade. The bars shall be selected at random so the same size bar in each size group is not tested each time. These tests are not required if material certificates, which report the results of the chemical analysis and mechanical tests, are obtained from the mill or manufacturer.

9. Test Reports—The results of each test shall be recorded and the test data shall be kept on file and maintained a minimum of three years for review.