International Standard 7313

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION•МЕЖДУНАРОДНАЯ ОРГАНИЗАЦИЯ ПО СТАНДАРТИЗАЦИИ•ORGANISATION INTERNATIONALE DE NORMALISATION

Aircraft — High temperature convoluted hose assemblies in polytetrafluoroethylene (PTFE)

Aéronefs — Tuyauterie flexible, haute température, convolutée, en polytétrafluoréthylène (PTFE)

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Foreword

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Draft International Standards adopted by the technical committees are circulated to the member bodies for approval before their acceptance as International Standards by the ISO Council.

International Standard ISO 7313 was developed by Technical Committee ISO/TC 20, *Aircraft and space vehicles*, and was circulated to the member bodies in June 1982.

It has been approved by the member bodies of the following countries:

Australia	Egypt, Arab Rep. of	Romania
Austria	France	South Africa, Rep. of
Belgium	Ireland	Spain
Brazil	Italy	Sweden
Canada	Japan	United Kingdom
China	Netherlands	USSR

The member bodies of the following countries expressed disapproval of the document on technical grounds:

Czechoslovakia
Germany, F.R.

Printed in Switzerland

Aircraft — High temperature convoluted hose assemblies in polytetrafluoroethylene (PTFE)

1 Scope and field of application

This International Standard specifies characteristics of hose assemblies with corrosion-resistant metallic braid and convoluted polytetrafluoroethylene (PTFE) inner tube for use in aircraft fluid systems at temperatures between −55 and +200 °C and at nominal pressures, depending on bore size, up to 6,8 MPa. Special approval from the proper national authority may be required if these hoses are to be part of a pressurized gas storage system.

Two types of hose assembly are covered in this International Standard:

Type 1: Non-conductive inner tube

Type 2: Conductive inner tube

2 References

ISO 756, *Propan-2-ol for industrial use — Methods of test —*

Part 1: General.

Part 2: Determination of acidity — Titrimetric method.

Part 3: Test for miscibility with water.

ISO 3768, *Metallic coatings — Neutral salt spray test (NSS test).*

3 Requirements

3.1 Qualification

The hose assemblies furnished under this International Standard shall be a product identical to that which has been tested and has passed the qualification tests herein and shall be suitable for use in aircraft fluid systems under conditions specified herein.

3.2 Materials

The hose assemblies shall be uniform in quality and free from defects in material as is consistent with good manufacturing practice. Materials shall conform to applicable specifications and the requirements specified herein.

3.2.1 Metals

Metals shall be of corrosion-resistant type or be suitably treated to resist corrosion due to fluid being conveyed and/or salt spray and atmospheric conditions to which the hose assembly may be subjected when in storage or during normal service use.

3.2.2 Non-metallic materials

All materials used in the hose assemblies shall be "non-ageing" for storage and shall be compatible with system fluids and other hose assembly materials and suitable for the service intended.

3.3 Design

The hose assembly shall consist of a convoluted PTFE inner tube which may be covered with convoluted woven glass cloth and other suitable material and reinforced with stainless steel wire braid and with end fittings suitable for the intended installation. This International Standard shall specifically cover the hose assembly made up of the specified hose and the hose attachment mechanism of the fitting.

3.3.1 Inner tube

The inner tube shall be of convoluted construction designed to promote easy bending. It shall be free from pitting or projections on the inner surface which may interfere with fluid flow.

3.3.2 Reinforcement

The reinforcement shall consist of a stainless steel wire braid or braids of sufficient strength and corrosion resistance to meet the requirements of this International Standard.

3.3.3 Interlayers

Interlayers, if used, shall be of suitable material.

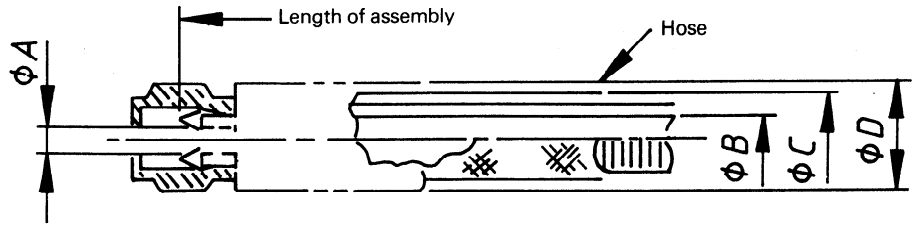
3.3.4 Fittings

The fittings shall be specifically designed for this hose and materials shall be selected for the specific operating conditions. When the requirements for these fittings and this International Standard conflict, this International Standard shall govern. Threads shall conform to ISO metric screw threads.

3.3.5 Dimensions

The dimensions of the hose assemblies shall be in accordance with table 1.

Table 1 — Hose assembly dimensions



A = diameter of the nipple
B = inside diameter of the inner tube
C = outside diameter of the reinforcement
D = outside diameter of the socket

Dimensions in millimetres

DN Hose size	A min.	B min.	C max.	D max.
06	3,0	4,8	11,3	14,0
10	6,0	8,6	14,3	19,1
12	8,7	12,7	20,0	22,3
16	10,9	14,9	21,9	24,1
20	16,1	19,0	27,8	32,5
25	21,2	23,8	33,4	38,1
32	27,5	30,1	39,7	43,2
40	33,3	36,5	47,7	50,8
50	46,3	49,2	60,4	65,0
63	57,8	61,9	73,1	76,2
80	70,4	74,6	87,3	94,0
105	94,0	100,0	112,7	119,4

3.4 Performance

Each hose assembly shall be free from defects of material, workmanship and finish; shall conform dimensionally with the requirements of this specification; shall withstand the proof pressure specified in table 2 without imperfection or leakage occurring when tested as specified in 4.4.2; and shall be capable of performance requirements specified as follows:

3.4.1 Examination of product

In accordance with 4.4.1.

3.4.2 Proof pressure

In accordance with 4.4.2.

3.4.3 Elongation and contraction

In accordance with 4.4.3.

3.4.4 Leakage

In accordance with 4.4.4.

3.4.5 Room temperature burst pressure

In accordance with 4.4.5.

3.4.6 High temperature burst pressure

In accordance with 4.4.6.

3.4.7 Oil resistance

In accordance with 4.4.7.

3.4.8 Fuel resistance

In accordance with 4.4.8.

3.4.9 Flexibility and vacuum

In accordance with 4.4.9.

3.4.10 Pressure surge

In accordance with 4.4.10.

3.4.11 Conductivity (type 2 only)

In accordance with 4.4.11.

Table 2 — Physical requirements of hose assemblies

DN Hose size	Nominal pressure max. MPa (bars)	Proof pressure min. MPa (bars)	Minimum burst pressure at: room temperature MPa (bars)	Minimum burst pressure at: high temperature MPa (bars)	Bend radius at inside of bend mm	Test samples* Quantity of samples	Test samples* Length mm
06	6,8 (68)	13,6 (136)	27,2 (272)	19,0 (190)	32	11	460
10	6,8 (68)	13,6 (136)	27,2 (272)	19,0 (190)	57	11	460
12	6,8 (68)	13,6 (136)	27,2 (272)	19,0 (190)	73	11	460
16	6,1 (61)	12,2 (122)	24,4 (244)	17,0 (170)	76	11	460
20	6,1 (61)	12,2 (122)	24,4 (244)	17,0 (170)	95	11	460
25	6,1 (61)	12,2 (122)	24,4 (244)	17,0 (170)	127	11	460
32	6,1 (61)	12,2 (122)	24,4 (244)	17,0 (170)	160	4	460
						7	510**
40	5,1 (51)	10,2 (102)	20,4 (204)	14,2 (142)	190	4	460
						7	635**
50	1,7 (17)	3,4 (34)	6,8 (68)	4,7 (47)	255	4	460
						7	790**
63	0,6 (6)	1,2 (12)	2,4 (24)	1,6 (16)	320	4	460
						7	965**
80	0,6 (6)	1,2 (12)	2,4 (24)	1,6 (16)	380	4	460
						7	1 145**
105	0,6 (6)	1,2 (12)	2,4 (24)	1,6 (16)	610	4	460
						7	1 525**

* For Type 2 testing, one additional sample as noted in 4.4.11 is required.

** Assembly length required for pressure surge test.

3.5 Length

Hose assembly lengths shall be specified in the following increments only:

500 mm long and under: not less than 5 mm;

500 to 1 000 mm long: not less than 10 mm;

1 000 to 1 500 mm long: not less than 20 mm;

over 1 500 mm long: not less than 30 mm.

Tolerances on hose assembly lengths shall be as follows:

±3 mm for lengths under 500 mm;

±7 mm for lengths from 500 to 900 mm;

±13 mm for lengths from 900 to 1 300 mm;

±1 % for lengths over 1 300 mm.

3.6 Interchangeability

All parts having the same manufacturer's part number shall be directly and completely interchangeable with respect to installation and performance.

3.7 Identification of product

Equipment, assemblies and parts shall be marked for identification in accordance with appropriate standards to the extent applicable. The following special marking shall be added:

3.7.1 Fittings

The manufacturer's name or trademark shall be permanently marked on each end fitting.

3.7.2 Assembly

The assembly shall be identified by a permanent marking on the end fitting or on a permanent band containing the following markings:

a) assembly manufacturer's name or trademark;

b) complete hose assembly part number;

c) nominal pressure in megapascals;

d) pressure test symbol "PT";

e) assembly specification "ISO 7313", and "type 1" or "type 2";

f) date of hose assembly manufacture expressed in terms of month and year.

3.8 Workmanship

3.8.1 General

The hose assembly including all parts shall be constructed and finished in a thoroughly workmanlike manner. All surfaces shall be free from burrs. All sealing surfaces shall be smooth, except that annular tool marks up to 2,5 µm maximum are acceptable.

3.8.2 Dimensions and tolerances

All pertinent dimensions and tolerances, where interchangeability, operation or performance of the hose assembly may be affected, shall be specified on all drawings.

3.8.3 Cleaning

All hose assemblies shall be free from oil, grease, dirt, or any other foreign material, both internally and externally. Unless otherwise specified, hose assemblies shall be cleaned by flushing with suitable degreasing solvent, blow drying with air, and sealing with clean end caps.

3.8.4 Openings and covers

Openings shall be suitably protected against ingress of foreign material; all threads shall be protected against damage. All protective covers shall be of a configuration that prohibits assembly with the mating part without removal of the cover.

4 Quality assurance provisions

4.1 Classification of tests

The inspection and testing of hose assemblies shall be classified as follows:

a) acceptance (see 4.2);

b) qualification testing (see 4.5).

4.2 Acceptance tests

Acceptance tests shall consist of:

a) individual test;

b) sampling test;

c) periodic control test.

4.2.1 Individual tests

Each hose assembly delivered under this International Standard shall be subjected to the following tests:

a) examination of product (see 4.4.1);

b) proof pressure test (see 4.4.2).

4.2.2 Sampling test

The following test shall be performed on hose assemblies picked at random from each lot. A lot is defined as 500 assemblies of a given dash size, manufactured by the same process free from any deviations likely to have a significant effect on product quality.

4.2.2.1 One hose assembly shall be consecutively subjected to the following tests:

a) elongation and contraction test (see 4.4.3);

b) leakage test (see 4.4.4).

4.2.3 Periodic control test

A fuel resistance test (see 4.4.8) shall be performed on at least two assemblies for each periodic control test selected from each 5 000 hose assemblies for each dash size, not necessarily manufactured during one continuous production run.

4.2.4 Rejection and retest

When one item selected from a production run fails to meet the specification, no items still on hand or later produced shall be accepted until the extent and cause of failure are determined and corrective action, as necessary, taken.

For operational reasons, the individual tests may be continued pending the investigation of a sampling or periodic control test failure. Final acceptance of items on hand or produced later shall not be made until it is determined that items meet the requirements on which the rejection was based.

4.3 Test conditions

4.3.1 Preparation of specimens

4.3.1.1 General

Length of the sample hose assemblies shall be in accordance with table 2 unless otherwise specified.

4.3.2 Test fluids

Unless otherwise specified, the test fluid shall be a petroleum base hydraulic fluid or water. When a high temperature test is performed, the test fluid shall be a synthetic base lubricating oil unless otherwise specified by the procuring authority.

4.3.3 Temperature measurements

Unless otherwise specified, temperature measurements shall be taken within 150 mm of the hose assemblies under test. All temperatures, unless otherwise specified, shall have a tolerance of $^{+8}_{-3}$ °C.

4.3.4 Test pressure

All test pressures, unless otherwise specified, shall have a tolerance within ±2 %.

4.4 Performance tests

See table 4 for test schedule.

4.4.1 Examination of product

All hose assemblies shall be examined to determine conformance to this specification with respect to material, size, workmanship and identification. Broken or missing reinforcing wires or any other evidence of malfunction shall be cause for rejection. Crossed over reinforcing wires shall not be cause for rejection.

4.4.2 Proof pressure test

All hose assemblies shall be pressure-tested to the values specified in table 2 for a period of not less than 30 s and not more than 5 min. All complete hose assemblies used for the tests described in this International Standard shall have this proof pressure test applied to them. Any evidence of leakage from hose or fittings or any other evidence of malfunction shall constitute failure.

4.4.3 Elongation and contraction test

The test assembly shall be held in a straight unpressurized condition and a 250 mm standard length marked off on the hose. It shall then be pressurized to operating pressure for 5 min minimum. At the end of this 5 min period, and while still pressurized, the standard length shall be measured and recorded. The standard length of hose shall not change in length more than $^{+3}_{-1}$ %.

4.4.4 Leakage test

Two hose assemblies of each size shall be subjected to this test. The assemblies shall be pressurized while at room temperature to 0,17 MPa for a minimum of 5 min. The pressure shall be increased to a value equal to 70 % of the minimum room temperature burst pressure specified in table 2 and again held for a minimum of 5 min. The pressure shall be completely released and again increased to 70 % of the minimum room temperature burst pressure and held for a minimum of 5 min. Any evidence of leakage shall constitute failure.

4.4.5 Room temperature burst pressure test

Room temperature shall be defined as 20 ± 15 °C. During this test the assemblies shall be fastened at one end to the source of pressure. They shall be straightened and the free end shall not be restrained or fastened in any way. The rate of pressure rise shall be 170 $^{0}_{-70}$ MPa/min until failure occurs. The hose shall not burst, the fittings shall not blow off or loosen, and there shall be no leakage from the hose or fittings or any other evidence of malfunction below the minimum room temperature burst pressure specified in table 2. The hose assemblies shall be under continuous observation during pressure increase and the type of failure shall be recorded.

4.4.6 High temperature burst pressure test

Two hose assemblies of each size shall be installed as described in 4.4.5, filled with a suitable test fluid and soaked for 1 h with ambient and fluid temperature at 200 ± 6 °C. After 1 h the pressure shall be raised to the operating pressure for 5 min. The pressure shall then be increased at the rate of 170 $^{0}_{-70}$ MPa/min until bursting or leakage occurs. Any leakage at pressure below the minimum high temperature burst pressure listed in table 2 shall be evidence of failure. The hose assemblies shall be under continuous observation during pressure increase and the type of failure shall be recorded.

4.4.7 Oil resistance test

4.4.7.1 Two test samples of each size shall be filled with a synthetic base lubricating oil or another oil approved for use by the procuring authority and placed in an oven which shall be maintained at 200 ± 6 °C. Care should be taken to ensure against the assembly coming in contact with parts of the oven which are at a higher temperature. The same test fluid shall be used throughout this test except as otherwise specified in 4.4.7.2. The assembly shall have a pressure applied equal to the nominal pressure as specified in table 2.

4.4.7.2 At the end of a minimum of 16 h, the assembly shall be removed from the oven, drained and refilled with commercial grade jet engine fuel. A pressure shall be applied equal to the nominal pressure and maintained for a minimum of 2 h at room temperature.

4.4.7.3 The procedure specified in 4.4.7.1 and 4.4.7.2 shall be repeated for a total of three times.

4.4.7.4 At the completion of the above procedure, the test samples shall be drained and then filled with oil and placed in a cold chamber for 4 h, maintained at −55 ± 3 °C. After the 4 h cold soak, the samples shall be subjected to a pressure equal to the nominal pressure specified in table 2. The pressure shall be held for a minimum of 5 min and then released. This shall be repeated for a total of 10 times with a minimum of 5 min between each pressure application.

4.4.7.5 The assemblies shall again be placed in the cold chamber with the temperature at −55 ± 3 °C for 24 h. At the end of this time, oil at a temperature of 200 ± 6 °C shall be circulated through the assemblies. Within 15 s after introduction of the hot oil, the pressure shall be increased to the proof pressure and held for a minimum of 2 min.

4.4.7.6 Any leakage of the test fluid from the assemblies during the preceding tests (4.4.7.1 to 4.4.7.5) shall be evidence of failure.

4.4.7.7 At the conclusion of the above tests, one of the test assemblies shall be used for the burst test of 4.4.5. The other assembly shall be subjected to the flexibility and vacuum test of 4.4.9.

4.4.8 Fuel resistance test

Two hose assemblies shall be subjected to the test with a commercial grade jet engine fuel at the nominal pressure as specified in table 2 and at a temperature of 125 ± 6 °C. The following sequence shall be performed.

4.4.8.1 The test assemblies shall be installed in a controlled temperature box with the fluid and ambient air at room temperature and the assemblies subjected to nominal pressure as specified in table 2. The temperature of the ambient air shall then be reduced to −55 ± 3 °C and held for a minimum of 1 h.

4.4.8.2 The temperature of the fluid and the ambient air shall then be increased to 125 ± 6 °C. The hose assembly shall remain at the ambient and fluid temperature of 125 ± 6 °C and at the nominal pressure for a minimum of 48 h.

4.4.8.3 The assemblies shall them be subjected for 5 min at room temperature to the proof pressure as specified in table 2. The assemblies shall show no evidence of leakage.

4.4.8.4 One of the assemblies shall then be subjected to the burst test as specified in 4.4.5 and the other assembly shall be subjected to the flexibility and vacuum test in 4.4.9.

4.4.9 Flexibility and vacuum test

4.4.9.1 One test assembly from the fuel resistance test (see 4.4.8), one from the oil resistance test (see 4.4.7) and one unaged sample shall be used for this test. The samples shall be filled with an iso-octane test fluid and placed in a cold chamber for 24 h maintained at a temperature of -55 ± 3 °C.

4.4.9.2 At the end of this time and while still at this temperature, the samples shall be bent to the extreme around a mandrel with a radius equal to the minimum bend radius specified in table 2. The bend shall then be reversed and returned to the straight position. This cycle shall be repeated a total of 5 times allowing about 4 s per cycle.

4.4.9.3 The assembly shall then be drained and a ball of the size specified in table 3 shall be inserted in the assembly. The assembly shall then be bent through 180° to the minimum bend radius specified in table 2 and placed in an oven. The appropriate pressure level as specified in table 3 shall be applied and the oven heated to 200 ± 6 °C for 4 h. At the end of this period, the assembly shall be removed from the oven while continually maintaining the required pressure level. When the samples have cooled to room temperature, the pressure shall be released and the ball rolled through the hose assembly from fitting to fitting. Failure to pass the ball shall be evidence of failure.

4.4.9.4 Upon completion of the test, the assembly shall be subjected for 5 min to the proof pressure specified in table 2. The test fluid shall be a synthetic base lubricating oil or water. The assembly shall show no evidence of leakage.

4.4.9.5 The assembly shall be dissected and inspected. Permanent damage to the assembly as a result of bending or vacuum shall be evidence of failure.

Table 3 — Values for vacuum test

DN Hose size	Pressure below standard atmosphere kPa (bar)	Minimum ball size mm
06	94 (0,94)	2,8
10	94 (0,94)	5,8
12	94 (0,94)	8,5
16	94 (0,94)	10,3
20	94 (0,94)	15,9
25	94 (0,94)	20,6
32	67 (0,67)	27,0
40	40 (0,40)	33,0
50	17 (0,17)	46,0
63	17 (0,17)	57,4
80	17 (0,17)	70,1
105	10 (0,10)	93,5

4.4.10 Pressure surge test

Four hose assemblies including two from the salt spray test (see 4.4.12) with standard end fittings and lengths as specified in table 2 shall be subjected to the pressure surge tests. Assemblies shall be mounted in a 90° bend to the minimum bend radius (see table 2) condition in an oven with the ambient air and internal fluid temperatures maintained at 200 ± 6 °C. The test fluid shall be a synthetic base lubricating oil. All four hose assemblies shall be pressure-cycled from zero to nominal pressure at a rate of not less than 20 cycles per minute or more than 30 cycles per minute, as shown in figure 1.

Any leakage from the hose or hose attachment to the end fittings at less than 50 000 cycles shall be cause for rejection.

4.4.11 Conductivity test

The test specimen shall be a 325 mm length of hose with a fitting attached to one end as shown in figure 2. The inner surface of the tube shall be washed first with a suitable degreasing solvent and then with isopropyl alcohol complying with ISO 756 to remove surface contamination and thoroughly dried at room temperature. The reinforcement shall be flared out to prevent contact with the end of the tube. One steel fitting of appropriate size shall be assembled on the hose end fitting.

The test specimen shall then be arranged vertically. The relative humidity shall be kept below 70 % and room temperature between 15 and 32 °C. One thousand volts, DC, shall be applied between the upper electrode and the lower electrode.

The current shall be measured with an instrument with a sensitivity of at least 1 µA (1×10^{-6} A). The current measured shall be equal to or greater than 6 µA for sizes DN06 to DN12 and equal to or greater than 12 µA for sizes DN16 to DN105.

4.4.12 Salt corrosion test

Two hose assemblies shall be pressurized to the nominal operating pressure in accordance with table 2, and, at room temperature, the hose assemblies shall be immersed in a 3,5 ± 0,1 % sodium chloride (NaCl) solution for 8 to 10 min, then allowed to air dry for the remainder of 1 h. This subsequent immersion and air-drying process shall be repeated no less than 50 times.

NOTE — The NaCl solution should contain a dry basis of not more than 0,1 % of sodium iodide and 0,5 % of total impurities.

4.5 Qualification testing

The qualification of hose assemblies shall consist of all the tests described in this specification. Unless otherwise specified by the purchaser, qualification samples and test sequence shall consist of:

a) eleven hose assemblies of each size of the length specified in table 2 plus a conductivity specimen in accordance with 4.4.11 when required;

b) the test schedule used shall be as specified in table 4.

5 Ordering data

Procurement documents shall specify the following:

a) size, length and type of hose assemblies to be furnished;

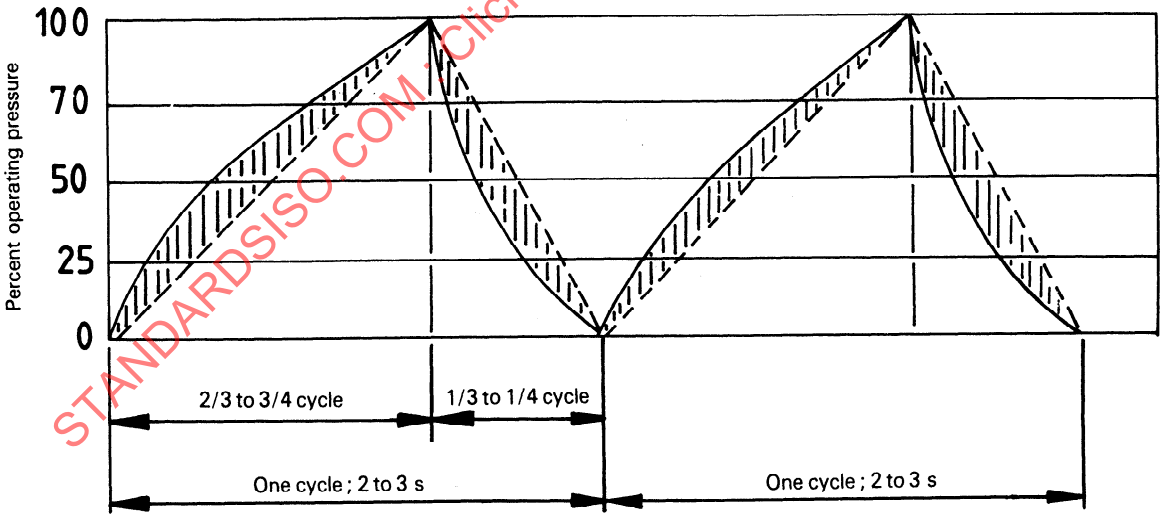
b) type, size, material, or special features of end fittings desired;

c) levels of packaging and packing desired.

Table 4 — Qualification test schedule

Tests	Sample No.											
	1	2	3	4	5	6	7	8	9	10	11	12*
4.4.1 Examination of product	X	X	X	X	X	X	X	X	X	X	X	X
4.4.2 Proof pressure	X	X	X	X	X	X	X	X	X	X	X	
4.4.3 Elongation and contraction	X											
4.4.4 Leakage	X	X										
4.4.7 Oil resistance			X		X							
4.4.8 Fuel resistance				X		X						
4.4.5 Room temperature burst pressure			X	X								
4.4.6 High temperature burst pressure	X	X										
4.4.9 Flexibility and vacuum					X	X	X					
4.4.12 Salt corrosion										X	X	
4.4.10 Pressure surge								X	X	X	X	
4.4.11 Conductivity												X

* For type 2 assemblies only.



The curve shown above is the approximate pressure/time cycle for proper severity for surge testing hose assemblies. It is mandatory that the pressure peak rises to 100 % of nominal pressure. It is considered desirable that the pressure time curve be confined to the shaded area so that results of tests performed on different test machines will be more nearly comparable.

Figure 1 — Pressure surge curve