MATERIAL AND EQUIPMENT STANDARD

FOR

WATER BLASTING EQUIPMENT

ORIGINAL EDITION

MAY 1997

This standard specification is reviewed and updated by the relevant technical committee on Aug. 2003(1) and Jun. 2014(2). The approved modifications are included in the present issue of IPS.

FOREWORD

The Iranian Petroleum Standards (IPS) reflect the views of the Iranian Ministry of Petroleum and are intended for use in the oil and gas production facilities, oil refineries, chemical and petrochemical plants, gas handling and processing installations and other such facilities.

IPS is based on internationally acceptable standards and includes selections from the items stipulated in the referenced standards. They are also supplemented by additional requirements and/or modifications based on the experience acquired by the Iranian Petroleum Industry and the local market availability. The options which are not specified in the text of the standards are itemized in data sheet/s, so that, the user can select his appropriate preferences therein

The IPS standards are therefore expected to be sufficiently flexible so that the users can adapt these standards to their requirements. However, they may not cover every requirement of each project. For such cases, an addendum to IPS Standard shall be prepared by the user which elaborates the particular requirements of the user. This addendum together with the relevant IPS shall form the job specification for the specific project or work.

The IPS is reviewed and up-dated approximately every five years. Each standards are subject to amendment or withdrawal, if required, thus the latest edition of IPS shall be applicable

The users of IPS are therefore requested to send their views and comments, including any addendum prepared for particular cases to the following address. These comments and recommendations will be reviewed by the relevant technical committee and in case of approval will be incorporated in the next revision of the standard.

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GENERAL DEFINITIONS:

Throughout this Standard the following definitions shall apply.

COMPANY:

Refers to one of the related and/or affiliated companies of the Iranian Ministry of Petroleum such as National Iranian Oil Company, National Iranian Gas Company, National Petrochemical Company and National Iranian Oil Refinery And Distribution Company.

PURCHASER:

Means the “Company” where this standard is a part of direct purchaser order by the “Company”, and the “Contractor” where this Standard is a part of contract documents.

VENDOR AND SUPPLIER:

Refers to firm or person who will supply and/or fabricate the equipment or material.

CONTRACTOR:

Refers to the persons, firm or company whose tender has been accepted by the company.

EXECUTOR:

Executor is the party which carries out all or part of construction and/or commissioning for the project.

INSPECTOR:

The Inspector referred to in this Standard is a person/persons or a body appointed in writing by the company for the inspection of fabrication and installation work.

SHALL:

Is used where a provision is mandatory.

SHOULD:

Is used where a provision is advisory only.

WILL:

Is normally used in connection with the action by the “Company” rather than by a contractor, supplier or vendor.

MAY:

Is used where a provision is completely discretionary.

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1. SCOPE

1.1 This specification contains the minimum general requirements for high pressure water blasting equipment used to clean effectively the inner and outer walls of fouled pipes, and tubes of, heat exchangers, coolers, condensers, water drain pipes, hydraulic pressure steel pipes, turbine blades, pump impellers and other equipment to be used in refinery services, chemical plants, gas plants, petrochemical plants and new ventures, where applicable.

No derivation from this specification is permitted without explicit approval of the Company.

The intended deviations shall be clearly indicated and separately listed in the Vendor's proposal.

Compliance with the requirements of this Standard does not relieve the Vendor of the responsibility for furnishing a unit of proper design, strength, workmanship and materials to suit the specified operating conditions.

1.2 In case of conflict between this Standard and inquiry or order following priority of documents shall apply:

First priority	**:**	Purchase order and variations thereto.
Second priority	**:**	Data-requisition sheets.
Third priority	**:**	This specification Standard.

Note 1:

This standard specification is reviewed and updated by the relevant technical committee on Aug. 2003. The approved modifications by T.C. were sent to IPS users as amendment No. 1 by circular No. 196 on Aug. 2003. These modifications are included in the present issue of IPS.

Note 2:

This standard specification is reviewed and updated by the relevant technical committee on Jun. 2014. The approved modifications by T.C. were sent to IPS users as amendment No. 2 by circular No. 424 on Jun. 2014. These modifications are included in the present issue of IPS.

1.3 Units

This standard is based on international system of units (SI), as per IPS-E-GN-100 except where otherwise specified.

2. REFERENCES

Throughout this Standard the following dated and undated standards/codes are referred to. These referenced documents shall, to the extent specified herein, form a part of this standard. For dated references, the edition cited applies. The applicability of changes in dated references that occur after the cited date shall be mutually agreed upon by the company and the vendor. For undated references, the latest edition of the referenced documents (including any supplements and amendments) applies.

API (AMERICAN PETROLEUM INSTITUTE)

API 674	"Positive Displacement Pumps-Reciprocating"

IPS (IRANIAN PETROLEUM STANDARDS)

IPS-E-GN-100	“Engineering Standard for Units”
IPS-E-PM-400	"Engineering Standard for Vendor Data Requirements"
IPS-M-EL-132	"Material and Equipment Standard for Medium and High Voltage Induction Motors"
IPS-M-PM-290	"Material and Equipment Standard for Reciprocating Internal Combustion Engines"

ASTM (AMERICAN SOCIETY FOR TESTING AND MATERIAL)

D 380	"Standard Test Methods for Rubber Hose"
D 1149	"Standard Test Methods for Rubber Deterioration -Cracking in an Ozone Controlled Environment"
D 622	"Standard Test Methods for Rubber Hose For Automotive Air and Vacuum Brake System"

SAE (SOCIETY OF AUTOMOTIVE ENGINEERS)

J 516	"Hydraulic Hose Fittings"
J 517	"Hydraulic Hose"

3. HIGH PRESSURE PUMP

3.1 General

High pressure pump shall be in accordance with API Std. 674 latest edition and shall also meet the requirements of Clauses 3.1.1 through 3.1.13.

3.1.1 Piston pumps shall not be used. Plunger pumps incorporated several cylinders into one pump with a smooth flow shall be used.

3.1.2 Pressure side of the plunger pump shall be protected by means of pressure control and safety devices.

3.1.3 The clutch between the pump and driver must be provided with a removable cover or guard.

3.1.4 The pump shall be equipped with a pressure adjustment device for continuous adjustment of the operating pressure, with a full lift safety valve to keep the pressure from exceeding the max. permissible operating pressure, and with a return line which drains off all excess water.

3.1.5 High pressure pump and driver (electric motor or internal combustion engine) shall be mounted on a common frame equipped with water reservoir, hose reel, and other accessories. Frame may be stationay or mobile upon request.

3.1.6 The connection between the suction line and the pump shall be of a flexible type. The flowrate in the suction line shall be specified.

3.1.7 When a centrifugal pump is additionally installed, the pump capacity shall be 1½ to 2 times as high as the suction volume of the high pressure pump.

A brake tank should be installed on the suction side.

3.1.8 When required, pulsation dampeners shall be installed.

3.1.9 Maximum pump operating pressure must not exceed pressure rating for spray guns, hoses, valves or other devices in the high pressure line.

3.1.10 A shut-off device in the high pressure line shall be required.

3.1.11 If a centrifugal pump is being used on the suction side a suction stabilizer shall be provided.

3.1.12 A switch-over filter element with a mesh size of not less than 50 mm shall be included.

The filter area shall be at least three times the size of the suction line diameter.

3.1.13 The suction stabilizer must be installed directly in front of the pump.

3.2 Pump Head

The pump head housing shall be of high quality, durable material.

4. DRIVER

4.1 The type of driver shall be specified by the Purchaser. The driver shall be sized to meet the maximum operating conditions, including external gear and/or coupling losses, and shall be in accordance with applicable specifications as stated in the inquiry and order.

4.2 All electrical motor drives including auxiliary equipment shall comply with Standard IPS-M-EL-132.

4.3 Internal combusion engine shall comply with Standard IPS-M-PM-290.

4.4 The fuel tank of diesel engine shall have capacity of 8 hrs. continuous operation and the fuel level shall read at the device control.

5. COUPLING AND GUARD

5.1 The flexible shaft coupling shall be of steel, and shall connect the shaft of the coupling at the driver (motor and/or engine) with the drive shaft of the pump.

5.2 Coupling shall be covered by a non-sparking guard in such a way that a contact with the parts rotating during operation be excluded.

6. BASE FRAME

Base frame shall be of the drain-rim or drain pan type and shall have a raised lip. Connections for a drain shall be tapped (DN 25 minimum) in the raised lip at the pump end and shall be located for complete drainage. The pan or upper surface of the base frame shall have adequate slope toward the drain end.

7. HYDRAULIC HOSE

7.1 General

7.1.1 Hoses shall withstand to surge pressure. Surge pressures higher than the maximum operating pressure will shorten hose life and should be taken into account by the hydraulic designer.

7.1.2 The hydraulic designer must consider the system demands on the hose assembly and correlate those demands with the test parameters defined, with particular concern for frequency and amplitude of pressure fluctuations.

7.2 Size Designation

Hose sizes are normally designated by the nominal hose inside diameter.

7.3 Hose Identification

The entire length of hoses shall be legibly marked, parallel to the longitudinal axis, with a stripe or stripes showing type designation and the fractional nominal hose inside diameter size repeated at intervals of not less than 460 mm.

Additionally, a colored yarn shall be incorporated into the wall of the hose identifying the manufacturer. The color shall be as designated by the rubber manufacturer's association.

7.4 One Steel Wire Braid Reinforced, Rubber Covered Hydraulic Hose*

One steel wire braid reinforced, rubber covered hydraulic hose shall conform to SAE 100 R1.

7.5 Two Steel Wire Braid Reinforced, Rubber Covered Hydraulic Hose*

Two steel wire braid reinforced, rubber covered hydraulic hose shall conform to SAE 100 R2.

7.6 Double Fiber Braid (Non-Metallic), Rubber Covered Hydraulic Hose*

Double fiber braid rubber covered hydraulic hose shall conform to SAE 100 R3.

7.7 Wire Inserted Hydraulic Suction Hose*

Wire inserted hydraulic suction hose shall conform to SAE 100 R4.

7.8 Single Wire Braid, Textile Covered Hydraulic Hose*

Single wire braid textile covered hydraulic hose shall conform to SAE 100 R5.

7.9 Fiber Reinforced (Nonmetallic), Rubber Covered Hydraulic Hose*

Fiber reinforced (nonmetallic), rubber covered hydraulic hose shall conform to SAE 100 R6.

7.10 Thermoplastic Hydraulic Hose*

Thermoplastic hydraulic hose shall conform to SAE 100 R7.

7.11 High Pressure Thermoplastic Hydraulic Hose*

High pressure thermoplastic hydraulic hose shall conform to SAE 100 R8.

7.12 High Pressure, 4-Spiral Steel Wire Reinforced, Rubber Covered Hydraulic Hose**

High pressure, 4-spiral steel wire reinforced, rubber covered hydraulic hose shall conform to SAE 100 R9.

7.13 Heavy Duty, 4-Spiral Steel Wire Reinforced, Rubber Covered Hydraulic Hose**

Heavy duty, 4-spiral steel wire reinforced, rubber covered hydraulic hose shall conform to SAE 100 R10.

7.14 Heavy Duty, 6-Spiral Steel Wire Reinforced, Rubber Covered Hydraulic Hose**

Heavy duty, 6-spiral steel wire reinforced, rubber covered hydraulic hose shall conform to SAE 100 R11.

**** :** The SAE J517 100R9, 100R10 100R11 Hose are discontinued due to lack of demand. For DOD orders see Appendix C of SAE J517

7.15 Four Spiral Steel Wire Reinforced, Rubber Covered Hydraulic Hose*

Four spiral steel wire reinforced, rubber covered hydraulic hose shall conform to SAE 100 R12.

7.16 Multiple Spiral Steel Wire Reinforced, Rubber Covered Hydraulic Hose*

Multiple spiral steel wire reinforced, rubber covered hydraulic hose shall conform to SAE 100 R13.

7.17 PTFE Lined Hydraulic Hose*

PTFE lined hydraulic hose shall conform to SAE 100R 14.

7.18. Multiple Spiral Steel Wire Reinforced, Rubber Covered Hydraulic Hose*

Multiple spiral steel wire reinforced, rubber covered hydraulic hose shall conform to SAE 100 R15.

7.19 Compact, One and Two Steel Wire Braid Reinforced, Rubber Covered Hydraulic Hose*

Compact, one and two steel wire braid reinforced, rubber covered hydraulic hose shall conform to SAE 100 R16.

7.20 Compact, 21 Mpa Maximum Working Pressure, One and Two Steel Wire Reinforced, Rubber Covered Hydraulic Hose*

Compact, 21 Mpa maximum working pressure, one and two steel wire reinforced, rubber covered hydraulic hose to shall conform to SAE 100 R17.

7.21 21 MPa Thermoplastic Hydraulic Hose*

21 MPa thermoplastic hydraulic hose shall conform to SAE 100 R18.

7.22 Compact, 28 MPa Maximum Working Pressure, One and Two Steel Wire Reinforced, Rubber Covered Hydraulic Hose*

Compact, 28 MPa maximum working pressure, one and two steel wire reinforced, rubber. Covered hydraulic hose shall conform to SAE 100 R19.

*** :** See SAE J517

7.23 Suction Hose

Hoses used for suction applications must be selected to insure the hose will withstand the negative pressure of the system.

7.24 Measuring Hose Tubes

The nominal length (L) of hose tubes with swivel fittings shall be measured from sealing head to sealing head, hoses equipped with other fittings shall be measured on overall length as shown in the following:

a) Hose tubes equipped with male fitting on one end and with swivel fitting on the other.

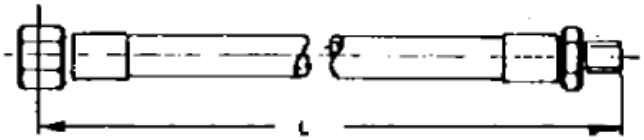


Fig. a

b) Hose tubes equipped with 90°swivel fittings on both ends. Elbow angle α=180°, (see Fig. e for configuration only)

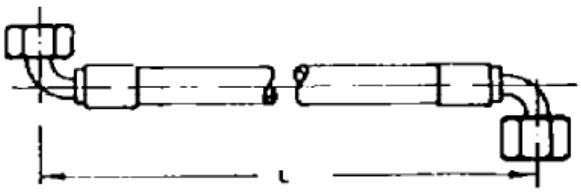


Fig. b

c) Hose tubes equipped with 0°swivel fittings on both ends

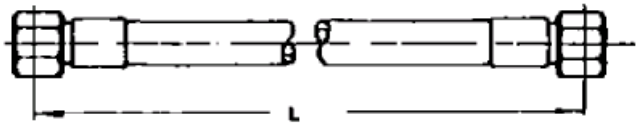


Fig. c

d) Hose tubes equipped with 45°swivel fittings. Elbow angle α=0°, (see Fig. e for configuration only)

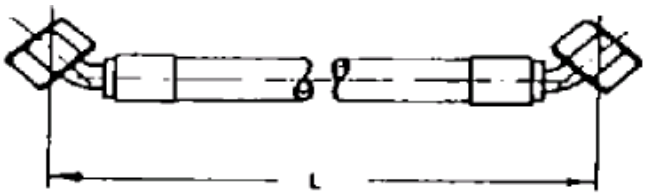


Fig. d

e) Elbow angle

For hose tubes with two elbows (45° or 90°) as shown in Figs. d and b the elbow angle as illustrated

in Fig. e has to be stated.

In case that both elbows are fitted in the same direction, as shown in Fig. d, state 0°. The example in Fig. e shows an elbow angle of 220°.

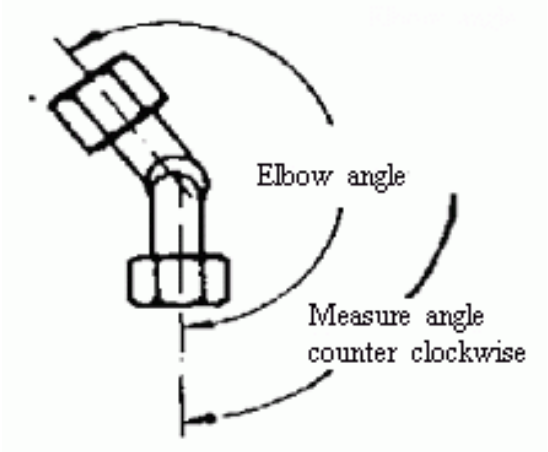


Fig. e

8. SAFETY VALVE

8.1 The maximum operating pressure and the set pressure of the safety valve shall be marked on the outside of the valve.

Full disassembling and readjusting information of the safety valve shall be included in the instruction manual.

8.2 The full-lift safety valves shall be selected in consideration of the respective mode of operation, the medium pumped and the maximum operating temperature, especially according to :

a) The maximum nominal flow volume;

b) the minimum permissible excess operating pressure;

c) the maximum permissible excess operating pressure.

8.3 In order to prevent the escaping medium from causing direct or indirect danger to persons or the surrounding area, relief tube must be connected to the spring housing.

The relief tube attached must be flexible so that the dynamic stress during operation and the reaction forces caused by the blowing-off process will not impair the function and the adjustment.

8.4 The safety valve shall be accessible for the purpose of checking its function and for maintenance, and it shall be protected against any damaging impact from outside.

8.5 The tube must be such as to allow the nominal flow volume to flow off readily.

8.6 Full instruction procedure adjustment of the relief valve shall be submitted by the Vendor.

9. CONTROL

9.1 As a minimum the automatic control units shall monitor the following functions:

- The driving motor or engine;
- the temperature of the pressurized water;

- the oil pressure;
- the water supply pressure.

In the event of any interruption of the normal working conditions, the control unit shall be shut-down the driving indicating at the same time the cause of interruption by means of control lamps.

9.2 If the water supply pressure (feed water line) becomes too low, and/or if the water filter becomes clogged, the drive motor shall be shut-down.

A control lamp shall show the reason.

9.3 Oil pressure shall be controlled in the oil circulation system and shut-down the unit if the required pressure is not reached. At the same time, a control lamp shall be light up, indicating, “OIL PRESSURE”.

9.4 The water temperature shall be controlled by a reliable means installed at the pump head, monitoring the water temperature. In case of the water temperature in the pump head has reached the maximum permissible valve, the driver shall be shut-down.

A light up control lamp shall indicate "WATER TEMPERATURE".

9.5 The operating pressure shall be controlled by a reliable means, monitoring the discharge pressure.

The driver shall be shut-down if the pressure rises above the preset value by as little as 2%. A control lamp shall indicate the cause of interruption "OPERATING PRESSURE EXCEEDED".

9.6 Control of Clutch Drive

Clutch shall be installed between engine and pump, and be fully engaged. A switch contact device shall shut-down the engine in the event of partial engagement of the clutch either by operator negligence, or as a result of vibration.

10. TEST AND PROCEDURES FOR HYDRAULIC HOSE AND HOSE ASSEMBLIES

10.1 General

Unless otherwise agreed upon between the manufacturer and purchaser, tests for evaluating conformance of product with specifications shall be on the basis of qualification tests and inspection tests set forth in this Standard.

Tests may be conducted by the manufacturer, the Purchaser, or both, as decreed by the Purchaser.

10.2 Test Procedures

The test procedures described in the current issue of ASTM D 380, Standard methods of testing rubber hose, shall be followed. However, in cases of conflict between the ASTM specifications and those described in Clause 10.3 below the latter shall take precedence.

10.3 Standard Tests

10.3.1 Dimensional check test

The hose shall conform to all dimensions tabulated in the applicable specification as mentioned in SAE J 517.

Reinforcement diameter and finished outside diameter measurements shall be made by calculation from measurement of the outside circumference. Use of a flexible tape graduated to read the diameter directly shall be acceptable. Inside diameter measurements shall be made by means of suitable expanding ball or telescopic gages.

Concentricity shall be measured both over the reinforcement and the finished outside diameter using either a dial indicator gage or a micrometer. The foot of the measuring instrument contacting the inside of the hose shall be rounded to conform to the curvature of the hose. The readings shall be taken at 90 deg. intervals around the hose and acceptability based on the total variation between high and low readings.

Inside and outside diameter measurements shall be made at a minimum distance of 25.4 mm and concentricity measurements at a minimum distance of 12.7 mm, back from the ends of the hose.

10.3.2 Proof test

Hose and/or hose assemblies shall be hydrostatically tested to the specified proof pressure as mentioned in SAE J 517 for a period of not less than 30 s nor more than 60 s. There shall be no indication of failure or leakage.

10.3.3 Change in length test

Conduct measurements for the determination of elongation or contraction on a previously untested, unaged hose assembly having at least 600 mm length of free hose between hose fittings.

Attach the hose assembly to the pressure source in an unrestricted straight position. If the hose is not straight due to its natural curvature, it may be fastened laterally to achieve a straight position. Pressurize to the specified operating pressure for a period of 30 s, then release the pressure.

Place accurate reference marks 500 mm apart on the outer cover of the hose, midway between fittings, after allowing the hose assembly to restabilize for a period of 30 s following pressure release.

Repressurize the hose assembly to the specified operating pressure for a period of 30 s.

Measure the final length while the hose is pressurized. The final length is the distance between reference marks while the hose is pressurized.

Complete the determination of the change in length using:

$$\Delta l = \frac{l_1 - l_0}{l_0} \times 100$$

Where:

l_0 is the distance between the reference marks when the hose was not pressurized following the initial pressurization

l_1 is the distance between the reference marks under pressure

Δl is the percentage change in length, which will be positive (+) in the case of an increase in length and negative (-) in the case of a decrease in length

10.3.4 Burst test

Hose and/or hose assemblies on which the end fittings have been attached not over 30 days shall be subjected to a hydrostatic pressure increased at a constant rate so as to attain the specified minimum burst pressure as mentioned in SAE J 517 within a period of not less than 15 s nor more than 30 s. There shall be no leakage, hose burst, or indication of failure below the specified minimum burst pressure.

10.3.5 Cold bend test

Subject hose assemblies to the specified temperature in a straight position for 24 h.

Then, while still at the specified temperature, the samples shall be evenly and uniformly bent once

over a mandrel having a diameter equal to twice the specified minimum bend radius. Bending shall be accomplished within a period of not less than 8 s nor more than 12 s.

In the case of hose sizes up to and including 22 mm nominal inside diameter, bend them through 180 degrees over the mandrel; in the case of hose sizes larger than 22 mm nominal inside diameter, bend them through 90 degrees over the mandrel.

After bending, allow the sample to warm to room temperature, visually examine it for cover cracks and subject it to the proof test. There shall be no cover cracks or leakage. (In lieu of the bending test, hoses larger than 22 mm nominal inside diameter may be considered acceptable if samples of tube and cover pass the Low Temperature Test on Tube and Cover of ASTM D 380.)

Reject any samples with visible cracks or leakage.

Note:

This is a destructive test. Assemblies which have been subjected to this test shall be destroyed.

10.3.6 Oil resistance test

After 70 h immersion in ASTM No. 3 oil at the designated temperature, the volume change of specimens taken from the hose inner tube and cover shall be within the specified limits.

10.3.7 Ozone resistance test

Hydraulic hose shall be tested for resistance of the cover compound to ozone in accordance with the latest issue of ASTM D 380, except that the mandrel shall be a diameter twice the minimum bend radius specified in the individual hose standard, and the cover shall be examined at the completion of the test under 2x magnification.

10.3.8 Impulse test

The impulse test has two categories:

1. High pressure, which covers pressures higher than 3 MPa

2. Low pressure, which covers 1.5 to 3 MPa

Test four unaged hose assemblies with end fittings, which have been attached for not more than 30 days. Where the individual standard requires, also test aged hose assemblies.

Calculate the free (exposed) length of hose under test, shown on Fig. 10.1, as follows:

a. Hose sizes up to and including 22 mm nominal inside diameter:

$$180 \text{ degrees bend free length} = \pi / 2(r + d / 2) + 2d$$

b. Hose sizes larger than 22 mm nominal inside diameter:

$$90 \text{ degrees bend free length} = \pi / 2(r + d / 2) + 2d$$

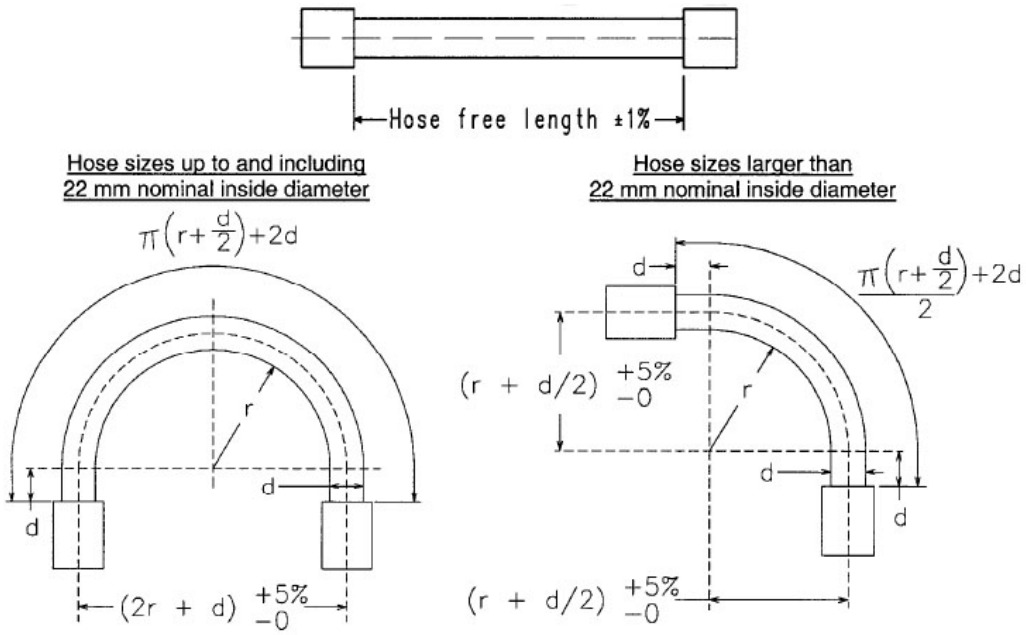
Where:

r = minimum bend radius

d = hose outside diameter

Note:

Use d = 25.4 mm until d is equal to or greater than 25.4 mm



TEST SPECIMEN FOR PRESSURE IMPULSE TEST

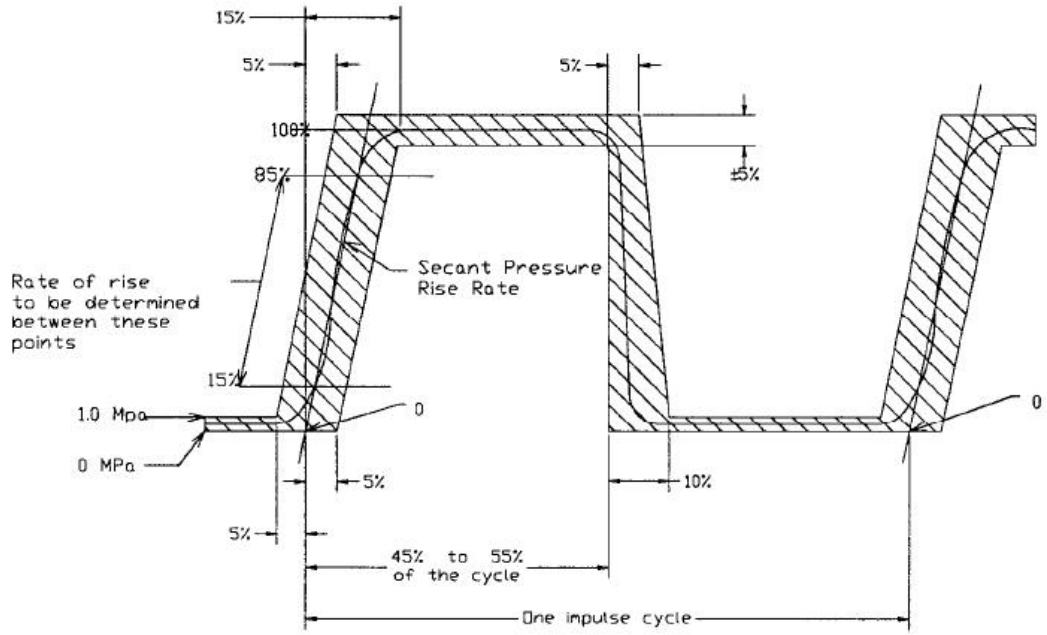
Fig. 10.1

Connect the test pieces to the apparatus. The test pieces shall be installed according to Fig. 10.1. Test pieces of hose of nominal inside diameter up to and including 22 mm shall be bent through 180 degrees and hoses of nominal inside diameter larger than 22 mm shall be bent through 90 degrees.

Select a test fluid from ISO VG 32 to VG 100 at 40 °C per ISO 3448, and circulate it at a rate sufficient to maintain a uniform fluid temperature within the hose assemblies. Other fluids may be used as agreed upon between the customer and the manufacturer.

Test the hose at the impulse test pressure indicated in the individual specification. The test fluid shall be circulated through the assemblies at the specified temperature with a tolerance of ±3 °C. Cooling or heating of the test chamber shall not be permitted, except when individual standards require testing with synthetic base test fluids at a temperature higher than 150 °C. When such higher temperatures are required, the impulse test fluid need not be circulated if both the fluid and the assemblies are externally heated in the test chamber, at the specified temperature with a tolerance of ±5 °C.

Apply a pulsating pressure internally to the hose assemblies at a rate described in the category chosen and record the frequency used. The pressure cycle shall fall within the shaded area of either Fig. 10.2 or Fig. 10.3, depending upon the test category and conform as closely as possible to the curve shown.



Note 1:

Secant pressure rise is the straight line drawn through two points on the pressure rise curve; one point at 15% of the test pressure and the other at 85% of the test pressure

Note 2:

Point '0' is the intersection of the secant pressure rise with 0 pressure.

Note 3:

Pressure rise rate is the slope of the secant pressure rise expressed in MPa/s.

Note 4:

Cycle rate shall be uniform at 0.5 to 1.3 Hz.

PRESSURE IMPULSE WAVE FORM ENVELOPE FOR

HIGH PRESSURE IMPULSE TEST CATEGORY 1

Fig. 10.2

The nominal rate of pressure rise shall be equal to that shown below:

$$R = f (10p – k)$$

Where:

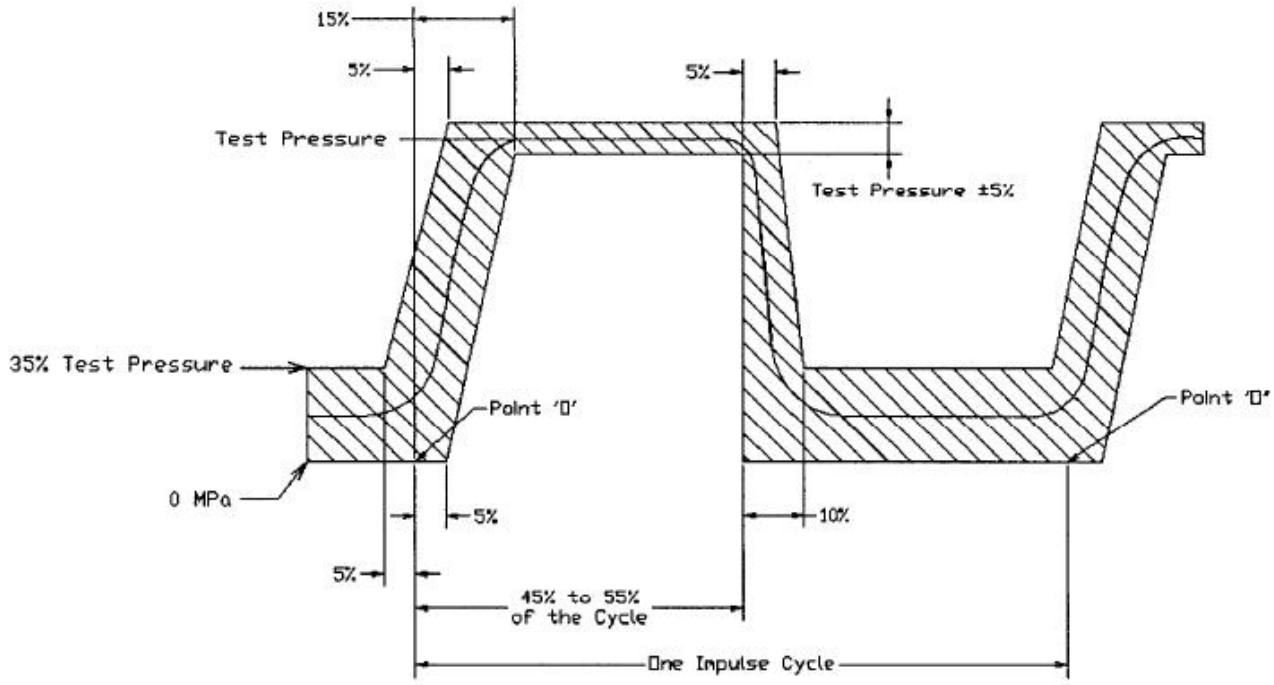
R = rate of pressure rise in MPa/s

f = frequency in Hz

p = nominal impulse test pressure in MPa

k = 5 MPa

The actual rate of pressure rise shall be determined as shown on Fig. 10.2, and shall be within a tolerance of ±10% of the calculated nominal value.



Note 1:

Cycle rate shall be uniform at 0.2 to 1.0 Hz.

Note 2:

The pressure rise rate shall be contained within the wave form envelope.

PRESSURE IMPULSE WAVE FORM ENVELOPE FOR

LOW PRESSURE IMPULSE TEST CATEGORY 2

Fig. 10.3

Determine the duration of the impulse test in total number of cycles by the individual standard for the hose assemblies. Where aged samples are required, refer to the individual standards.

It is recommended the test fluid be changed frequently to prevent breakdown.

Note: This is a destructive test. Assemblies, which have been subjected to this test, shall be destroyed.

10.3.9 Leakage test

Unaged hose assemblies on which the end fittings have been attached not over 30 days shall be subjected to a hydrostatic pressure equal to 70% of the specified minimum burst pressure for a period of 5-5.5 min. and then reduced to zero after which the 70% of minimum burst pressure shall be reapplied for another 5 min. There shall be no leakage or evidence of failure. This test is to be considered a destructive test and sample shall be destroyed.

10.3.10 Visual examination of product

All bulk hose shall be visually inspected to see that the hose identification has been properly applied and all assemblies shall be inspected to see that the correct fittings are properly installed.

10.3.11 Electrical conductivity test

10.3.11.1 Electrical conductivity test (for thermoplastic hose only)

Hose assemblies having a free length of 152 ± 13 mm without fluid and capped to prevent entry of moisture shall be exposed to a minimum of 85% relative humidity at 24 ±3°C for a period of 168 hrs. Surface moisture shall be removed prior to testing.

Conditioned assemblies shall have one end fitting attached to the lead from a source of 50 Hz sinusoidal, 37.5 kV (rms) electricity. This lead shall be suspended by dry fabric strings so that the hose hangs free, at least 600 mm from any extraneous objects. The lower end of the hose shall be connected to ground through a 1000-1000000 Ω resistor, keeping the resistor near the end of the hose. A suitable AC voltmeter shall be connected across the resistor, using a fully shielded cable with the shielding well grounded. Thirty seven and one-half kV shall be applied to the specimen for 5 min. and a current reading taken. This current shall not exceed the value specified.

10.3.11.2 Electrical conductivity test (PTFE hose only)

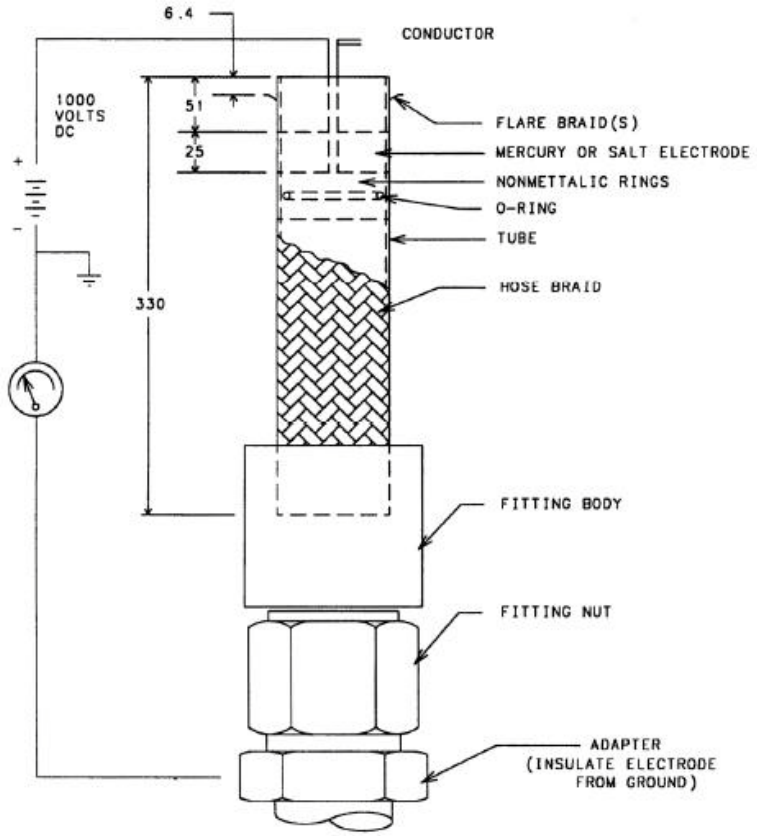
Test specimen shall be a 330 mm ± 10 mm cut length of hose with fitting attached to one end and the reinforcing braid flared away from the PTFE tube on the opposite end to prevent contact with the free end of the tube. The inner surface of the tube shall be cleaned, first with naphtha dry cleaning fluid or Stoddard solvent, and then with isopropyl alcohol to remove surface contamination, followed by thorough drying at room temperature.

Relative humidity shall be kept below 70% and room temperature between 16 °C and 32 °C.

The specimen shall be mounted in a vertical position as shown in Fig. 10.4. The adapter at the base is simply a convenient means of assuring proper electrical contact if a swivel female fitting is chosen, and may be omitted if a male fitting is used. In either case, the electrode must be insulated from ground.

A mercury or salt water solution electrode shall be provided at the upper end as shown, by inserting a nonmetallic plug with an O-ring seal to a distance of 75 mm from the end of the tubing, thus providing an average test length of 255 mm. Mercury or salt water solution shall then be added to a level 25 mm above the plug. Any suitable conductor to this electrode may be used, including a threaded end attached to the plug if so desired. Concentration of salt water, if used, shall be 450 g NaCl per liter of H_2O.

1000 V DC shall be applied between the upper electrode and the lower electrode (adapter or male fitting hex). The current shall be measured with an instrument with a sensitivity of at least 1 µA (1×10^{-6} A).



CONDUCTIVITY TEST DIAGRAM

Fig. 10.4

10.3.12 Resistance to vacuum test

The hose shall not blister nor show any other indication of failure when subjected to the specified vacuum for a period of 5 min. Where practicable, one end of the hose shall be equipped with a transparent cap and electric light to permit visual examination for failure. Where the length or size of the hose precludes visual examination, failure shall be determined by inability to pass through the hose a ball or cylinder 6.4 mm less in diameter than the bore of hoses of 12.7 mm nominal inside diameter and larger. For hoses under 12.7 mm nominal inside diameter, a ball or cylinder 3.2 mm smaller in diameter than the bore shall be used.

10.3.13 Volumetric expansion test

Volumetric expansion tests shall be run in accordance with the current issue of ASTM D 380.

10.4 Retests and Rejection

In the event of failure of one or more samples to meet any of the tests specified, the material shall be resampled and retested. Twice the number of specimens designated under initial test procedure shall be selected from the lot in question for such retests, and failure of any of the retested samples shall be cause for rejection. Rejected material shall be disposed of as directed by the manufacturer and his expense.

11. HOSE FITTING

Hydraulic hose fittings shall be conformed to SAE J 516 latest edition.

12. CLEANING ACCESSORIES

12.1 General

12.1.1 The accessories shall be designed for the maximum operating pressure of the pressure generator plus 10%.

12.1.2 Vendor shall submit flow rate chart of nozzles as a function of pressure in his proposal.

12.1.3 Instruction manual shall include full directions for use of the nozzle flow chart and the nozzle sheets.

12.1.4 Nozzles shall have an index as well as a part number.

12.1.5 Unless otherwise specified as a minimum following accessories shall be included in Vendor's proposal:

Guns, round and flat jet nozzle, tube and pipe cleaning nozzles, rotating nozzles in one or two planes, oscillating nozzles, control valve (foot operated is preffered), special hoses.

12.2 High Pressure Gun

12.2.1 Guns shall be of high-quality precision tools which, if properly applied, will always function to user full satisfaction.

12.2.2 Gun shall be easy to opening and closing.

12.2.3 Guns shall have a protection frame and a reliable safety lock which prevents an unintended operation of the trigger.

12.2.4 The high-pressure guns shall be designed for max. Operating pressure plus 10%.

12.2.5 Guns shall be designed to be safe, when several spraying units connected with the same pressure to operate at the same time, no dangerous reaction forces occur in one or more guns when one spraying gun is opened or closed.

12.2.6 Gun shall be designed to make sure that there is no sudden recoil as long as the trigger is pulled slowly.

12.2.7 Gun shall be designed for different jetting purposes.

12.3 Lances

Rigid and flexible lances shall be supplied suitable for the inner cleaning of pipes from 10 mm diameter. Depending upon the various applications the lances shall be applied in connection with spray guns and foot-operated valves.

12.4 Pressure Regulator

An automatic unloader valve or pressure regulator shall be installed. The automatic unloader or pressure regulator shall be flanged-mounted and provide stepless adjustment of the operating pressure from 0 to maximum. A separate safety valve to permit overloading shall be installed.

12.5 Footvalve

12.5.1 Footvalve shall be of high-quality precision products which, if properly applied, shall always

function to userfull satisfaction.

12.5.2 Footvalve shall be designed to suit for a maximum permissible operating pressure.

12.5.3 When required the footvalve shall be designed for sea-water application.

12.5.4 Footvalve shall be so designed to switch on pressure generator and start spraying operation by pressing the footvalve.

12.5.5 Full design characteristics and operation condition of footvalve shall be stated in the proposal and instruction manual.

12.5.6 Full instruction of disassembling and repair and assembling of the footvalve shall be submitted by manufacturer.

13. VENDOR'S DATA

Vendor's data including Vendor's proposal, drawings, etc., shall be in accordance with IPS-E-PM-400.

14. GUARANTEES AND WARRANTIES

All equipment and component parts shall be guaranteed by the Vendor against faulty design, defective or improper materials, poor workmanship, and failure due to normal usage for one year after being placed in the specified service, but not exceeding 18 months after the date of shipment. If any defects or malfunctions occur during the warranty period, the Vendor shall make all necessary or desirable alterations, repairs, and replacements free of charge.

15. PREPARATION FOR SHIPMENT

15.1 Equipment shall be suitably prepared for the type of shipment specified. The preparation shall be suitable for outdoor storage.

15.2 Preparation for shipment shall not be made until all testing and inspection of the equipment has been accomplished and the equipment has been approved by the Purchaser. Minimum preparation shall include that specified in 15.3 through 15.10.

15.3 All exterior surfaces with the exception of machined surfaces shall be given a coat of the manufacturer's Standard paint.

15.4 All exterior machined surfaces shall be coated with a suitable rust preventive.

15.5 The interior of the equipment (including auxiliaries) shall be sprayed or flushed with a suitable rust preventive which is removable by solvent.

15.6 All flanged openings shall be provided with metal closures of 5 millimeters minimum thickness, with rubber gaskets and at least four full-diameter bolts.

15.7 All threaded openings shall be provided with steel caps or solid-shank steel plugs of metallurgy equal to or better than that of the pressure casing. In no case shall nonmetallic plugs (such as plastic) be used.

15.8 Lifting points and lifting lugs shall be clearly identified.

15.9 Equipment shall be identified with a serial number and the Purchaser's item number. All material shipped separately shall be identified with securely affixed, corrosion-resistant metal tags indicating the item and serial number for which it is intended.

15.10 Packing for piston rods and plungers shall be removed from the stuffing boxes and shipped separately.

APPENDICES

APPENDIX A
DATA SHEETS

Job No. ..... Item No. .....

Purchase Order No. .....

Water Jet Cleaning **Requisition No. .....**

Machine Data Sheet **Inquiry No. .....**

Page ..... of .....

Date ..... Revision .....

Application to: O Proposal O Purchase O as built	**No. of unit required ……**
For ……	**Driver type ……**
Site ……	**Driver furnished by ……**
Remarks: ……	**Manufacture ……**
……	**Unit serial No ……**
……	

Notes:

O Indicators information to be completed by purchaser

☐ Indicators information to be completed by manufacture.

	DRAWING NO.	**PART NO.**	
		NO .FRONT/ REAR	
BASE FRAME	**TYPES**	**DIMENSIONS**	**FRONT**
			REAR
	WHEEL BASE	**mm**	
	TRACK	**Center of tyre, Front / Rear.mm**	
	GROUND CLEARANCE	**mm**	
UNIT SIZE	**☐ Length mm ☐ Width mm ☐ Height mm ☐ Weight kg**		
MOUNTING	**O Movable Trailer Mounted O Movable Skid Base Mounted** **O Stationary Common Base Mounted**		

(to be continued)

APPENDIX A (continued)

DATA SHEETS

Water Jet Cleaning
Machine Data Sheet

Job No. ..... Item No. .....
Purchase Order No. .....
Requisition No. .....
Inquiry No. .....
Page ..... of .....
Date ..... Revision .....

WORKED TO BE CLEANED
O Tube of (Heat Exchanger): ID. Min. ..... mm. MAX. ..... mm. Length Min. ..... m. MAX. ..... m.
O Pipe ID. Min. ..... mm. MAX. ..... mm. Length Min. ..... m. MAX. ..... m.
O Tank ID. Min. ..... mm. MAX. ..... mm. Length Min. ..... m. MAX. ..... m.
O Filter O Screen
O Hull of Ship O Rusts and Paint of Structure
O Processed Part of Machine O Descaling in Steel Works
O Jet Cutting
OPERATING CONDITIONS
Water: ..... PH
O Pumping Temperature (°c): Max. ..... Min. .....
O Sp.Gr.@ Pumping Temperature .....
O Vapor Pressure @ Pumping Temperature (kPa abs).....
O Viscosity @ Pumping Temperature (m Pa –s).....
O Ambient Temperature (°c) Norm. ..... Max. ..... Min. .....
Electrical Area Hazard: Class ..... Group ..... Division .....
Location: O Indoor O Outdoor O Unheated O Heated

(to be continued)

APPENDIX A (continued)

DATA SHEETS

Job No. ..... Item No. .....

Purchase Order No. .....

Water Jet Cleaning **Requisition No. .....**

Machine Data Sheet **Inquiry No. .....**

Page ..... of .....

Date ..... Revision .....

PERFORMANCE DATE: ..... HOURS RUN:
At Rated Conditions: **Pump type .....Serial No. .....**
☐ **NPSH Required (kPa) .....**
☐ **Rated rpm .....** ☐ **Maximum rpm .....**
☐ **Piston Speed (m/min) .....**
☐ **Stroke mm .....**
☐ **Volumetric Efficiency (%) .....**
☐ **Hydraulic kW .....** ☐ **Brake kW .....**
☐ **Brake kW .....@ Relief Valve Setting .....**
☐ **Working Pressure (kPa)**
☐ **Inlet Pressure (kPa)**
☐ **Safety Valve Setting Pressure**
Remarks: .....
.....
.....

(to be continued)

APPENDIX A (continued)

DATA SHEETS

Water Jet Cleaning
Machine Data Sheet

Job No. ..... Item No. .....
Purchase Order No. .....
Requisition No. .....
Inquiry No. .....
Page ..... of .....
Date ..... Revision .....

PUMP MATERIALS (TO BE COMPLETED BY MANUFACTURER)	
PART	**ASTM NO.**
Cylinder	.....
Liner	.....
Plunger	.....
Valves /value seats	.....
Gland	.....
Throttle bushing	.....
Packing	.....
Lantern ring	.....
Bolting	.....
Other	.....
Remarks:	
.....	
.....	

(to be continued)

APPENDIX A (continued)

DATA SHEETS

Water Jet Cleaning
Machine Data Sheet

Job No. ..... Item No. .....
Purchase Order No. .....
Requisition No. .....
Inquiry No. .....
Page ..... of .....
Date ..... Revision .....

POWER FRAME (TO BE COMPLETED BY MANUFACTURE)	
Maximum Frame Rating:	**Power and lubrication:**
……..kW @ ……..rpm	**Type ……**
Maximum Pressure Rating (kPa gage)…..	**Oil Pump ……**
Crankshaft Material……..	**Main ……..**
No. of Main Bearings……..	**Auxiliary ……..**
Type of Main Bearings……	**Driven by ……**
Internal Gears: ☐ Yes ☐ No	**Type ……**
Gear Ratio……	**Size ……**
Gear Service Factor……	**Specification ……**
	Oil Piping Material ……
Remarks: ……	
……	
……	

(to be continued)

APPENDIX A (continued)

DATA SHEETS

Job No. ..... Item No. .....

Purchase Order No. .....

Water Jet Cleaning **Requisition No. .....**

Machine Data Sheet **Inquiry No. .....**

Page ..... of .....

Date ..... Revision .....

DRIVER
DIESEL ENGINE:
MANUFACTURER: ……
☐ TYPE ……..…..… ☐ Serial NO. ……..……
☐ Performance ……(kW) ☐ rpm …… min^{-1} ☐ Cooling ……
☐ Starter …… ☐ voltage ……..(v) ☐ Capacity ……..…..(Ah)
☐ Fuel Consumption ……..(g/kWh) ☐ Tank Cap ……..(liter)
ELECTRIC MOTOR DRIVER:
☐ Manufacturer …… ☐ Size……..
☐ Type …….. O Enclosure ……
☐ Frame Number …….. O Mounted by……
☐ Output …….. (kW) ☐ rpm …… min^{-1}
O Volts …….. Phase ……..Hz ……
Remarks: ……