

**MATERIAL AND EQUIPMENT STANDARD**  
**FOR**  
**MOBILE AIR COMPRESSORS**



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## **1. GENERAL**

### **1.1 Scope**

This Standard covers the minimum requirements for mobile air compressor packages complete with diesel engine driver, air receiver and all necessary accessories for general purpose services in refineries, chemical and petrochemical plants, gas plants and oil field areas.

All necessary accessories shall be mounted on package skid.

### **1.2 Referenced Publications**

Throughout this Standard the following Standards and Codes are referred to. The editions of these standards and codes that are in effect at the time of publication of this Standard shall, to the extent specified herein, form a part of this Standard.

#### **IPS (IRANIAN PETROLEUM STANDARDS)**

M-PM-290	"Internal Combustion Reciprocating Engines"
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#### **ANSI (AMERICAN NATIONAL STANDARDS INSTITUTE)**

B 1.1	"Unified Inch Screw Threads (UN and UNR Thread Form)"
B 2.1	"Pipe Threads"
B 16.5	"Steel Pipe Flanges and Flanged Fittings"
B 31.1	"Power Piping"
Y 14.2M	"Line Conventions and Lettering"

#### **ASME (AMERICAN SOCIETY OF MECHANICAL ENGINEERS)**

Boiler and Pressure Vessel Code:  
 Section VIII, Division 1, "Pressure Vessels"  
 Section IX, "Welding Qualifications"

#### **API (AMERICAN PETROLEUM INSTITUTE)**

615	"Sound Control of Mechanical Equipment for Refinery Services"
526	"Flanged Steel Safety Relief Valves"

#### **ASTM (AMERICAN SOCIETY FOR TESTING AND MATERIALS)**

A 106	"Seamless Carbon Steel Pipe for High Temperature Service"
A 194	"Carbon and Alloy Steel Nuts for Bolts for High-Pressure and High Temperature Service"
A 269	"Seamless and Welded Austenitic Stainless Steel Tubing for General Service"
A 278	"Gray Iron Casting for Pressure Containing Parts for Temperatures Up to 345°C"
A 312	"Seamless and Welded Austenitic Stainless Steel Pipe"
A 320	"Alloy Steel Bolting Materials for Low Temperature Service"

A 395	"Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperature"
A 536	"Ductile Iron Castings"

## ISO (INTERNATIONAL ORGANIZATION FOR STANDARDIZATION)

1217	"Displacement Compressor-Acceptance Tests"
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## BSI (BRITISH STANDARDS INSTITUTION)

BS 1571	"Testing of Positive Displacement Compressors and Exhausters"
Part 2	"Simplified Acceptance Tests for Air Compressors and Exhausters"
AFBMA	"Anti-Friction Bearing Manufacturers Association "

### 1.3 Definition of Terms

The terms used in this Standard, most of which are illustrated in Figs. 1, 2 and 3, are defined as follows:

**Maximum allowable working pressure** is the maximum continuous pressure for which the manufacturer has designed the equipment (or any part to which the term is referred) when handling the air at the specified temperature.

**Rated discharge pressure** is the highest pressure required to meet the conditions the Purchaser specifies for the intended service.

**Maximum allowable temperature** is the maximum continuous temperature for which the manufacturer has designed the equipment (or any part to which the term is referred) when handling the air at the specified pressure.

**Rated discharge temperature** is the predicted actual operating temperature resulting from rated service conditions.

**Rated speed** (revolutions per minute) of the power input rotor is the speed corresponding to the requirements of the compressor rated capacity.

**Maximum allowable speed** (revolutions per minute) of the power input rotor is the highest speed at which the manufacturer's design will permit continuous operation. The maximum allowable speed shall be at least 105 percent of rated speed.

**Maximum continuous speed** (revolutions per minute) of the power input rotor is the speed at least equal to the product of 105 percent and the highest speed required by any of the specified operating conditions.

**Minimum allowable speed** (revolutions per minute) of the power input rotor is the lowest speed at which the manufacturer's design will permit continuous operation for the intended service.

**Normal speed** (revolutions per minute) of the power input rotor is the speed corresponding to the requirements of the normal operating point.

**Rated power** is the maximum kilowatts the compressor and any shaft-driven appurtenances require for any of the specified operating conditions. The rated power shall include the effect of any equipment (such as pulsation suppression devices, intercoolers, after-coolers, and separators) furnished by the compressor vendor.

**Inlet (or actual) cubic meter per minute** refers to the flow rate determined at the conditions of pressure, temperature, compressibility, and moisture at the compressor inlet flange.

#### Note:

To determine inlet cubic meter per hour, allowance must be made for pulsation suppressor pressure drop.

**Rated capacity** is the largest number of inlet cubic meter per minute required by the specified operating conditions.

**Normal operating point** is the specified set of conditions at which usual operation is expected and optimum efficiency is desired.

**Rotor body** is the profile section on or integral with the shaft.

**Rotor** is the complete rotor body and the shaft and shrunk-on sleeves (when furnished).

**Rotor assembly** consists of all rotating elements mounted on the rotor, excluding couplings.

**Axially (horizontally) spilt** refers to casing joints that are parallel to the shaft centerline.

**Radially (vertically) split** refers to casing joints that are transverse to the shaft centerline.

**Pressure casing** is the composite of all stationary pressure containing parts of the unit, including all nozzles and other attached parts.

**Critical speed corresponding to resonant frequencies of the rotor-bearing support system**

Use of the word DESIGN in any term (such as design power, design pressure, design temperature, or design speed) should be avoided in the purchaser's specifications. This terminology should be used only by the equipment designer and manufacturer.

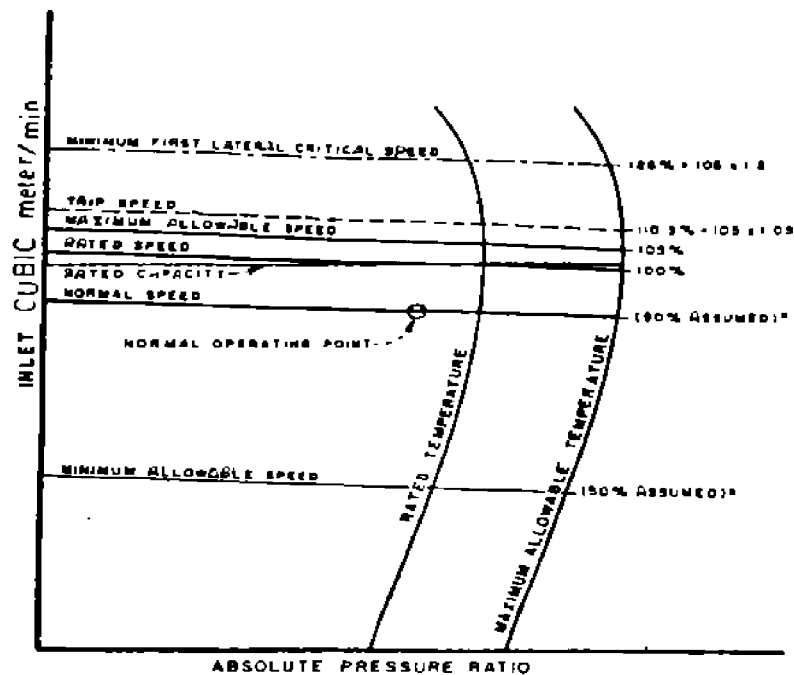
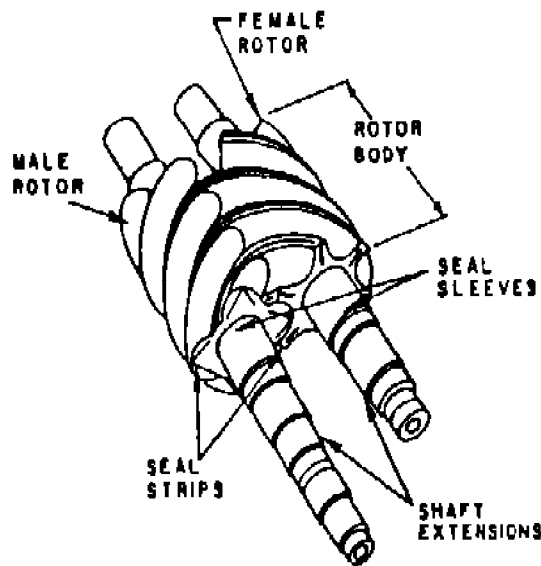


ILLUSTRATION OF TERMS

Fig. 1

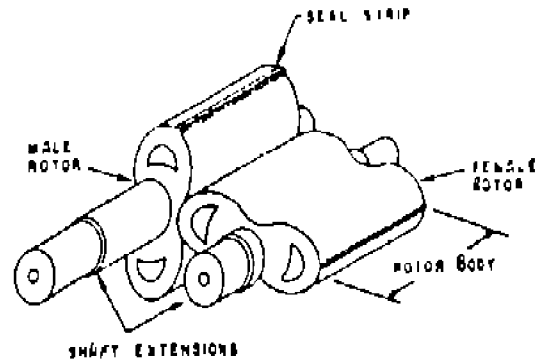
**Note:**

Asterisk (\*) indicates values assumed for illustration only.



HELICAL COMPRESSOR ROTORS

Fig. 2



STRAIGHT LOBE BLOWER ROTORS

Fig. 3

## 1.4 Units

This Standard is based on International System of Units (SI), except where otherwise specified.

## 1.5 Conflicting Requirements

In the case of conflict between documents relating to the inquiry or order, the following priority of documents shall apply:

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

## 2. BASIC DESIGN

### 2.1 General

**2.1.1** Compressors, drivers and auxiliary equipment shall be suitable for the specified operating conditions and shall be designed and constructed for a minimum service life of 15 years.

**2.1.2** Compressors and drivers (including auxiliaries) shall be designed to run safely to max. continuous speed, relief valve setting, and specified maximum allowable working pressure.

**Note:**

To run safely involves factors other than maximum pressure, such as maximum discharge temperature or limiting driver power.

**2.1.3** Compressors and auxiliaries shall be designed for rapid, economical maintenance. Such major parts as casing components and bearing housings shall be designed (shouldered, doweled, or matchmarked) to ensure accuracy of alignment on assembly.

**2.1.4** The combined performance of the compressor and engine shall be the responsibility of the Vendor.

**2.1.5** The arrangement of the equipment shall provide adequate clearance areas and safe access for operation and maintenance.

Oil reservoirs and housing that enclose moving lubricated parts (such as bearings, shaft seals, highly polished parts, instruments, and control elements) shall be designed to minimize contamination by moisture, dust, and other foreign matter during periods of operation or idleness.

**2.1.6** When special tools and fixtures are required to disassemble, assemble, or maintain the unit, they shall be included in the quotation and furnished as part of the initial supply of the package unit.

**2.1.7** Control of the sound level of the compressor package (including the design of sound enclosures, if required) shall be performed by the Vendor.

Unless otherwise specified the maximum sound pressure level at any measuring location not less than 1m from the unit surface shall be 90 dBA.

## **2.2 Pressure Casing**

**2.2.1** Casing shall be designed in accordance with ASME Code Section VIII Div. I.

**2.2.2** Horizontally split casing shall employ a flat joint tightly sealed with a suitable material. The joints between the end covers and the casing of vertically split compressors shall be sealed with confined gaskets.

**2.2.3** Threading for pressure bolting shall conform to ANSI B1.1. Tapped holes for bolting in pressure parts shall be held to a minimum; studs are preferred to cap screws. Sufficient metal shall be left below the bottom of tapped holes in pressure sections to prevent leakage. Studded connections shall be furnished with studs installed. The stud hole shall not be drilled deeper than necessary to allow a maximum tap depth of one and one-half times the major diameter of the stud.

**2.2.4** Clearance shall be provided at bolting locations to permit the use of socket or box type wrenches.

**2.2.5** Unless otherwise specified, compressor packages shall be suitable for out door operation in the climatic zone specified in the data sheets.

## **2.3 Casing Connections**

**2.3.1** Compressor discharge nozzle shall be suitable for hose connections and the working pressure of the casing.

**2.3.2** Openings for pipe sizes of DN 32 (NPS 1¼) DN 65 (NPS 2½) shall not be used.

**2.3.3** All interconnection piping flanges and couplings will be of carbon steel.

**2.3.4** Flanged connections shall conform to ANSI B16.5.

**2.3.5** Threaded connections shall not exceed DN 40 (1½ inch IPS). Tapped openings and bosses for pipe threads shall conform to ANSI B16.5. Pipe threads shall be taper threads conforming to ANSI B 16.1.

**2.3.6** External tapped openings (exclusive of holes such as core support-type holes tapped for repair purposes) not connected to piping shall be plugged with solid steel, long-shank plugs. Threads shall be lubricated. Tetrafluoroethylene (TFE) tape shall not be applied to threads of plugs inserted into oil passages.

## **2.4 Rotating Elements**

**2.4.1** Rotors shall be manufacturer's standard construction for the intended service.

**2.4.2** Shafts shall be one piece forged steel unless otherwise approved by the Purchaser.

## **2.5 Seals**

**2.5.1** Shaft seals shall be provided to prevent leakage from or into the compressor over the range of specified operating conditions and during periods of idleness. Seal operation shall be suitable for all conditions that may PREVAIL during startup, shutdown, and any other special operation specified by the Purchaser.

**2.5.2** Shaft seals preferably shall be accessible for inspection and replacement without removing the top half of the casing of a horizontally split compressor or the end housings of a vertically split unit.

**2.5.3** Shaft seals shall be manufacturer's standard for the intended operating conditions. However, the seals shall incorporate a self closing feature to prevent air leakage from the compressor on shutdown.

## **2.6 Vibration and Balance**

Major parts of the rotor assembly shall be statically and dynamically balanced individually.

## **2.7 Bearings**

**2.7.1** Unless otherwise specified, bearings shall be of antifriction type, selected to provide a minimum B-10 life of 30,000 hours of continuous duty for rated compressor operating conditions. (At 30,000 hours, 90 percent of identical bearings would show no evidence of failure).

Bearings other than the angular contact type shall have loose internal clearance and shall conform to AFBMA symbol 3 single row or double-row bearings shall be conrad type (no filling slots).

The shaft and housing fits and methods of retention shall be in accordance with recommended practices of the AFBMA. Locking of ball thrust bearings shall be by tongue-type lock-washer.

**2.7.2** Oil for the bearings shall be supplied in sufficient quantity to prevent the temperature rise through the bearing housings from exceeding 50 degrees Fahrenheit under the most adverse specified operating conditions.

## **2.8 Lubrication**

**2.8.1** Bearings and bearing housings shall be arranged for hydrocarbon oil lubrication unless otherwise specified by the Purchaser.

**2.8.2** Unless otherwise specified, manufacturer's standard shall apply for oil systems.

## **2.9 Materials**

### **2.9.1 General**

**2.9.1.1** Materials shall be identified by reference to appropriate ASTM specification. When no such appropriate designation is available, the manufacturer's code or trade name may be used. In such cases, the manufacturer shall be identified and the chemical composition and significant physical properties of the material shall be presented elsewhere in the proposal.

**2.9.1.2** External parts subject to rotary or sliding motions (such as control linkage joints and adjusting mechanisms) shall be corrosion-resistant materials suitable for the site environment.

**2.9.1.3** Bearing housing, supports and covers shall be made of steel for compressors having steel castings.

## **2.9.2 Castings**

**2.9.2.1** Castings shall be sound and free of shrink holes, blow holes, cracks, scales, blisters, or other similar injurious defects. Surfaces of castings shall be cleaned by sandblasting, shotblasting, pickling, or any other standard method. All mold-parting fins and remains of gates and risers shall be chipped, filed, or ground flush.

**2.9.2.2** The use of chaplets in pressure castings shall be held to a minimum. They shall be clean and corrosion-free (plating permitted) and of a composition compatible with the casting.

**2.9.2.3** Ferrous castings shall not be repaired by welding, peening, plugging, burning in, or impregnating, except as specified in 2.9.2.3.1 and 2.9.2.3.2.

**2.9.2.3.1** Fully enclosed cored voids, including voids closed by plugging, are prohibited.

**2.9.2.3.2** Cast gray iron or nodular iron may be repaired by plugging within the limits specified in ASTM A 278, A 536, or A 395. The drilled holes for a plug shall be carefully examined using dye penetrant to ensure that all defective material has been removed. All necessary repairs not covered by ASTM specifications shall be subject to approval by the purchaser.

**2.9.2.3** The Vendor shall specify the material grade of castings on the data sheet.

## **2.9.3 Welding**

**2.9.3.1** All fabricated casings (regardless of thickness) shall be post-weld heat treated.

**2.9.3.2** Piping welds shall be made before the component is heat treated.

**2.9.3.3** All welding of piping and pressure-containing parts as well as any weld repairs, shall be performed by operators and procedures qualified in accordance with Section IX of the ASME Code.

## **2.9.4 Material inspection**

**2.9.4.1** When radiographic, ultrasonic, magnetic particle, or dye penetrant inspection of welds or materials is required or specified, the inspection shall be in accordance with Section VIII, Division I, of the ASME Code .

**2.9.4.2** Fabricated casings made of wrought materials or combinations of wrought and cast materials shall conform to the following:

- 1)** Plate edges shall be inspected by means of a magnetic particle or a liquid penetrant examination as required by Paragraph UG-93 (b)(3), Section VIII, division 1 of the ASME Code.
- 2)** All accessible surfaces of welds shall be inspected after back chipping or gouging and after stress relieving. Magnetic particle inspection shall be used except that liquid penetrant examination may be used on non-magnetic material.
- 3)** All pressure-containing welds (including flange-to-nozzle and case-circumferential welds) shall be full-penetration double-welded or the equivalent.

## **2.10 Nameplates**

**2.10.1** A stainless steel nameplate shall be provided for each compressor package.

The plate shall be securely fastened by pins of similar material and in an accessible position on the unit.

**2.10.2** The following data, as a minimum shall be legibly stamped or preferably engraved on the plate:

- a) Vendor's name .....
- b) Serial number .....
- c) Size and type .....
- d) Rated capacity ..... m<sup>3</sup>/min.
- e) First critical speed ..... rev/min.
- f) Rated speed ..... rev/min.
- g) Maximum continuous speed ..... rev/min.
- h) Maximum case design pressure ..... kg/Cm<sup>2</sup>
- i) Maximum allowable temperature ..... °C
- j) Maximum casing working pressure ..... kg/Cm<sup>2</sup>
- k) Total weight ..... kg
- l) Heaviest component removable for overhaul ..... kg
- m) Engine manufacturer's name .....
- n) Engine rated power ..... kw
- o) Compressor power required ..... kw
- p) Order no .....
- q) Order placed by .....

### 3. ACCESSORIES

#### 3.1 Drivers

Compressor shall be driven by diesel engine supplied by the compressor vendor in accordance with IPS-M-PM-290.

#### 3.2 Package Accessories

**3.2.1** A steel skid shall be furnished to accommodate all equipment being furnished to allow shipment and setting in place as a unit .

**3.2.2** Unless otherwise specified the skid shall be mounted on trailer with four or two spring mounted pneumatic tyres and running gear according to manufacturer's standard.

**3.2.3** The four wheel trailer shall be furnished with a turnable front axle with a towbar suitable to transport the unit via a truck.

**3.2.4** The trailer shall be complied with latest edition of the Traffic Regulations having parking and overrun brake and full road-going lighting consisting of, stop, tail, indicator, fog, side and front marker.

**3.2.5** A telescopic jockey wheel shall be furnished with tow wheels trailer.

**3.2.6** The unit shall be furnished with cathaphoretic painted steel canopy.

**3.2.7** The package shall be provided with suitably designed hook for safe towing.

**3.2.8** Mudguard to each wheel and sliding stands shall be furnished according to manufacturer's standard.

**3.2.9** Extra space shall be furnished on the skid for storing of flexibles and other accessories of the package.

**3.2.10** The concealed lifting eye with retractable guard shall be provided for the unit. Methods of lifting the assembled machine shall be specified by the Vendor.

- 3.2.11** For easy service access for routine maintenance high-lift doors/canopies shall be provided.
- 3.2.12** Oil and fuel filters shall be mounted at hand level and can easily be reached for maintenance.
- 3.2.13** Enclosure shall be lockable and silences the unit to a sound power level as specified in 2.1.10.
- 3.2.14** For protecting against careless reversing, the package shall be furnished with built-in rear bumpers.

### **3.3 Controls and Instrumentation**

#### **3.3.1 General**

- 3.3.1.1** All controls and instrumentation shall be suitable for outdoor installation.
- 3.3.1.2** The loading/unloading mechanism of the compressor shall be actuated by its own pressure switch(es) supplied by vendor.
- 3.3.1.3** Vendor's proposal shall fully describe the instruments and control system design and operation under a separate heading.

#### **3.3.2 Control panels**

- 3.3.2.1** A local free standing control panel shall be supplied with the compressor package, mounted on the skid.
- 3.3.2.2** The panel shall be common to the compressor and driver. Compressor shall be started and stopped from the panel.
- 3.3.2.3** The panel shall be totally enclosed, water-tight and dusttight, suitable for safe area.
- 3.3.2.4** All instruments shall be located on one panel. Instruments shall include discharge air pressure/temperature gages, interstage pressure gage, engine water temperature indicator (if applicable), oil pressure gages, intake airfilter differential pressure gage, hour counter ammeter and starting switch. The panel shall include pressure gages and temperature indicators before and after any intercoolers.

The panel shall be furnished with auto-shutdown protection systems.
- 3.3.2.5** Controls shall be covered by a clear plastic cover for protection and easy monitoring. The control panel shall be provided with lockable doors to prevent unauthorized use.
- 3.3.2.6** The diesel compressor shall be started via hand switch/activating starting motor.
- 3.3.2.7** The Vendor shall supply any additional instrumentation required by purchaser as specified on the data sheets.
- 3.3.3** The Vendor shall furnish relief valves that are to be installed on equipment, the size and set pressure of all relief valves shall be determined by the Vendor. Relief valves shall meet the requirement of API Standard 520, if applicable.
- 3.3.4** Unless otherwise specified, the control range limits shall be from maximum continuous speed to 95 percent of the minimum speed required for any specified operating case or 70 percent of the maximum continuous speed, whichever is lower.

#### **3.3.5 Alarms and shutdowns**

The compressor shall be furnished with high air/oil outlet temperature shutdown switches. Alarm switch settings shall always precede the shut down switch function.

### 3.4 Piping and Appurtenance

**3.4.1** Piping systems include piping, check valves isolating valves, switch valves, control valves, relief valves, pressure reducers, restriction orifices, thermometers and thermowells, pressure gages, sight flow indicators, and all related vents and drains.

**3.4.2** Auxiliary piping systems include all necessary lube oil, control oil, cooling oil, drain, vent, and water lines attendant to the compressor, the driver, and the auxiliaries. Auxiliary piping also includes any piping required to mount valves, controls, pressure reducers, thermometers, pressure gages, or instrumentation on the compressor package. The Vendor shall furnish all piping systems.

**3.4.3** The piping shall be designed to provide proper flexibility and normal accessibility for operation, maintenance, thorough cleaning piping, valves, and instrumentation shall be securely fastened to avoid vibration and breakage. The piping shall comply with latest edition of ANSI B 31.1.

**3.4.4** Air outlet manifold shall be furnished with valves for multiple flexible hoses.

**3.4.5** Oil drains shall be sized to flow no more than half full and shall be arranged to ensure good drainage (despite possible foaming conditions). Horizontal runs shall slope continuously, inch per foot minimum, toward the reservoir. Laterals (not more than one in any transverse plane) should, if possible, enter drain headers at a 45 degree angle in the direction of the flow.

**3.4.6** Pipe threads shall be taper threads in accordance with ANSI B2.1. Flanges shall be in accordance with ANSI B16.5.

**3.4.7** Piping systems containing air or fluids at pressures above 5.2 bar gages (75 pounds per square inch gage) shall be of seamless carbon steel manufactured in accordance with ASTM A106, or a purchaser-approved equivalent.

**3.4.8** Where space does not permit the use of ½ , ¾, or 1-inch pipe, seamless steel tubing conforming to ASTM A192 may be furnished with steel fittings, or stainless tubing conforming to ASTM A269 may be furnished with steel fittings.

### 3.5 Intercoolers and Aftercoolers

**3.5.1** Intercoolers (if any) and aftercoolers preferably shall be air type and designed to be suitable for operation under specified ambient conditions. The coolers shall be combined in a common cooler with the cylinder jacket cooler by incorporating separate sections for each service.

**3.5.2** Unless otherwise specified, air-cooled heat exchangers used for intercoolers and aftercoolers shall have automatic temperature control. This control may be accomplished by a thermostatically controlled by-pass valve.

**3.5.3** When water-cooled shell-and-tube intercoolers and aftercoolers are specified, design and construction shall be in accordance with TEMA Class C. They shall be furnished in accordance with Section VIII, Division 1, of the ASME code.

**Note:**

**Caution should be exercised regarding the susceptibility of heat exchangers and their supporting structures to pulsation-induced vibration.**

**3.5.4** When condensate separation and collection facilities are furnished by the Vendor, they shall include an automatic drain trap with manual bypass.

### 3.6 Oil Separator

For oil injected compressors a combination air receiver oil separator may be furnished, oil shall be removed from air and collected in the storage reservoir formed by the lower portion of the receiver/separator shell.

### **3.7 Air Receiver**

The unit shall be furnished with an air receiver complete with safety valve, gage and drain valve.

Pressure vessels including receiver shall be designed, manufactured and tested in accordance with ASME VIII, Division 1.

### **3.8 Oil Cooler**

Oil coolers, if required shall be air cooled.

### **3.9 Air Intake Filters**

Unless otherwise specified, the Vendor shall furnish dry high-efficiency air intake filters for air compressors taking suction from the atmosphere. High efficiency filters shall be capable of removing 97 percent of particles 10 micron or larger over the inlet capability range.

### **3.10 Silencers**

**3.10.1** Unless otherwise specified, inlet and exhaust silencers for each casing shall be supplied by the Vendor. The primary function of silencers shall be to provide the maximum practical reduction of pulsations in the frequency range of audible sound without exceeding the pressure drop limit specified in 3.11.2.

**3.10.2** The pressure drop through each silencer shall not exceed 1 percent of the absolute pressure at the silencer inlet.

**3.10.3** The minimum quality material allowed for shells shall be carbon steel with the minimum corrosion allowance of 1.5 millimeters (1/16 inch).

**3.10.4** Construction of silencers shall be suitable for service in an unprotected outdoor location.

**3.10.5** Silencers shall be designed and fabricated in accordance with ANSI B 31.1 and shall be suitable for pressure not less than the specified relief valve setting pressure.

## **4. INSPECTION, TESTING, AND PREPARATION FOR SHIPMENT**

### **4.1 General**

**4.1.1** The Vendor shall provide the Purchaser with advance notification of certain shop inspections and testing as outlined in the purchase order or other agreement. The purchaser's representative shall have entry, after prior notification by the Purchaser, to all vendor and subvendor plants where work upon or testing of the equipment is in progress.

**4.1.2** It shall be the responsibility of the Vendor to notify subvendors of the purchaser's inspection requirements.

### **4.2 Inspection**

**4.2.1** Each completed compressor package shall be inspected at the manufacturer's facility, by a representative of the Purchaser. The Purchaser reserves the right to inspect parts in the manufacturing process.

**4.2.2** All painting of surfaces of pressure-containing parts shall be deferred until the specified inspection of that part is completed.

**4.2.3** During assembly of the system and prior to testing, each component (including cast-in passages), and all piping and appurtenances shall be cleaned by an appropriate method to remove foreign materials, corrosion products, and mill scale.

**4.2.4** When specified, the Purchaser may make an inspection for cleanliness of the equipment and all piping and appurtenances furnished by or through the Vendor prior to the welding of heads to vessels, the closure of openings in vessels or exchangers, or the final assembly of piping.

### **4.3 Testing**

#### **4.3.1 General**

**4.3.1.1** The purchaser's acceptance of shop test results shall not constitute a waiver of the vendor's obligation to provide equipment that meets all specified operating conditions.

**4.3.1.2** The Purchaser reserves the right to witness or observe the testing, dismantling, inspection, and reassembly of equipment.

#### **4.3.2 Pressure tests**

**4.3.2.1** Pressure-containing parts (including auxiliaries) shall be tested hydrostatically in accordance with ASME Code Section VIII, Div. I.

The test liquid should be at a higher temperature than the nil ductility transition temperature of the material being tested.

**4.3.2.2** Tests shall be maintained for a sufficient period of time to permit complete examination of parts under pressure. The hydrostatic test shall be considered satisfactory when no seepage through the casing or casing joints is observed for a minimum of 30 minutes. Large, heavy castings may require a longer testing period to be agreed upon by the Purchaser and the Vendor.

**4.3.2.3** All tests shall be in accordance with ASME Code requirements. In the event a discrepancy exists between the test pressure in this Standard and the specified code test pressure, the higher pressure shall govern.

#### **4.3.3 Mechanical running test**

**4.3.3.1** When specified the complete compressor package shall be operated at the maximum allowable speed and, after case and lube oil temperatures have stabilized, the mechanical performance shall be checked, including oil temperature, cooling water temperature, lateral vibration amplitude, and seal operation. Operation shall be continued at the maximum allowable speed for 2 hours after the temperature has stabilized.

**4.3.3.2** When specified a "heat run" shall be performed at the maximum allowable speed, with the discharge temperature stabilized at the rated discharge temperature plus 20°F (11°C) for a minimum of 1 hour.

**4.3.3.3** After the heat run, a check shall be performed with the compressor operating on air at the highest test pressure practical at normal speed. The capacity, the power required, and the temperature of the bearings where instrumentation is included shall be noted.

**4.3.3.4** When specified the requirements of 4.3.3.4.1 through 4.3.3.4.5 shall be met for the running test.

**4.3.3.4.1** The contract shaft seals and bearings shall be used in the machine for the mechanical running test.

**4.3.3.4.2** All oil pressures, viscosities, and temperatures shall be at the operating values recommended in the manufacturer's operating instructions for the specific unit under test. Oil flow rates for bearing housings shall be determined. (Accepted methods other than flowmeter may be used). Test-stand oil filtration shall be 10 microns or better.

**4.3.3.4.3** Joints and connections in the casing and oil system shall be checked for tightness, and any leaks shall be corrected.

**4.3.3.4.4** All warning, protective, and control devices shall be checked, and adjustments shall be made as required.

**4.3.3.4.5** Facilities to ensure against the entrance of oil into the compressor shall be in operation throughout the test.

**4.3.3.4.6** When spare rotor sets are ordered to permit concurrent manufacture, each spare rotor set shall be mechanically fitted into the casing prior to the mechanical run test of the contract rotor set.

**4.3.3.5** During the running test, the mechanical operation of all equipment being tested and the operation of the test instrumentation shall be satisfactory.

**4.3.3.6** When specified the bearings and seals shall be inspected after the running tests.

**4.3.3.7** If replacement or modification of bearings or seals, or dismantling of the case to replace or modify other parts is required for correction of mechanical or performance deficiencies, the initial test will not be acceptable, and the final shop tests shall be run after such replacements or corrections are made.

#### **4.3.4 Performance test**

The compressor shall be performance tested in accordance with the BS 1571 or ISO 1217.

#### **4.3.5 Auxiliary equipment test**

When specified the auxiliary equipment such as oil systems and control systems shall be tested in the Vendor's shop. Details of the auxiliary-equipment tests shall be developed jointly by the Purchaser and the Vendor.

### **4.4 Preparation for Shipment**

**4.4.1** Equipment shall be suitably prepared for the type of shipment specified, including blocking of the rotor when necessary. The preparation shall include protection such that the equipment may be stored outdoors for 6 months from the time of shipment without requiring disassembly, except for inspection of bearings and seals, before operation. If storage for longer periods is contemplated, the purchaser shall consult with the Vendor regarding recommended procedures to be followed.

**4.4.2** The Vendor shall provide the Purchaser with the necessary instructions to preserve the integrity of the storage preparation after the equipment arrives at the job site.

**4.4.3** Preparation for shipment shall be made after all testing and inspection of the equipment has been accomplished and the equipment has been approved by the Purchaser. The preparation shall include at least that specified in 4.4.3.1 through 4.4.3.9

**4.4.3.1** All exterior surfaces except machined surfaces shall be given a coat of the manufacturer's standard paint.

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

**4.4.3.3** The interior of the equipment shall be clean and free of scale, welding spatter, and foreign objects and shall be sprayed or flushed with a suitable rust preventive that is removable by solvent. The rust preventive shall be applied through all openings while the machine is slow-rolled.

**4.4.3.4** All internal steel areas of bearing housings and of carbon steel oil systems' auxiliary equipment such as reservoirs, vessels, and piping shall be coated with a suitable oil-soluble rust preventive.

**4.4.3.5** All flanged openings shall be provided with metal closures at least 4.8 millimeters thick, with rubber gaskets and at least four full-diameter bolts. For studed openings, all nuts needed for the intended service shall be used for securing closures.

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

**4.4.3.7** Lifting points and lifting lugs shall be clearly identified.

**4.4.3.8** The equipment shall be identified with serial numbers, separate shipment of materials is not allowed.

**4.4.4** Auxiliary piping connections furnished on the purchased equipment shall be impression stamped or permanently tagged to agree with the vendor's connection table or general arrangements drawing.

**4.4.5** Exposed shafts and shaft couplings shall be wrapped with waterproof moldable waxed cloth or vapor phase inhibitor paper. The seams shall be sealed with adhesive tape.

**4.4.6** One copy of the manufacturer's standard installation instruction shall be packed and shipped with the equipment.

**4.4.7** Bearing assemblies and the exposed ends of shafts shall be fully protected from contamination by moisture and dirt. If vapor phase inhibitor crystals in bags are installed in large cavities, they must be attached in an accessible area for ease of removal. Bags must be installed in wire cages attached to flanged covers, where applicable, and all locations shall be indicated by corrosion-resistant tags attached by stainless steel wire.

**4.4.8** All components (individual pieces, as well as packaged sets) shipped with mounted preassembled piping, tubing, or wiring shall comply with the requirements of the Occupational Safety and Health Administration (OSHA) and shall carry outside securely affixed, large, red, all-weather tags stating the following in bold letters:

**THIS SYSTEM HAS BEEN PREASSEMBLED AND TESTED FOR OPERABILITY AND SAFETY, COMPLIES WITH ALL REQUIREMENTS OF OSHA (OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION), AND SHALL NOT BE DISTURBED BY UNAUTHORIZED PERSONNEL.**

## **5. GUARANTEE AND WARRANTY**

### **5.1 Mechanical**

**5.1.1** 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 (freight on board), at the vendor's factory. Field labor charges shall be negotiated between the Purchaser and the Vendor.

### **5.2 Performance**

Unless a specific exception is recorded by the Vendor in his proposal, it shall be understood that the Vendor guarantees and agrees to the following:

- 1)** The compressor shall be guaranteed for satisfactory performance at all specified operating conditions. The compressor performance shall be guaranteed at the normal operating point unless otherwise specified. At this point no negative tolerance is permitted on capacity and the horsepower may not exceed 104 percent of the quoted horsepower.
- 2)** No internal painting shall be permitted in order to achieve the capacity guarantee.

## **6. VENDOR'S DATA**

Vendor's data at proposal stage and after the order being placed shall be in accordance with IPS-E-PM-400.

APPENDICES

APPENDIX A

TYPICAL COMPRESSORS DATA SHEETS

PORTABLE ROTARY TYPE POSITIVE  
DISPLACEMENT COMPRESSORS  
DATA SHEET SI UNITS

JOB NO. \_\_\_\_\_ ITEM NO. \_\_\_\_\_  
PAGE 1 OF 4 BY \_\_\_\_\_  
DATE \_\_\_\_\_ REVISION \_\_\_\_\_

APPLICABLE TO: ☐ PROPOSAL ☐ PURCHASE ☐ AS BUILT

FOR \_\_\_\_\_ UNIT \_\_\_\_\_  
SITE \_\_\_\_\_ DRIVE EQUIP. \_\_\_\_\_  
SERVICE \_\_\_\_\_ NO. REQUIRED \_\_\_\_\_  
MANUFACTURER \_\_\_\_\_ MODEL \_\_\_\_\_ SERIAL NO. \_\_\_\_\_

NOTE: ☐ INDICATES INFORMATION TO BE COMPLETED BY PURCHASER:  
☐ BY MANUFACTURER

OPERATING CONDITIONS		COOLING SYSTEM	
<input type="checkbox"/> ACTUAL FREE AIR CAPACITY _____ m <sup>3</sup> /min		AIRCOOLERS:	
<input type="checkbox"/> RATED DISCHARGE PRESSURE _____ kPa		<input type="checkbox"/> MAKE _____ <input type="checkbox"/> MODEL _____	
<input type="checkbox"/> Max. ALLOWABLE WORKING PRESSURE _____ kPa		COOLING:	
<input type="checkbox"/> RANGE OF PRESSURE ADJUSTABLE FROM _____ kPa TO _____ kPa		<input type="checkbox"/> AIR <input type="checkbox"/> WATER <input type="checkbox"/> OTHERS (SPECIFIED) _____	
<input type="checkbox"/> RATED DISCHARGE TEMPERATURE _____ °C		OILCOOLERS:	
<input type="checkbox"/> Max. ALLOWABLE TEMPERATURE _____ °C		<input type="checkbox"/> MAKE _____ <input type="checkbox"/> MODEL _____	
<input type="checkbox"/> RATED SPEED _____ RPM		AIR AND OILCOOLERS ARE:	
<input type="checkbox"/> RATED POWER REQUIREMENT (ALL LOSSES INCL.) _____ kW		<input type="checkbox"/> INTEGRATED <input type="checkbox"/> SEPARATED	
<input type="checkbox"/> VOLUMETRIC EFF. (%) _____		<input type="checkbox"/> OTHERS (SPECIFIED) _____	
MISCELLANEOUS PACKAGE		DRIVERS	
GENERATOR <input type="checkbox"/> YES <input type="checkbox"/> NO		FOR DRIVERS USE DATA SHEETS IN APPENDIX B	
<input type="checkbox"/> VOLTS <input type="checkbox"/> PHASE _____ Hz		SPEEDS	
<input type="checkbox"/> POWER WITHOUT AIR DELIVERY _____ kW		<input type="checkbox"/> MAX. CONT. _____ RPM TRIP _____ RPM	
BRAKES:		<input type="checkbox"/> MAX. TIP SPEEDS _____ m/s @ RATED SPEED	
<input type="checkbox"/> OVERRUN <input type="checkbox"/> PARKING		<input type="checkbox"/> _____ m/s @ MAX. CONT. SPEED	
<input type="checkbox"/> AUTOMATIC REVERSE		<input type="checkbox"/> CRITICAL SPEEDS:	
TOWBAR:		FIRST CRITICAL _____ RPM	
<input type="checkbox"/> ADJUSTABLE <input type="checkbox"/> FIXED		ROTATION, VIEWED FROM COMP. END:	
REAR BUMPERS <input type="checkbox"/> YES <input type="checkbox"/> NO		<input type="checkbox"/> C.W. <input type="checkbox"/> C.C.W.	
AIR OUTLET VALVE FOR MULTIPLE FLEXIBLE HOSES:		ACCESSORY	
<input type="checkbox"/> NO <input type="checkbox"/> SIZE _____		<input type="checkbox"/> TOOL STORAGE	
LOCATION:		<input type="checkbox"/> PACKAGE LIFTING EYE	
<input type="checkbox"/> UNDER ROOF		<input type="checkbox"/> FULL ROAD GOING LIGHTS	
<input type="checkbox"/> OUTDOOR		<input type="checkbox"/> OIL SEPARATOR	
<input type="checkbox"/> ELECTRICAL AREA CLASS _____ GR. _____ DIV. _____		<input type="checkbox"/> SILENCER	
<input type="checkbox"/> WINTERIZATION REQ'D. <input type="checkbox"/> TROPICALIZATION REQ'D.		<input type="checkbox"/> INLET FILTER DIRT INDICATOR	
SITE DATA:		<input type="checkbox"/> JOCKY WHEEL	
<input type="checkbox"/> ELEVATION _____ PM BAROMETER _____ (kPa abs)		REMARK: _____	
<input type="checkbox"/> RANGE OF AMBIENT TEMPS.:		_____	
DRY BULB WET BULB		_____	
SITE RATED °C _____		_____	
NORMAL °C _____		NOISE SPECIFICATIONS:	
MAXIMUM °C _____		ACOUSTIC HOUSING: <input type="checkbox"/> YES <input type="checkbox"/> NO	
MINIMUM °C _____		SOUND LEVEL _____ dB @ _____ PM	
UNUSUAL CONDITIONS: <input type="checkbox"/> DUST <input type="checkbox"/> HUMID		dB RE: 0.0001 MICROBAR	
<input type="checkbox"/> OTHER _____		_____	
REMARKS: _____		PAINTING:	
_____		<input type="checkbox"/> MANUFACTURER'S STD.	
_____		<input type="checkbox"/> OTHERS _____	
_____		SHIPMENT:	
_____		<input type="checkbox"/> DOMESTIC <input type="checkbox"/> EXPORT <input type="checkbox"/> EXPORT BOXING REQ'D.	
_____		<input type="checkbox"/> LONG TERM STORAGE FOR _____ MONTHS	

(to be continued)

APPENDIX A (continue)

PORTABLE ROTARY TYPE POSITIVE  
DISPLACEMENT COMPRESSORS  
DATA SHEET SI UNITS

JOB NO. \_\_\_\_\_ ITEM NO. \_\_\_\_\_  
PAGE 2 OF 4 BY \_\_\_\_\_  
DATE \_\_\_\_\_ REVISION \_\_\_\_\_

<input type="checkbox"/> CASING		<input type="checkbox"/> BEARING HOUSING	
MODEL _____		TYPE: <input type="checkbox"/> SEPARATE <input type="checkbox"/> INTEGRAL	
CASING SPLIT _____		SPLIT _____ MATERIAL _____	
MATERIAL _____		BEARINGS	
THICKNESS mm _____ CORR. ALLOW. mm _____		RADIAL: MAKE _____ TYPE _____	
(BARG) _____		SPAN (mm) _____ AREA (mm <sup>2</sup> ) _____	
MAX. WORK. PRESS. _____ (kPa)		LOADING (N/mm <sup>2</sup> ): ACT _____ ALLOW _____	
(BARG) _____		THRUST BEARING: _____	
RELIEF VALVE SETTING _____ (kPa)		LOCATION _____ TYPE _____	
(BARG) _____		MFR _____ AREA (mm <sup>2</sup> ) _____	
TEST PRESS. (kPa) HELIUM _____ HYDRO _____		LOADING (N/mm <sup>2</sup> ) _____ ACT. _____ ALLOW. _____	
MAX. ALLOW. TEMP. _____ °C MIN. OPER. TEMP. _____ °C		CONNECTIONS	
MAX. CASING CAPACITY (INLET m <sup>3</sup> /h) _____		SERVICE	NO
RADIOGRAPH QUALITY <input type="radio"/> YES <input type="radio"/> NO		SIZE	TYPE
<input type="checkbox"/> ROTORS		DISCHARGE AIR	
DIAMETER (mm): _____		LUBE OIL INLET	
NO. LOBES: MALE _____ FEMALE _____		LUBE OIL OUTLET	
TYPE: _____		CASING DRAINS	
TYPE FABRICATION _____		VENTS	
MATERIAL _____		COOLING	
MAX. YIELD STRENGTH (N) _____		PRESSURE	
BRINELL HARDNESS: MAX. _____ MIN. _____		TEMPERATURE	
ROTOR LENGTH TO DIAMETER RATIO (L/D) _____		REMARK: _____ _____ _____ _____ _____	
ROTOR CLEARANCE (mm) _____			
MAX. DEFLECTION (mm) _____			
MAX. MACHINE MACH NO. @ LOBES _____			
INTERNALLY COOLED _____ UNCOOLED _____			
SHAFT			
<input type="checkbox"/> MATERIAL _____			
<input type="checkbox"/> DIA @ ROTORS (mm) _____			
<input type="checkbox"/> DIA @ COUPLING (mm) _____			
SHAFT END <input type="checkbox"/> TAPERED <input type="checkbox"/> CYLINDRICAL			

(to be continued)

APPENDIX A (continue)

PORTABLE ROTARY TYPE POSITIVE  
DISPLACEMENT COMPRESSORS  
DATA SHEET SI UNITS

JOB NO. \_\_\_\_\_ ITEM NO. \_\_\_\_\_  
PURCH. ORDER NO. \_\_\_\_\_ DATE \_\_\_\_\_  
REQUISITION NO. \_\_\_\_\_  
INQUIRY NO. \_\_\_\_\_  
PAGE 3 OF 4 BY \_\_\_\_\_

DATE \_\_\_\_\_ REVISION \_\_\_\_\_

INSTRUMENT REQUIREMENTS			☐ PACKAGE MEASUREMENTS		
<b>PRESSURE GAGE:</b>			<b>○ OVERALL LENGTH (STRAIGHT TOWBAR)</b>		
LUBE OIL PUMP DISCHARGE	<input type="checkbox"/>	<input type="checkbox"/>	_____ m		
LUBE OIL FILTER ΔP	<input type="checkbox"/>	<input type="checkbox"/>	<b>BODY WIDTH</b> _____ m <b>TRACK WIDTH</b> _____ m		
LUBE OIL SUPPLY	<input type="checkbox"/>	<input type="checkbox"/>	<b>HEIGHT</b> _____ m		
DISCHARGE AIR	<input type="checkbox"/>	<input type="checkbox"/>	<b>GROUND CLEARANCE</b> _____ m		
INTAKE AIR FILTER ΔP	<input type="checkbox"/>	<input type="checkbox"/>	<b>TYPE SIZE</b> _____ m		
COOLING	<input type="checkbox"/>	<input type="checkbox"/>	<b>DRY WEIGHT</b> _____ kg		
<b>REMARKS</b> _____ _____			<b>WET WEIGHT</b> _____ kg		
			<b>SHOP INSPECTION AND TESTS</b>		
<b>TEMPERATURE GAGE:</b>				<b>REQ'D</b>	<b>WITNESS</b>
LUBE OIL DISCHARGE FROM			SHOP INSPECTION	<input type="checkbox"/>	<input type="checkbox"/>
COMPRESSOR BEARINGS	<input type="checkbox"/>	<input type="checkbox"/>	HYDROSTATIC	<input type="checkbox"/>	<input type="checkbox"/>
ENGINE BEARINGS	<input type="checkbox"/>	<input type="checkbox"/>	MECHANICAL RUN	<input type="checkbox"/>	<input type="checkbox"/>
COOLER OIL INLET & OUTLET	<input type="checkbox"/>	<input type="checkbox"/>	PERFORMANCE TEST (AIR)	<input type="checkbox"/>	<input type="checkbox"/>
COMPRESSOR DISCHARGE	<input type="checkbox"/>	<input type="checkbox"/>	COMP. WITH DRIVER	<input type="checkbox"/>	<input type="checkbox"/>
LUBE OIL RESERVOIR	<input type="checkbox"/>	<input type="checkbox"/>	COMP. LESS DRIVER	<input type="checkbox"/>	<input type="checkbox"/>
<b>MISCELLANEOUS INSTRUMENTATION:</b>			PRESSURE COMP. TO FULL OPER. PRESS.	<input type="checkbox"/>	<input type="checkbox"/>
ALARM HORN & ACKNOWLEDGEMENT SWITCH	<input type="checkbox"/>	<input type="checkbox"/>	DISASSEMBLE REASSEMBLE COMP		
LUBE OIL RESERVOIR LEVEL INDICATOR	<input type="checkbox"/>	<input type="checkbox"/>	AFTER TEST	<input type="checkbox"/>	<input type="checkbox"/>
ENGINE FUEL TANK LEVEL INDICATOR	<input type="checkbox"/>	<input type="checkbox"/>	CHECK BRGS.	<input type="checkbox"/>	<input type="checkbox"/>
ENGINE SPEED INDICATOR	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>
ENGINE HOURS COUNTER	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>
<b>ALARM AND SHUTDOWN SWITCHES:</b>				<input type="checkbox"/>	<input type="checkbox"/>
	<b>ALARM</b>	<b>TRIP</b>	<b>REMARKS:</b> _____ _____ _____ _____ _____ _____ _____ _____ _____ _____		
HI ENGINE SPEED	<input type="checkbox"/>	<input type="checkbox"/>			
HI ENGINE COOLENT TEMP	<input type="checkbox"/>	<input type="checkbox"/>			
LOW LUBE OIL PRESSURE	<input type="checkbox"/>	<input type="checkbox"/>			
HI LUBE OIL FILTER ΔP	<input type="checkbox"/>	<input type="checkbox"/>			
HI COMP. DISCH. TEMP.	<input type="checkbox"/>	<input type="checkbox"/>			
HI LUBE OIL OUTLET TEMP. (COOLER)	<input type="checkbox"/>	<input type="checkbox"/>			
	<input type="checkbox"/>	<input type="checkbox"/>			
	<input type="checkbox"/>	<input type="checkbox"/>			
	<input type="checkbox"/>	<input type="checkbox"/>			

# APPENDIX B INTERNAL COMBUSTION DIESEL ENGINE DATA SHEET

JOB No. \_\_\_\_\_ ITEM No. \_\_\_\_\_  
PAGE \_\_\_\_\_ OF \_\_\_\_\_ BY \_\_\_\_\_  
DATE \_\_\_\_\_ REVISION \_\_\_\_\_

NOTE: INFORMATION TO BE COMPLETED BY:		<input type="checkbox"/> PURCHASER	<input type="checkbox"/> VENDOR
FOR _____ UNIT _____ ENGINE ITEM NO. _____ ENGINE SERIAL NO. <input type="checkbox"/> _____ ENGINE MANUFACTURER <input type="checkbox"/> _____		SITE _____ SERVICE _____ QUANTITY _____ SIZE/TYPE <input type="checkbox"/> _____	
<input type="checkbox"/> OPERATING CONDITION		<input type="checkbox"/> DESIGN AND CONSTRUCTION	
DRIVE EQUIPMENT _____ DUTY: PORTABLE AIR COMPRESSOR _____ KW MAX. POWER REQ'D _____ SPEED REQ'D (RPM) _____ ALTITUDE (m) _____ MAX. AMBIENT TEMP. (°C) _____ TYPE OF ENGINE FUEL GAS OIL _____ INSTAL: <input type="checkbox"/> INDOOR <input checked="" type="radio"/> OUTDOOR <input type="checkbox"/> SHELTERED <input type="checkbox"/> UNSHELTERED C/P CY AT _____ °C      kPa FUEL HHV _____ kJ/m <sup>3</sup> LHV _____ kJ/m <sup>3</sup> FUEL PRESS. MAX/MIN _____ kPa FUEL TEMP. MAX/MIN _____ °C		NO. CYLINDERS/NO. CYCLES _____ ARRANGEMENT _____ BORE (mm) _____ STROKE (mm) _____ PISTON SPEED (MAX) _____ m/sec      SPM MAX. ALLOW. SHAFT SPEED _____ RPM SHAFT ROTATION _____ VIEWED FROM CPLG. END CYLINDERS: <input type="checkbox"/> LINED, <input type="checkbox"/> UNLINED, <input type="checkbox"/> WET, <input type="checkbox"/> DRY ENGINE COOLING: <input type="checkbox"/> RADIATOR, <input type="checkbox"/> AIR FN, <input type="checkbox"/> _____ MAIN BRGS. NO. _____ TYPE _____ SIZE _____ CRANK BRGS. NO. _____ TYPE _____ SIZE _____ INTAKE VALVES NO. _____ SIZE _____ SEATS: <input type="checkbox"/> INTEGRAL, <input type="checkbox"/> RENEWABLE LUBRICATION SYSTEM _____ <input type="checkbox"/> FORCED FEED, <input type="checkbox"/> SPLASH, <input type="checkbox"/> _____ OIL PUMP: <input type="checkbox"/> INTEGRAL, <input type="checkbox"/> SEPARATE, <input type="checkbox"/> _____ OIL FILTER: <input type="checkbox"/> SINGLE, <input type="checkbox"/> DUPLEX, <input type="checkbox"/> _____ LUBE OIL TYPE/GRADE _____ <input type="checkbox"/> TURBOCHARGED <input type="checkbox"/> NAT. ASPIRATED <input type="checkbox"/> _____ TUFF. IN. EQUIP. _____ REMARKS _____ _____ _____	
<input type="checkbox"/> PERFORMANCE		<input type="checkbox"/> MATERIALS OF CONSTRUCTION	
ISO CONT. RATING _____ kW AT _____ RPM ISO PEAK RATING _____ kW AT _____ RPM SITE CONT. RATING _____ kW AT _____ RPM COMP. RATIO _____ FUEL PRESS. REQ'D MAX/MIN _____ kPa FUEL HEATER REQ'D FOR START UP _____ <input type="checkbox"/> YES <input type="checkbox"/> NO REMARKS _____		FRAME _____ CRANK SHAFT _____ CONN. RODS _____ CYLINDERS _____ LINERS _____ PISTONS _____ CYLINDER HEADS _____ MAIN BRGS. _____ CRANK BRGS. _____ WRIST PINS _____ VALVES _____ INTAKE _____ SEAT _____ EXHAUST _____ SEAT _____ REMARKS _____	
<input type="checkbox"/> EQUIPMENT & ACCESSORIES		<input type="checkbox"/> INSTRUMENTATION	
STARTER: <input checked="" type="radio"/> ELECTRIC <input type="radio"/> HYDRAULIC <input type="radio"/> PNEUMATIC START UP: <input type="checkbox"/> MANUAL (LOCAL/REMOTE) <input type="checkbox"/> AUTO <input type="checkbox"/> BOTH BATTERIES TYPE _____ AMP. IRR. CAP. <input type="checkbox"/> _____ BATTERY CHARGER <input type="checkbox"/> _____ DRIVE TYPE: <input type="checkbox"/> DIRECT, <input type="checkbox"/> GEAR, <input type="checkbox"/> _____ CLASS TYPE/MFR. _____ CLUTCH REQ'D: <input type="checkbox"/> NO <input type="checkbox"/> YES, TYPE, MFR. _____ GEAR REQ'D: <input type="checkbox"/> NO <input type="checkbox"/> YES, RATIO _____ MFR. _____ GOVERNOR TYPE/MFR. _____ CLASS _____ PRELUBE PUMP & DRIVE REQ'D <input type="checkbox"/> NO <input type="checkbox"/> YES LUBE OIL COOLER: <input type="checkbox"/> AIR BLAST, <input type="checkbox"/> SHELL & TUBE LUBE OIL HEATER WITH THERMOSTAT: _____ C.W. HEATER WITH THERMOSTAT: _____ INTAKE AIR FILTER: <input type="checkbox"/> DRY, <input type="checkbox"/> WET, <input type="checkbox"/> _____ EXHAUST SYSTEM COMPLETE WITH: SILENCER, <input type="checkbox"/> SPARK ARRESTOR, <input type="checkbox"/> EXPA. JOINT HORIZ. PIPE (mm) <input type="checkbox"/> _____ VERT. PIPE (mm) <input type="checkbox"/> _____ <input type="checkbox"/> DOWN <input type="checkbox"/> _____ LAGGING <input type="checkbox"/> _____ DAY FUEL TANK CAPACITY _____ LIT <input checked="" type="radio"/> SKID MOUNTED FUEL FILTER: <input type="checkbox"/> SINGLE, <input type="checkbox"/> DUPLEX, _____ TACHOMETER: <input type="checkbox"/> MECHANICAL, <input type="checkbox"/> ELECTRICAL, <input type="checkbox"/> _____ COMPLETE ENGINE ENCLOSURE REQ'D <input type="checkbox"/> NO <input type="checkbox"/> YES DIMENSIONS (mm): LENGTH <input type="checkbox"/> _____ WIDTH <input type="checkbox"/> _____ HEIGHT <input type="checkbox"/> _____ WEIGHTS (kg): TOTAL <input type="checkbox"/> _____ HEAVIEST PART FOR OVERHAUL <input type="checkbox"/> _____		SHUTDOWN DEVICES <input checked="" type="radio"/> LOW OIL PRESS <input checked="" type="radio"/> HIGH COOLING TEMP <input checked="" type="radio"/> HIGH OIL TEMP <input checked="" type="radio"/> OVER SPEED INDICATION <input checked="" type="radio"/> SPEED <input checked="" type="radio"/> HOUR COUNTER <input checked="" type="radio"/> FUEL TANK LEVEL <input checked="" type="radio"/> OIL PRESSURE <input checked="" type="radio"/> COOLING TEMP. <input checked="" type="radio"/> BATTERY CHARGING <input checked="" type="radio"/> LOW BATTERY VOLTAGE	