Packaged Reciprocating Plant and Instrument Air Compressors for General Refinery Services

API STANDARD 680
FIRST EDITION, OCTOBER 1987

American Petroleum Institute
1220 L Street, Northwest
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Refining Department

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FOREWORD

This standard is based on the accumulated knowledge and experience of petroleum refiners and manufacturers of packaged reciprocating plant and instrument air compressors. The objective of this publication is to provide a purchase specification for double-acting reciprocating compressors of 600 brake horsepower and below for use in refinery services.

The primary purpose of API standards on mechanical equipment is to establish minimum mechanical requirements. This limitation in scope is one of charter as opposed to interest and concern. Energy conservation is of concern and has become increasingly important in all aspects of equipment design, application, and operation. Thus, innovative energy-conserving approaches should be aggressively pursued by the manufacturer and the user during these steps. Alternative approaches that may result in improved energy utilization should be thoroughly investigated and brought forth. This is especially true of new equipment proposals, since the evaluation of purchase options will be based increasingly on total life costs as opposed to acquisition cost alone. Equipment manufacturers, in particular, are encouraged to suggest alternatives to those specified when such approaches achieve improved energy effectiveness and reduced total life costs without sacrifice of safety or reliability.

This standard requires the purchaser to specify certain details and features. Although it is recognized that the purchaser may desire to modify, delete, or amplify sections of this standard, it is strongly recommended that all modifications, deletions, and amplifications be made by supplementing this standard, rather than by rewriting or by incoporating sections thereof into another complete standard.

Suggested revisions are invited and should be submitted to the director of the Refining Department, American Petroleum Institute, 1220 L Street, N.W., Washington, D.C. 20005.

IMPORTANT INFORMATION CONCERNING USE OF ASBESTOS OR ALTERNATIVE MATERIALS

Asbestos is specified or referenced for certain components of the equipment described in some API standards. It has been of extreme usefulness in minimizing fire hazards associated with petroleum processing. It has also served as a universal sealing material, compatible with most refining fluid services.

Certain serious adverse health effects are associated with asbestos, among them the serious and often fatal diseases of lung cancer, asbestosis, and mesothelioma (a cancer of the chest and abdominal linings). The degree of exposure to asbestos varies with the product and the work practices involved.

Consult the most recent edition of the Occupational Safety and Health Administration, U.S. Department of Labor, Occupational Safety and Health Standard for Asbestos, Tremolite, Anthophyllite, and Actinolite, 29 *Code of Federal Regulations* Section 1910.1001; the U.S. Environmental Protection Agency, National Emission Standard for Asbestos, 40 *Code of Federal Regulations* Sections 61.140 through 61.156; and the proposed rule by the U.S. Environmental Protection Agency proposing labeling requirements and phased banning of asbestos products, published at 51 *Federal Register* 3738-3759 (January 29, 1986).

There are currently in use and under development a number of substitute materials to replace asbestos in certain applications. Manufacturers and users are encouraged to develop and use effective substitute materials that can meet the specifications for, and operating requirements of, the equipment to which they would apply.

Information concerning safety and health risks and proper precautions with respect to particular materials and conditions should be obtained from the employer, the manufacturer or supplier of that material, or the Material Safety Data Sheet.

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SECTION 1—GENERAL

1.1 Scope

This standard covers the minimum requirements for double-acting reciprocating compressors of 600 brake horse power (448 kilowatts) and below used in refinery services with lubricated or nonlubricated cylinders in utility air and/or instrument air service up to 125 pounds per square inch gage (8.6 bar). Driver, related lubricating systems, controls, instrumentation, intercooler, aftercooler, receiver, and other auxiliary equipment are covered in this standard. The compressor will generally be spared.

CAUTION: Compressors intended for instrument air service require dry cylinders to supply oil-free air. Compressors used in plant air service can be either of the dry-cylinder or lubricated-cylinder type construction. Because air/oil mixtures may ignite, the purchaser/user is cautioned of the need to carefully select the cylinder lubricant and consider all operating conditions. Temperature criteria are described in 2.3.

NOTE: A bullet (•) at the beginning of a paragraph indicates that a decision by the purchaser is required. These decisions should be indicated on the data sheets (see Appendix A); otherwise, they should be stated in the quotation request or in the order.

1.2 Alternative Designs

The vendor may offer alternative designs (see 5.1 for proposal requirements). Equivalent metric dimensions, fasteners, and flanges may be substituted as mutually agreed upon by the purchaser and the vendor.

1.3 Conflicting Requirements

In case of conflict between this standard and the inquiry or order, the information included in the order shall govern.

1.4 Definition of Terms

1.4.1 Terms used in this standard are defined in 1.4.1.1 through 1.4.1.18.

1.4.1.1 *Combined rod loading* is the algebraic sum of gas load and inertia force. *Gas load* is the force resulting from differential gas pressure acting on the piston differential area. *Inertia force* is the force resulting from the acceleration of reciprocating mass. The inertia force with respect to the crosshead pin is the summation of all reciprocating masses (piston and rod assembly and crosshead assembly including pin) times their acceleration.

1.4.1.2 *Inlet cubic feet per minute (ICFM)* refers to the flow rate determined at the conditions of pressure, temperature, compressibility, and moisture at the compressor inlet flange. [Inlet cubic feet per minute is identical to actual cubic feet per minute (ACFM).]

1.4.1.3 *Manufacturer's rated capacity* is the capacity used to size the compressor. The manufacturer's rated capacity is calculated by dividing the rated capacity (see 1.4.1.11) by 0.97. This result accommodates the acceptable normal manufacturing tolerance of ±3 percent in capacity so that the rated capacity will never be less than the lower limit of the tolerance.

1.4.1.4 *Maximum allowable continuous rod loading* is the highest force that a manufacturer will permit for continuous operation on the compressor piston rod, the cross head assembly, the connecting rod, and the crankshaft.

1.4.1.5 *Maximum allowable speed* (in revolutions per minute) is the highest speed at which the manufacturer's design will permit continuous operation.

1.4.1.6 *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). This includes operating in the unloaded condition.

1.4.1.7 *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) (see 2.6.1.1).

1.4.1.8 *Minimum allowable speed* (in revolutions per minute) is the lowest speed at which the manufacturer's design will permit continuous operation.

1.4.1.9 The *normal operating point* is the point at which usual operation is expected and optimum efficiency is desired. This point is usually the point at which the vendor certifies that performance is within the tolerances stated in this standard.

1.4.1.10 The *pressure casing* is the composite of all stationary pressure-containing parts of the unit, including all connections, nozzles, and other attached parts.

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

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

1.4.1.13 *Rated discharge temperature* is the predicted (not theoretical adiabatic) operating temperature resulting from the rated service conditions.

1.4.1.14 *Rated power* of the compressor is the maximum power the compressor plus any shaft-driven appurtenances require for any of the specified operating conditions. The rated power includes the effect of any equipment (such as pulsation suppression devices, piping, intercoolers, aftercoolers, and separators) furnished by the compressor vendor. (Drive system losses are stated separately.)

1.4.1.15 *Rated speed* (in revolutions per minute) is the operating speed necessary to meet the rated service conditions.

1.4.1.16 *Standard cubic feet per minute (SCFM)* refers to capacity at a pressure of 14.7 pounds per square inch absolute (1.01 bar) and a temperature of 60 F (15.6 C).

1.4.1.17 *Standby service* refers to a normally idle or idling piece of equipment that is capable of immediate automatic or manual startup and continuous operation.

1.4.1.18 *Trip speed* (in revolutions per minute) is the speed at which the independent emergency overspeed device operates to shut down a prime mover. (For steam turbines and reciprocating engines, the trip speed shall be at least 110 percent of the maximum continuous speed. For gas turbines, the trip speed shall be at least 105 percent of the maximum continuous speed.)

1.4.2 The 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 the manufacturer.

1.5 Referenced Publications

1.5.1 The editions of the following standards, codes, and specifications that are in effect at the time of publication of this standard shall, to the extent specified herein, form a part of this standard. The applicability of changes in standards, codes, and specifications that occur after the inquiry shall be mutually agreed upon by the purchaser and the vendor.

AFBMA[1]

Std 7 *Shaft and Housing Fits for Metric Radial Ball and Roller Bearings*

AISI[2]

Standards, codes, and specifications of the American Iron and Steel Institute

ANSI[3]

B1.1 *Unified Inch Screw Threads (UN and UNR Thread Form)*
B16.1 *Cast Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250, and 800*
B16.5 *Pipe Flanges and Flanged Fittings*
B16.11 *Forged Steel Fittings, Socket-Welding and Threaded*
B16.42 *Ductile Iron Flanges and Flanged Fittings, Class 150 and 300*
B31.3 *Chemical Plant and Petroleum Refinery Piping* (ANSI/ASME B31.3)
S2.19 *Balance Quality of Rotating Rigid Bodies*
Y14.2M *Line Conventions and Lettering*

API

RP 500A *Classification of Areas for Electrical Installations in Petroleum Refineries*
RP 520 *Recommended Practice for the Design and Installation of Pressure-Relieving Systems in Refineries*, Part I—Design and Part II—Installation
Std 526 *Flanged Steel Safety Relief Valves*
RP 550 *Manual on Installation of Refinery Instruments and Control Systems*
Std 611 *General-Purpose Steam Turbines for Refinery Services*
Std 613 *Special-Purpose Gear Units for Refinery Services*
Std 615 *Sound Control for Mechanical Equipment for Refinery Services*
Std 660 *Shell-and-Tube Heat Exchangers for General Refinery Services*
Std 661 *Air-Cooled Heat Exchangers for General Refinery Services*
Std 677 *General-Purpose Gear Units for Refinery Services* (in preparation)

ASME[4]

Boiler and Pressure Vessel Code, Section VIII, Rules for Construction of Pressure Vessels, and Section IX, Welding and Brazing Qualifications

B1.20.1 *General Purpose (Inch) Pipe Threads*

PTC 9 *Performance Test Code—Displacement Compressors, Vacuum Pumps and Blowers*

ASTM[5]

A 53 *Zinc-Coated Welded and Seamless Black and Hot-Dipped Steel Pipe*

A 106 *Seamless Carbon Steel Pipe for High-Temperature Service*

A 192 *Seamless Carbon Steel Boiler Tubes for High-Pressure Service*

A 247 *Evaluating the Microstructure of Graphite in Iron Castings*

A 269 *Seamless and Welded Austenitic Stainless Steel Tube for General Service*

A 278 *Gray Iron Castings for Pressure-Containing Parts for Temperatures up to 650°F (345°C)*

A 312 *Seamless and Welded Austenitic Stainless Steel Pipe*

A 358 *Electric-Fusion-Welded Austenitic Chromium-Nickel Alloy Steel Pipe for High-Temperature Service*

A 395 *Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures*

A 515 *Carbon Steel Pressure Vessel Plates for Intermediate- and Higher-Temperature Service*

A 536 *Ductile Iron Castings*

E 125 *Reference Photographs for Magnetic Particle Indications on Ferrous Castings*

E 709 *Practice for Magnetic Particle Examination*

AWS[6]

D1.1 *Structural Welding Code—Steel*

NEMA[7]

MG 1 *Motors and Generators*

NFPA[8]

70 *National Electrical Code*, Article 500, "Hazardous Locations," and Article 501, "Class I Installation—Hazardous Locations"

OSHA[9]

Occupational Safety and Health Standards of the *Federal Register*

SAE[10]

Standards and specifications of the Society of Automotive Engineers

TEMA[11]

Standards of the Tubular Exchanger Manufacturers Association

1.5.2 The purchaser and the vendor shall mutually determine the measures that must be taken to comply with any federal, state, or local codes, regulations, ordinances, or rules that are applicable to the equipment.

SECTION 2—BASIC DESIGN

2.1 General

2.1.1 The equipment (including auxiliaries) covered by this standard shall be designed and constructed for a minimum service life of 20 years. It is recognized that this is a design criterion.

2.1.2 The package vendor shall assume responsibility for the engineering coordination of the equipment and all auxiliary systems included in the scope of supply.

2.1.3 Control of the sound pressure level (SPL) of all equipment furnished shall be a joint effort of the purchaser and the vendor. Unless otherwise specified, the equipment furnished by the vendor shall conform to the requirements of API Standard 615 and to the maximum allowable sound pressure level specified by the purchaser.

[1]Anti-Friction Bearing Manufacturers Association, 1234 Jefferson Davis Highway, Arlington, Virgnia 22202.

[2]American Iron and Steel Institute, 1000 16th Street, N W , Washington, D C. 20036.

[3]American National Standards Institute, 1430 Broadway, New York, New York 10018.

[4]American Society of Mechanical Engineers, 345 East 47th Street, New York, New York 10017

[5]ASTM, 1916 Race Street, Philadelphia, Pennsylvania 19103.

[6]American Welding Society, 550 LeJeune Road, N W. Miami, Florida 33135.

[7]National Electrical Manufacturers Association, 2101 L Street, N W , Washington, D C. 20037

[8]National Fire Protection Association, Batterymarch Park, Quincy, Massachusetts 02269.

[9]Occupational Safety and Health Administration, U.S. Department of Labor, Washington, D C. 20210.

[10]Society of Automotive Engineers, 400 Commonwealth Drive, Warrendale, Pennsylvania 15096.

[11]Tubular Exchanger Manufacturers Association, 25 North Broadway, Terrytown, New York 10591.

2.1.4 Unless otherwise specified, cooling water systems shall be designed for the following conditions:

Velocity over heat exchange surfaces	5-8 ft/s	1.5-2.5 m/s
Maximum allowable working pressure	≥75 psig	≥5.2 bar (ga)
Test pressure	≥115 psig	≥7.9 bar (ga)
Maximum pressure drop	15 psi	1 bar
Maximum inlet temperature	90 F	32 C
Maximum outlet temperature	120 F	49 C
Maximum temperature rise	30 F	17 C
Minimum temperature rise	20 F	11 C
Fouling factor on water side	0.002 hr-ft²-°F/Btu	0.35 m²•K/kw

Provision shall be made for the complete venting and draining of the system.

NOTE: The vendor shall notify the purchaser if the criteria for minimum temperature rise and velocity over heat exchange surfaces result in a conflicting design. The criterion for velocity over heat exchange surfaces is intended to minimize water-side fouling; the criterion for minimum temperature rise is intended to minimize the use of cooling water. The purchaser will approve the final selection.

2.1.5 Equipment shall be designed to run without damage to the trip speed and relief valve settings.

2.1.6 The arrangement of the equipment, including piping and auxiliaries, shall be developed jointly by the purchaser and the vendor. The arrangement shall provide adequate clearance areas and safe access for operation and maintenance.

2.1.7 Electrical components and installations shall be suitable for the area classification (class, group, and division) specified by the purchaser on the data sheets and shall meet the requirements of NFPA 70, Articles 500 and 501, as well as local codes specified and furnished by the purchaser.

2.1.8 Oil reservoirs and housings 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 and idleness.

2.1.9 All equipment shall be designed to permit rapid and economical maintenance, particularly packing and valves. Major parts such as cylinders and compressor frames should be shouldered or doweled to ensure accurate alignment on reassembly.

2.1.10 After installation, the combined performance of the package shall be the joint responsibility of the vendor and the purchaser. Units shall perform on the test stand and on their permanent foundation within the specified acceptance criteria.

2.1.11 The compressor power at the manufacturer's rated capacity shall not exceed the rated power by more than 3 percent.

●**2.1.12** Many factors (such as piping loads, alignment at operating conditions, supporting structure, handling during shipment, and handling and assembly at site) may adversely affect site performance. To minimize the influence of these factors, the vendor shall review and comment on the purchaser's piping and foundation drawings, and the vendor's representative shall observe a check of the piping performed by parting the flanges. The vendor's representative shall check alignment at the operating temperature and, when specified, shall be present during initial alignment check.

●**2.1.13** The purchaser will specify whether the installation is indoors (heated or unheated) or outdoors (with or without a roof), as well as the weather and environmental conditions in which the equipment must operate (including maximum and minimum temperatures and unusual humidity or dust problems). The unit and its auxiliaries shall be suitable for operation in these specified conditions. For the purchaser's guidance, the vendor shall list in the proposal any special protection that the purchaser is required to supply (see 5.1, item l).

2.1.14 Spare parts for the machine and all furnished auxiliaries shall meet all the criteria of this standard.

2.1.15 Bolting shall be furnished as specified in 2.1.15.1 through 2.1.15.4.

2.1.15.1 The details of threading shall conform to ANSI B1.1.

2.1.15.2 Studs are preferred to cap screws.

2.1.15.3 Adequate clearance shall be provided at bolting locations to permit the use of socket or box wrenches. The vendor shall supply any required special tools and fixtures.

2.1.15.4 Socket-, slotted-nut-, or spanner-type bolting shall not be used unless specifically approved by purchaser.

2.1.16 Jackscrews, guide rods, and casing alignment dowels shall be provided to facilitate disassembly and reassembly of cylinder heads to cylinders.

2.1.17 Methods of lifting the assembled machine shall be specified by the vendor.

2.1.18 Provisions to ease removal of vertical piston and rod assemblies shall be included.

2.1.19 The machined finish of the mounting surfaces shall be 125 micro-inches (3.2 micrometers) arithmetic average roughness height (R_a) or better. Hold-down or foundation bolt holes shall be drilled perpendicular to the mounting surface or surfaces and spot faced to a diameter three times that of the hole.

2.1.20 Jacket cooling systems shall be designed to positively prevent leakage of air into the coolant or coolant into the air passages. The vendor shall state the method for achieving this in the proposal.

2.1.2.1 Compressor capacity shall at least equal the requirements of 1.4.1.3.

2.2 Allowable Speeds

● **2.2.1** Compressors shall be conservatively rated at a speed not in excess of that known by the manufacturer to result in low maintenance and trouble-free operation under the specified service conditions. The maximum acceptable average piston velocity [in feet (meters) per minute] and the maximum allowable rotating speed (in revolutions per minute) may be specified by the purchaser where experience indicates limits that should not be exceeded for a given service.

NOTE: Generally the piston velocities of compressors in nonlubricated services should be less than those in lubricated services.

● **2.2.2** To avoid excitation of torsional and acoustic resonances, reciprocating compressors should normally be specified for constant speed operation. When variable speed drivers are specified, all equipment shall be designed to run safely to the trip speed. For variable speed drives, a listing of unsafe or undesirable speeds shall be furnished to the purchaser by the vendor (see 2.5 and 3.1).

2.3 Discharge Temperature

2.3.1 The rated discharge temperature resulting from any specified service conditions, including part-load operation, shall not exceed the following for each stage;

a. 300 F for hydrocarbon oil lubricated cylinders.
b. 360 F for nonlubricated cylinders.
c. A temperature mutually agreed upon by the vendor and the purchaser for synthetic oil lubricated cylinders.

2.3.2 An alarm shall actuate when the discharge temperature of any cylinder exceeds the rated discharge temperature by 20 F (11 C).

2.3.3 An alarm shall actuate and the compressor shall shut down when the discharge temperature of any cylinder exceeds the rated discharge temperature by 40 F (22 C).

2.4 Rod Loading

The combined rod loading at any specified operating load step shall not exceed the manufacturer's maximum allowable continuous rod loading for the compressor. These combined rod loads shall be calculated on the basis of relief valve set point pressure and normal suction pressure corresponding to each load step.

2.5 Dynamics

2.5.1 The compressor package vendor shall assume full responsibility for the performance of necessary lateral and torsional studies and the elimination of any lateral or torsional vibrations that may occur within the specified operating range in any specified loading step. The vendor shall state the speeds (from dead stop up to or down from trip speed or synchronous speed) at which all critical speeds occur.

2.5.2 Torsional natural frequencies of the driver-compressor system (including couplings and any gear unit) within 10 percent of any operating shaft speed or trip speed and within 5 percent of twice any operating shaft speed in the rotating system shall be avoided. For motor driven compressors, torsional natural frequency orders shall be separated from the first and second harmonics of the electrical frequency by the same range.

2.5.3 For geared units, involving either motor or steam turbine drivers, the vendor shall perform a torsional analysis of the compressor-gear-driver arrangement. This analysis shall verify that the limits of encroachment upon torsional natural frequencies as noted in 2.5.2 are met.

2.6 Compressor Cylinders

2.6.1 GENERAL

2.6.1.1 Maximum allowable working pressure shall exceed the rated discharge pressure by at least 10 percent or 10 pounds per square inch (0.7 bar), whichever is greater. The maximum allowable working pressure of the cylinder shall be at least equal to the specified relief valve setting.

2.6.1.2 Cylinders shall be spaced and arranged to permit access to all openings and components (including water jacket opening covers, distance piece covers, packing, valves, unloaders, or other controls mounted on the cylinder) without removing the cylinder, the cylinder head, or major piping.

2.6.1.3 Tandem two-stage construction is not acceptable.

2.6.1.4 If cylinder supports are required to avoid misalignment, they shall not be attached to the cylinder head. Rod run out shall not exceed 0.0005 inch per inch (0.012 millimeters per 25.4 millimeters) of stroke.

2.6.1.5 The walls of cylinders without liners shall be of a thickness sufficient to provide for a total of ⅛-inch (3.2-millimeter) diameter of overboring without encroaching upon either the maximum allowable working pressure or the maximum allowable rod load. Cylinder bore finish for lubricated services shall not exceed 63 micro-inches (1.6 micrometers) arithmetic average roughness height (R_a). Cylinder bores for nonlubricated services shall not exceed 32 micro-inches (0.81 micrometers) arithmetic average roughness height (R_a).

2.6.1.6 Cylinder heads, stuffing boxes for pressure packing, clearance pockets, and valve covers shall be fastened with studs. The cylinder lips supporting these components shall be so proportioned that overtorquing studs up to 100 percent above the manufacturer's recommended torque will not cause lip failure. All stud holes shall be drilled no deeper than necessary to allow a maximum tap depth of one and one-half times the major diameter of the stud.

2.6.1.7 Cylinders shall have cooling provisions as required by conditions of service.

2.6.1.7.1 Air-cooled cylinders are acceptable for compressors rated at 75 horsepower (56 kilowatts) or less, provided that allowable discharge temperature limits as specified in 2.3 are not exceeded.

2.6.1.7.2 Compressors rated at powers greater than 75 horsepower (56 kilowatts) must be liquid cooled as follows:

a. For services where maximum expected discharge temperatures are less than 190 F (88 C) and the requirements of 2.6.1.7.2 item b have been satisfied, static-filled coolant systems may be supplied (see Plan A in Figure B-1 of Appendix B).

b. For services where expected maximum discharge temperatures are between 190 F (88 C) and 210 F (99 C), or where the adiabatic air temperature rise (difference between suction temperature and discharge temperature based on isentropic compression) is less than 150 F (66 C) and where cylinders will not be required to operate unloaded for extended periods of time, thermosyphon coolant systems may be supplied (see Plan B in Figure B-1).

c. For services where maximum expected discharge temperatures are above 210 F (99 C), where the adiabatic air temperature rise exceeds 150 F (66 C), or where cylinders will operate fully unloaded for extended periods of time, forced liquid coolant circulation through cylinder jackets shall be provided (see Figure B-1, Plan C and cautionary note).

NOTE: For a high ambient temperature site condition of 110 F (43 C) or higher, thermosyphon or static-filled systems may not be suitable.

2.6.1.8 The cylinder cooling system provided shall be adequate to prevent condensation in the cylinder that may dilute or remove lubricant or cause knocking. The purchaser is cautioned regarding the following:

a. Coolant inlet temperatures less than 10 F (6 C) higher than air inlet temperatures may cause air constituent condensation.
b. Insufficient coolant flow and velocities may cause fouling of jackets and passages.
c. Coolant exit temperature higher than 30 F (17 C) above air inlet temperature may result in a capacity reduction.

●**2.6.1.9** When specified, a self-contained, closed-jacket coolant system shall be furnished. It shall meet the following requirements (refer to Figure B-2 of Appendix B):

a. The coolant supply to each cylinder jacket shall enter the jacket at a temperature at least 10 F (6 C) above air inlet temperature. A heating unit shall be provided for use during cold weather operation and prior to startup to bring the system up to temperature
b. The quantity of coolant circulated by each pump shall be regulated to maintain a coolant temperature rise across any individual cylinder, including the cylinder head, between 10 and 20 F (6 and 11 C).
c. The system shall be pre-piped, factory skid mounted, and complete with the various pressure and temperature indicators, alarms, and other instrumentation as specified on the data sheets.

2.6.1.10 If nonlubricated or other special construction is specified, a complete description of piston, ring, and rod-packing designs (including materials of construction and cylinder bore finish) shall be included in the proposal.

2.6.1.11 Tapped holes in pressure parts shall be held to a minimum. To prevent leakage in pressure sections of castings, sufficient metal in addition to the allowance for corrosion shall be left around and below the bottom of drilled and tapped holes.

2.6.2 CYLINDER CONNECTIONS

2.6.2.1 Flanged or machined and studded inlet and outlet air connections are preferred. They shall be oriented as specified on the data sheets and suitable for the working pressure of the cylinder as defined in 1.4. Where flanged or machined and studded openings are impractical, threaded

openings are permissible in sizes 2-inch and 3-inch nominal pipe size, installed as described in 2.6.2.1.1 through 2.6.2.1.4.

2.6.2.1.1 A pipe nipple, preferably not more than 6 inches (152 millimeters) long, shall be screwed into the threaded opening.

2.6.2.1.2 Pipe nipples shall be Schedule 80.

2.6.2.1.3 The pipe nipple shall be provided with either a slip-on, welding-neck, or socket-weld flange.

2.6.2.1.4 Tapped openings and bosses for pipe threads shall conform to ANSI B16.5.

2.6.2.2 Flanges shall conform to ANSI B16.1, B16.5, or B16.42 as applicable, except as noted in 2.6.2.2.1 and 2.6.2.2.2.

2.6.2.2.1 Flat-faced flanges with full raised face thicknesses are acceptable.

2.6.2.2.2 Flanges that are thicker or have a larger outside diameter than that required by ANSI are acceptable.

2.6.2.3 Machined and studded connections shall conform to ANSI B16.1, B16.5, or B16.42 for the facing and drilling requirements. Studs and nuts shall be furnished installed.

● **2.6.2.4** When specified, each cylinder shall have connections for attaching pressure transducers.

2.6.2.5 Openings for water and oil services may be threaded in sizes ½ inch through 2 inch nominal pipe size.

2.6.2.6 Openings for pipe sizes of 1¼, 2½, 3½, 5, 7, and 9 inches shall not be used.

2.6.2.7 Tapped openings not connected to piping shall be plugged with solid steel plugs furnished in accordance with ANSI B16.11. Plugs that may later require removal shall be of corrosion-resistant material. Threads shall be lubricated. Tape shall not be applied to threads of plugs inserted into oil passages. Plastic plugs are not permitted.

2.6.2.8 All purchaser's connections shall be accessible for disassembly without moving the machine.

2.7 Valves

2.7.1 Average inlet valve air velocity shall be computed as follows:

$$V = 288\ D/A$$

Where:

V = average air velocity, in feet (meters) per minute.

D = cylinder displacement, in cubic feet (cubic meters) per minute.

A = product of the actual lift obtained in service and the valve-opening periphery; total for all inlet valves per cylinder in square inches (square meters).

NOTE: Valve lifts used in the above equation shall be shown on the data sheet.

● **2.7.2** Valve and unloader designs shall be suitable for operation as specified on the data sheets. Each individual step of unloading shall be provided with a visual indication of its position and its load (loaded or unloaded) condition. If valve unloading is required for startup, it shall be so stated in the proposal.

2.7.3 The valve design, including that for double-decked valves, shall be such that valve assemblies cannot be incorrectly assembled or interchanged nor shall it be possible to insert a valve assembly upside down.

2.7.4 Valve seats shall be removable. Valve seat-to-cylinder gaskets shall be the manufacturer's standard. Jacketed gaskets are preferred for the cover-to-cylinder joint.

2.7.5 The valve and cylinder designs shall be such that the valve cage or the assembly bolts (or both) cannot fall into the cylinder even if the valve assembly bolts break or unfasten.

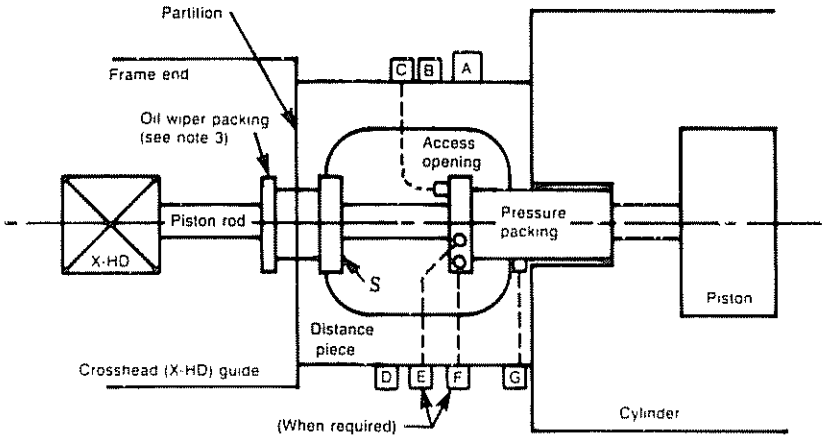
2.7.6 When furnished, the ends of the valve coil springs shall be square and ground to protect the plate against damage by the spring ends.

2.7.7 Valve hold-downs shall bear at no less than three points on the valve assembly. The bearing points shall be arranged as symmetrically as possible.

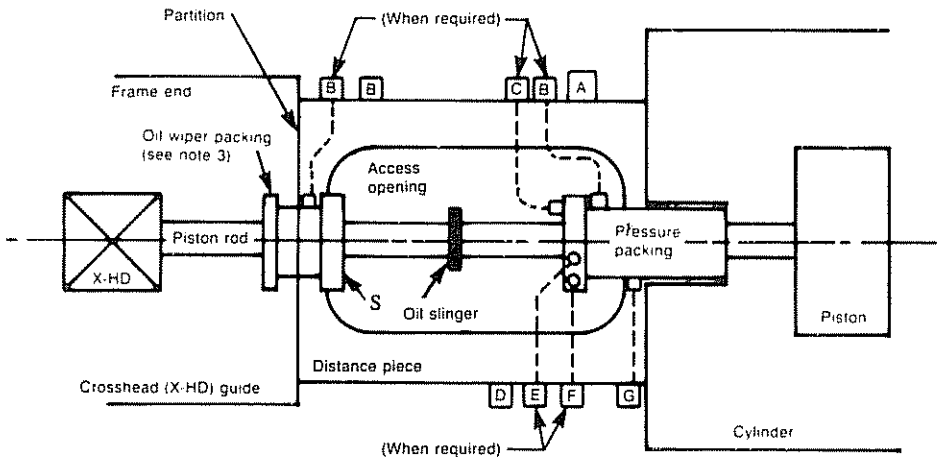
2.7.8 Metal valve disks or plates, when furnished, shall be suitable for installation with either side sealing and shall be lapped on both sides. Edges shall be suitably finished to remove stress risers.

2.8 Piston and Piston Rods

2.8.1 When pistons are removable from the rod, they shall be attached to the rod by a shoulder and lock nut design. The nuts on the end shall be positively locked in place. The rod shall be positively locked to the crosshead (when installed) to prevent rotation. The operating and maintenance



TYPE A
Short single-compartment distance piece
(may be integral with crosshead guide or distance piece)



TYPE B
Long single-compartment distance piece
(sufficient length for oil slinger travel)

Key
A Vent (distance piece)
B Purge, buffer, or pressure (packing or distance piece)
C Lube (pressure packing)
D Drain (distance piece)
E Coolant out (pressure packing)
F Coolant in (pressure packing)
G Common vent and drain (pressure packing)
S Seal or buffer packing (distance piece)

NOTES:
1 See 2.6 for connection sizes.
2. Orientation of distance pieces and packing flange/case connections may vary depending on individual distance piece and type of packing case used.
3 Oil wiper packing may be located in distance piece on either side of the partition from that shown and would be an integral assembly with the seal or buffer packing (S).

Figure 1—Distance Piece and Packing Arrangement

distance piece shall be equipped with oil wiper rings. For lubricated service, the crank end of the distance piece shall be equipped with two oil wiper rings installed for wiping in both directions.

2.11 Stuffing Boxes and Packing

2.11.1 If a particular packing is not specified by the purchaser on the data sheets, the manufacturer shall recommend a packing arrangement for the specified service.

2.11.2 Glands shall be bolted to the cylinder head or to the cylinder.

2.11.3 In both lubricated and nonlubricated service, adequate radial clearance shall be provided between the piston rod surface and the crank-end cylinder head bore, the compressor cylinder packing case, and the gland bore to eliminate possible scoring when maximum wear of the piston wear band occurs.

2.11.4 All oil wiper and seal rings shall be segmented and have garter springs.

2.12 Compressor Frame Lubrication

2.12.1 The frame lubrication system shall be a pressure system; however, splash systems may be used to lubricate crankshaft antifriction bearings on compressors of 350 horsepower (261 kilowatts) or less. Crankcase oil temperature shall not exceed 160 F (71 C) for pressurized oil systems and 180 F (82 C) for splash systems.

2.12.2 Pressure lubrication systems shall consist of a shaft-driven oil pump with a suction strainer, a supply and return system, an oil cooler (when required), a full-flow filter, and other necessary instruments. Unless otherwise specified, the compressor crankcase shall also function as the oil reservoir.

2.12.3 All oil-containing pressure components, including the auxiliary pump (if any), shall be steel, except that crankshaft-driven lube oil pumps and other components internal to the compressor frame may have cast iron or nodular iron construction.

●**2.12.4** When specified, a separate, full-capacity, full-pressure auxiliary pump with an automatic start at low lubrication oil pressure shall be provided by the package vendor.

2.12.5 Both main and auxiliary pumps shall be provided with pressure relief valves piped back to the crankcase reservoir. Nonintegral relief valves are preferred.

●**2.12.6** An oil cooler shall be provided if required to maintain lube oil supply temperature at or below 130 F (54 C). The cooler shall be a water-cooled, shell-and-tube type, or it shall be a suitable air-cooled type, as specified. Shell-and-tube coolers shall have water on the tube side. A removable bundle design is required for coolers having more than 5 square feet (0.46 square meter) of surface, unless otherwise specified by the purchaser. Removable bundle coolers shall be in accordance with TEMA Class C and shall be constructed with a removable channel cover. Tubes shall not have an outside diameter of less than ⅝ inch (16 millimeters), and the tube wall shall not have a thickness of less than 18 Birmingham wire gage (BWG) [0.049 inches (91.25 millimeters)]. U-bend tubes are not permitted. The vendor shall state the lubricating oil pressure at the cooler outlet so that the purchaser may provide water at a lower pressure, if desired, to prevent contamination of the lubricating oil in case of cooler failure. Unless otherwise specified, shells, channels, and covers for the coolers shall be steel; tube sheets shall be naval brass; and tubes shall be inhibited admiralty. Coolers shall be equipped with vent and drain connections on their oil and water sides. The vendor shall include complete details of any proposed air-cooled cooler in the proposal. Internal oil coolers are not acceptable. When specified, lube oil temperature should be thermostatically controlled.

●**2.12.7** The manufacturer's standard full-flow filter shall be supplied with filtration of 25 microns nominal or finer for babbitted bearings and 10 microns nominal or finer for aluminum or microbabbitted bearings. The filter shall be located downstream of the cooler. Filter cases and heads shall be suitable for operation at a pressure not less than the discharge pressure of the oil pump. The filter shall not be equipped with an internal relief valve or bypass. Filter cartridge materials shall be corrosion resistant. For all replaceable cartridge filters, the clean pressure drop shall not exceed 5 pounds per square inch (0.34 bar) at design temperature and flow. The cartridge collapse differential pressure drop shall not be less than 70 pounds per square inch (4.8 bar). When specified, dual filters shall be supplied complete with a separate or integral continuous flow transfer valve. The filter or filters shall be equipped with vent and clean- and dirty-side drain connections. A dual filter system shall be designed to permit cartridge replacement and repressuring during operation.

●**2.12.8** When specified, a removable steam-heating element inserted in the crankcase (oil reservoir) or a thermostatically controlled electrical immersion heater with sheath of Series 300 stainless steel shall be provided for heating the charge capacity of oil before startup in cold weather. The heating device shall have sufficient capacity to heat the oil in the crankcase from the specified minimum

site ambient temperature to 80 F (27 C) within 12 hours. If an electrical immersion heater is used, it shall have a maximum watt density of 15 watts per square inch (2.3 watts per square centimeter).

2.12.9 The crankcase (oil reservoir) shall be supplied with the following characteristics and appendages:

a. The capacity to settle moisture and foreign matter adequately, to avoid frequent refilling, and to provide adequate allowance for system run down.
b. Fill connections, level indicators, and breathers suitable for outdoor use.
c. Sloped bottoms and connections to complete drainage.
d. Cleanout openings as large as is practicable.
e. An interior that has been descaled and protected from rust by the manufacturer's standard procedure, subject to the purchaser's approval. (Permanent surface coatings shall not be applied without the purchaser's specific approval.)

2.13 Cylinder and Packing Lubrication

2.13.1 Lubrication to compressor cylinders shall be provided by forced-feed mechanical lubricators, as specified, either single-plunger-per-feed or divider-block types separate from the frame lubrication pump and complete with necessary tubing or piping (see 3.7.3). Single-plunger-per feed lubricators shall have a sight flow indicator for each lubrication point. A lubrication point (or points) shall be provided on the compressor cylinder bore. A lubrication point shall be provided for rod packing except in certain air compressors where the packing is lubricated from the cylinder. A check valve shall be provided at each lubrication point. Mechanical lubricators shall have provision for a prelubrication operation prior to compressor startup. Reservoir capacity shall be adequate for 30 hours. All controls on the cylinder and packing lubrication system shall be adjustable while the compressor is operating. If an electrical immersion heater is used, it shall have a maximum watt density of 15 watts per square inch (2.3 watts per square centimeter).

● **2.13.2** When specified, a heating device for the reservoir oil shall be provided.

● **2.13.3** The purchaser will specify when compressor cylinders will be lubricated by synthetic lubricants. The lubricant specifications shall be entered on the data sheets by the purchaser unless the vendor's recommendation is desired. All gaskets, seals, unloader diaphragms, packing, lubricator parts, and other parts coming in contact with the synthetic lubricant shall be of compatible materials agreed upon by the compressor manufacturer and the lubricant manufacturer. Synthetic cylinder lubricant in the cylinders may contaminate the crankcase oil; therefore, crankcase interior surfaces should be left unpainted. If interior surfaces must be painted, a synthetic-lubricant-resistant coating recommended by the lubricant manufacturer shall be used.

2.14 Materials

2.14.1 GENERAL

2.14.1.1 Materials for compressor parts shall be in accordance with those listed in Appendix C, except that superior or alternative materials recommended by the vendor shall be listed on the data sheets. See 3.7.1 for auxiliary piping material requirements.

2.14.1.2 Materials shall be identified in the proposal with their applicable ASTM, AISI, ASME, or SAE numbers, including the material grade (see Appendix C). When no such designation is available, the vendor's material specification, giving physical properties, chemical composition, and test requirements, shall be included in the proposal (see 5.1, item k and 5.2.4.3).

2.14.1.3 The vendor shall specify the ASTM optional tests and inspection procedures necessary to ensure that materials are satisfactory for the service. Such tests and inspections shall be listed in the proposal. The purchaser should consider specifying additional tests and inspections, especially for material in critical service (see 5.1, item j).

2.14.1.4 ASTM A 515 steel can be notch sensitive and prone to brittle fracture at ambient temperatures. Use of ASTM A 515 is, therefore, prohibited.

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

2.14.1.6 Minor parts that are not identified (such as nuts, springs, washers, gaskets, and keys) shall have corrosion resistance equal to that of specified parts in the same environment.

2.14.1.7 Where mating parts such as studs and nuts of Series 300 stainless steel or materials with similar galling tendencies are used, they shall be lubricated with a suitable antiseizure compound.

2.14.1.8 Materials, casting factors, and the quality of any welding shall be equal to those required by Section VIII, Division 1, of the ASME Code. The manufacturer's data report forms, as specified in the code, are not required (see 2.14.4.2).

2.14.2 CASTINGS

2.14.2.1 The vendor shall specify the material grade of castings on the data sheets.

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

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

2.14.2.4 For compressors below 150 horsepower (112 kilowatts), crankshafts made of ASTM A 536 ductile iron Grade 100-70-03 are acceptable. Crankshafts of ASTM A 278 gray cast iron are not acceptable. All offerings for ductile iron crankshafts (see 2.10) shall be reviewed with the purchaser for additional nondestructive testing requirements not required by the ASTM specification.

2.14.2.5 Ferrous castings shall not be repaired by welding, peening, plugging, or burning in except as specified in 2.14.2.5.1 and 2.14.2.5.2.

2.14.2.5.1 Weldable grades of steel castings may be repaired by welding, using a qualified welding procedure based on the requirements of Section IX of the ASME Code.

2.14.2.5.2 Cast gray iron or ductile iron may be repaired by plugging within the limits specified in ASTM A 278 or A 395, respectively. The drilled holes for a plug shall be carefuly examined, using dye penetrant, to ensure the removal of all defective material. All necessary repairs not covered by ASTM specifications shall be subject to the purchaser's approval. Weld repairs are not permitted.

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

●**2.14.2.7** If specified, cylinders and cylinder heads of ductile iron shall be produced in accordance with ASTM A 395. The production of the castings shall also conform to the conditions specified in 2.14.2.7.1 through 2.14.2.7.5.

2.14.2.7.1 A minimum of one set of Charpy V-notch impact specimens at one third of the thickness of the test block shall be made from material adjacent to the tensile specimen on each keel or Y-block. These specimens shall have a minimum impact value of 10 foot-pounds (13.6 joules) at room temperature.

2.14.2.7.2 The keel or Y-block cast at the end of the pour shall be at least as thick as the thickest section of the main casting.

2.14.2.7.3 Integrally cast test bosses, preferably at least 1 inch (25 millimeters) in height and diameter, shall be provided at critical areas of the casting for subsequent removal for the purposes of hardness testing and microscopic examination. Critical areas are typically heavy sections, section changes, and high-stress points such as lubrication drilling points, the cylinder bore, valve ports, flanges, and other points as agreed upon by the purchaser and the vendor. Classification of graphite nodules shall be in accordance with ASTM A 247.

2.14.2.7.4 An as-cast sample from each ladle shall be chemically analyzed.

2.14.2.7.5 Brinell hardness readings shall be made on the actual casting at feasible locations on section changes, flanges, the cylinder bore, and valve ports. Sufficient surface material shall be removed before hardness readings are made to eliminate skin effect. Readings also shall be made at the extremities of the casting at locations that represent the sections poured first and last. These shall be made in addition to Brinell readings on the keel or Y-blocks.

2.14.2.8 Impregnation of pressure-containing castings shall require prior purchaser approval.

NOTE: Appendix D describes some repair procedures that may be considered for gray or ductile iron castings. These techniques should only be applied after a thorough mutual evaluation by the purchaser and the vendor.

2.14.3 FORGINGS

Unless otherwise agreed upon by the purchaser and the vendor, forging material shall be selected from those listed in Appendix C.

2.14.4 WELDING

2.14.4.1 Welding of pipes and pressure-containing parts, as well as any dissimilar-metal welds or weld repairs, shall be performed by operators and procedures qualified in accordance with Section IX of the ASME Code.

2.14.4.2 The vendor shall be responsible for the review of all repairs and repair welds to ensure that they are properly heat treated and nondestructively examined for soundness and compliance with the applicable qualified procedures (see 2.14.1.8).

2.14.4.3 Inspection of repair welds shall be performed in accordance with 2.14.6.3.

2.1.4.4.4 Unless otherwise specified, all welding other than that covered by Section VIII, Division 1, of the ASME Code and ANSI/ASME B31.3, such as welding on baseplates, nonpressure ducting, lagging, and control panels, shall be performed in accordance with AWS D1.1.

● 2.14.5 LOW TEMPERATURE

For operating temperatures below −20 F (−29 C) and when specified for other low ambient temperature, steels shall have, at the lowest specified temperature, an impact strength sufficient to qualify under the minimum Charpy V-notch impact energy requirements of Section VIII, Division 1, UG-84, of the ASME Code. For materials and thicknesses not covered by the code, the purchaser shall specify the requirements on the data sheets.

2.14.6 MATERIAL INSPECTION

● **2.14.6.1** When radiography, ultrasonic, magnetic particle, or liquid penetrant inspection of welds or materials is required or specified, radiography shall be in accordance with Section VIII, UW-52, of the ASME Code; ultrasonic examination shall be in accordance with Section VIII, Division 1, Appendix 12, of the ASME Code; magnetic particle examination shall be in accordance with Section VIII, Division 1, Appendix 6, and liquid penetrant examination shall be in accordance with Section VIII, Division 1, Appendix 8, of the ASME Code.

2.14.6.2 For crankshafts, frames, and cylinders and any other major components, fully identified records of all heat treatment and radiography, whether performed in the normal course of manufacture or as part of a repair procedure, shall be kept available for 5 years for review by the purchaser.

2.14.6.3 When magnetic particle examination as described in ASTM E 709 is required, acceptability of defects shall be based on a comparison with the photographs in ASTM E 125. For each type of defect, the degree of severity shall not exceed the limits in the following table:

Type	Degree
I	1
II	2
III	2
IV	1
V	1
VI	1

Regardless of these generalized limits, it shall be the vendor's responsibility to review the design limits of all castings in the event that more stringent requirements are specified. Defects that exceed the limits imposed above shall be removed to meet the quality standards cited above, as determined by additional magnetic particle inspection, before repair welding (see 2.14.4.3).

2.15 Nameplates and Rotation Arrows

2.15.1 A nameplate shall be securely attached at an easily accessible point on the compressor frame and to any other major piece of equipment.

2.15.2 Rotation arrows shall be cast in or attached to each major item of rotating equipment. Nameplates and rotation arrows (if attached) shall be of Series 300 stainless steel or of nickel-copper alloy (Monel or its equivalent). Attachment pins shall be of the same material.

2.15.3 The purchaser's item number, the vendor's name, the machine's serial number, the compressor size and type, the maximum allowable design limits and rating data (including pressures, temperatures, speeds, and power), cylinder rated pressure(s), the maximum allowable working pressures and temperatures, hydrostatic test pressures, the total end clearance, and the cold clearance setting for each end shall appear on each compressor nameplate.

SECTION 3—ACCESSORIES

3.1 Drivers

3.1.1 The type of driver shall be specified by the purchaser. The driver shall be sized to meet the manufacturer's rated capacity (see 1.4.1.3), including external gear and/or coupling losses, and shall be in accordance with applicable specifications, as stated in the inquiry and the order. The driver shall be suitable for satisfactory operation under the utility and site conditions specified by the purchaser.

● **3.1.2** Anticipated inlet variations that may affect the sizing of the driver (such as changes in temperature and special plant startup conditions) will be specified by the purchaser.

● **3.1.3** The starting conditions for the driven equipment will be specified by the purchaser, and the starting method shall be mutually agreed upon by the purchaser and the vendor. The driver's starting-torque capabilities shall exceed the speed-torque requirements of the driven equipment.

3.1.4 For motor-driven units, the motor nameplate rating (exclusive of the service factor) shall be at least 110 percent of the manufacturer's rated capacity (including gear and coupling losses) for any of the specified operating conditions.

3.1.5 The purchaser will specify the type of motor and its characteristics, including the following:

a. Electrical characteristics.
b. Starting conditions (including the expected voltage drop on starting).
c. The type of enclosure.
d. The sound pressure level.
e. The area classification, based on API Recommended Practice 500A.
f. The type of insulation.
g. The required service factor.
h. The ambient temperature and elevation above sea level.
i. Transmission losses.

NOTE: If required, temperature detectors, vibration sensors, space heaters, and other accessories will be specified.

●**3.1.6** The motor's starting-torque requirements shall be met at a reduced voltage specified by the purchaser, and the motor shall accelerate to full speed within a period of time agreed upon by the purchaser and the vendor. Unless otherwise specified, the starting voltage will be 80 percent of the normal voltage, and the time required to accelerate to full speed will be less than 15 seconds.

3.1.7 Motors for auxiliary equipment shall be suitable for the area classification specified and shall be in accordance with Article 500 of NFPA 70.

3.1.8 Steam turbine drivers shall conform to API Standard 611. Steam turbine drivers shall be sized to continuously deliver 110 percent of the manufacturer's rated capacity while operating at a corresponding speed with the specified steam conditions.

3.1.9 Speed irregularity of belt driven units shall not exceed 2 percent of nominal compressor speed.

3.1.10 The inertia of the rotating parts of the combined synchronous motor-compressor installation shall be sufficient to limit motor current variations to a value not exceeding 66 percent of the full-load current (see NEMA MG 1, Paragraph 21.84) for all specified loading conditions including unloaded suction pressures. For induction motor-compresser installations, motor current variations shall not exceed 40 percent of the full load current. The purchaser shall furnish the vendor with the electrical system data necessary for proper design.

NOTE: The power supply for some installations may require tighter control of current variations to protect other equipment in the electrical system. Standard motor performance data are based on steady-state load conditions and may not reflect actual performance when subjected to the variable torque conditions encountered when driving reciprocating compressors. With induction motor drivers, the effects of variable torque and resultant current pulsations are more pronounced and require closer evaluation. See 2.2.2.

●**3.1.11** When the motor is supplied by the purchaser, the compressor vendor shall furnish the purchaser with the following:

a. Compressor torque effort diagram and/or inertia to satisfy flywheel requirements of the compressor for all specified operating conditions.
b. Starting torque requirements.
c. Mounting details, coupling details, or both.

3.1.12 All motor bearing lubrication points shall be piped to an accessible point. Piping and bearings shall be connected by flexible, heavy-duty braided grease hose.

3.2 Couplings and Guards

3.2.1 GENERAL

3.2.1.1 Flexible couplings and guards between drivers and driven equipment shall be supplied by the manufacturer of the driven equipment, unless otherwise specified on the data sheets.

3.2.1.2 The coupling make, type, and mounting arrangement shall be agreed upon by the driver and driven equipment vendors and by the purchaser. A spacer coupling shall be used, unless otherwise specified.

3.2.1.3 Information on shafts, keyway dimensions (if any), and shaft end movements due to end play and thermal effects shall be furnished to the vendor supplying the coupling.

3.2.1.4 The coupling-to-shaft juncture shall be designed and manufactured to be capable of transmitting power at least equal to the power rating of the coupling.

3.2.1.5 Each coupling shall have a coupling guard that sufficiently encloses the coupling and shafts to prevent any access to the danger zone by personnel during operation of the equipment train.

3.2.1.6 The guard shall be readily removable for inspection and maintenance of the coupling without disturbing the coupled machines.

3.2.1.7 The guard shall comply with OSHA Standard 1910.219.

● **3.2.1.8** When specified by the purchaser, the guard shall be fabricated from spark-resistant materials. A description of the materials of construction shall be submitted to the purchaser for approval.

3.2.1.9 Guards that are fastened to the equipment foundation or baseplate shall be removable in one piece.

3.2.1.10 Base-mounted guards shall preferably be fabricated from solid metal sheet or plate with no openings. Guards fabricated from expanded metal or perforated plate are acceptable provided that the size of the opening is small enough to prevent entry by objects ⅜ inch (9.5 millimeters) or larger in diameter. Guards fabricated from woven wire are unacceptable.

3.2.2 GUARDS FOR FLEXIBLE-DISK HIGH-SPEED COUPLINGS

● **3.2.2.1** When specified by the purchaser for turbine-gear box drivers, guards shall be designed to be essentially airtight at the radial and axial flanged joints and at the slip joint, if any. Guard design shall allow for potential heating caused by windage.

● **3.2.2.2** When specified, a flanged oil-drain connection [1 inch (2.5 centimeters) nominal or larger] shall be provided to handle any oil carry over into the guard from the coupled equipment.

●3.3 Reduction Gears

The gear unit design shall conform to API Standard 613 or 677, as specified.

3.4 Belt Drives

● **3.4.1** Belt drives shall be limited to compressors of 200 brake horsepower (149 kilowatts) or less and shall be banded multi-vee belts, unless otherwise specified. If more than one banded multi-vee belt is required, the vendor shall furnish matched belt lengths. All belt drives shall be oil resistant (with a neoprene or equivalent material cover). The drive service factor shall not be less than 1.75 times the driver nameplate power rating. When service in a hazardous area is specified, belt drivers of the static-conducting type shall be provided (see 3.2 for belt drive guards).

3.4.2 The vendor shall provide a positive belt-tensioning device on all belt drives. This device shall incorporate a lateral adjustable base with guides and hold-down bolts, two belt tensioning screws, and locking bolts.

3.4.3 The compressor manufacturer shall inform the driver manufacturer when the driver is to be used to belt-drive a compressor. The driver manufacturer shall be provided with the radial load and vibratory torque conditions associated with reciprocating compressors and shall account for this in the driver selection.

3.4.4 For belt drives, the practices described in 3.4.4.1 through 3.4.4.7 shall be incorporated.

3.4.4.1 Sheave center distance shall be no less than 1.5 times the large sheave diameter.

3.4.4.2 The belt wrap (contact) angle on the smaller sheave shall be no less than 140 degrees.

3.4.4.3 The shaft length for fitting the sheave hub shall be equal to or greater than the sheave hub width.

3.4.4.4 Shaft key fitting lengths for sheave mounting shall be no less than the sheave bore length.

3.4.4.5 The sheave shall be mounted on a tapered adapter bushing.

3.4.4.6 To reduce bearing moment loading (belt tension), a minimum sheave overhang distance for the sheave-to-shaft fitting shall be provided.

3.4.4.7 Sheaves shall be balanced to ANSI S2.19 Grade 6.3.

3.5 Baseplates

● **3.5.1** When a baseplate is specified, the data sheets will show the extent. A baseplate shall be a single fabricated steel unit, unless the purchaser and the vendor mutually agree that it may be fabricated in multiple sections. Multiple-section baseplates shall have machined and doweled mating surfaces to ensure accurate field reassembly.

NOTE: A baseplate with a nominal length of more than 40 feet (12 meters) or a nominal width of more than 12 feet (3.6 meters) may have to be fabricated in multiple sections because of shipping restrictions

● **3.5.2** When specified, the baseplate shall be suitable for column mounting (that is, of sufficient rigidity to be supported at specified points) without continuous grouting under structural members. The baseplate design shall be mutually agreed upon by the purchaser and the vendor.

● **3.5.3** The bottom of the baseplate between structural members shall be open. When the baseplate is installed on a concrete foundation, accessibility shall be provided for

grouting under all load-carrying structural members. The mounting pads on the bottom of the baseplate shall be in one plane to permit use of a single-level foundation. When specified, subsoleplates shall be provided by the vendor.

3.5.4 Unless otherwise specified, nonskid decking covering all walk and work areas shall be provided on the top of the baseplate.

● **3.5.5** When specified, the equipment feet and baseplates shall be equipped with vertical jackscrews to ease shim installation.

3.5.6 If mounted direct-driven rotating equipment weighs more than 1000 pounds (454 kilograms), the mounting plates shall be furnished with horizontal jackscrews the same size or larger than the vertical jackscrews.

3.5.7 Machinery supports shall be designed to limit a change of alignment caused by the worst combination of pressure, torque, or allowable piping stress to 0.005 inches (127 micrometers) at the coupling flange.

● **3.5.8** When epoxy grout is specified on the data sheets, the vendor shall precoat all the grouting surfaces of the mounting plates with a catalyzed epoxy primer applied to degreased white metal. The epoxy primer shall be compatible with the epoxy grout. The vendor shall submit to the purchaser instructions for field preparation of the epoxy primer.

3.5.9 Anchor bolts shall not be used to fasten machinery to the mounting plates.

3.5.10 Mounting plates shall not be drilled for equipment to be mounted by others. Mounting plates intended for installation on concrete shall be supplied with leveling screws. Mounting plates that are to be grouted shall have 2-inch-radiused (50-millimeter-radiused) corners (in the plan view).

3.5.11 Anchor bolts will be furnished by the purchaser.

3.6 Controls and Instrumentation

3.6.1 GENERAL

● **3.6.1.1** Compressor control systems may be pneumatic, electrical, or electronic and may be operated either manually or automatically. The purchaser will specify the control signal, the type of control system (manual or automatic), the control range, and the equipment to be furnished by the vendor.

3.6.1.2 Controls and instrumentation shall conform where practical, with API Recommended Practice 550, Part I.

3.6.1.3 Unless otherwise specified, controls and instrumentation shall be suitable for outdoor installation.

3.6.1.4 When more than one wiring point is required on the package for instrumentation control, wiring to each switch or instrument shall be provided from a single terminal box mounted on the package. Wiring shall be installed in conduit.

● **3.6.1.5** When specified, lead-lag or base-loaded control methods to sequence multiple compressor systems shall be provided.

● **3.6.1.6** When specified, all instruments and controls other than shutdown-sensing devices shall be installed with sufficient valving to permit removal of instruments and controls while the system is in operation.

3.6.2 CAPACITY CONTROL SYSTEMS

● **3.6.2.1** Capacity control shall normally be obtained by suction valve unloading, clearance pockets, a combination of both pockets and unloaders, or other control methods mutually agreed upon by the purchaser and the vendor. Control operation shall be automatic and/or manual as specified on the data sheets. Five-step unloading shall provide capacities of 100, 75, 50, 25, and 0 percent; three-step unloading shall provide capacities of 100, 50, and 0 percent; and two-step unloading shall provide capacities of 100 and 0 percent.

NOTE: Suction and clearance valve unloading configurations normally available consist of the following: two-step, less than 100 brake horsepower (75 kilowatts); three-step, 100-250 brake horsepower (75-187 kilowatts); five-step, optional for over 250 brake horsepower (187 kilowatts).

3.6.2.2 For turbine and engine drivers, actuation of the control signal or failure of the signal or actuator shall not prevent the governor from limiting the speed to the maximum permissible speed.

3.6.2.3 When furnished, clearance pockets shall be of the two-position type (either open or closed).

● **3.6.2.4** The unloading arrangement used for startup shall be stated on the data sheets or shall be mutually agreed upon by the purchaser and the vendor.

● **3.6.2.5** Cylinder unloading may be accomplished by the use of valve depressors, the opening of clearance pockets,

an internal bypass, or other methods mutually agreed upon by the purchaser and the vendor. Valve lifters shall not be used. When valve depressors are specified, all inlet valves of the cylinder ends involved shall be provided with unloaders.

3.6.3 CONTROL STATION

● **3.6.3.1** When specified, a control station shall be provided that includes a gage board and a NEMA 4 enclosure. All electrical devices shall be housed in the NEMA 4 enclosure, and other instrumentation and controls shall be mounted on the gage board. Motor-driven compressors shall be started from the station. The station shall be mounted on the compressor baseplate and protected from vibration. Refer to the data sheets for area classification and enclosures required. Certain area classifications may require purging or alternative types of enclosures. When required, purge connections shall be provided with a rotameter-type flow indicator. The instruments on the panel shall be clearly readable by the operator.

● **3.6.3.2** When specified, a weather hood for outdoor installations, including an overhead light, shall be provided over the control station.

3.6.3.3 The station shall include the following:

a. Pressure gages.
   (1). Lube oil.
   (2). Discharge air (each stage).
b. All required start/stop buttons.
c. Running light(s).
d. One alarm and one shutdown indicating light for each of the following:
   (1). Low lube oil pressure (if applicable).
   (2). High discharge air temperature (each stage).
   (3). High cooling water discharge temperature (each stage)
e. Lamp test push button.
f. Capacity control load indicators.
g. Load-unload selector switch.
h. Horn.

● In addition to the mandatory shutdowns listed above, additional alarms and shutdowns may be specified on the data sheets. When this is done, switches, control devices, indicating lights, and/or annunciator display units shall be furnished and mounted by the vendor, as specified by the purchaser.

3.6.3.4 The control station shall be completely piped and wired, requiring only connection to the purchaser's external piping and wiring circuits. Wiring shall be installed in conduit. All leads, posts on terminal strips, switches, and instruments shall be tagged for proper identification.

3.6.3.5 No terminal blocks shall be located in wireways. The terminals shall be of the straight-through-compression type with shrouded screws (dead front) and center tapping for test purposes. Terminal block connections shall be single level (not tiered). The NEMA enclosure shall contain two ¼ by 1 inch minimum (6 by 25 millimeters) bare soft copper, solid bar grounding buses. One shall be used for a signal ground, the other as an equipment ground bus. The instrument case shall not be grounded through the steel of the enclosure.

3.6.4 INSTRUMENTATION

3.6.4.1 Locally Mounted Instrumentation

Locally mounted instrumentation shall be provided as follows:

a. Discharge air temperature at each stage.
b. Cooling jacket water discharge temperature.
c. Reservoir oil level indicator.
d. Oil cooler inlet and outlet oil temperature.

●3.6.4.2 Tachometers

A tachometer shall be provided for engine-driven units and, when specified, for other variable-speed units. The type of tachometer (electrical, mechanical, vibrating reed, and so forth) will be specified by the purchaser on the data sheets. Mechanical tachometers shall be equipped with a disengaging clutch. Unless otherwise specified, the minimum tachometer range shall be from 0 to 125 percent of the maximum continuous speed.

3.6.4.3 Temperature Measurement Thermometers and Temperature Gages

3.6.4.3.1 Dial-type temperature gages shall be heavy duty and corrosion resistant. They shall be at least 5 inches (127 millimeters) in diameter and bimetallic or mercury filled. Black printing on a white background is standard for gages.

3.6.4.3.2 Metal-case, glass-front, stem-type bimetallic mercury thermometers shall be furnished.

3.6.4.3.3 The sensing element of thermometers and temperature gages shall be in the flowing fluid.

3.6.4.4 Thermowells

Thermometers and temperature gages shall be furnished with Series 300 stainless steel solid-bar thermowells at least

¾-inch nominal pipe size (NPS) (19 millimeters).

● 3.6.4.5 Pressure Gages

Pressure gages shall be furnished with Type 316 stainless steel bourdon tubes and stainless steel movements, 4½-inch (114-millimeter) dials and ½-inch National pipe thread (NPT) male alloy steel connections. Black printing on a white background is standard for gages. When specified, oil-filled gages shall be furnished in locations subject to vibration. Gage ranges shall preferably be selected so that the normal operating pressure is at the middle of the gage's range. In no case, however, shall the maximum reading on the dial be less than the applicable relief valve setting plus 10 percent. Each pressure gage shall be provided with a device, such as a disk insert or blowout back, designed to relieve excess case pressure.

3.6.4.6 Solenoid Valves

3.6.4.6.1 Direct solenoid-operated valves shall be used only in clean, dry, instrument-air service, shall have Class F insulation or better, and shall have a continuous service rating. When required for other services, the solenoid shall act as a pilot valve to pneumatic valves, hydraulic valves, and the like.

3.6.4.6.2 Solenoid valves shall not be used in continuous services that may affect normal operations, such as fuel controls. They may be used in intermittent instrument services, such as starting-cycle controls.

3.6.4.7 Relief Valves

The vendor shall furnish the relief valves that are to be installed on equipment or in piping that the vendor is supplying. Other relief valves will be furnished by the purchaser. Relief valves for all operating equipment shall meet the limiting relief valve requirements defined in API Recommended Practice 520, Parts I and II, and in API Standard 526. The vendor shall determine the size and set pressure of all relief valves related to the equipment. The vendor's quotation shall list all relief valves and shall clearly indicate those to be furnished by the vendor. Relief valve settings, including accumulation, shall take into consideration all possible types of equipment failure and the protection of piping systems.

3.6.5 ALARMS AND SHUTDOWNS

● 3.6.5.1 General

Switches, control devices, and annunciator display units shall be furnished and mounted by the vendor as specified by the purchaser.

3.6.5.2 Alarm and Trip Switches

3.6.5.2.1 Each alarm switch and each trip switch shall be furnished in a separate housing located to facilitate inspection and maintenance. Hermetically sealed, single-pole, double-throw switches with a minimum capacity of 5 amperes at 120 volts AC shall be used. Mercury switches shall not be used.

3.6.5.2.2 Unless otherwise specified, electric switches that open (deenergize) to alarm and close (energize) to trip shall be furnished by the vendor.

3.6.5.2.3 Alarm and trip switch settings shall not be adjustable from outside the housing. Alarm and trip switches shall be arranged to permit testing of the control circuit, including, when possible, the actuating element, without interfering with normal operation of the equipment. The vendor shall provide a clearly visible light on the panel to indicate when trip circuits are in a test bypass mode. Unless otherwise specified, trip systems shall be provided with switches or another suitable means to permit testing without shutting down the unit.

3.6.5.2.4 Pressure-sensing elements shall be of Series 300 stainless steel. Low-pressure alarms shall be equipped with a valved bleed or vent connection to allow controlled depressuring so that the operator can note the alarm set pressure on the associated pressure gage. High-pressure alarms shall be equipped with valved test connections so that a portable test pump can be used to raise the pressure.

3.6.5.2.5 With the proposal the vendor shall furnish a complete description of the alarm and trip facilities provided (see 5.1, item n).

3.6.6 ANNUNCIATOR

● **3.6.6.1** The annunciator, when specified, shall be of the first-out-sequence type with approximately 25 percent spare points.

3.6.6.2 Dry contacts shall be provided to actuate a remote alarm when any of the locally displayed compressor alarms operate or trip. The sequence of operation shall be as follows:

a. Alarm indication shall consist of a flashing light and the sounding of an annunciator horn or buzzer.
b. Acknowledgment of the alarm condition shall be accomplished by operating a common alarm-silencing button suitably located on the panel.
c. When the alarm is acknowledged, the horn or buzzer shall be silenced and the alarm light shall remain steadily lit.

The silenced annunciator shall still be capable of being sounded by a subsequent alarm from another station.

3.6.7 ELECTRICAL SYSTEMS

● **3.6.7.1** The characteristics of electrical power supplies for motors, heaters, and instrumentation will be specified by the purchaser. A pilot light shall be provided on the incoming side of each supply circuit to indicate that the circuit is energized. The pilot lights shall be installed on the control panels.

3.6.7.2 Electrical equipment located on the unit or on any separate panel shall be suitable for the hazard classification specified. Electrical starting and supervisory controls may be either AC or DC.

3.6.7.3 Power and control wiring within the confines of the baseplate shall be resistant to heat, moisture, and abrasion. Stranded conductors shall be used within the confines of the baseplate and in other areas subject to vibration. Measurement and remote-control panel wiring may be solid conductor. Where rubber insulation is used, a neoprene (or equivalent material) or high-temperature thermoplastic sheath shall be provided for insulation protection. All wiring shall be suitable for environmental temperatures.

3.6.7.4 To facilitate maintenance, liberal clearances shall be provided for all energized parts (such as terminal blocks and relays) on all equipment. The clearances required for 600-volt service shall also be provided for lower voltages.

● **3.6.7.5** Electrical materials including insulation shall be corrosion resistant and nonhygroscopic insofar as is possible. When specified for tropical locations, all material shall be given the following treatments:

a. Parts (such as coils and windings) shall be protected against fungus attack.
b. Unpainted surfaces shall be protected from corrosion by plating or other suitable coating.

3.6.7.6 Control, instrumentation, and power wiring within the limits of the baseplate shall be installed in rigid metallic conduits and boxes, properly bracketed to minimize vibration and isolated or shielded to prevent interference between voltage levels. Conduits may terminate with a flexible metallic conduit long enough to permit access to the unit for maintenance without removal of the conduit.

3.6.7.7 For Division 2 locations, flexible metallic conduits shall have a liquidtight thermosetting or thermoplastic outer jacket. For Division 1 locations, an NFPA-approved connector shall be provided.

3.6.7.8 Unless otherwise specified, all leads on terminal strips, switches, and instruments shall be permanently tagged for identification. All terminal boards in junction boxes and control panels shall have at least 20 percent spare terminal points.

3.7 Piping and Appurtenances

3.7.1 GENERAL

3.7.1.1 Piping design and joint fabrication, examination, and inspection shall be in accordance with ANSI/ASME B31.3.

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

3.7.1.3 The vendor shall furnish all piping systems, including mounted appurtenances, located within the confines of the main unit's base area, any console base area, or any auxiliary base area. The piping shall terminate with flanged connections at the edge of the base. The purchaser shall furnish only interconnecting piping between equipment groupings and off-base facilities.

3.7.1.4 Design of piping systems shall achieve the following:

a. Proper support and protection to prevent damage from vibration or from shipment, operation, and maintenance.
b. Proper flexibility and normal accessibility for operation, maintenance, and thorough cleaning.
c. Installation in a neat and orderly arrangement adapted to the contour of the machine without obstruction of access openings.
d. Elimination of air pockets.
e. Complete drainage through low points without disassembly of piping.

3.7.1.5 Piping shall preferably be fabricated by bending and welding to minimize the use of flanges and fittings. Welded flanges are permitted only at equipment connections, at the edge of any base, and for ease of maintenance. The use of flanges at other points is permitted only with the purchaser's specific approval. Other than tees and reducers, welded fittings are permitted only to facilitate pipe layout in congested areas. Threaded connections shall be held to a minimum. Pipe bushings shall not be used.

3.7.1.6 Pipe threads shall be taper threads in accordance with ANSI B2.1. Flanges shall be in accordance with ANSI B16.5. Slip-on flanges are permitted only with the pur-

Table 1—Minimum Piping Schedules

Material	Nominal Pipe Size (inches)	Minimum Schedule
Carbon steel	1½	80
Carbon steel	2 and larger	40
Stainless steel	1½ and smaller	40S
Stainless steel	2 and larger	10S

Table 2—Minimum Tubing Wall Thickness

Nominal Tubing Size (inches)	Minimum Wall Thickness	
	inches	millimeters
½	0.065	1.65
¾	0.095	2.41
1	0.109	2.76

chaser's specific approval. For socket-welded construction, a $\frac{1}{16}$-inch (1.6-millimeter) gap shall be left between the pipe end and the bottom of each socket.

3.7.1.7 Connections, pipe, valves, and fittings that are 1¼, 2½, 3½, 5, 7, or 9 inches in size shall not be used

3.7.1.8 Piping systems that contain steam at pressures above 75 pounds per square inch gage (5.2 bar gage) shall be of seamless carbon steel manufactured in accordance with ASTM A 106, Grade B; ASTM A 53, Grade B; or a purchaser-approved equivalent. Stainless steel shall be seamless in accordance with ASTM A 312 or shall be electric-fusion welded in accordance with ASTM A 358. The schedules in Table 1 apply.

3.7.1.9 Where space does not permit the use of ½-, ¾- or 1-inch nominal pipe, seamless steel tubing conforming to ASTM A 192 or stainless steel tubing conforming to ASTM A 269 may be furnished. Steel fittings may be furnished with ASTM 269 tubing. Tubing thickness shall meet the requirements of Table 2. The make and model of fittings shall be subject to the purchaser's approval.

3.7.1.10 Valves shall have bolted bonnets and glands.

3.7.1.11 Piping systems furnished by the vendor shall be fabricated, installed in the shop, and properly supported. Bolt holes for flanged connections shall straddle lines parallel to the main horizontal or vertical centerlines of the equipment.

3.7.1.12 Welding shall be performed by operators and procedures qualified in accordance with Section IX of the ASME Code.

3.7.1.13 Piping nipples shall be provided with unions or flanges for separation for maintenance purposes.

3.7.1.14 Unless otherwise specified, all oil-supply piping and tubing, including fittings (excluding slip-on flanges), shall be of Series 300 stainless steel.

3.7.2 FRAME LUBRICATING OIL PIPING REQUIREMENTS

3.7.2.1 Piping shall be flanged if sizes exceed 1½ inches; threaded piping is acceptable in smaller sizes. The vendor shall supply interconnecting piping between any lube oil subassembly and the compressor frame.

3.7.2.2 Piping or tubing shall conform to 3.7.1. Galvanized piping is not permitted. Bends for tubing or piping shall be used to minimize the number of fittings wherever possible. Pressure piping downstream of oil filters shall be free of internal obstructions or pockets (such as those created by socket-weld fittings) where dirt could accumulate. After fabrication, oil lines shall be thoroughly cleaned. Carbon steel lines shall be pickled, passivated, and immediately coated with a rust inhibitor.

3.7.3 FORCED-FEED LUBRICATION TUBING

Oil lines from forced-feed lubricators to cylinder and packing lubrication points shall have a minimum outside diameter of ¼ inch (6.4 millimeters) and a minimum wall thickness of 0.065 inch (1.7 millimeters). Tubing, fittings, and double-ball check valves shall be made of Series 300 stainless steel.

3.7.4 INSTRUMENT PIPING

3.7.4.1 The vendor shall supply all necessary piping, valves, and fittings for instruments and control stations (see 3.6.3.4).

3.7.4.2 Connections on equipment and piping for pressure instruments and test points shall conform to 3.7.1.3. Beyond the initial ¾-inch isolating valve, ½-inch piping, valves, and fittings may be used. Where convenient, a common connection may be used for remotely mounted instruments that measure the same pressure. Separate secondary ½-inch isolating valves are required for each instrument on a common connection. Where a pressure gage is to be used for testing pressure alarm or shutdown switches, common connections are required for the pressure gage and switches.

3.7.4.3 Instrument- and control-air tubing and fittings shall be of Series 300 stainless steel. Tubing thicknesses shall meet the requirements of Table 3.

Table 3—Minimum Tubing Wall Thickness for Instrument and Control Air

Nominal Tubing Size (inches)	Minimum Wall Thickness	
	inches	millimeters
¼	0 035	0 09
⅜	0 035	0 09
½	0 065	1 65

3.7.5 COOLANT PIPING

3.7.5.1 The vendor shall supply a cooling water piping system for all equipment mounted on the compressor package. The piping shall be arranged to provide single flanged inlet and outlet connections at the edge of the skid. Series-type circuits shall have the necessary valves and bypasses to provide temperature control. See 2.1.4 for system design criteria.

3.7.5.2 Unless otherwise specified, coolant piping of 2 inches and smaller may be threaded or flanged (slip-on, socket weld, or weld neck). Above 2-inch pipe size, only flanged connections shall be used. Piping material shall be of seamless steel per ASTM A 53, Grade B. Cooling water piping schedule shall be in accordance with Table 1. All fittings shall be carbon steel.

3.8 Intercoolers and Aftercoolers

3.8.1 Unless otherwise specified, intercoolers and aftercoolers shall be furnished in accordance with Section VIII, Division 1, of the ASME Code. When TEMA Class R is specified, the heat exchangers shall be in accordance with API Standard 660.

3.8.2 Materials of construction shall be those specified on the data sheets.

3.8.3 When condensate separation and collection facilities are furnished by the vendor, they shall include the following:

a. An automatic drain trap with a manual bypass.
b An armored gage glass on the collection pot.
c Separate connections and level switches for high-level alarm and trip on the collection pot.

3.8.4 Corrosion allowance for cast iron and carbon steel pressure parts shall be a minimum of ⅛ inch (3 millimeters).

3.8.5 Relief valves shall be provided on the air side of both intercoolers and aftercoolers.

3.8.6 Unless otherwise approved by the purchaser, intercoolers and aftercoolers shall be constructed to allow removal of tube bundles without dismantling piping or compressor components. Water is to be on the tube side (see Appendix E).

● **3.8.7** When air coolers are specified, they shall be in accordance with API Standard 661 (see also Appendix E).

3.8.8 Unless otherwise specified, air-cooled heat exchangers used for intercoolers shall have automatic temperature control. This control may be accomplished by louvers, variable-pitch fans, bypass valves, or any combination of these controls. Proposed control systems will be approved by the purchaser.

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

● **3.8.9** The purchaser will specify aftercooler outlet air requirements.

● 3.9 Air Intake Filters

For air compressors with an atmosphere suction, a dry-type air intake filter-silencer suitable for outdoor mounting shall be provided by the vendor and mounted on the suction flange, unless otherwise specified. The purchaser will specify which special design details, if any, are required. The vendor shall bring to the purchaser's attention any hazards believed to result from complying with the purchaser's specifications. As a minimum, the following features should be considered in the design of the filter-silencer:

a. Filtration rating (microns).
b. Galvanized metal parts.
c. In-service cleanable type.
d. Corrosion protection of the internal surface of inlet piping.
e. Corrosion-resistant fasteners.

NOTE: The purchaser is cautioned that local area conditions other than acoustical and vibration considerations (for example, local dust levels or fumes) may require remote location of the inlet filter

3.10 Pulsation Controls

3.10.1 System pulsation levels shall be in accordance with Table 4.

3.10.2 Basic techniques used for control of detrimental pulsations and vibrations are:

a. Pulsation suppression devices such as pulsation filters and attenuators including proprietary commercial designs based on acoustical suppression techniques, volume bottles without internals, choke tubes, orifice systems, and selected piping configurations.
b. System design based on studies of the interactive effects

Table 4—Maximum Peak-to-Peak Pressure Levels
(Percent of Mean Absolute Pressure)

Compressor Rated Horsepower (kw)	Suction Conditions	First Stage Cylinder Discharge Flange	Second Stage Cylinder Suction and Discharge Flange	Second Stage Pulsation Device Discharge Flange	Package Discharge Flange (user connection) (%)
To 99 (74)	Inlet filter mounted on cylinder suction flange (Note 1)	Manufacturer's standard	Manufacturer's standard	Not applicable	2
100-200 (75-149)	Note 1	7 percent (Note 2)	7 percent (Note 2)	Not applicable	2
201 (150) and up	Note 1	7 percent (Note 2)	7 percent (Note 2)	2 percent	

NOTES:
1. Remote inlet air filters are acceptable, however, the system shall be designed to limit pressure pulsations to 7 percent peak-to-peak of the absolute pressure at the suction flange of the first stage cylinder and shall not impair compressor performance (see 2.1.11 and 2.1.12).

2 For those cases where the 7 percent pulsation level cannot be met with the manufacturer's standard equipment, higher limits may then be used as agreed upon by the purchaser and the vendor.

of pulsations and the attenuation requirements for satisfactory piping vibration, compressor performance, and valve life.

● **3.10.3** Pulsation control shall be accomplished through the use of pulsation suppression devices designed using proprietary and/or empirical analytical techniques to meet the pulsation levels required. If specified, a simplified analysis of the purchaser's piping system based on the operating condition shall be performed to determine critical piping lengths that may be in resonance with acoustical harmonics. Acoustical simulation analysis is not required.

3.11 Air Receivers

3.11.1 Unless otherwise specified, an air receiver shall be provided.

● **3.11.2** Unless otherwise specified, the receiver shall be designed, fabricated, and code stamped in accordance with the ASME *Boiler and Pressure Vessel Code*, Section VIII, Division 1, latest addenda. If another code is required, this code shall be noted on the data sheets.

3.11.3 The receiver shall include the following features:

a. A drain piped and valved to the edge of the baseplate (if baseplate mounted unit is specified) or to the edge of the air receiver support stand.

b. A minimum wall thickness of ¼ inch. The corrosion allowance, if any, shall be as specified on the data sheets.

c. A relief valve.

d. A pressure gage.

3.11.4 The receiver shall be located as close to the aftercooler discharge flange as is practical.

● **3.11.5** Appendix F provides guidelines for sizing air receiver volume as a function of air compressor capacity. The purchaser will specify when air receiver volumes are required that are different from these standard sizes.

3.12 Special Tools

3.12.1 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 machine. For multi-unit installations, the requirements for quantities of special tools and fixtures shall be mutually agreed upon by the purchaser and the vendor.

3.12.2 When special tools are provided, they shall be packaged in separate, rugged boxes and marked "special tools for (tag/item number)." Each tool shall be tagged to indicate its intended use.

SECTION 4—INSPECTION, TESTING, AND PREPARATION FOR SHIPMENT

4.1 General

4.1.1 After advance notification of the vendor by the purchaser, the purchaser's representative shall have entry to all vendor and subvendor plants where manufacturing, testing, or inspection of the equipment is in progress.

4.1.2 The vendor shall notify subvendors of the purchaser's inspection and testing requirements.

4.1.3 The vendor shall provide sufficient advance notice to the purchaser before conducting any inspection or test that the purchaser desires to be witnessed or observed.

4.1.3.1 *Witnessed* means that a hold shall be applied to the production schedule and the inspection or test shall be carried out with the purchaser or his representative in attendance. For mechanical running or performance tests, this requires written notification of a successful preliminary test.

4.1.3.2 *Observed* means that the purchaser shall be notified of the timing of the inspection or test; however, the inspection or test is performed as scheduled, and if the purchaser or his representative is not present, the vendor shall proceed to the next step. (The purchaser should expect to be in the factory longer than for a witnessed test.)

4.1.4 Equipment for the specified inspection and tests shall be provided by the vendor.

4.1.5 The purchaser's representative shall have the right to reject any equipment or equipment components that do not conform to the purchase order.

4.2 Inspection

4.2.1 GENERAL

The vendor shall keep the following data available for at least 5 years for examination by the purchaser or his representative upon request:

a. Test data to verify that the requirements of the specification have been met.
b. Results of quality-control tests and inspections.
● c. When specified, final-assembly, maintenance, and running clearances.

4.2.2 MATERIAL INSPECTION

The vendor shall provide the purchaser with assurance that materials of construction are in accordance with the purchase order. Mill test reports are not required for standard components normally carried in inventory nor for bulk raw material.

4.2.3 MECHANICAL INSPECTION

4.2.3.1 During assembly of the system and before testing, each component (including cast-in passages of components) and all piping and appurtenances shall be cleaned by pickling or by another appropriate method to remove foreign materials, corrosion products, and mill scale.

● **4.2.3.2** When specified, the purchaser may inspect the equipment and all piping and appurtenances furnished by or through the vendor for cleanliness before the heads are welded to vessels, openings in vessels or exchangers are closed, or piping is finally assembled.

4.2.3.3 When requested by the purchaser, the purchaser's representative shall have access to the vendor's quality control program for review.

4.3 Testing

4.3.1 GENERAL

4.3.1.1 Equipment shall be tested in accordance with 4.3.2 and 4.3.3. Other tests that may be specified by the purchaser are described in 4.3.4.

4.3.1.2 The vendor shall notify the purchaser not less than 5 working days before the date the equipment will be ready for testing.

4.3.2 HYDROSTATIC TEST

4.3.2.1 Pressure-containing parts (including auxiliaries) shall be tested hydrostatically with liquid at a minimum of 1½ times the maximum allowable working pressure but not less than 20 pounds per square inch gage (1.4 bar gage). The test liquid shall be at a higher temperature than the nil-ductility transition temperature of the material being tested (not applicable to cast iron).

4.3.2.2 Where applicable, tests shall be in accordance with the ASME Code. In the event that a discrepancy exists between the code test pressure and the test pressure in this standard, the higher pressure shall govern.

4.3.2.3 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 neither leaks nor seepage through the casing or

casing joint are 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. Seepage past internal closures required for testing of segmented cases and operation of a test pump to maintain pressure are acceptable.

4.3.3 MECHANICAL RUNNING TEST

4.3.3.1 The compressor shall be operated for 4 hours at rated speed consisting of 2 hours of progressive loading and a minimum of 2 continuous hours at the rated discharge pressure level and full load.

4.3.3.2 The requirements of 4.3.3.2.1 through 4.3.3.2.4 shall be met before the mechanical running test is performed.

4.3.3.2.1 The contract valves, rod packing, piston rings/bands, and bearings shall be used in the machine.

4.3.3.2.2 All oil pressures, viscosities, and temperatures shall be within the operating range of values recommended by the manufacturer for the specific unit being tested.

4.3.3.2.3 All casing and oil system joints and connections shall be checked for tightness, and any leaks shall be corrected prior to test.

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

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

4.3.3.4 Control systems shall be demonstrated to the extent practicable.

4.3.3.5 If replacement or modification of bearings, valves, or packing or dismantling of the machine to replace or modify other parts is required to correct mechanical or performance deficiencies, the initial test will not be acceptable, and the final shop tests shall be run after these replacements or corrections are made.

4.3.3.6 Post-test inspection shall include the following as a minimum: Visual examination of the cylinder bores and crosshead guides for scoring and the power frame for the presence of foreign material.

4.3.4 OPTIONAL TESTS

The purchaser shall specify in the inquiry or in the order whether any of the shop tests specified in 4.3.4.1 and 4.3.4.2 shall be performed.

4.3.4.1 Performance Test

The machine shall be tested in accordance with the ASME power test code, PTC 9.

4.3.4.2 Complete-Unit Tests

Such components as compressors, gears, drivers, and auxiliaries that make up a complete unit shall be tested together during the mechanical running test. A separate auxiliary test may be performed with the purchaser's approval.

4.4 Preparation for Shipment

4.4.1 Equipment shall be suitably prepared for the type of shipment specified. The preparation shall make the equipment suitable for 6 months of outdoor storage from the time of shipment, with no disassembly required before operation, except for inspection of bearings and seals. If storage for a longer period is contemplated, the purchaser will consult with the vendor regarding the recommended procedures to be followed.

4.4.2 The vendor shall provide the purchaser with the instructions necessary to preserve the integrity of the storage preparation after the equipment arrives at the job site and before startup.

4.4.3 The equipment shall be prepared for shipment after all testing and inspection has been completed and the equipment has been approved by the purchaser. The preparation shall include that specified in 4.4.3.1 through 4.4.3.9.

4.4.3.1 Exterior surfaces, except for machined surfaces, shall be given at least one coat of the manufacturer's standard paint.

4.4.3.2 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 from scale, welding spatter, and foreign objects. The interior of the equipment shall be sprayed or flushed with a suitable rust preventive that is compatible with and soluble in the lube oil. Nonlubricated compressor cylinders shall be fogged with a vapor corrosion inhibitor (VCI) mist. This shall be done through all openings while the machine is slow rolled. Valves and packing shall be assembled in the compressor.

4.4.3.4 All internal areas of crankcases and carbon steel oil systems' auxiliary equipment such as reservoirs, vessels,

and piping shall be coated with a suitable oil-soluble rust preventive for lubricated compressors. For nonlubricated compressors, preservation will be as stated in the proposal and mutually agreed upon between the purchaser and the vendor.

4.4.3.5 Flanged openings shall be provided with metal closures at least 3/16 inch (4.8 millimeters) thick, rubber gaskets, and at least four full-diameter bolts. For studded openings, all nuts needed for the intended service shall be used to secure closures.

4.4.3.6 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 item and serial numbers. Material shipped separately shall be identified with securely affixed, corrosion-resistant metal tags indicating the item and serial number of the equipment for which it is intended. In addition, crated equipment shall be shipped with duplicate packing lists, one inside and one on the outside of the shipping container.

4.4.3.9 Exposed shafts and shaft couplings shall be wrapped with waterproof, moldable waxed cloth or vapor-corrosion-inhibitor paper. The seams shall be sealed with oilproof adhesive tape.

4.4.4 Components (both individual pieces and packaged sets) shipped with mounted preassembled piping, tubing, or wiring shall comply with the requirements of the Occupational Safety and Health Administration 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 THE OSHA (OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION), AND SHALL NOT BE DISTURBED BY UNAUTHORIZED PERSONNEL.

4.4.5 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 arrangement drawing.

4.4.6 Bearing assemblies and crankcases shall be fully protected from the entry of moisture and dirt. If vapor-corrosion-inhibitor crystals in bags are installed in large cavities to absorb moisture, the bags must be attached in an accessible area for ease of removal. Where applicable, bags shall be installed in wire cages attached to flanged covers, and bag locations shall be indicated by corrosion-resistant tags attached with stainless steel wire.

4.4.7 One copy of the manufacturer's standard installation instructions shall be packed and shipped with the equipment.

SECTION 5—VENDOR'S DATA

5.1 Proposals

The vendor's proposal shall include the information specified in items a through o below:

a. A copy of the Vendor Drawing and Data Requirements form (see Appendix G) indicating the schedule according to which the vendor agrees to furnish the data requested by the purchaser (see 5.2.3.1).

b. A specific statement that the system and all its components are in strict accordance with this standard. If the system and components are not in strict accordance, the vendor shall include a specific list that details and explains each deviation.

c. Copies of the purchaser's data sheets with complete vendor's information entered thereon.

d. Utility requirements such as steam, water, electricity, air, gas and lube oil, including the quantity of lube oil required at supply pressure, the heat load to be removed by the oil, and the nameplate power rating and operating power requirements of auxiliary drivers. (Approximate data shall be defined and clearly identified as such.) This information shall be entered on the data sheets.

e. Net and maximum operating weights, maximum shipping and erection weights with identification of the item, and the maximum normal maintenance weight with identification of the item. These data shall be stated individually where separate shipments, packages, or assemblies are involved. These data shall be entered on the data sheets where applicable.

f. Preliminary outline and arrangement drawings and schematic diagrams.

g. Typical cross-sectional drawings and literature to fully describe details of the offerings.

h. A list of spare parts recommended for startup and normal maintenance purposes. (The purchaser will specify any special requirements for long-term shortage.)
i. An itemized list of the special tools included in the offering. The vendor shall list any metric items included in the offering.
j. A description of the tests and procedures for materials as required by 2.14.1.3.
k. A description of special requirements, as outlined in 2.14.1.2. and 3.6.5.2.5.
l. An outline of all necessary special weather and winterizing protection required by the equipment, its auxiliaries, and the driver (if furnished by the vendor) for startup, operation, and idleness. The vendor shall separately list the protective items he proposes to furnish.
m. A list of similar machines installed and operating under analogous conditions.
n. Any startup, shutdown, or operating restrictions required to protect the integrity of the equipment.
o. A list of all relief valves, specifying those furnished by the vendor, as required by 3.6.4.7.

5.2 Contract Data

5.2.1 GENERAL

5.2.1.1 The following paragraphs specify information to be furnished by the vendor. The vendor shall complete and forward the Vendor Drawing and Data Requirements form (see Appendix G) to the address or addresses noted on the order. This form shall detail the schedule for transmission of drawings, curves, and data as agreed to at the time of order, as well as the number and type of copies required by the purchaser.

5.2.1.2 The data shall be identified on transmittal (cover) letters and in title blocks or pages with the following information:

a. The purchaser/user's corporate name
b. The job/project number.
c. The equipment name and item number.
d. The purchase order number.
e. Any other identification specified in the purchase order.
f. The vendor's identifying shop order number, serial number, or other reference required to identify return correspondence completely.

● 5.2.2 COORDINATION MEETING

When specified, a coordination meeting shall be held, preferably at the vendor's plant, within 4-6 weeks after the purchaser commitment. An agenda should be prepared for this meeting and should include the following items:

a. The purchase order, scope of supply, and subvendor items.
b. The data sheets.
c. Schedules for transmittal of drawings, production, and tests.
d. Inspection, expediting, and testing.
e. The physical orientation of equipment, piping, and auxiliary systems.
f. Schematics of the lube oil and cooling systems.
g. A review of applicable specifications and previously agreed-upon exceptions to specifications.

5.2.3 DRAWINGS

5.2.3.1 The purchaser will state in the inquiry and in the order the number of prints and/or reproducibles required and the times within which they are to be submitted by the vendor (see 5.1, item a).

5.2.3.2 The purchaser will promptly review the vendor's drawings when he receives them; however, this review shall not constitute permission to deviate from any requirements in the order unless specifically agreed upon in writing. After the drawings have been reviewed, the vendor shall furnish certified copies in the quantity specified. Drawings shall be clearly legible and in accordance with ANSI Y14.2M.

5.2.3.3 The following information shall be provided on the drawings (typical drawings are not acceptable):

a. The purchaser's order number (on every drawing).
b. The purchaser's equipment item number (on every drawing).
c. The vendor' shop order and/or serial number (on every drawing).
d. The weight of each assembly, of the heaviest piece of equipment which must be handled for erection and of significant items to be handled for maintenance.
e. Principal dimensions, including those required for the piping design, maintenance clearances and dismantling clearances, and the maximum loading limit on the flanges (both forces and moments).
f. The direction, magnitude, and frequency of all unbalanced forces and couples, and the location of the center of gravity.
g. The direction of rotation.
h. The size, type, location, and identification of all purchaser's connections, including vents, drains, lubricating oil, conduits, and instruments. (The vendor's plugged connections shall be identified.)
i. When couplings are furnished, their make, size, and type and the style of the coupling guards.
j. Complete bills of material covering the vendor's entire

scope of supply.
k. A list of reference drawings.
l. A list of any special weather-protection and climatization features.
m. Cold-alignment setting data for equipment furnished by the vendor. Data on expected thermal growth, including transient effects, shall be included.
n. Complete information to permit adequate foundation design by purchaser. This shall include but not be limited to the following:

(1). Grouting details.
(2). The size and location of foundation bolts.
(3). The weight distribution for each bolt/subsoleplate location.
(4). Any unbalanced forces and moments generated by the unit or units in the operating range.

o. The location of the center of gravity and rigging provisions for removal of the cylinders or other subassemblies weighing more than 300 pounds (136 kilograms).

5.2.3.4 The vendor shall supply schematic diagrams of each system in the vendor's scope of supply, as well as outline drawings and specifications for the components.

5.2.3.5 The vendor shall supply cross-sectional or assembly-type drawings for all equipment furnished, showing all parts, running fits, clearances, and weight distribution at lifting points for package installation. (Typical drawings are not acceptable.)

5.2.3.6 The vendor shall proceed with manufacturing upon receipt of the order and without awaiting purchaser's review of drawings when necessary to meet the scheduled shipping date.

5.2.4 DATA

5.2.4.1 The vendor shall provide full information to enable completion of the data sheets, first for "as purchased" and then for "as built." This should be done by correcting and filling out the data sheets and submitting copies to the purchaser.

5.2.4.2 The vendor shall make the following information available to the purchaser prior to shipment:

a. The vendor's physical and chemical data from mill reports (or certification) of ductile iron or steel parts and forgings.
b. Completed as-built data sheets.
c. Certified shop logs of the mechanical running test.
● d. A record of shop test data (which the vendor shall maintain for at least 5 years after the date of shipment). When specified, the vendor shall submit certified copies of the test data to the purchaser before shipment.
e. Optional test data and reports specified by the purchaser.

● **5.2.4.3** The vendor shall furnish a parts list for all equipment supplied. The list shall include pattern, stock, or production drawing numbers and materials of construction. The list shall completely identify each part so that the purchaser may determine the interchangeability of the part with other equipment furnished by the same manufacturer. Standard purchased items shall be identified by the original manufacturer's name and part number. Materials shall be identified as specified in 2.14.1.2.

5.2.4.4 Within 5 days after the scheduled shipping date, the vendor shall furnish the required number of instruction manuals for the equipment and any auxiliaries and instruments provided by the vendor. The manuals shall include legible drawings for the specific equipment included (typical drawings are not acceptable), a parts list, and completed data sheets. They shall also include instructions covering installation, final test and checks, startup, shutdown, operating limits, and operating and maintenance procedures. The recommended clearances and maximum and minimum design clearances shall be clearly stated. The maintenance section of the manual shall include required torque values or elongations for tensioning the valve cover and valve hold-down bolts, the crank and main bearing bolts, the piston and crosshead piston rod nuts, and any other bolts that the vendor feels are critical.

5.2.4.5 The vendor shall state in the operating manual the amount of and the specifications and supply temperature/pressure ranges for the lubricating oil required.

5.2.4.6 The vendor shall submit a supplementary list of spare parts other than those included in the original proposal. This supplementary list shall include recommended spare parts, cross-sectional or assembly-type drawings, part numbers, and materials. Part numbers shall identify each part for purposes of interchangeability. Standard purchased items shall be identified by the original manufacturer's numbers. The vendor shall forward this supplementary list to the purchaser promptly after receipt of the approved drawings and in time to permit order and delivery of parts before field startup.

5.2.4.7 At least 6 weeks before shipment, the vendor shall submit his preservation, packaging, and shipping procedure to the purchaser for review.

● 5.2.5 PROGRESS REPORTS

When specified, the vendor shall submit progress reports to the purchaser at the specified frequency. The reports shall include engineering and manufacturing information on all major components.

APPENDIX A

TYPICAL DATA SHEETS

APPENDIX A

TYPICAL DATA SHEETS

UTILITY/INSTRUMENT AIR COMPRESSOR DATA SHEET CUSTOMARY UNITS

JOB NO. _____ ITEM NO. _____

PAGE 2 OF 15 BY _____

DATE _____ REVISION _____

OPERATING CONDITIONS WITH CAPACITY CONTROL

	START UP (3.6.2.4)					
◯ % CAPACITY/STAGE						
☐ LBS/HR-WET						
☐ INLET CFM						
☐ POCKETS/VALVES OPERATION*						
☐ INLET PRESSURE PSIA						
☐ DISCHARGE PRES. PSIA						
☐ DISCH. TEMP.° F (ACTUAL)						
☐ BRAKE HORSEPOWER/STAGE						
☐ TOTAL BHP (W/DRIVE LOSSES)						
☐ ACTUAL ROD LOAD (LBS) T**						
☐ ACTUAL ROD LOAD (LBS) C**						
☐ DEGREES ROD REVERSAL						

◯ % CAPACITY/STAGE						
☐ LBS/HR-WET						
☐ INLET CFM						
☐ POCKETS/VALVES OPEN *						
☐ INLET PRESSURE PSIA						
☐ DISCHARGE PRESSURE PSIA						
☐ DISCH. TEMP.° F (ACTUAL)						
☐ BRAKE HORSEPOWER/STAGE						
☐ TOTAL BHP (W/DRIVE LOSSES)						
☐ ACTUAL ROD LOAD (LBS) T**						
☐ ACTUAL ROD LOAD (LBS) C**						
☐ DEGREES ROD REVERSAL						

* SHOW OPERATION WITH THE FOLLOWING SYMBOLS:

HEAD END = H OR CRANK END = C } PLUS { SUCTION VALVE UNLOADERS = S OR FIXED POCKET OPEN = F OR VARIABLE POCKET OPEN = V

EXAMPLE: HS/CF = HEAD END SUCTION VALVE UNLOADERS & CRANK END FIXED POCKET OPEN

**T = TENSION (GAS + INERTIA LOAD)

**C = COMPRESSION (GAS + INERTIA LOAD)

CONTROL SYSTEM (2.7.2)

BASIC OPERATING CONTROL TYPE:

◯ AUTO. START/STOP
◯ CONSTANT SPEED CONTROL
◯ DUAL CONTROL

UNLOADER CONTROL TYPE: (3.6.1.1)

◯ PNEUMATIC ◯ MANUAL
◯ ELECTRICAL ◯ FIVE STEP
◯ ELECTRONIC ◯ THREE STEP
◯ AUTOMATIC (3.6.2.1) ◯ OTHER _____

◯ PURCHASERS BY-PASS
◯ VARIABLE SPEED TO _____ % RATED CAPACITY
◯ CONTROL SIGNAL _____ RANGE (3.6.1.1)

UNLOADER TYPES SHALL BE: (3.6.2.5)

◯ VALVE DEPRESSOR
◯ CLEARANCE POCKET
◯ PLUG
◯ INTERNAL BY-PASS
◯ OTHER _____

UPON AIR/POWER FAILURE COMPRESSOR SHALL:

◯ LOAD
◯ UNLOAD

UTILITY/INSTRUMENT AIR COMPRESSOR DATA SHEET CUSTOMARY UNITS

JOB NO. _____ ITEM NO. _____
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○ SITE DATA

ALTITUDE _____ FT. BAROMETER _____ PSIA
DESIGN TEMP.° F _____ SUMMER _____ WINTER MIN.
DESIGN WET BULB TEMP.° F _____
○ WINTERIZATION REQ'D. ○ TROPICALIZATION REQ'D. (3.6.7.5)
UNUSUAL CONDITIONS: ○ DUST ○ FUMES ○ OTHER _____

EQUIPMENT SHALL BE SUITABLE FOR (2.1.13)

○ INDOORS ○ HEATED ○ UNHEATED
○ OUTDOORS ○ UNDER ROOF ○ WITHOUT ROOF

ELECTRICAL EQUIPMENT HAZARDOUS CLASSIFICATION (2.1.7)

CLASS _____ GROUP _____ DIVISION _____

COOLING WATER FOR COMP. CYLINDERS (2.6.1.9)

TYPE WATER _____

COOLING WATER FOR (OIL COOLER) (INTERCOOLERS) (2.6.1.9)

TYPE WATER _____

COOLING FOR ROD PACKING COOLING

TYPE FLUID _____

ELECTRIC POWER FOR HEATERS

_____ VOLTS _____ PHASE _____ HERTZ

MOTOR CONTROL & INSTRUMENT VOLTAGE

_____ VOLTS _____ PHASE _____ CYCLES

ALARM AND SHUT DOWN VOLTAGE

_____ VOLTS _____ PHASE _____ CYCLES _____ DC

STEAM FOR HEATERS

NORMAL _____ PSIG @ _____ ° FTT
MAX. _____ PSIG @ _____ ° FTT

INSTRUMENT AIR SUPPLY

PRESS., PSIG _____ MAX. _____ NORMAL _____ MIN.
DEW POINT _____ ° F

COMPRESSOR LUBRICATION (2.12)

FRAME

○ PRESSURE SYSTEM ○ SPLASH SYSTEM
○ MAIN OIL PUMP DRIVEN BY COMP. SHAFT
○ AUX. OIL PUMP DRIVEN BY ELECTRIC MOTOR
☐ HAND OPERATED PUMP FOR STARTING
TYPE MAIN BEARINGS ☐ SLEEVE ☐ ROLLER
☐ OUTBOARD BEARING INCLUDED ☐ MATERIALS _____

CYLINDERS

○ NON LUBRICATED ○ SYNTHETIC LUBE (2.1.3.3)
LUBE DRIVEN BY: ○ COMP. SHAFT ○ ELEC. MTR. ○ CHAIN
TYPE LUBRICATOR: ○ SINGLE PLUNGER/FEED ○ DIV. BLOCK
☐ LUBRICATOR MAKE _____ MODEL _____
☐ NO. PER COMP. _____ CAP. ○ 24 HRS. _____ GAL.
☐ NO. OF SPARE LUB. BLOCKS _____ ○ HEATER _____

COMPRESSOR DATA

ITEM NO./SERVICE		
STAGE		
NO. OF CYL.		
TYPE CYL. COOLING REQD. (2.6.1.7) (APP.B)		
LUBRICATED/NON-LUBRICATED		
SINGLE/DOUBLE ACTING		
CYLINDER LINER YES/NO		
BORE, INCHES		
STROKE, INCHES		
PISTON DISPLACEMENT, CFM		
CLEARANCE, %		
VOLUMETRIC EFFICIENCY, %		
API VALVE GAS VELOCITY, FT/MIN. (2.7.1)		
NO. INLET/DISCH. VALVES/CYL.		
TYPE OF VALVES (2.7.2)		
INLET/DISCH. VALVE LIFT. MILS (2.7.1)		
MAX. ALLOW PISTON SPEED, FPM (2.2.1)		
NORMAL PISTON SPEED, FPM (2.2.1)		
ROD DIAMETER, INCHES		
MAX. ALLOW. ROD LOADING T* (N)		
MAX. ALLOW. ROD LOADING C* (N)		
ROD RUN-OUT (ALLOWABLE), MILS		
MIN. CYLINDER WALL THICKNESS INCHES		
CYLINDER FINISH (R_A) (2.6.1.5)		
MAX. ALLOW. CYL. WKG. PRESS., PSIG (1.4.1.6)		
MAX. ALLOW. CYL. TEMP. ° F (1.4.1.6)		
RECOMMENDED RELIEF VALVE, PSIG		
HYDROSTATIC TEST, PSIG		
CYLINDER		
WATER JACKET		
MIN. ALLOWABLE SPEED (1.4.18)		
TRIP SPEED (1.4.1.18)		

*T = TENSION *C = COMPRESSION

☐ COMPRESSOR MATERIALS (APPEN. B)

CYLINDERS (2.14.2.7)		
CYLINDER LINERS		
PISTONS		
PISTON RINGS		
RIDER RINGS		
PISTON RODS		
PISTON ROD HARDNESS (ROCKWELL "C")		
VALVE SEATS/SEAT PLATE		
VALVE STOPS		
VALVE		
VALVE SPRINGS		
ROD PACKING		
MAIN BEARINGS		
CRANK PIN BEARING		
LOW TEMP. MATERIAL (2.1.4.5)		

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COMPRESSOR MATERIALS (APPEN. B) CONT'D.

CRANKSHAFT (2.14.2.4)	____	____
CROSS HEAD BEARING	____	____
CROSS HEAD	____	____
CROSS HEAD SHOES	____	____
FLYWHEEL	____	____
CYLINDER MAT'L. PER ASTM A 395 (2.13.2.7)	____	____
CYLINDER HEAD MAT'L PER ASTM A 395	____	____

COUPLINGS (3.2.)

	DRIVER–COMP OR DRIVER–GEAR	GEAR–COMP
○ MAKE		
☐ MODEL		
○ LUBRICATION		
○ MOUNT CPLG. HALVES		
○ SPACER REQD.		
○ LMT'D. END FLOAT REQ'D.		
○ IDLING ADAPTOR REQ'D.		
☐ CPLG. RATING (HP/100 RPM)		
☐ KEYS (1) OR (2); OR HYDR. FIT		

☐ CPLGS –(MAIN) (AUX) OIL PUMP JACKET WATER PUMPS

MFR. _____ MODEL _____

TYPE _____

TYPE GUARDS ○ CODE ○ STANDARD ○ NON-SPARK (3.2.1.8)

○ STATIC COND. V-BELTS (3.4.1) ○ TOT. ENCL V-BELT GRD

COMPRESSOR PACKING (2.11)

○ FULL FLOATING VENTED PACKING WITH STAINLESS STEEL SPRINGS _____

○ FORCED FEED LUBRICATED _____

○ NON-LUBE ○ TEFLON ○ CARBON ○ OTHER _____

☐ WATER COOLED _____

○ PROVISIONS FOR FUTURE (WATER) (OIL) – COOLING

○ VENTED TO _____

DISTANCE PIECE (2.10.1 & 2.10.2)

○ STANDARD _____

○ EXTRA LONG SINGLE COMPARTMENT _____

○ SCREENED ○ LOUVERED

○ SOLID COVER DESIGN PRESS., PSIG _____

MISCELLANEOUS

BARRING DEVICE ○ MANUAL ○ PNEU.

AIR INTAKE FILTER BY (3.9): ☐ PACKAGE MFR. ○ PURCH

☐ MFR. _____ MODEL _____

☐ TYPE _____ ○ FLANGED OUTLET CONNECTION _____

PAINTING

○ MANUFACTURER'S STANDARD

○ OTHER _____

SHIPMENT

○ DOMESTIC ○ EXPORT ○ EXPORT BOXING REQ'D.

(X) OUTDOOR STORAGE OVER 6 MONTHS (4.4.1)

☐ UTILITY CONSUMPTION

ELECTRIC	H.P.	LOCKED ROTOR AMPS	FULL LOAD AMPS
MAIN DRIVER			
MAIN LUBE OIL PUMP			
AUX. LUBE OIL PUMP			
PKG. COOLANT OIL PUMP			
MECH. LUBRICATOR			

FRAME OIL HEATER ____ WATTS ____ VOLTS ____ HZ

LUBRICATOR HEATER ____ WATTS ____ VOLTS ____ HZ

SPACE HEATER ____ WATTS ____ VOLTS ____ HZ

STEAM

MAIN DRIVER ____ @/HR ____ PSIG ____° FTT TO ____ PSIG

LUBR. HEATER ____ @/HR ____ PSIG ____° FTT TO ____ PSIG

FRAME HEATER ____ @/HR ____ PSIG ____° FTT TO ____ PSIG

____ @/HR ____ PSIG ____° FTT TO ____ PSIG

COOLING WATER

	COMP. CY JKTS	ROD PKG	L.O. COOLER	INTER COOLERS	OTHER
QUANTITY GPM					
INLET TEMP., °F					
OUTLET TEMP., °F					
INLET PRESS. PSIG					
OUTLET PRESS. PSIG					
MAX PRESS., PSIG					
TOTAL C.W., GPM					

WEIGHTS AND DIMENSIONS

☐ MAX. ERECTION WEIGHT _____ LBS

☐ MAX. MAINTENANCE WEIGHT _____ LBS

☐ TOTAL WT. LESS DRIVER & GEAR _____ LBS

☐ TOTAL WT. COMPLETE UNIT _____ LBS

☐ SPACE REQ'D. FEET & INCHES _____

COMPRESSOR L ____ W ____ H ____

COMPLETE UNIT L ____ W ____ H ____

☐ ROD REMOVAL DISTANCE _____ INCHES

☐ COOLER TUBE REMOVAL DISTANCE _____ INCHES

☐ LUBE OIL CONSOLE

TOTAL WEIGHT _____ LBS

DIM. FT. & IN L ____ W ____ H ____

☐ CLOSED COOLANT SYSTEM

TOTAL WEIGHT _____ LBS

DIM. FT. & IN. L ____ W ____ H ____

☐ OR ○ FREE STANDING INSTRUMENT/CONTROL PANEL

TOTAL WEIGHT _____ LBS

DIM. FT. & IN. L ____ W ____ H ____

UTILITY/INSTRUMENT AIR COMPRESSOR DATA SHEET CUSTOMARY UNITS

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BASEPLATE & SOLEPLATES: (3.5.1)

SOLEPLATES FOR: ○ COMPRESSOR ○ GEAR ○ DRIVER
BASEPLATE: SUB SOLE PLATE (3.5.3)
○ COMMON (UNDER COMP. GEAR & DRIVER)
○ UNDER COMP. ONLY ○ OTHER
○ OPEN CONSTRUCTION
○ DRIP RIM ○ WITH OPEN DRAIN
○ HORIZONTAL ADJUSTING SCREWS FOR EQUIPMENT
○ VERTICAL ADJUSTING SCREWS FOR EQUIPMENT (3.5.5)
○ SUITABLE FOR POINT SUPPORT (3.5.2)
○ SUITABLE FOR PERIMETER SUPPORT
○ GROUTING PREP EPOXY (3.5.8)
☐ RECOMMENDED STRAIGHT RUN OF PIPE DIAMETER BEFORE SUCTION _____
○ VENDOR'S REVIEW & COMMENTS ON PURCHASER'S PIPING & FOUNDATION (2.1.12)
○ _____
○ _____

INSPECTION AND SHOP TESTS

	Reqd.	Obsvd.	Witn'd.
SHOP INSPECTION	○	○	○
MFR. STANDARD SHOP TESTS	○	○	○
VALVE LEAK TEST	○	○	○
CYLINDER HYDRO TEST	○	○	○
HYDRO CYL WATER JKTS @ _____ PSIG	○	○	○
BAR OVER TO CHECK RUNOUT, ETC.	○	○	○
MECHANICAL RUN TEST W/SHOP DRIVER	○	○	○
PERFORMANCE TEST (4.3.4.1)	○	○	○
MECH. RUN TEST W/JOB DRIVER	○	○	○
COMPLETE UNIT TEST (4.3.4.2)	○	○	○
AUX. EQUIP. OPER. TEST	○	○	○
DISMANTLE-REASSEMBLE INSPECTION	○	○	○
KEROSENE LEAK TEST	○	○	○
○ OPTIONAL TEST DATA (4.3.4) (5.2.4.2(e))	○	○	○
_____	○	○	○
_____	○	○	○

☐ MAIN CONNECTIONS:

	SIZE	ANSI RATING	FACING	POSITION
INLET				
DISCHARGE				
INLET				
DISCHARGE				
INLET				
DISCHARGE				

CONTRACT DATA

○ CERTIFIED COPIES OF TEST DATA PRIOR TO SHIPMENT (5.2.4.2)
○ MATERIAL INSP (NDT) (2.14.6.1)
○ RETAIN ASS'Y CLEARANCES FOR 5 YEARS (4.2.1 (C))
○ VESSEL CLEANLINESS INSPECTION (4.2.3.2)
○ KEEP SHOP TEST DATA FOR 5 YEARS (5.2.4.2 (d))
○ MFR. PRESENT FOR INITIAL ALIGNMENT (2.1.12)
○ PROGRESS REPORTS (5.2.5)
○ CO-ORDINATION MEETING (5.2.2)
○ DRAWING REQUIREMENTS (5.2.3.1)
○ PROGRESS REPORTS (5.2.5)
○ COORDINATION MEETING (5.2.2)
○ DRAWING REQUIREMENTS (5.2.3.1)
○ MFR. REP. PRESENT FOR INITIAL ALIGNMENT (2.1.12)
○ _____
○ _____

☐ ALLOWABLE PIPING FORCES & MOMENTS:

	INLET		DISCHARGE			
	FORCE LB	MOMT LB-FT	FORCE LB	MOMT LB-FT	FORCE LB	MOMT LB-FT
AXIAL						
VERTICAL						
HORIZ. 90°						

	FORCE LB	MOMT LB-FT	FORCE LB	MOMT LB-FT	FORCE LB	MOMT LB-FT
AXIAL						
VERTICAL						
HORIZ. 90°						

REMARKS:

☐ OTHER CONNECTIONS:

	NO.	SIZE	
LUBE OIL INLET			
LUBE OIL OUTLET			
CYLINDER DRAINS			
VENTS			
COOLING WATER			
SUCTION DAMPER			
DISCHARGE DAMPER			
COUPLING DRAIN (FLANGED) (3.2.2.2)			

UTILITY/INSTRUMENT AIR COMPRESSOR DATA SHEET CUSTOMARY UNITS

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FRAME LUBE OIL SYSTEM (2.12)

BASIC SYSTEM REQ'TS. (NORMAL OIL FLOW)

☐ LUBE OIL	GPM	PSIG	SSU@100°F
COMPRESSOR			
DRIVER			

SYSTEMS PRESSURES:

☐ DESIGN _____ PSIG ☐ HYDROTEST _____ PSIG
☐ PUMP RELIEF VALVE(S) SETTINGS _____ PSIG

PUMPS:

	MAIN	STANDBY
○ SHAFT DRIVEN		
○ MOTOR DRIVEN		
○ TURBINE DRIVEN		
○ HORIZ. CENTRIFUGAL		
○ GEAR/SCREW		
○ _____		
☐ GPM (RATED)		
☐ @ PSIG		
☐ BHP @ 100 SSU		
☐ DRIVEN HP		
○ CASING MATERIAL		
☐ SPEED		
○ COUPLING		
☐ GUARD		
○ MECH. SEAL		
○ STANDBY (2.12.4)		

MISCELLANEOUS:

HEATING COIL (2.13.2)
○ STEAM ○ ELECTRIC
○ DENSITY _____ WATTS/SQ. INCH
○ S S COIL.

PIPING MATERIALS:

	CARBON STEEL	STAINLESS STEEL
○ COMPLETE SYSTEM		
○ RETURN PIPING		
○ CARBON STL SLIP ON FLANGES ON STAINLESS STL PIPING		
○ _____		

COOLERS: (2.12.6)

○ SINGLE ○ TWIN W/TRANSFER VALVE ○ AIR COOLED
○ WITH BY PASS & TEMP. CONTROL VALVE
○ MANUAL ○ AUTO
SEE SEPARATE DATA SHEET FOR COOLER DETAILS

FILTERS: (2.12.7)

○ SINGLE ○ TWIN
○ ASME CODE DESIGN ○ ASME CODE STAMP
○ MICRON (μ) _____
☐ FILTER MEDIUM _____
☐ DESIGN PRESS., PSIG _____
☐ ΔP CLEAN (PSI) _____
☐ ΔP COLLAPSE (PSI) _____
☐ CASING MATERIAL _____
○ VALVED CLEAN SIDE OIL DRAIN _____
○ VALVED DIRTY SIDE OIL DRAIN _____
○ VALVED VENT SIDE OIL DRAIN _____
○ VALVED CROSSOVER PIPING W/ORIFICE _____
☐ CARTRIDGE IDENT. NO. _____
○ FURNISH SET OF SPARE CARTRIDGES WITH FILTERS

REMARKS:

SKETCH:

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SELF CONTAINED COOLING SYSTEM (2.6.19 REF. FIG. B-2 APP. B)

○ SYS. TO BE CONSOLE MOUNTED W/DECK PLATE SUITABLE FOR PERIMETER SUPPORT AND GROUTING
○ ONE CONSOLE FOR EACH COMPRESSOR
○ ONE CONSOLE FOR _____ COMPRESSORS
○ JACKET WATER TO BE _____ % ETHYLENE GLYCOL

BASIC SYSTEM REQUIREMENTS (NORMAL FLOW)

☐ WATER	GPM	PSIG	CYL. TEMP.(°F)

SYSTEM PRESSURES:

☐ DESIGN _____ PSIG ☐ HYDROTEST _____ PSIG
☐ PUMP RELIEF VALVE(S) SETTINGS _____ PSIG

WATER STORAGE TANK

TANK HOLDING CAPACITY GALLONS _____
TANK SIZE _____ FT X _____ FT X _____ FT
○ HEATER ○ ELECTRIC ○ STEAM
○ TANK MATERIAL _____
○ LEVEL GAGE ○ LEVEL SWITCH

PUMPS:	MAIN	STANDBY
○ HORIZONTAL		
○ MOTOR DRIVEN		
○ TURBINE DRIVEN		
○ CENTRIFUGAL		
○ GEAR/SCREW		
☐ GPM (RATED)		
☐ @ PSIG		
☐ BHP @ 100 SSU		
☐ DRIVEN HP		
○ CASING MATERIAL		
☐ SPEED		
○ COUPLING		
☐ GUARD		
○ MECH. SEAL		
○ _____		
○ _____		

STANDBY PUMP CONTROL RESET:

○ MANUAL ○ AUTOMATIC
○ "ON-OFF-AUTO" SELECTOR SWITCH BY _____

COOLERS:

○ SHELL & TUBE ○ AIR COOLER
○ SINGLE ○ TWIN WITH TRANSFER VALVE
○ WITH BYPASS & TEMP. CONTROL VALVE (WITH TIC & 2 WAY VALVE)
○ MANUAL ○ AUTO
○ SEE SEPARATE DATA SHEET FOR COOLER DETAILS

SYSTEM COMPONENT SUPPLIERS:

	MANUFACTURER	MODEL
☐ MAIN PUMP		
☐ STANDBY PUMP		
☐ ELECTRIC MOTOR(S)		
☐ STEAM TURBINE(S)		
☐ COOLER(S)		
☐ OIL FILTER(S)		
☐ ACCUMULATOR(S)		
☐ SUCT. STRAINER(S)		
☐ CHECK VALVE(S)		
☐ SWITCH VALVE(S)		
☐ PUMP COUPLING(S)		
☐ _____		
☐ _____		

INSTRUMENTATION MOUNTED ON CONSOLE

○ _____
○ _____
○ _____
○ _____
○ _____
○ _____
○ _____
○ _____
○ _____
○ _____
○ _____

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INSTRUMENTATION

LOCAL CONTROL STATION: (3.6.3)

NOTE: [X] SUPPLIED BY VENDOR

FURNISHED BY VENDOR

[X] CAPACITY CONTROL SELECTOR SWITCH [X] LAMP TEST BUTTON [X] POWER SUPPLY LIGHT [X] START STOP BUTTON
[X] CAPACITY CONTROL LOAD/INDICATOR [X] RUNNING LIGHT [X] BASE MOUNTED [ ] FREE STANDING [ ] WEATHERPROOF
[ ] TOTALLY ENCLOSED [ ] EXTRA CUTOUTS [X] VIBRATION ISOLATORS [ ] STRIP HEATERS [ ] PURGE CONNECTIONS
[ ] ANNUNCIATOR WITH FIRST OUT INDICATION WITH ROTAMETER LOCATED ON LOCAL PANEL ○ ISOLATION VALVES (3.6.1.6)
○ WEATHER HOOD (3.6.3.2) ○ TROPIC-PROOF ELECTRICAL MATERIALS

REMARKS: _____

ALARM & SHUTDOWN SWITCHES & LIGHTS: (3.6.3.3)

FUNCTION	ALARM	TRIP
☐○ LOW FRAME OIL PRESSURE		
☐○ HIGH FRAME OIL TEMP.		
☐○ HIGH LUBE OIL FILTER Δ P		
☐○ LOW MECH LUBRICATOR OIL LEVEL		
☐○ HIGH INLET AIR PRESSURE DIFFERENTIAL		
☐○ HIGH COOLING WATER TEMP. (EA. CYL.)		
☐○ HIGH GAS DISCHARGE PRESSURE (EA. CYL)		
☐○ AUX. LUBE OIL PUMP START		
☐○ HIGH LIQUID LEVEL MOISTURE SEP.		
☐○ HIGH GAS DISCH TEMP (EA. CYL)		
☐○ HIGH INTERCOOLER AIR TEMP		
☐○ HIGH INTERCOOLER COND. LEVEL		

FUNCTION	ALARM	TRIP
☐○ COMPRESSOR FRAME VIBRATION		
☐○ GEAR VIBRATION		
☐○ GEAR AXIAL POSITION		
☐○ COMPRESSOR DRIVER SHUTDOWN		
☐○ HIGH DRIVER THRUST BRG. TEMP.		
☐○ CYLINDER LUBRICATOR DRIVE FAILURE		
☐○		
☐○		
☐○		
☐○		
☐○		
☐○		
☐○		

SWITCH CLOSURES: (3.6.5.2)

ALARM CONTACTS SHALL [X] OPEN [ ] CLOSE TO SOUND
ALARM &/BE NORM. [ ] ENERG'D [X] DE-ENERG'D
SHUTDOWN CONT. SHALL [ ] OPEN [X] CLOSE TO TRIP
NORMALLY [X] ENERG'D [ ] DE-ENERG'D
NOTE: NORMAL COND. WHEN COMPRESSOR IN OPERATION

MISCELLANEOUS:

PRE ALARM & SHUTDOWN SWITCHES SHALL BE SEPARATE
PURCH. ELECTRICAL & INSTRUMENT CONN. SHALL BE:
[ ] BROUGHT OUT TO TERMINAL BOXES
[ ] MADE DIRECTLY BY THE PURCHASER
SWITCH ENCLOSURE: ○ EXP. PROOF ○ WEATHERPROOF
○ NEMA TYPE _____

PRESSURE GAGE REQUIREMENTS: (3.6.4.5)

(x) MANDATORY

OIL FILLED _____ YES _____ NO

FUNCTION	GAUGE BOARD
LUBE OIL PUMP DISCHARGE	☐○
LUBE OIL FILTER Δ P	☐○
LUBE OIL SUPPLY	[X](x)
_____	☐○
_____	☐○
_____	☐○
_____	☐○

FUNCTION	GAUGE BOARD
COMPRESSOR SUCTION EACH STAGE	☐○
COMPRESSOR DISCHARGE EA. STG.	☐(x)
_____	☐○
_____	☐○
_____	☐○
_____	☐○
_____	☐○

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TEMPERATURE GAGE REQUIREMENTS

(X) MANDATORY

FUNCTION	LOCALLY MOUNTED	GAUGE BOARD	FUNCTION	LOCALLY MOUNTED	GAUGE BOARD
LUBE OIL PUMP DISCHARGE FROM:	☐○	☐○	COOLER OIL INLET & OUTLET _____	☐(X)	☐○
GEAR OUTLET	☐○	☐○	COMPRESSOR SUCTION EA. _____	☐○	☐○
DRIVER JOURNAL BEARING _____	☐○	☐○	COMPRESSOR DISCHARGE EA. CYL.	☐(X)	☐○
DRIVER THRUST BEARING _____	☐○	☐○	JACKET WATER SUPPLY _____	☐○	☐○
C.W. IN & OUT OF INTERCOOLER	☐○	☐○	JACKET WATER RETURN EA. CYL.	☐(X)	☐○
CRANKCASE _____	☐○	☐○	GEAR JOURNAL BEARING EA. _____	☐○	☐○
_____	☐○	☐○	AIR COOLER INLET & OUTLET _____	☐○	☐○
_____	☐○	☐○	_____	☐○	☐○
_____	☐○	☐○	_____	☐○	☐○

MISCELLANEOUS INSTRUMENTS

	LOCALLY MOUNTED	GAUGE BOARD		LOCALLY MOUNTED	GUAGE BOARD
TACHOMETER (3.6.4.2)	☐○	☐○	ANNUNCIATOR (3.6.6)	☐○	☐○

INSTRUMENT SUPPLIERS:

PRESSURE GAGES:	MFR. _____	SIZE & TYPE _____
TEMPERATURE GAGES:	MFR. _____	SIZE & TYPE _____
LEVEL GAGES:	MFR. _____	SIZE & TYPE _____
DIFF. PRESSURE GAGES:	MFR. _____	SIZE & TYPE _____
PRESSURE SWITCHES:	MFR. _____	SIZE & TYPE _____
DIFF. PRESSURE SWITCHES:	MFR. _____	SIZE & TYPE _____
TEMPERATURE SWITCHES:	MFR. _____	SIZE & TYPE _____
LEVEL SWITCHES:	MFR. _____	SIZE & TYPE _____
CONTROL VALVES:	MFR. _____	SIZE & TYPE _____
PRESSURE RELIEF VALVES:	MFR. _____	SIZE & TYPE _____
THERMAL RELIEF VALVES:	MFR. _____	SIZE & TYPE _____
SIGHT FLOW INDICATORS:	MFR. _____	SIZE & TYPE _____
GAS FLOW INDICATOR:	MFR. _____	SIZE & TYPE _____
VIBRATION EQUIPMENT:	MFR. _____	SIZE & TYPE _____
TACHOMETER:	MFR. _____	FLANGE & TYPE _____
SOLENOID VALVES:	MFR. _____	SIZE & TYPE _____
ANNUNICATOR	MFR. _____	MODEL & NO. POINTS _____
_____	_____	_____
_____	_____	_____

CONTROL PANEL INSTRUMENTS

QUANTITY	PURCHASER TAG NUMBER	VENDOR TAG NUMBER	LOCATION	DESCRIPTION & SET POINT	MOUNTING (3.6.5.1.1)

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INTERCOOLER

DUTY _____ BTU/HR COOLER ITEM NO. _____
SUPPLIER _____ NO. UNITS REQUIRED _____
MODEL NO. _____ TYPE _____ (3.8.1)(3.8.7)

OPERATION CONDITIONS	SHELL SIDE (3.8.9)	TUBE SIDE
◯ FLUID		
☐ TOTAL FLOW LBS/HR		
☐ SPECIFY GRAVITY	@ °F	@ °F
☐ THERMAL COND. BTU/HR X SQ. FT. X°F/FT.	@ °F	@ °F
☐ SPECIFIC HEAT – BTU/LB X °F	@ °F	@ °F
☐ VISCOSITY – SSU	@ °F	@ °F
☐ OPERATING TEMPERATURES, °F		
INLET PRESSURE PSIG		
INLET VELOCITY, FT/SEC		
◯ PRESSURE DROP PSI	ALLOW CALC.	ALLOW CALC.
☐ DESIGN TEMPERATURE °F		
PRESSURE, PSIG	MIN. TEST	MIN. TEST
FOUL RESISTANCE, SQ. FT. X HR. X°F/BTU		
◯ MIN. CORROSION ALLOWANCE, INCHES		
☐ NUMBER OF PASSES PER SHELL		
_____		

CONSTRUCTION DETAILS

☐ TOTAL AREA (1) SQ. FT. _____ FT^2
☐ LMTD _____
☐ CORRECTED MTD (EFF) _____ °F
☐ TRANSFER RATE, CLEAN _____ BTU/HR FT^2 °F
☐ TRANSFER RATE, SERVICE _____ BTU/HR FT^2 °F
☐ CROSS BATTLES, TYPE _____
◯ CODE REQUIREMENTS (2) _____ ASME TEMA _____
☐ WEIGHTS _____ BUNDLE _____ LBS.: BUNDLE & SHELL _____ LBS.: FULL OF WATER _____ LBS.:
⊗ AUTO DRAIN TRAP WITH MANUAL BYPASS (3.8.3.A) ◯ TEMA CLASS R (3.8.1)
◯ ORIFICED DRAIN TRAP BLEED

☐ SHELL, NO. X ID. _____ X _____ IN
☐ TUBES, NO. PER SHELL _____
☐ O.D. X LENGTH _____ IN X _____ IN
☐ GAUGE, BWG _____ (AVG.), (MIN.) WALL
☐ TUBE PITCH _____ IN △ □ ◯
☐ REMOVABLE TUBE BUNDLE ☐ YES ☐ NO
⊗ ASME CODE STAMP ☐ YES ☐ NO

NOZZLE SIZES

	SHELL SIDE			TUBE SIDE		
	NO.	SIDE	RATING & FACING	NO.	SIZE	RATING & FACING
INLET						
OUTLET						
DRAIN						
VENT						

MATERIALS

TUBES _____ BAFFLES _____
TUBE SHEETS _____ CHANNEL _____
SHELL _____ CHANNEL FLANGES _____
SHELL FLANGES _____ CHANNEL NOZ. FLANGES _____

(1) OUTSIDE TUBE AREA EXCLUDING AREA IN TUBE SHEETS
(2) UNITS EXEMPT FROM CODE STAMP SHALL HAVE LONGITUDINAL WELD SEAMS SPOT EXAMINED PER PARA UW-52 OF ASME CODE

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AFTER COOLER

DUTY _____ BTU/HR COOLER ITEM NO. _____
SUPPLIER _____ NO. UNITS REQUIRED _____
MODEL NO. _____ TYPE _____ (3.8.1) (3.8.7)

OPERATION CONDITIONS	SHELL SIDE (3.8.9)	TUBE SIDE
○ FLUID		
☐ TOTAL FLOW LBS/HR		
☐ SPECIFY GRAVITY	@ °F	@ °F
☐ THERMAL COND. BTU/HR X SQ. FT. X°F/FT.	@ °F	@ °F
☐ SPECIFIC HEAT – BTU/LB X °F	@ °F	@ °F
☐ VISCOSITY – SSU	@ °F	@ °F
☐ OPERATING TEMPERATURES, °F		
INLET PRESSURE PSIG		
INLET VELOCITY, FT/SEC.		
○ PRESSURE DROP PSI	ALLOW CALC.	ALLOW CALC.
☐ DESIGN TEMPERATURE °F		
PRESSURE, PSIG	MIN. TEST	MIN. TEST
FOUL RESISTANCE, SQ. FT. X HR. X°F BTU		
○ MIN. CORROSION ALLOWANCE, INCHES		
☐ NUMBER OF PASSES PER SHELL		
_____		

CONSTRUCTION DETAILS

☐ TOTAL AREA (1) _____ FT^2
☐ LMTD _____
☐ CORRECTED MTD (EFF) _____ °F
☐ TRANSFER RATE, CLEAN _____ BTU/HR FT^2 °F
☐ TRANSFER RATE, SERVICE _____ BTU/HR FT^2 °F
☐ CROSS BATTLES, TYPE _____
○ CODE REQUIREMENTS (2) _____ ASME TEMA _____
☐ WEIGHTS _____ BUNDLE _____ LBS.: BUNDLE & SHELL _____ LBS.: FULL OF WATER _____ LBS.:
⊗ AUTO DRAIN TRAP WITH MANUAL BYPASS (3.8.3.A) ○ TEMA CLASS R (3.8.1)
○ ORIFICED DRAIN TRAP BLEED

☐ SHELL, NO. X ID. _____ X _____ IN
☐ TUBES, NO. PER SHELL _____
☐ O.D. X LENGTH _____ IN X _____ IN
☐ GAUGE, BWG _____ (AVG.), (MIN.) WALL
☐ TUBE PITCH _____ IN △ □ ○
☐ REMOVABLE TUBE BUNDLE ☐ YES ☐ NO
⊗ ASME CODE STAMP ☐ YES ☐ NO

NOZZLE SIZES

	SHELL SIDE			TUBE SIDE		
	NO.	SIDE	RATING & FACING	NO.	SIZE	RATING & FACING
INLET						
OUTLET						
DRAIN						
VENT						

MATERIALS

TUBES _____ BAFFLES _____
TUBE SHEETS _____ CHANNEL _____
SHELL _____ CHANNEL FLANGES _____
SHELL FLANGES _____ CHANNEL NOZ. FLANGES _____

(1) OUTSIDE TUBE AREA EXCLUDING AREA IN TUBE SHEETS

(2) UNITS EXEMPT FROM CODE STAMP SHALL HAVE LONGITUDINAL WELD SEAMS SPOT EXAMINED PER PARA UW-52 OF ASME CODE

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APPLICABLE TO: ○ PROPOSAL ○ PURCHASE ○ AS BUILT FURNISHED BY (3.1.1) _____
FOR _____ UNIT _____
SITE _____ DRIVER EQUIP. _____
SERVICE _____ NO. REQUIRED _____
MANUFACTURER _____ MODEL _____ SERIAL NO. _____
NOTE: ○ INDICATES INFORMATION TO BE COMPLETED BY PURCHASER: ☐ BY MANUFACTURER

MOTOR DESIGN DATA

APPLICABLE SPECIFICATIONS:

○ NEMA _____
○ _____
○ _____

SITE DATA:

AREA: ○ C.L. ___ GR. ___ DIV. ___ ○ NON-HAZARDOUS
○ ALT. ___ FT. ○ AMB'T TEMPS: MAX. ___ °F MIN. ___ °F
UNUSUAL CONDITIONS: ○ DUST ○ FUMES
○ OTHER _____

DRIVE SYSTEM: ○ DIRECT CONNECTED ○ GEAR ○ OTHER _____

TYPE OF MOTOR: (3.1.5)

○ SQUIRREL CAGE INDUCTION ○ NEMA DESIGN
○ SYNCHRONOUS
○ POWER FACTOR REQ'D. _____
EXCITATION: ○ BRUSHLESS ○ SLIP RING
○ FIELD DISCHARGE RESISTOR BY MOTOR MFR.
○ WOUND ROTOR INDUCTION
○ _____

ENCLOSURE:

○ CLASS _____ , GROUP _____ DIV. _____
○ TEFC, SEVERE DUTY ○ EXP. PROOF
○ WEATHER PROTECTED, TYPE _____
○ TEWAC ○ TEIGF, USING _____ GAS
○ DOUBLE WALL CARBON STEEL TUBES
○ WATER SUPPLY: PRESS. _____ PSIG TEMP. _____ °F
☐ ○ WATER ALLOW: Δ P ___ PSI & TEMP., RISE ___ °F
☐ ○ WATER SIDE MIN. CORR. ALLOW. _____ IN.
AND FOUL FACTOR _____
○ (AIR) (GAS) SUPPLY PRESS. _____ PSIG
○ FORCED VENTILATED
○ OPEN-DRIPPROOF
○ OPEN
○ _____
○ _____

BASIC DATA: (3.1.5) (3.1.4)

○ _____ VOLTS _____ PHASE _____ HERZT
☐ NAMEPLATE HP _____ SERVICE FACTOR _____
○ SYNCHRONOUS RPM
○ INSULATION: CLASS _____ TYPE _____
○ TEMP. RISE: _____ °C ABOVE _____ °C BY _____

MOTOR DESIGN DATA CONTINUED

STARTING: (3.1.6)

○ FULL VOLTAGE ○ REDUCED VOLTAGE _____ % (3.1.6)
○ LOADED ○ UNLOADED (3.1.3)
○ VOLTAGE DIP _____ % (3.1.6)

VIBRATION:

○ NEMA STANDARD ○ _____

NOISE: (2.1.3)

○ NEMA STANDARD ○ _____

ACCESSORY EQUIPMENT

○ BASEPLATE ○ SOLEPLATE ○ STATOR SHIFT
○ MFR. STD. FANS ○ NONSPARKING FANS
○ **D.C. EXCITATION**
☐ KW REQ'D. _____ VOLTS _____
BY: ○ PURCHASER ○ MANUFACTURER
DESCRIPTION _____
○ **ENCLOSED COLLECTOR RINGS:**
○ PURGED: MEDIUM _____ PRESS. _____ PSIG
○ EXPLOSION-RESISTANT NONPURGED
○ FORCED VENTILATION
☐ CFM _____ PRESS. DROP _____ IN. H_2O
○ **BEARING TEMP. DEVICES: (3.1.5)**
☐ LOCATION _____
☐ DESCRIPTION _____
☐ SET @ ___ °C FOR ALARM ___ °C FOR SHUTDOWN
○ **SPACE HEATERS:**
☐ ___ KW ○ ___ VOLTS ___ PHASE ___ HERTZ
○ MAX. SHEATH TEMP. _____ %

WINDING TEMPERATURE DETECTOR:

○ TERMISTORS: NO/PHASE _____
TYPE: ○ POS. TEMP. COEFF ○ NEG. TEMP. COEFF.
TEMPERATURE SWITCH: ○ YES ○ NO
○ RESISTANCE TEMPERATURE DETECTORS: NO/PHASE ___
○ RESISTANCE MATL. _____ ○ _____ OHMS
SELECTOR SWITCH & INDICATOR BY: ○ PURCH. ○ MFR.
☐ MAX. STATOR WINDING TEMPS:
_____ °C FOR ALARM _____ °C FOR SHUTDOWN

WINDING TEMP. DETECTOR & SPACE HEATER LEADS:

○ IN SAME CONDUIT BOX
○ IN SEPARATE CONDUIT BOXES

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ACCESSORY EQUIPMENT (CONTINUED)

○ MOTOR ARRANGED FOR DIFFERENTIAL PROTECTION:
- ○ SELF-BALANCE PRIMARY-CURRENT METHOD
- ○ C.T. DESCRIPTION _____
- ○ EXTENDED LEADS ☐ LENGTH _____ FT.

○ SURGE CAPACITORS:
○ LIGHTNING ARRESTERS
○ C.T. FOR AMMETER
- ○ DESCRIPTION _____

MAIN CONDUIT BOX SIZED FOR:
○ MAIN MOTOR LEADS ○ TYPE: _____
- ○ INSULATED ○ NON-INSUATED

○ C.T.'S FOR DIFF. PROTECTION (MOUNTED BY): _____
○ SURGE CAPACITORS (MOUNTED BY): _____
○ LIGHTNING ARRESTERS (MOUNTED BY): _____
○ C.T. FOR AMMETER (MOUNTED BY): _____
○ SPACE FOR STRESS CONES
○ AIR FILTERS:
- ☐ MFR _____ ☐ TYPE _____

MANUFACTURER'S DATA

MANUFACTURER _____
FRAME NO. _____ FULL LOAD RPM (IND.) _____
EFFICIENCY: F.L. _____ 3/4L _____ 1/2L _____
PWR FACTOR (IND.): F.L. 3/4L _____ 1/2L _____
CURR (RATED VOLT.): FULL LOAD _____ LOCKED ROTOR _____
LOCKED ROTOR POWER FACTOR _____
LOCKED ROTOR W/STAND TIME (COLD START) _____
LOCKED ROTOR W/STAND TIME (HOT START) _____
TORQUES (FT-LBS): FULL LOAD _____
- LOCKED ROTOR _____ STARTING (SYN) _____
- PULL-UP (IND.) _____ PULL-IN (SYN.) _____
- BREAKDOWN (IND.) _____ PULL-OUT (SYN.) _____

OPEN CIRCUIT TIME CONSTANT (SEC) _____
SYMMETRICAL CONTRIBUTION TO 3 PHASE TERMINAL FAULT:
AT 1/2 CYCLES _____ AT 3 CYCLES _____
REACTANCES: SUB-TRANSIENT (X"D) _____
- TRANSIENT (X'D) _____ SYNCHRONOUS (XD) _____

A.C. STATOR RESISTANCE _____ OHMS @ _____ °C
RATED KVA _____
KVA INRUSH @ FULL VOLT. & LOCKED ROTOR (SYN.) _____ %
KVA @ FULL VOLTAGE & 95% SPEED _____ %
MAX. LINE CURR. IN STATOR ON 1ST SLIP CYC. & PULL-OUT (SYN) _____
ACCELERATION TIME (MTR ONLY & RATED VOLT.) _____ SEC.
ACCEL. TIME (MTR & LOAD & 85% RATED VOLT.) _____ SEC.
ROTOR/FIELD WK^2 & MTR SHAFT ($LB-FT^2$) _____
NO. OF STARTS PER HOUR _____

MANUFACTURER'S DATA (CONTINUED)

BEARING: TYPE _____ LUBR. _____
LUBE OIL REQUIRED: _____ GPM: & _____ PSIG
TOTAL SHAFT END FLOAT _____
LIMIT END FLOAT TO _____
CURVES REQD. BASED ON MTR SATURATION & RATED VOLT:
- ○ SPEED VS. TORQUE @ 100%, 90% & 80% RATED VOLTAGE
- ○ SPEED VS CURRENT@ 100%, 90% & 80% RATED VOLTAGE

WEIGHTS (LBS):
NET WEIGHT _____ SHIPPING WEIGHT _____
ROTOR WT. _____ MAX. ERECTION WT. _____
MAX. MAINT. WT. (IDENTIFY) _____

DIMENSIONS (FEET & INCHES):
L _____ W _____ H _____

SHOP INSPECTION AND TESTS

	REQD	WITNESS
SHOP INSPECTION	○	○
TESTING PER NEMA	○	○
MFR. STD. SHOP TESTS	○	○
IMMERSION TEST	○	○
SPECIAL TESTS (LIST BELOW)	○	○
_____	○	○
_____	○	○
_____	○	○
_____	○	○

PAINTING:
○ MANUFACTURER'S STANDARD
○ _____
○ _____

SHIPMENT:
○ DOMESTIC ○ EXPORT ○ EXPORT BOXING REQD.
○ OUTDOOR STORAGE OVER 3 MONTHS
○ _____
○ _____

REMARKS: _____

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PULSATION SUPPRESSION DEVICES (FOR MACHINES OF 201 BHP AND LARGER SEE TABLE 4) (PAR 3.10)

THESE SHEETS TO BE FILLED OUT FOR EACH SERVICE AND/OR STAGE OF COMPRESSION

APPLICABLE TO: ○ PROPOSALS ○ PURCHASE ○ AS BUILT

FOR/USER _____

SITE/LOCATION _____ AMBIENT TEMPERATURE MIN/MAX _____ / _____ °F

COMPRESSOR MFR. _____ NUMBER OF COMPRESSORS _____

SUPPRESSOR MFR. _____ MODEL/TYPE _____

NOTE: ○ IND. DATA COMP'D PURCH. ☐ BY COMPR/SUPP. MFG. W/PROPOSAL

◇ BY MFR(S) AFTER ORDER ⊡ BY MFG(S)/PURCHASER AS APPLICABLE

GENERAL INFORMATION APPLICABLE TO ALL SUPPRESSORS

TOTAL NUMBER OF SERVICES AND/OR STAGES _____

TOTAL NUMBER OF COMPRESSOR CYL. _____ TOTAL NUMBER OF CRANKTHROWS _____ STROKE _____ IN. RPM _____

⊗ ASME CODE STAMP ○ STATE/COUNTRY/PROVINCE OF _____ CODE REGUATIONS APPLY

○ OTHER APPLICABLE PRESSURE VESSEL SPEC. OR CODE _____

○ LUBE SERVICE ○ NON-LUBE SERV. ○ NO OIL ALLOWED INTERNALLY

DRY TYPE INTERNAL CORROSION COATING ○ YES ○ NO

RADIOGRAPHY (X-RAY OF WELDS): ○ NONE ○ SPOT ○ 100% ○ IMPACT TEST

○ SPECIAL WELDING REQUIREMENTS ○ SHOP INSPECTION ○ WITNESS HYDROTEST

○ OUTDOODR STORAGE OVER 6 MONTHS ○ SPECIAL PAINT SPEC _____

○ WITNESSED ○ OBSERVED

CYLINDER, GAS, OPERATING, AND SUPPRESSOR DESIGN DATA

	SERVICE _____ STAGE NO. _____		
⊡ COMPRESSOR CYL. DATA, THIS SERVICE OR STAGE ONLY	NUMBER OF CYL. _____ ON CRANKTHROW NO('S) _____ CRANK ANGLE(S) BETW. MANIFOLDED CYLS _____ DEG CYL BORE DIA _____ IN. STROKE _____ IN. RPM _____ PISTON ROD DIA _____ IN. PISTON DISPLACEMENT _____ CFM UNLOADERS FOR: ○ START-UP ONLY ○ CAP CONT ○ NONE		
☐ COMPRESSOR MANUFACTURER'S DERATED CAPACITY	LBS/HR _____ SCFM _____ MMSCFD _____		
⊡ RECEIVER OPERATING PRESSURE	INLET, _____ PSIA	DISCHARGE, _____ PSIA	
⊡ OPERATING TEMP. WITHIN SUPPRESSORS	INLET, _____ °F	⊡ DISCHARGE, _____ PSIA	
○ ALLOWABLE PRESSURE DROP THROUGH SUPPRESSORS	ΔP _____ PSI / _____ %	ΔP _____ PSI / _____ %	
	INLET SUPPRESSOR	DISCHARGE SUPPRESSOR	
○ COMBINATION INLET SUPPRESSOR SEPARATOR/ INTERNALS	○ YES ○ NO / ○ YES ○ NO	○ YES ○ NO	
⊡ NO. (QTY) OF INLET & DISCH. SUPP. PER STAGE RECEIVER			
○ DESIGN FOR FULL VACUUM CAPABILITY	○ YES ○ NO		

COMMENTS _____

UTILITY/INSTRUMENT AIR COMPRESSOR DATA SHEET CUSTOMARY UNITS

JOB NO. _____ ITEM NO. _____
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PULSATION SUPPRESSION DEVICES FOR RECIPROCATING COMPRESSORS (3.10)

THESE SHEETS TO BE FILLED OUT FOR EACH SERVICE AND/OR STAGE OF COMPRESSION

SERVICE _____
STAGE NO. _____

◇ TO BE COMPLETED BY MANUFACTURER AFTER ORDER
⊡ BY MANUFACTUROR OR PURCHASER AS APPLICABLE

CONSTRUCTION REQUIREMENTS & DATA	INLET SUPPRESSION	DISCHARGE SUPPRESSOR
○ BASIC MATERIAL REQUIRED, CARBON STEEL, SS, ETC.		
◇ ACT. MAT., ASTM OR SAE DESIGNATION SHELL / HEAD	/	/
⊡ CORROSION ALLOWANCE, INCHES ○ REQUIRED	IN.	IN.
◇ WALL THICKNESS, INCHES SHELL / HEAD	IN. /	IN. /
□ NOM. SHELL DIA X OVERALL LENGTH INCH / VOL. FT^3	x IN. / FT^3	x IN. / FT^3
□ PIPE OR ROLLED PLATE CONSTRUCTION	□ PIPE □ ROLLED PLATE	□ PIPE □ ROLLED PLATE
◇ ACT. MAX ALLOW. WORKING PRESS. & TEMPERATURE	PSI @ °F	PSI @ °F
◇ MAX EXPECTED PRESSURE DROP ΔP, PSI/% LINE PRESS.	ΔP PSI / %	ΔP PSI / %
◇ WEIGHT, LBS EACH	LBS	LBS
○ EXTEND VENTS/DRAINS TO ALLOW FOR INSULATION	○ YES ○ NO	○ YES ○ NO
◇ EXPECTED PK TO PK PULSE @ LINE SIDE/CYL. FLG, % PRESS. BASED ON FINAL SUPPRESSOR DESIGN	% / %	% / %
⊡ SUPPORTS, TYPE / QUANTITY		

CONNECTION REQUIREMENTS & DATA		
○ RECEIVER SIDE FLANGE, SIZE/RATING/FACING/TYPE		
○ COMP CYL FLANGE(S), QTY/SIZE/RATING/FACING/TYPE		
⊗ PER ANSI 16.5		
○ INSPECTION OPENINGS REQUIRED	○ YES ○ NO ○ BLINDED	○ YES ○ NO ○ BLINDED
○ SPEC. QTY, SIZE, 6000 LB NPT CPLG, /FLG TYPE & RATG.		
◇ *QTY, SIZE, 6000 LB NPT CPLG, /FLG TYPE & RATG.		
○ VENT CONNECTIONS REQUIRED	○ YES ○ NO	○ YES ○ NO
○ SPEC. QTY, SIZE, 6000 LB NPT CPLG, /FLG TYPE & RATG.		
◇ *QTY, SIZE, 6000 LB NPT CPLG, /FLG TYPE & RATG.		
○ DRAIN CONNECTIONS REQUIRED	○ YES ○ NO	○ YES ○ NO
○ SPEC. QTY, SIZE, 6000 LB NPT CPLG, /FLG TYPE & RATG.		
◇ *QTY, SIZE, 6000 LB NPT CPLG, /FLG TYPE & RATG.		
○ PRESSURE CONNECTIONS REQUIRED ○ CYL NOZZLE	○ YES ○ NO	○ YES ○ NO
○ SPEC. QTY, SIZE, 6000 LB NPT CPLG, /FLG TYPE & RATG.		
◇ *QTY, SIZE, 6000 LB NPT CPLG, /FLG TYPE & RATG.		
○ PRESSURE CONNECTIONS REQUIRED ○ MAIN BODY	○ YES ○ NO	○ YES ○ NO
○ SPEC. QTY, SIZE, 6000 LB NPT CPLG, /FLG TYPE & RATG.		
◇ *QTY, SIZE, 6000 LB NPT CPLG, /FLG TYPE & RATG.		

OTHER DATA AND NOTES		
◇ ACT. MAX ALLOW. WORKING PRESS. & TEMPERATURE		
◇ MAX EXPECTED PRESSURE DROP		

NOTES* = AS BUILT

UTILITY/INSTRUMENT AIR COMPRESSOR DATA SHEET SI UNITS

JOB NO. _____ ITEM NO. _____
PURCH ORDER NO. _____ DATE _____
REQUISITION NO. _____
INQUIRY NO. _____
BY _____
REVISION _____ DATE _____

APPLICABLE TO: ◯ PROPOSAL ◯ PURCHASE ◯ AS BUILT
FOR _____ UNIT _____
SITE _____ SERIAL NO. _____
SERVICE _____ NO. REQUIRED _____
MANUFACTURER _____ MODEL _____ TYPE DRIVER (3.1.1) _____
NOTE: ◯ INDICATES INFORMATION TO BE COMPLETED BY PURCHASER: ☐ BY MANUFACTURER ⊗ MANDATORY

PERFORMANCE

CONDITION	SUMMER			WINTER		
STAGE	1	2	3	1	2	3
INLET CONDITIONS @ COMPRESSOR SUCTION FLANGE (3.1.2)						
◯ BAROMETRIC PRESS. BAR (kPa abs)						
◯ TEMPERATURE (° C)						
◯ MOLECULAR WEIGHT						
☐ Cp/Cv (K_1) OR (K_{AVE})						
◯ INLET VOLUME (m^3/h)						
CONDITIONS @ COMPRESSOR DISCHARGE FLANGE						
☐ PRESSURE BAR (kPa abs)						
☐ TEMPERATURE (° C) (2.3)						
– ADIABATIC						
– ACTUAL (1.4.1.13)						
CONDITIONS @ RECEIVER DISCHARGE						
◯ TEMPERATURE (° C)						
◯ PRESSURE BAR (kPa abs)						
RATED CONDITIONS						
kg/h WET (1/4/1/3)						
☐ INLET (m^3/h) (CORRECTED)						
PRESSURE RATIO (R)						
☐ SPEED (RPM) (2.2.1)						
POWER kW						
☐ TOTAL POWER kW (1.4.1.3)						

◯ MAXIMUM SOUND PRESSURE LEVEL (2.1.3)
◯ SYSTEM SUITABLE FOR PARALLEL OPERATION WITH:
_____ CENTRIF. COMP. _____ RECIP. COMP. _____ BOTH
◯ STANDBY DUTY ◯ CONTINUOUS DUTY (1.4.1.17)

◯ NORMAL OPERATING POINT (1.4.1.9)

◯ m^3_n/h (760mm HG & 0° C) DRY _____
◯ DISCHARGE PRESSURE _____ BARG (kPa)
@ ◯ CYLINDER ◯ PULSATION DAMPER ◯ RECEIVER DISCHARGE
☐ PRESSURE DROP ALLOWED FOR:
INLET FILTER _____ BAR (kpa)
INLET PULSATION DAMPER _____ BAR (kpa)
DISCHARGE PULSATION DAMPER _____ BAR (kpa)
AFTER COOLER _____ BAR (kpa)
RECEIVER _____ BAR (kpa)

◯ PACKAGE MANUFACTURER SHALL FURNISH THE FOLLOWING:

◯ ALL PIPING TO EDGE OF SKID (3.7.1.3)
◯ DRIVER: _____ MOTOR (3.1) _____
STEAM TURBINE _____ OTHER _____
◯ SPEED REDUCING GEAR
◯ SHEAVES & V-BELT
◯ SHAFT COUPLING
◯ COUPLING GUARDS
◯ INTERCOOLER & SEPARATOR (3.8)
◯ AFTERCOOLER & SEPARATOR (3.8)
◯ RECEIVER (3.11)
PULSATION DAMPERS (3.10)
◯ INLET ◯ DISCHARGE
◯ CONTROL STATION (3.6.3)
◯ INLET FILTER & SILENCER (3.9)
INLET PIPING
◯ STAINLESS STEEL
◯ PVC
◯ C.S. INTERNALLY COATED
◯ CYLINDER LUBRICATORS (2.13.1)
◯ DISCHARGE CHECK VALVE
◯ AUTO CONDENSATE TRAPS (3.8.3)
◯ ORIFICED BLEED (3.8.3)
◯ COOLING WATER MANIFOLD (3.7.5)
◯ THERMAL RELIEF VALVES (COOLANT) (3.8.5)
⊗ TORSIONAL ANALYSIS (2.2.2), (2.5.2) (GEARED UNITS ONLY)
◯ ANALOG STUDY (3.10)
COOLING WATER SYSTEM:
◯ EXTERNAL SUPPLY
◯ AIR COOLERS (3.8.8)
◯ CLOSED SYSTEM
◯ PRESSURE TRANSDUCER CONN (2.6.2.4)
◯ LATERAL CRITICAL ANALYSIS
◯ SPECIAL TOOLS (3.12)
COMMENTS: _____

UTILITY/INSTRUMENT AIR COMPRESSOR DATA SHEET SI UNITS

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OPERATING CONDITIONS WITH CAPACITY CONTROL

	START UP (3.6.2.4)					
◯ % CAPACITY/STAGE						
☐ kg/h – WET						
☐ INLET (m^3/h)						
☐ POCKETS/VALVES OPERATION*						
☐ INLET PRESSURE BAR (kPa abs)						
☐ DISCHARGE PRES. BAR (kPa abs)						
☐ DISCH. TEMP.° C (ACTUAL)						
☐ POWER/STAGE						
☐ TOTAL POWER kW (W/DRIVE LOSSES)						
☐ ACTUAL ROD LOAD (N) T**						
☐ ACTUAL ROD LOAD (N) C**						
☐ DEGREES ROD REVERSAL						

◯ % CAPACITY/STAGE						
☐ kg/h – WET						
☐ INLET (m^3/h)						
☐ POCKETS/VALVES OPEN *						
☐ INLET PRESSURE BAR (kPa abs)						
☐ DISCHARGE PRESSURE BAR (kPa abs)						
☐ DISCH. TEMP.° C (ACTUAL)						
☐ POWER/STAGE						
☐ TOTAL POWER kW (W/DRIVE LOSSES)						
☐ ACTUAL ROD LOAD (N) T**						
☐ ACTUAL ROD LOAD (N) C**						
☐ DEGREES ROD REVERSAL						

* SHOW OPERATION WITH THE FOLLOWING SYMBOLS:

HEAD END = H OR CRANK END = C } PLUS { SUCTION VALVE UNLOADERS = S OR FIXED POCKET OPEN = F OR VARIABLE POCKET OPEN = V

EXAMPLE: HS/CF = HEAD END SUCTION VALVE UNLOADERS & CRANK END FIXED POCKET OPEN

**T = TENSION (GAS + INERTIA LOAD)

**C = COMPRESSION (GAS + INERTIA LOAD)

CONTROL SYSTEM (2.7.2)

BASIC OPERATING CONTROL TYPE:

◯ AUTO. START/STOP
◯ CONSTANT SPEED CONTROL
◯ DUAL CONTROL

UNLOADER CONTROL TYPE: (3.6.1.1)

◯ PNEUMATIC ◯ MANUAL
◯ ELECTRICAL ◯ FIVE STEP
◯ ELECTRONIC ◯ THREE STEP
◯ AUTOMATIC (3.6.2.1) ◯ OTHER _____

◯ PURCHASERS BY-PASS
◯ VARIABLE SPEED TO _____ % RATED CAPACITY
◯ CONTROL SIGNAL _____ RANGE (3.6.1.1)

UNLOADER TYPES SHALL BE: (3.6.2.5)

◯ VALVE DEPRESSOR
◯ CLEARANCE POCKET
◯ PLUG
◯ INTERNAL BY-PASS
◯ OTHER _____

UPON AIR/POWER FAILURE COMPRESSOR SHALL:

◯ LOAD
◯ UNLOAD

UTILITY/INSTRUMENT AIR COMPRESSOR DATA SHEET SI UNITS

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○ SITE DATA

ALTITUDE _____ M. BAROMETER _____ BAR (kPa abs)
DESIGN TEMP.° C _____ SUMMER _____ WINTER MIN.
DESIGN WET BULB TEMP.° C _____
○ WINTERIZATION REQ'D. ○ TROPICALIZATION REQ'D. (3.6.7.5)
UNUSUAL CONDITIONS: ○ DUST ○ FUMES ○ OTHER _____

EQUIPMENT SHALL BE SUITABLE FOR (2.1.13)

○ INDOORS ○ HEATED ○ UNHEATED
○ OUTDOORS ○ UNDER ROOF ○ WITHOUT ROOF

ELECTRICAL EQUIPMENT HAZARDOUS CLASSIFICATION (2.1.7)

CLASS _____ GROUP _____ DIVISION _____

COOLING WATER FOR COMP. CYLINDERS (2.6.1.9)

TYPE WATER _____

COOLING WATER FOR (OIL COOLER) (INTERCOOLERS) (2.6.1.9)

TYPE WATER _____

COOLING FOR ROD PACKING COOLING

TYPE FLUID _____

ELECTRIC POWER FOR HEATERS

_____ VOLTS _____ PHASE _____ HERTZ

MOTOR CONTROL & INSTRUMENT VOLTAGE

_____ VOLTS _____ PHASE _____ CYCLES

ALARM AND SHUT DOWN VOLTAGE

_____ VOLTS _____ PHASE _____ CYCLES _____ DC

STEAM FOR HEATERS

NORMAL _____ BARG (kPa) _____ ° CTT
MAX. _____ BARG (kPa) _____ ° CTT

INSTRUMENT AIR SUPPLY

PRESS., BARG (kPa) _____ MAX. _____ NORMAL _____ MIN.
DEW POINT _____ ° C

COMPRESSOR LUBRICATION (2.12)

FRAME

○ PRESSURE SYSTEM ○ SPLASH SYSTEM
○ MAIN OIL PUMP DRIVEN BY COMP. SHAFT
○ AUX. OIL PUMP DRIVEN BY ELECTRIC MOTOR
☐ HAND OPERATED PUMP FOR STARTING
TYPE MAIN BEARINGS ☐ SLEEVE ☐ ROLLER
☐ OUTBOARD BEARING INCLUDED ☐ MATERIALS _____

CYLINDERS

○ NON LUBRICATED ○ SYNTHETIC LUBE (2.1.3.3)
LUBE DRIVEN BY: ○ COMP. SHAFT ○ ELEC. MTR. ○ CHAIN
TYPE LUBRICATOR: ○ SINGLE PLUNGER/FEED ○ DIV. BLOCK
☐ LUBRICATOR MAKE _____ MODEL _____
☐ NO. PER COMP. _____ CAP. ○ 24 HRS. _____ LITERS
☐ NO. OF SPARE LUB. BLOCKS _____ ○ HEATER _____

COMPRESSOR DATA

ITEM NO./SERVICE		
STAGE		
NO. OF CYL.		
TYPE CYL. COOLING REQD. (2.6.1.7) (APP.B)		
LUBRICATED/NON-LUBRICATED		
SINGLE/DOUBLE ACTING		
CYLINDER LINER YES/NO		
BORE, mm		
STROKE, mm		
PISTON DISPLACEMENT, m^3		
CLEARANCE, %		
VOLUMETRIC EFFICIENCY, %		
API VALVE GAS VELOCITY, m/MIN. (2.7.1)		
NO. INLET/DISCH. VALVES/CYL.		
TYPE OF VALVES (2.7.2)		
INLET/DISCH. VALVE LIFT, mm (2.7.1)		
MAX. ALLOW PISTON SPEED, m/MIN (2.2.1)		
NORMAL PISTON SPEED, m/MIN (2.2.1)		
ROD DIAMETER, mm		
MAX. ALLOW. ROD LOADING T* (N)		
MAX. ALLOW. ROD LOADING C* (N)		
ROD RUN-OUT (ALLOWABLE), mm		
MIN. CYLINDER WALL THICKNESS mm		
CYLINDER FINISH (R_A) (2.6.1.5)		
MAX. ALLOW. CYL. WKG. PRESS., BARG (kPa)		
MAX. ALLOW. CYL. TEMP. ° C (1.4.1.6)		
RECOMMENDED RELIEF VALVE, BARG (kPa)		
HYDROSTATIC TEST, BARG (kPa)		
CYLINDER		
WATER JACKET		
MIN. ALLOWABLE SPEED (1.4.18)		
TRIP SPEED (1.4.1.18)		

*T = TENSION *C = COMPRESSION

☐ COMPRESSOR MATERIALS (APPEN. B)

CYLINDERS (2.14.2.7)		
CYLINDER LINERS		
PISTONS		
PISTON RINGS		
RIDER RINGS		
PISTON RODS		
PISTON ROD HARDNESS (ROCKWELL "C")		
VALVE SEATS/SEAT PLATE		
VALVE STOPS		
VALVE		
VALVE SPRINGS		
ROD PACKING		
MAIN BEARINGS		
CRANK PIN BEARING		
LOW TEMP. MATERIAL (2.1.4.5)		

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COMPRESSOR MATERIALS (APPEN. B) CONT'D.

CRANKSHAFT (2.14.2.4) _____ _____
CROSS HEAD BEARING _____ _____
CROSS HEAD _____ _____
CROSS HEAD SHOES _____ _____
FLYWHEEL _____ _____
CYLINDER MAT'L. PER ASTM A 395 (2.13.2.7) _____ _____
CYLINDER HEAD MAT'L PER ASTM A 395 _____ _____

COUPLINGS (3.2.)

	DRIVER–COMP OR DRIVER–GEAR	GEAR,–COMP.
○ MAKE		
☐ MODEL		
○ LUBRICATION		
○ MOUNT CPLG. HALVES		
○ SPACER REQD.		
○ LMT'D. END FLOAT REQ'D.		
○ IDLING ADAPTOR REQ'D.		
☐ CPLG. RATING (kW/100 RPM)		
☐ KEYS (1) OR (2); OR HYDR. FIT		

☐ CPLGS –(MAIN) (AUX) OIL PUMP JACKET WATER PUMPS
MFR. _____ MODEL _____
TYPE _____
TYPE GUARDS ○ CODE ○ STANDARD ○ NON–SPARK (3.2.1.8)
○ STATIC COND. V–BELTS (3.4.1) ○ TOT. ENCL V–BELT GRD.

COMPRESSOR PACKING (2.11)

○ FULL FLOATING VENTED PACKING WITH
STAINLESS STEEL SPRINGS _____
○ FORCED FEED LUBRICATED _____
○ NON–LUBE ○ TEFLON ○ CARBON ○ OTHER _____
☐ WATER COOLED _____
○ PROVISIONS FOR FUTURE (WATER) (OIL) – COOLING
○ VENTED TO _____

DISTANCE PIECE (2.10.1 & 2.10.2)

○ STANDARD _____
○ EXTRA LONG SINGLE COMPARTMENT _____
○ SCREENED ○ LOUVERED
○ SOLID COVER DESIGN PRESS., PSIG _____

MISCELLANEOUS

BARRING DEVICE ○ MANUAL ○ PNEU.
AIR INTAKE FILTER BY (3.9): ☐ PACKAGE MFR ○ PURCH.
☐ MFR. _____ MODEL _____
☐ TYPE _____ ○ FLANGED OUTLET CONNECTION _____

PAINTING

○ MANUFACTURER'S STANDARD
○ OTHER _____

SHIPMENT

○ DOMESTIC ○ EXPORT ○ EXPORT BOXING REQ'D.
(X) OUTDOOR STORAGE OVER 6 MONTHS (4.4.1)

☐ UTILITY CONSUMPTION

ELECTRIC	kW	LOCKED ROTOR AMPS	FULL LOAD AMPS
MAIN DRIVER			
MAIN LUBE OIL PUMP			
AUX. LUBE OIL PUMP			
PKG. COOLANT OIL PUMP			
MECH. LUBRICATOR			

FRAME OIL HEATER _____ WATTS _____ VOLTS _____ HZ
LUBRICATOR HEATER _____ WATTS _____ VOLTS _____ HZ
SPACE HEATER _____ WATTS _____ VOLTS _____ HZ

STEAM

MAIN DRIVER _____ @/HR _____ BARG _____ ° CTT TO _____ BARG
LUBR HEATER _____ @/HR _____ BARG _____ ° CTT TO _____ BARG
FRAME HEATER _____ @/HR _____ BARG _____ ° CTT TO _____ BARG
_____ @/HR _____ BARG _____ ° CTT TO _____ BARG

COOLING WATER

	COMP. CY JKTS	ROD PKG	L.O. COOLER	INTER COOLERS	OTHER
QUANTITY (m^3/h)					
INLET TEMP., °C					
OUTLET TEMP., °C					
INLET PRESS. BARG (kPa)					
OUTLET PRESS BARG (kPa)					
MAX PRESS., BARG (kPa)					
TOTAL C.W., m^3/h					

WEIGHTS AND DIMENSIONS

☐ MAX. ERECTION WEIGHT _____ kg
☐ MAX. MAINTENANCE WEIGHT _____ kg
☐ TOTAL WT. LESS DRIVER & GEAR _____ kg
☐ TOTAL WT. COMPLETE UNIT _____ kg
☐ SPACE REQ'D. m _____
COMPRESSOR L _____ W _____ H _____
COMPLETE UNIT L _____ W _____ H _____
☐ ROD REMOVAL DISTANCE _____ m
☐ COOLER TUBE REMOVAL DISTANCE _____ m
☐ LUBE OIL CONSOLE
TOTAL WEIGHT _____ kg
DIM. m L _____ W _____ H _____
☐ CLOSED COOLANT SYSTEM
TOTAL WEIGHT _____ kg
DIM. m L _____ W _____ H _____
☐ OR ○ FREE STANDING INSTRUMENT/CONTROL PANEL
TOTAL WEIGHT _____ kg
DIM. m L _____ W _____ H _____

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BASEPLATE & SOLEPLATES: (3.5.1)

SOLEPLATES FOR: ○ COMPRESSOR ○ GEAR ○ DRIVER
BASEPLATE: SUB SOLE PLATE (3.5.3)
○ COMMON (UNDER COMP. GEAR & DRIVER)
○ UNDER COMP. ONLY ○ OTHER
○ OPEN CONSTRUCTION
○ DRIP RIM ○ WITH OPEN DRAIN
○ HORIZONTAL ADJUSTING SCREWS FOR EQUIPMENT
○ VERTICAL ADJUSTING SCREWS FOR EQUIPMENT (3.5.5)
○ SUITABLE FOR POINT SUPPORT (3.5.2)
○ SUITABLE FOR PERIMETER SUPPORT
○ GROUTING PREP EPOXY (3.5.8)
☐ RECOMMENDED STRAIGHT RUN OF PIPE DIAMETER BEFORE SUCTION _____
○ VENDOR'S REVIEW & COMMENTS ON PURCHASER'S PIPING & FOUNDATION (2.1.12)
○ _____
○ _____

INSPECTION AND SHOP TESTS

	Reqd.	Obsvd.	Witn'd.
SHOP INSPECTION	○	○	○
MFR. STANDARD SHOP TESTS	○	○	○
VALVE LEAK TEST	○	○	○
CYLINDER HYDRO TEST	○	○	○
HYDRO CYL WATER JKTS @ _____ BARG (kPa)	○	○	○
BAR OVER TO CHECK RUNOUT, ETC.	○	○	○
MECHANICAL RUN TEST W/SHOP DRIVER	○	○	○
PERFORMANCE TEST (4.3.4.1)	○	○	○
MECH. RUN TEST W/JOB DRIVER	○	○	○
COMPLETE UNIT TEST (4.3.4.2)	○	○	○
AUX. EQUIP. OPER. TEST	○	○	○
DISMANTLE-REASSEMBLE INSPECTION	○	○	○
KEROSENE LEAK TEST	○	○	○
○ OPTIONAL TEST DATA (4.3.4) (5.2.4.2(e))	○	○	○
_____	○	○	○
_____	○	○	○

☐ MAIN CONNECTIONS:

	SIZE	ANSI RATING	FACING	POSITION
INLET				
DISCHARGE				
INLET				
DISCHARGE				
INLET				
DISCHARGE				

CONTRACT DATA

○ CERTIFIED COPIES OF TEST DATA PRIOR TO SHIPMENT (5.2.4.2)
○ MATERIAL INSP (NDT) (2.14.6.1)
○ RETAIN ASS'Y CLEARANCES FOR 5 YEARS (4.2.1 (C))
○ VESSEL CLEANLINESS INSPECTION (4.2.3.2)
○ KEEP SHOP TEST DATA FOR 5 YEARS (5.2.4.2 (d))
○ MFR. PRESENT FOR INITIAL ALIGNMENT (2.1.12)
○ PROGRESS REPORTS (5.2.5)
○ CO-ORDINATION MEETING (5.2.2)
○ DRAWING REQUIREMENTS (5.2.3.1)
○ PROGRESS REPORTS (5.2.5)
○ COORDINATION MEETING (5.2.2)
○ DRAWING REQUIREMENTS (5.2.3.1)
○ MFR. REP. PRESENT FOR INITIAL ALIGNMENT (2.1.12)
○ _____
○ _____

☐ ALLOWABLE PIPING FORCES & MOMENTS:

	INLET		DISCHARGE			
	FORCE N	MOMT N-m	FORCE N	MOMT N-m	FORCE N	MOMT N-m
AXIAL						
VERTICAL						
HORIZ. 90°						
	FORCE N	MOMT N-m	FORCE N	MOMT N-m	FORCE N	MOMT N-m
AXIAL						
VERTICAL						
HORIZ. 90°						

REMARKS:

☐ OTHER CONNECTIONS:

	NO.	SIZE	
LUBE OIL INLET			
LUBE OIL OUTLET			
CYLINDER DRAINS			
VENTS			
COOLING WATER			
SUCTION DAMPER			
DISCHARGE DAMPER			
COUPLING DRAIN (FLANGED) (3.2.2.2)			

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FRAME LUBE OIL SYSTEM (2.12)

BASIC SYSTEM REQ'TS. (NORMAL OIL FLOW)

☐ LUBE OIL	GPM	PSIG	SSU@100°F
COMPRESSOR			
DRIVER			

SYSTEMS PRESSURES:

☐ DESIGN _____ PSIG ☐ HYDROTEST _____ PSIG
☐ PUMP RELIEF VALVE(S) SETTINGS _____ PSIG

PUMPS:

	MAIN	STANDBY
○ SHAFT DRIVEN		
○ MOTOR DRIVEN		
○ TURBINE DRIVEN		
○ HORIZ. CENTRIFUGAL		
○ GEAR/SCREW		
○ _____		
☐ m^3 /h (RATED)		
☐ @ BARG (kPa)		
☐ kW @ 17.8 mPa.S		
☐ DRIVEN kW		
○ CASING MATERIAL		
☐ SPEED		
○ COUPLING		
☐ GUARD		
○ MECH. SEAL		
○ STANDBY (2.12.4)		

MISCELLANEOUS:

HEATING COIL (2.13.2)
○ STEAM ○ ELECTRIC
○ DENSITY _____ WATTS/SQ. m
○ S S COIL.

PIPING MATERIALS:

	CARBON STEEL	STAINLESS STEEL
○ COMPLETE SYSTEM		
○ RETURN PIPING		
○ CARBON STL SLIP ON FLANGES ON STAINLESS STL PIPING		
○ _____		

COOLERS: (2.12.6)

○ SINGLE ○ TWIN W/TRANSFER VALVE ○ AIR COOLED
○ WITH BY PASS & TEMP. CONTROL VALVE
○ MANUAL ○ AUTO
SEE SEPARATE DATA SHEET FOR COOLER DETAILS

FILTERS: (2.12.7)

○ SINGLE ○ TWIN
○ ASME CODE DESIGN ○ ASME CODE STAMP
○ MICRON (μ) _____
☐ FILTER MEDIUM _____
☐ DESIGN PRESS., BARG (kPa) _____
☐ ΔP CLEAN BAR (kpa) _____
☐ ΔP COLLAPSE BAR (kpa) _____
☐ CASING MATERIAL _____
○ VALVED CLEAN SIDE OIL DRAIN _____
○ VALVED DIRTY SIDE OIL DRAIN _____
○ VALVED VENT SIDE OIL DRAIN _____
○ VALVED CROSSOVER PIPING W/ORIFICE _____
☐ CARTRIDGE IDENT. NO. _____
○ FURNISH SET OF SPARE CARTRIDGES WITH FILTERS

REMARKS:

SKETCH:

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SELF CONTAINED COOLING SYSTEM (2.6.19 REF. FIG. B-2 APP. B)

○ SYS. TO BE CONSOLE MOUNTED W/DECK PLATE SUITABLE FOR PERIMETER SUPPORT AND GROUTING
○ ONE CONSOLE FOR EACH COMPRESSOR
○ ONE CONSOLE FOR _____ COMPRESSORS
○ JACKET WATER TO BE _____ % ETHYLENE GLYCOL

BASIC SYSTEM REQUIREMENTS (NORMAL FLOW)

	m^3/h	BARG (kPa)	CYL. TEMP.(°C)
☐ WATER			

SYSTEM PRESSURES:

☐ DESIGN _____ BARG (kPa) ☐ HYDROTEST _____ BARG (kPa)
☐ PUMP RELIEF VALVE(S) SETTINGS _____ BARG (kPa)

WATER STORAGE TANK

TANK HOLDING CAPACITY GALLONS _____
TANK SIZE _____ m X _____ m X _____ m
○ HEATER ○ ELECTRIC ○ STEAM
○ TANK MATERIAL _____
○ LEVEL GAGE ○ LEVEL SWITCH

PUMPS:	MAIN	STANDBY
○ HORIZONTAL		
○ MOTOR DRIVEN		
○ TURBINE DRIVEN		
○ CENTRIFUGAL		
○ GEAR/SCREW		
☐ m^3/h (RATED)		
☐ @ BARG (kPa)		
☐ kW @ 17.8 mPa.S		
☐ DRIVEN kW		
○ CASING MATERIAL		
☐ SPEED		
○ COUPLING		
☐ GUARD		
○ MECH. SEAL		
○ _____		
○ _____		

STANDBY PUMP CONTROL RESET:

○ MANUAL ○ AUTOMATIC
○ "ON-OFF-AUTO" SELECTOR SWITCH BY _____

COOLERS:

○ SHELL & TUBE ○ AIR COOLER
○ SINGLE ○ TWIN WITH TRANSFER VALVE
○ WITH BYPASS & TEMP. CONTROL VALVE (WITH TIC & 2 WAY VALVE)
○ MANUAL ○ AUTO
○ SEE SEPARATE DATA SHEET FOR COOLER DETAILS

SYSTEM COMPONENT SUPPLIERS:

	MANUFACTURER	MODEL
☐ MAIN PUMP		
☐ STANDBY PUMP		
☐ ELECTRIC MOTOR(S)		
☐ STEAM TURBINE(S)		
☐ COOLER(S)		
☐ OIL FILTER(S)		
☐ ACCUMULATOR(S)		
☐ SUCT. STRAINER(S)		
☐ CHECK VALVE(S)		
☐ SWITCH VALVE(S)		
☐ PUMP COUPLING(S)		
☐ _____		
☐ _____		

INSTRUMENTATION MOUNTED ON CONSOLE

○ _____
○ _____
○ _____
○ _____
○ _____
○ _____
○ _____
○ _____
○ _____
○ _____
○ _____

SKETCH:

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INSTRUMENTATION

LOCAL CONTROL STATION: (3.6.3)

NOTE: [X] SUPPLIED BY VENDOR

FURNISHED BY VENDOR

[X] CAPACITY CONTROL SELECTOR SWITCH [X] LAMP TEST BUTTON [X] POWER SUPPLY LIGHT [X] START STOP BUTTON
[X] CAPACITY CONTROL LOAD/INDICATOR [X] RUNNING LIGHT [X] BASE MOUNTED [ ] FREE STANDING [ ] WEATHERPROOF
[ ] TOTALLY ENCLOSED [ ] EXTRA CUTOUTS [X] VIBRATION ISOLATORS [ ] STRIP HEATERS [ ] PURGE CONNECTIONS
[ ] ANNUNCIATOR WITH FIRST OUT INDICATION WITH ROTAMETER LOCATED ON LOCAL PANEL ○ ISOLATION VALVES (3.6.1.6)
○ WEATHER HOOD (3.6.3.2) ○ TROPIC-PROOF ELECTRICAL MATERIALS

REMARKS: _____

ALARM & SHUTDOWN SWITCHES & LIGHTS: (3.6.3.3)

FUNCTION	ALARM	TRIP
☐○ LOW FRAME OIL PRESSURE		
☐○ HIGH FRAME OIL TEMP.		
☐○ HIGH LUBE OIL FILTER Δ P		
☐○ LOW MECH LUBRICATOR OIL LEVEL		
☐○ HIGH INLET AIR PRESSURE DIFFERENTIAL		
☐○ HIGH COOLING WATER TEMP. (EA. CYL.)		
☐○ HIGH GAS DISCHARGE PRESSURE (EA. CYL)		
☐○ AUX. LUBE OIL PUMP START		
☐○ HIGH LIQUID LEVEL MOISTURE SEP.		
☐○ HIGH GAS DISCH TEMP (EA. CYL)		
☐○ HIGH INTERCOOLER AIR TEMP		
☐○ HIGH INTERCOOLER COND. LEVEL		

FUNCTION	ALARM	TRIP
☐○ COMPRESSOR FRAME VIBRATION		
☐○ GEAR VIBRATION		
☐○ GEAR AXIAL POSITION		
☐○ COMPRESSOR DRIVER SHUTDOWN		
☐○ HIGH DRIVER THRUST BRG. TEMP.		
☐○ CYLINDER LUBRICATOR DRIVE FAILURE		
☐○		
☐○		
☐○		
☐○		
☐○		
☐○		
☐○		

SWITCH CLOSURES: (3.6.5.2)

ALARM CONTACTS SHALL [X] OPEN [ ] CLOSE TO SOUND
ALARM &/BE NORM. [ ] ENERG'D [X] DE-ENERG'D
SHUTDOWN CONT. SHALL [ ] OPEN [X] CLOSE TO TRIP
NORMALLY [X] ENERG'D [ ] DE-ENERG'D
NOTE: NORMAL COND. WHEN COMPRESSOR IN OPERATION

MISCELLANEOUS:

PRE ALARM & SHUTDOWN SWITCHES SHALL BE SEPARATE
PURCH. ELECTRICAL & INSTRUMENT CONN. SHALL BE:
[ ] BROUGHT OUT TO TERMINAL BOXES
[ ] MADE DIRECTLY BY THE PURCHASER
SWITCH ENCLOSURE: ○ EXP. PROOF ○ WEATHERPROOF
○ NEMA TYPE _____

PRESSURE GAGE REQUIREMENTS: (3.6.4.5)

(X) MANDATORY

OIL FILLED _____ YES _____ NO

FUNCTION	GAUGE BOARD
LUBE OIL PUMP DISCHARGE	☐○
LUBE OIL FILTER Δ P	☐○
LUBE OIL SUPPLY	[X](X)
	☐○
	☐○
	☐○
	☐○

FUNCTION	GAUGE BOARD
COMPRESSOR SUCTION EACH STAGE	☐○
COMPRESSOR DISCHARGE EA. STG.	☐(X)
	☐○
	☐○
	☐○
	☐○
	☐○

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TEMPERATURE GAGE REQUIREMENTS

(x) MANDATORY

FUNCTION	LOCALLY MOUNTED	GAUGE BOARD	FUNCTION	LOCALLY MOUNTED	GAUGE BOARD
LUBE OIL PUMP DISCHARGE FROM:	☐	○	COOLER OIL INLET & OUTLET _____	☐	(x)
GEAR OUTLET	☐	○	COMPRESSOR SUCTION EA. _____	☐	○
DRIVER JOURNAL BEARING _____	☐	○	COMPRESSOR DISCHARGE EA. CYL.	☐	(x)
DRIVER THRUST BEARING _____	☐	○	JACKET WATER SUPPLY _____	☐	○
C.W. IN & OUT OF INTERCOOLER	☐	○	JACKET WATER RETURN EA. CYL.	☐	(x)
CRANKCASE _____	☐	○	GEAR JOURNAL BEARING EA. _____	☐	○
_____	☐	○	AIR COOLER INLET & OUTLET _____	☐	○
_____	☐	○	_____	☐	○
_____	☐	○	_____	☐	○

MISCELLANEOUS INSTRUMENTS

	LOCALLY MOUNTED	GAUGE BOARD		LOCALLY MOUNTED	GUAGE BOARD
TACHOMETER (3.6.4.2)	☐	○	ANNUNCIATOR (3.6.6)	☐	○

INSTRUMENT SUPPLIERS:

PRESSURE GAGES:	MFR. _____	SIZE & TYPE _____
TEMPERATURE GAGES:	MFR. _____	SIZE & TYPE _____
LEVEL GAGES:	MFR. _____	SIZE & TYPE _____
DIFF. PRESSURE GAGES:	MFR. _____	SIZE & TYPE _____
PRESSURE SWITCHES:	MFR. _____	SIZE & TYPE _____
DIFF. PRESSURE SWITCHES:	MFR. _____	SIZE & TYPE _____
TEMPERATURE SWITCHES:	MFR. _____	SIZE & TYPE _____
LEVEL SWITCHES:	MFR. _____	SIZE & TYPE _____
CONTROL VALVES:	MFR. _____	SIZE & TYPE _____
PRESSURE RELIEF VALVES:	MFR. _____	SIZE & TYPE _____
THERMAL RELIEF VALVES:	MFR. _____	SIZE & TYPE _____
SIGHT FLOW INDICATORS:	MFR. _____	SIZE & TYPE _____
GAS FLOW INDICATOR:	MFR. _____	SIZE & TYPE _____
VIBRATION EQUIPMENT:	MFR. _____	SIZE & TYPE _____
TACHOMETER:	MFR. _____	FLANGE & TYPE _____
SOLENOID VALVES:	MFR. _____	SIZE & TYPE _____
ANNUNICATOR	MFR. _____	MODEL & NO. POINTS _____
_____	_____	_____
_____	_____	_____

CONTROL PANEL INSTRUMENTS

QUANTITY	PURCHASER TAG NUMBER	VENDOR TAG NUMBER	LOCATION	DESCRIPTION & SET POINT	MOUNTING (3.6.5.1.1)

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INTERCOOLER

DUTY _____ BTU/HR COOLER ITEM NO. _____
SUPPLIER _____ NO. UNITS REQUIRED _____
MODEL NO. _____ TYPE _____ (3.8.1)(3.8.7)

OPERATION CONDITIONS	SHELL SIDE (3.8.9)	TUBE SIDE
○ FLUID		
☐ TOTAL FLOW kg/h		
☐ SPECIFY GRAVITY	@ °C	@ °C
☐ THERMAL COND. W/(m²•°C/m)	@ °C	@ °C
☐ SPECIFIC HEAT – KJ/kg•° C)	@ °C	@ °C
☐ VISCOSITY – mPa.S	@ °C	@ °C
☐ OPERATING TEMPERATURES, °C		
INLET PRESSURE BARG (kPa)		
INLET VELOCITY, m/SEC		
○ PRESSURE DROP BAR (kpa)	ALLOW CALC.	ALLOW CALC.
☐ DESIGN TEMPERATURE°C		
PRESSURE, BARG (kPa)	MIN. TEST	MIN. TEST
FOUL RESISTANCE, m² K/W		
○ MIN. CORROSION ALLOWANCE, mm		
☐ NUMBER OF PASSES PER SHELL		
_____		

CONSTRUCTION DETAILS

☐ TOTAL AREA (1) SQ. FT. _____ m²
☐ LMTD _____
☐ CORRECTED MTD (EFF) _____ °C
☐ TRANSFER RATE, CLEAN _____ W/(m²•K)
☐ TRANSFER RATE, SERVICE _____ W/(m²•K)
☐ CROSS BATTLES, TYPE _____
○ CODE REQUIREMENTS (2) _____ ASME TEMA _____
☐ WEIGHTS _____ BUNDLE _____ kg.: BUNDLE & SHELL _____ kg.: FULL OF WATER _____ kg.:
⊗ AUTO DRAIN TRAP WITH MANUAL BYPASS (3.8.3.A) ○ TEMA CLASS R (3.8.1)
○ ORIFICED DRAIN TRAP BLEED

☐ SHELL, NO. X ID. _____ X _____ mm
☐ TUBES, NO. PER SHELL _____
☐ O.D. X LENGTH _____ mm _____ mm
☐ GAUGE, BWG _____ (AVG.), (MIN.) WALL
☐ TUBE PITCH _____ IN △ □ ○
☐ REMOVABLE TUBE BUNDLE ☐ YES ☐ NO
⊗ ASME CODE STAMP ☐ YES ☐ NO

NOZZLE SIZES

	SHELL SIDE			TUBE SIDE		
	NO.	SIDE	RATING & FACING	NO.	SIZE	RATING & FACING
INLET						
OUTLET						
DRAIN						
VENT						

MATERIALS

TUBES _____ BAFFLES _____
TUBE SHEETS _____ CHANNEL _____
SHELL _____ CHANNEL FLANGES _____
SHELL FLANGES _____ CHANNEL NOZ. FLANGES _____

(1) OUTSIDE TUBE AREA EXCLUDING AREA IN TUBE SHEETS

(2) UNITS EXEMPT FROM CODE STAMP SHALL HAVE LONGITUDINAL WELD SEAMS SPOT EXAMINED PER PARA UW-52 OF ASME CODE

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AFTERCOOLER

DUTY _____ BTU/HR COOLER ITEM NO. _____
SUPPLIER _____ NO. UNITS REQUIRED _____
MODEL NO. _____ TYPE _____ (3.8.1) (3.8.7)

OPERATION CONDITIONS	SHELL SIDE (3.8.9)	TUBE SIDE
○ FLUID		
☐ TOTAL FLOW kg/h		
☐ SPECIFY GRAVITY	@ °C	@ °C
☐ THERMAL COND. W/(m²•°C/m)	@ °C	@ °C
☐ SPECIFIC HEAT - KJ/kg•° C)	@ °C	@ °C
☐ VISCOSITY - mPa.S	@ °C	@ °C
☐ OPERATING TEMPERATURES, °C		
INLET PRESSURE BARG (kPa)		
INLET VELOCITY, m/SEC		
○ PRESSURE DROP BAR (kpa)	ALLOW CALC.	ALLOW CALC.
☐ DESIGN TEMPERATURE °C		
PRESSURE, BARG (kPa)	MIN. TEST	MIN. TEST
FOUL RESISTANCE, m² K/W		
○ MIN. CORROSION ALLOWANCE, mm		
☐ NUMBER OF PASSES PER SHELL		
_____		

CONSTRUCTION DETAILS

☐ TOTAL AREA (1) SQ. FT. _____ m²
☐ LMTD _____
☐ CORRECTED MTD (EFF) _____ °C
☐ TRANSFER RATE, CLEAN _____ W/(m²•K)
☐ TRANSFER RATE, SERVICE _____ W/(m²•K)
☐ CROSS BATTLES, TYPE _____
○ CODE REQUIREMENTS (2) _____ ASME TEMA _____
☐ WEIGHTS _____ BUNDLE _____ kg.: BUNDLE & SHELL _____ kg.: FULL OF WATER _____ kg.:
(X) AUTO DRAIN TRAP WITH MANUAL BYPASS (3.8.3.A) ○ TEMA CLASS R (3.8.1)
○ ORIFICED DRAIN TRAP BLEED

☐ SHELL, NO X ID. _____ X _____ mm
☐ TUBES, NO. PER SHELL _____
☐ O.D. X LENGTH _____ mm _____ mm
☐ GAUGE, BWG _____ (AVG.), (MIN.) WALL
☐ TUBE PITCH _____ IN △ □ ○
☐ REMOVABLE TUBE BUNDLE ☐ YES ☐ NO
(X) ASME CODE STAMP ☐ YES ☐ NO

NOZZLE SIZES

	SHELL SIDE			TUBE SIDE		
	NO.	SIDE	RATING & FACING	NO.	SIZE	RATING & FACING
INLET						
OUTLET						
DRAIN						
VENT						

MATERIALS

TUBES _____ BAFFLES _____
TUBE SHEETS _____ CHANNEL _____
SHELL _____ CHANNEL FLANGES _____
SHELL FLANGES _____ CHANNEL NOZ. FLANGES _____

(1) OUTSIDE TUBE AREA EXCLUDING AREA IN TUBE SHEETS
(2) UNITS EXEMPT FROM CODE STAMP SHALL HAVE LONGITUDINAL WELD SEAMS SPOT EXAMINED PER PARA UW-52 OF ASME CODE

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APPLICABLE TO: ○ PROPOSAL ○ PURCHASE ○ AS BUILT FURNISHED BY (3.1.1) _____
FOR _____ UNIT _____
SITE _____ DRIVER EQUIP. _____
SERVICE _____ NO. REQUIRED _____
MANUFACTURER _____ MODEL _____ SERIAL NO. _____
NOTE: ○ INDICATES INFORMATION TO BE COMPLETED BY PURCHASER: ☐ BY MANUFACTURER

MOTOR DESIGN DATA

APPLICABLE SPECIFICATIONS:

○ NEMA _____
○ _____
○ _____

SITE DATA:

AREA: ○ C.L. ___ GR. ___ DIV. ___ ○ NON-HAZARDOUS
○ ALT. ___ m ○ AMB'T TEMPS: MAX. ___ °C MIN. ___ °C
UNUSUAL CONDITIONS: ○ DUST ○ FUMES
○ OTHER _____

DRIVE SYSTEM: ○ DIRECT CONNECTED ○ GEAR ○ OTHER _____

TYPE OF MOTOR: (3.1.5)

○ SQUIRREL CAGE INDUCTION ○ NEMA DESIGN
○ SYNCHRONOUS
○ POWER FACTOR REQ'D. _____
EXCITATION: ○ BRUSHLESS ○ SLIP RING
○ FIELD DISCHARGE RESISTOR BY MOTOR MFR.
○ WOUND ROTOR INDUCTION
○ _____

ENCLOSURE:

○ CLASS _____ , GROUP _____ DIV. _____
○ TEFC, SEVERE DUTY ○ EXP. PROOF
○ WEATHER PROTECTED, TYPE _____
○ TEWAC ○ TEIGF, USING _____ GAS
○ DOUBLE WALL CARBON STEEL TUBES
○ WATER SUPPLY: PRESS _____ BARG (kPa) TEMP _____ °C
☐ ○ WATER ALLOW: Δ P ___ BAR & TEMP., RISE ___ °C
☐ ○ WATER SIDE MIN. CORR. ALLOW. _____ mm
AND FOUL FACTOR _____
○ (AIR) (GAS) SUPPLY PRESS. _____ BARG (kPa)
○ FORCED VENTILATED
○ OPEN-DRIPPROOF
○ OPEN
○ _____
○ _____

BASIC DATA: (3.1.5) (3.1.4)

○ _____ VOLTS _____ PHASE _____ HERZT
☐ NAMEPLATE HP _____ SERVICE FACTOR _____
○ SYNCHRONOUS RPM
○ INSULATION: CLASS _____ TYPE _____
○ TEMP. RISE: _____ °C ABOVE _____ °C BY _____

MOTOR DESIGN DATA CONTINUED

STARTING: (3.1.6)

○ FULL VOLTAGE ○ REDUCED VOLTAGE _____ % (3.1.6)
○ LOADED ○ UNLOADED (3.1.3)
○ VOLTAGE DIP _____ % (3.1.6)

VIBRATION:

○ NEMA STANDARD ○ _____

NOISE: (2.1.3)

○ NEMA STANDARD ○ _____

ACCESSORY EQUIPMENT

○ BASEPLATE ○ SOLEPLATE ○ STATOR SHIFT
○ MFR. STD. FANS ○ NONSPARKING FANS
○ **D.C. EXCITATION**
☐ KW REQ'D. _____ VOLTS _____
BY: ○ PURCHASER ○ MANUFACTURER
DESCRIPTION _____
○ **ENCLOSED COLLECTOR RINGS:**
○ PURGED: MEDIUM _____ PRESS. _____ BARG (kPa)
○ EXPLOSION-RESISTANT NONPURGED
○ FORCED VENTILATION
☐ m^3/h _____ PRESS. DROP _____ mm H_2O
○ **BEARING TEMP. DEVICES: (3.1.5)**
☐ LOCATION _____
☐ DESCRIPTION _____
☐ SET @ ___ °C FOR ALARM ___ °C FOR SHUTDOWN
○ **SPACE HEATERS:**
☐ ___ KW ○ ___ VOLTS ___ PHASE ___ HERTZ
○ MAX. SHEATH TEMP. _____ %

WINDING TEMPERATURE DETECTOR:

○ TERMISTORS: NO/PHASE _____
TYPE: ○ POS. TEMP. COEFF. ○ NEG. TEMP. COEFF.
TEMPERATURE SWITCH: ○ YES ○ NO
○ RESISTANCE TEMPERATURE DETECTORS: NO/PHASE ___
○ RESISTANCE MATL. _____ ○ _____ OHMS
SELECTOR SWITCH & INDICATOR BY: ○ PURCH. ○ MFR.
☐ MAX. STATOR WINDING TEMPS:
_____ °C FOR ALARM _____ °C FOR SHUTDOWN

WINDING TEMP. DETECTOR & SPACE HEATER LEADS:

○ IN SAME CONDUIT BOX
○ IN SEPARATE CONDUIT BOXES

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ACCESSORY EQUIPMENT (CONTINUED)

○ MOTOR ARRANGED FOR DIFFERENTIAL PROTECTION:
- ○ SELF-BALANCE PRIMARY-CURRENT METHOD
- ○ C.T. DESCRIPTION _____
- ○ EXTENDED LEADS ☐ LENGTH _____ m

○ SURGE CAPACITORS:
○ LIGHTNING ARRESTERS
○ C.T. FOR AMMETER
- ○ DESCRIPTION _____

MAIN CONDUIT BOX SIZED FOR:
○ MAIN MOTOR LEADS ○ TYPE: _____
- ○ INSULATED ○ NON-INSUATED

○ C.T.'S FOR DIFF. PROTECTION (MOUNTED BY): _____
○ SURGE CAPACITORS (MOUNTED BY): _____
○ LIGHTNING ARRESTERS (MOUNTED BY): _____
○ C.T. FOR AMMETER (MOUNTED BY): _____
○ SPACE FOR STRESS CONES
○ AIR FILTERS:
- ☐ MFR _____ ☐ TYPE _____

MANUFACTURER'S DATA

MANUFACTURER _____
FRAME NO. _____ FULL LOAD RPM (IND.) _____
EFFICIENCY: F.L. _____ 3/4L _____ 1/2L _____
PWR FACTOR (IND.): F.L. 3/4L _____ 1/2L _____
CURR. (RATED VOLT): FULL LOAD _____ LOCKED ROTOR _____
LOCKED ROTOR POWER FACTOR _____
LOCKED ROTOR W/STAND TIME (COLD START) _____
LOCKED ROTOR W/STAND TIME (HOT START) _____
TORQUES (FT-LBS): FULL LOAD _____
- LOCKED ROTOR _____ STARTING (SYN) _____
- PULL-UP (IND.) _____ PULL-IN (SYN.) _____
- BREAKDOWN (IND.) _____ PULL-OUT (SYN.) _____

OPEN CIRCUIT TIME CONSTANT (SEC) _____
SYMMETRICAL CONTRIBUTION TO 3 PHASE TERMINAL FAULT:
AT 1/2 CYCLES _____ AT 3 CYCLES _____
REACTANCES: SUB-TRANSIENT (X"D) _____
- TRANSIENT (X'D) _____ SYNCHRONOUS (XD) _____

A.C. STATOR RESISTANCE _____ OHMS @ _____ °C
RATED KVA _____
KVA INRUSH @ FULL VOLT. & LOCKED ROTOR (SYN.) _____ %
KVA @ FULL VOLTAGE & 95% SPEED _____ %
MAX. LINE CURR. IN STATOR ON 1ST SLIP CYC. & PULL-OUT (SYN) _____
ACCELERATION TIME (MTR ONLY & RATED VOLT.) _____ SEC.
ACCEL. TIME (MTR & LOAD & 85% RATED VOLT.) _____ SEC
ROTOR/FIELD WK^2 & MTR SHAFT ($N\text{-}m^2$) _____
NO. OF STARTS PER HOUR _____

MANUFACTURER'S DATA (CONTINUED)

BEARING: TYPE _____ LUBR. _____
LUBE OIL REQUIRED: _____ m^3/h: & _____ BARG (kPa)
TOTAL SHAFT END FLOAT _____
LIMIT END FLOAT TO _____
CURVES REQD. BASED ON MTR SATURATION & RATED VOLT:
- ○ SPEED VS. TORQUE @ 100%, 90% & 80% RATED VOLTAGE
- ○ SPEED VS CURRENT@ 100%, 90% & 80% RATED VOLTAGE

WEIGHTS (kg):
NET WEIGHT _____ SHIPPING WEIGHT _____
ROTOR WT _____ MAX. ERECTION WT. _____
MAX. MAINT. WT. (IDENTIFY) _____

DIMENSIONS (METERS)
L _____ W _____ H _____

SHOP INSPECTION AND TESTS

	REQD	WITNESS
SHOP INSPECTION	○	○
TESTING PER NEMA	○	○
MFR. STD. SHOP TESTS	○	○
IMMERSION TEST	○	○
SPECIAL TESTS (LIST BELOW)	○	○
_____	○	○
_____	○	○
_____	○	○
_____	○	○

PAINTING:
○ MANUFACTURER'S STANDARD
○ _____
○ _____

SHIPMENT:
○ DOMESTIC ○ EXPORT ○ EXPORT BOXING REQD.
○ OUTDOOR STORAGE OVER 3 MONTHS
○ _____
○ _____

REMARKS: _____

UTILITY/INSTRUMENT AIR COMPRESSOR DATA SHEET SI UNITS

JOB NO. _____ ITEM NO _____
PAGE 14 OF 15 BY _____
DATE _____ REVISION _____

PULSATION SUPPRESSION DEVICES (FOR MACHINES OF 201 BHP AND LARGER SEE TABLE 4) (PAR 3.10)

THESE SHEETS TO BE FILLED OUT FOR EACH SERVICE AND/OR STAGE OF COMPRESSION

APPLICABLE TO: ○ PROPOSALS ○ PURCHASE ○ AS BUILT

FOR/USER _____

SITE/LOCATION _____ AMBIENT TEMPERATURE MIN/MAX _____ / _____ °F

COMPRESSOR MFR. _____ NUMBER OF COMPRESSORS _____

SUPPRESSOR MFR. _____ MODEL/TYPE _____

NOTE: ○ IND. DATA COMP'D PURCH. ☐ BY COMPR/SUPP. MFG W/PROPOSAL

◇ BY MFR(S) AFTER ORDER ☒ BY MFG(S)/PURCHASER AS APPLICABLE

GENERAL INFORMATION APPLICABLE TO ALL SUPPRESSORS

TOTAL NUMBER OF SERVICES AND/OR STAGES _____

TOTAL NUMBER OF COMPRESSOR CYL. _____ TOTAL NUMBER OF CRANKTHROWS _____ STROKE _____ mm RPM _____

(x) ASME CODE STAMP ○ STATE/COUNTRY/PROVINCE OF _____ CODE REGUATIONS APPLY

○ OTHER APPLICABLE PRESSURE VESSEL SPEC. OR CODE _____

○ LUBE SERVICE ○ NON-LUBE SERV ○ NO OIL ALLOWED INTERNALLY

DRY TYPE INTERNAL CORROSION COATING ○ YES ○ NO

RADIOGRAPHY (X-RAY OF WELDS): ○ NONE ○ SPOT ○ 100% ○ IMPACT TEST

○ SPECIAL WELDING REQUIREMENTS ○ SHOP INSPECTION ○ WITNESS HYDROTEST

○ OUTDOODR STORAGE OVER 6 MONTHS ○ SPECIAL PAINT SPEC _____

○ WITNESSED ○ OBSERVED

CYLINDER, GAS, OPERATING, AND SUPPRESSOR DESIGN DATA

SERVICE _____ STAGE NO. _____

☒ COMPRESSOR CYL. DATA, THIS SERVICE OR STAGE ONLY

NUMBER OF CYL. _____ ON CRANKTHROW NO(°S) _____

CRANK ANGLE(S) BETW. MANIFOLDED CYLS _____ DEG

CYL BORE DIA _____ mm STROKE _____ mm RPM _____

PISTON ROD DIA _____ mm PISTON DISPLACEMENT _____ m^3/h

UNLOADERS FOR: ○ START-UP ONLY ○ CAP CONT ○ NONE

☐ COMPRESSOR MANUFACTURER'S DERATED CAPACITY

kg/h _____ m^3_n/h _____ m^3_n/D _____

☒ RECEIVER OPERATING PRESSURE	INLET, _____ BAR (kPa abs)	DISCHARGE, _____ BAR (kPa abs)
☒ OPERATING TEMP. WITHIN SUPPRESSORS	INLET, _____ °C	☒ DISCHARGE, _____ BAR (kPa abs)
○ ALLOWABLE P;RESSURE DROP THROUGH SUPPRESSORS	ΔP _____ BAR _____ %	ΔP _____ BAR _____ %
○ COMBINATION INLET SUPPRESSOR SEPARATOR/ INTERNALS	INLET SUPPRESSOR	DISCHARGE SUPPRESSOR
	○ YES ○ NO / ○ YES ○ NO	○ YES ○ NO
☒ NO. (QTY) OF INLET & DISCH. SUPP. PER STAGE RECEIVER		
○ DESIGN FOR FULL VACUUM CAPABILITY	○ YES ○ NO	

COMMENTS _____

UTILITY/INSTRUMENT AIR COMPRESSOR DATA SHEET SI UNITS

JOB NO. _____ ITEM NO. _____
PAGE 15 OF 15 BY _____
DATE _____ REVISION _____

PULSATION SUPPRESSION DEVICES FOR RECIPROCATING COMPRESSORS (3.10)

THESE SHEETS TO BE FILLED OUT FOR EACH SERVICE AND/OR STAGE OF COMPRESSION

SERVICE _____

STAGE NO. _____

◇ TO BE COMPLETED BY MANUFACTURER AFTER ORDER

⊡ BY MANUFACTUROR OR PURCHASER AS APPLICABLE

CONSTRUCTION REQUIREMENTS & DATA	INLET SUPPRESSION	DISCHARGE SUPPRESSOR
○ BASIC MATERIAL REQUIRED, CARBON STEEL, SS, ETC.		
◇ ACT MAT., ASTM OR SAE DESIGNATION SHELL / HEAD	/	/
⊡ CORROSION ALLOWANCE, mm ○ REQUIRED	mm	mm
◇ WALL THICKNESS, mm SHELL / HEAD	mm /	mm /
□ NOM. SHELL DIA X OVERALL LENGTH mm/VOL. m^3	x mm / mm^3	x mm / mm^3
□ PIPE OR ROLLED PLATE CONSTRUCTION	□ PIPE □ ROLLED PLATE	□ PIPE □ ROLLED PLATE
◇ ACT. MAX ALLOW. WORKING PRESS. & TEMPERATURE	BAR (kPa) @ °C	BAR (kPa) @ °C
◇ MAX EXPECTED PRESSURE DROP ΔP, BAR (kPa) /% LINE PRESS	ΔP BAR (kPa) / %	ΔP BAR (kPa) / %
◇ WEIGHT, kg EACH	kg	kg
○ EXTEND VENTS/DRAINS TO ALLOW FOR INSULATION	○ YES ○ NO	○ YES ○ NO
◇ EXPECTED PK TO PK PULSE @ LINE SIDE/CYL. FLG, % PRESS. BASED ON FINAL SUPPRESSOR DESIGN	% / %	% / %
⊡ SUPPORTS, TYPE / QUANTITY		

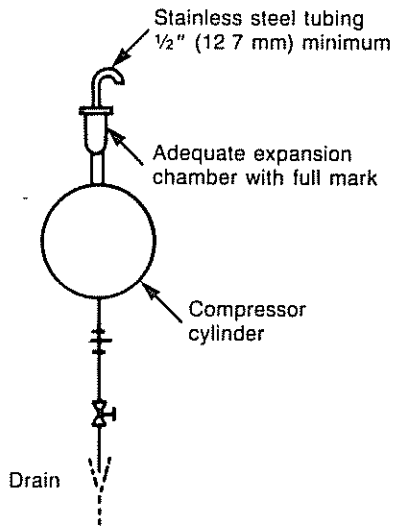
CONNECTION REQUIREMENTS & DATA		
○ RECEIVER SIDE FLANGE, SIZE/RATING/FACING/TYPE		
○ COMP CYL FLANGE(S), QTY/SIZE/RATING/FACING/TYPE		
⊗ PER ANSI 16.5		
○ INSPECTION OPENINGS REQUIRED	○ YES ○ NO ○ BLINDED	○ YES ○ NO ○ BLINDED
○ SPEC. QTY, SIZE, 6000 LB NPT CPLG, /FLG TYPE & RATG		
◇ *QTY, SIZE, 6000 LB NPT CPLG, /FLG TYPE & RATG.		
○ VENT CONNECTIONS REQUIRED	○ YES ○ NO	○ YES ○ NO
○ SPEC. QTY, SIZE, 6000 LB NPT CPLG, /FLG TYPE & RATG		
◇ *QTY, SIZE, 6000 LB NPT CPLG, /FLG TYPE & RATG.		
○ DRAIN CONNECTIONS REQUIRED	○ YES ○ NO	○ YES ○ NO
○ SPEC. QTY, SIZE, 6000 LB NPT CPLG, /FLG TYPE & RATG		
◇ *QTY, SIZE, 6000 LB NPT CPLG, /FLG TYPE & RATG.		
○ PRESSURE CONNECTIONS REQUIRED ○ CYL NOZZLE	○ YES ○ NO	○ YES ○ NO
○ SPEC. QTY, SIZE, 6000 LB NPT CPLG, /FLG TYPE & RATG		
◇ *QTY, SIZE, 6000 LB NPT CPLG, /FLG TYPE & RATG.		
○ PRESSURE CONNECTIONS REQUIRED ○ MAIN BODY	○ YES ○ NO	○ YES ○ NO
○ SPEC. QTY, SIZE, 6000 LB NPT CPLG, /FLG TYPE & RATG		
◇ *QTY, SIZE, 6000 LB NPT CPLG, /FLG TYPE & RATG.		

OTHER DATA AND NOTES		
◇ ACT. MAX ALLOW. WORKING PRESS. & TEMPERATURE		
◇ MAX EXPECTED PRESSURE DROP		

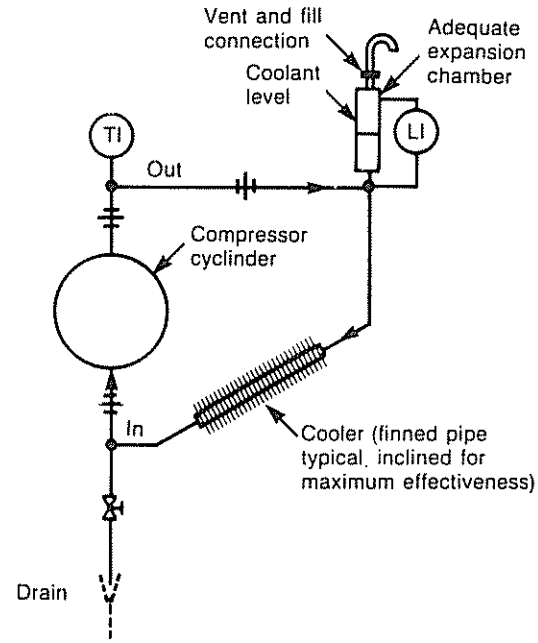
NOTES* = AS BUILT

APPENDIX B

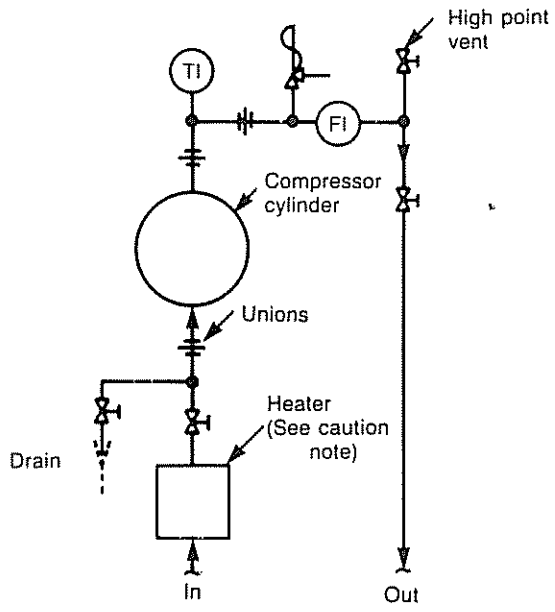
CYLINDER COOLING SYSTEMS



PLAN A — STATIC (STANDPIPE) SYSTEM



PLAN B — THERMOSYPHON SYSTEM

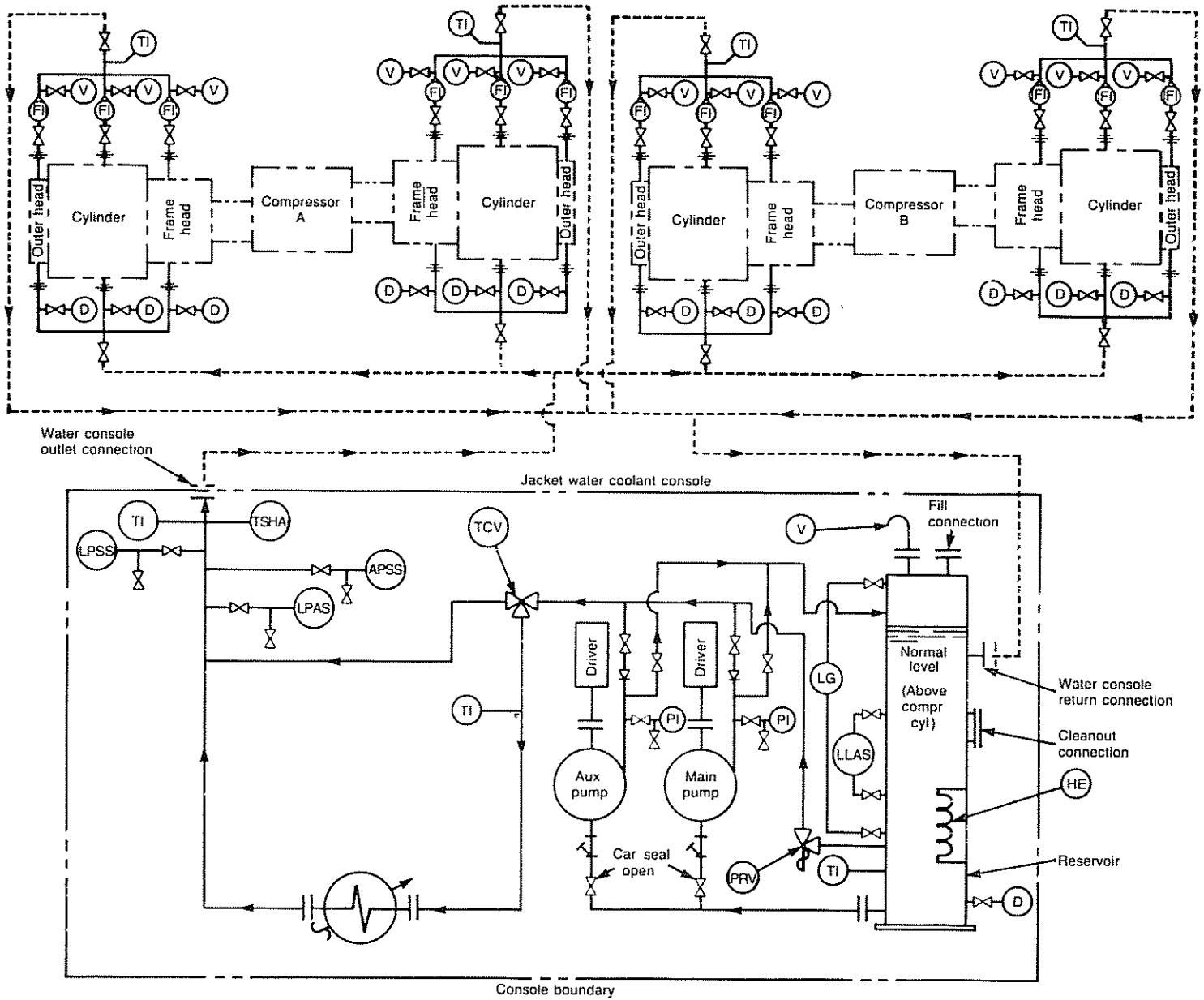


PLAN C — FORCED COOLING SYSTEM

NOTES:

1. The heater, used for preheating of cylinder cooling water, if required by 2 6 1 9 may be electric, hot water, or steam. The heater must be sized to compensate for heat losses of surface areas of the cylinder, pipe, and fittings. Good judgment must be used so the heater will not be undersized.
2. *CAUTION:* When jacket water temperature is to be controlled by steam sparging, the following precautions should be observed:
   a. A silent (water-hammer-cushion type) steam sparger should be placed in the water inlet line to the jacket system.
   b. The water flow rate must remain constant in accordance with the manufacturer's requirements.
   c. Temperature should be controlled automatically by regulating the steam flow into the water in order to maintain the water jacket exit temperature at not less than 10 F nor greater than 30 F above gas inlet temperature.
3. Instrumentation and identifications are consistent with Instrument Society of America, ISA-S5.1, *Instrumentation Symbols and Identification*, 1981.

Figure B-1—Cylinder Cooling System



NOTE: Jacket water cooling console is typical. More or less equipment can be furnished. Instrumentation and identifications are consistent with Instrument Society of America, ISA-S5.1, *Instrumentation Symbols and Identification*, 1981.

Figure B-2—Jacket Water Coolant Console Schematic

APPENDIX C

MATERIAL SPECIFICATIONS FOR MAJOR COMPONENT PARTS

Table C-1—Material Specifications for Major Component Parts

Part	Material	Specification	Form
Frame	Cast iron	ASTM A 48, Class 30	Cast
	Cast iron	ASTM A 278, Class 40	
Crankshaft	Ductile iron	ASTM A 536, Grade 100-70-03	Cast
	Steel	ASTM A 108, Grade 1045	Forged
Connecting rod	Ductile iron	ASTM A 536, Grade 100-70-03	Cast
	Steel	ASTM A 108, Grade 1035	Forged
Crosshead	Cast iron	ASTM A 48, Class 40	Cast
	Ductile iron	ASTM A 536, Grade 80-55-06	Cast
	Steel	ASTM A 216, Grade WCB	Cast
Crosshead pin	Steel (carburizing)	ASTM 108, Grade 1018	Cold-rolled
	Steel (carburizing)	ASTM A 304, 8620H	Hot-rolled
Distance piece	Cast iron	ASTM A 48, Class 30	Cast
	Cast iron	ASTM A 278, Class 40	Cast
Cylinders	Cast iron	ASTM A 48, Class 30	Cast
	Cast iron	ASTM A 278, Class 35	Cast
	Cast iron	ASTM A 278, Class 40	Cast
	Ductile iron	ASTM A 395, Class 60-40-18	Cast
	Ductile iron	ASTM A 536, Class 60-40-18	Cast
Cylinder liners	Cast iron	ASTM A 278, Class 40	Cast
	Cast iron	ASTM A 436-729, Type 1	Cast
	Ductile iron	ASTM A 536, Grade 60-40-18	Cast
	Ni-resist	ASTM A 436, Type 1b	Cast
Cylinder heads	Cast iron	ASTM A 268, Class 35 and 40	Cast
	Ductile iron	ASTM A 536, Grade 60-40-18	Cast
	Cast iron	ASTM A 48, Class 30	
Packing cases	Cast iron	ASTM A 278, Class 30	Cast
	Cast iron	ASTM A 278, Class 40	Cast
Pistons	Aluminum	ASTM B 26-SC51A	Cast
	Aluminum	ASTM B 211, Alloy 2024, or B-221, Alloy 2024	Bar
	Alumnium	ASTM B 211, Alloy 2014, or B-221, Alloy 2014	Bar
	Cast iron	ASTM A 278, Class 35 and 40	Cast
	Cast iron	ASTM A 48, Class 30	Cast
Piston rings (nonmetallic and packing)	Cast iron	ASTM A 278, Class 30	Cast
	Cast iron	ASTM A-278, Class 40	Cast
Piston rings, wear bands, and packing rings (nonmetallic)	Glass-filled Teflon Carbon, filled Teflon Bronze-filled Teflon Micarta		
Piston rods	Steel	ASTM A 108, Grade 1144	Bar
	Steel	ASTM A 322, Grade 4140	Bar
	Steel-12%Cr	ASTM A 276, Type 410	Bar
	Steel	ANSI 4140 and C-1050-1055	Bar
Piston rod nut	Steel	ASTM A 108, Grade 1144	Bar
	Steel	ASTM A 107, Grade 1117	Bar
	Steel	SA-193, Grade B	Bar
	Steel	SA-194, Grade 2H	
	Stainless steel	Type 410 SST	
	Stainless steel	SA-517, Grade F	
Valve seats	Ductile iron	ASTM A 536, Grade 100-70-03	Cast
	12%Cr Steel	ASTM A 473, Type 416	Bar
	Steel	ASTM A 108, Type 1141	Bar
	Stainless steel	ANSI 410	
Valve guards	Cast iron	ASTM A 278, Class 45	Bar
	Cast iron	ASTM A 48, Class 40	Bar
Valve plates	Steel	ASTM A 108, Grade 1117	Bar
	Ductile iron	ASTM A 536, Grade 100-70-03	Cast
	Steel 12%Cr	ASTM A 176, Type 410	Plate
	Steel 12%Cr	ASTM A 276, Type 420	Plate
Valve springs	Stainless steel	Inconel X-750	Wire
	Stainless steel	Armco 17-4 PH	Wire
	Steel 12%Cr	ASTM A 580, Type 420	Wire
	Stainless steel	ASTM A 176, Type 410	
	Steel 12%Cr	ASTM A 276, Type 420	

APPENDIX D

REPAIRS TO GRAY OR NODULAR IRON CASTINGS

D.1 Scope

This section covers repair procedures that have been successfully applied to gray and nodular iron castings for compressor cylinders and related parts in various services. These procedures are only briefly described for reference by the purchaser and the vendor. Detailed descriptions of the procedures are beyond the scope of this standard. Limitations on the use of the procedures are included. These procedures should be applied only after careful evaluation of the situation by the purchaser and the vendor.

D.2 Repair Methods and Limitations

No repairs of any type shall be made to defects that leak between the cylinder bore and water jacket during hydrotest. With the purchaser's written approval, the repair methods described in D.2.1 through D.2.3 may be used.

D.2.1 Areas that leak between the water jacket and atmosphere, between the air passage and atmosphere, or between the water jacket and the air passage during hydrotest may be repaired by plugging within the limits of ASTM A 395, by approved procedures for welding, or by vacuum plus pressure impregnating. Impregnating should be considered for correcting limited-porosity-type leakage only after hydrotest of both the water jacket and the air passage have proven the mechanical integrity of the casting.

D.2.2 Defects that show up on machined surfaces or in other areas where no leak is involved may be either repaired by welding or by iron plating. Such defects could include porosity in valve seats, out-of-tolerance cylinder bores requiring a liner, or head and cylinder end faces. Surfaces swept by the compressor piston are excluded from this repair.

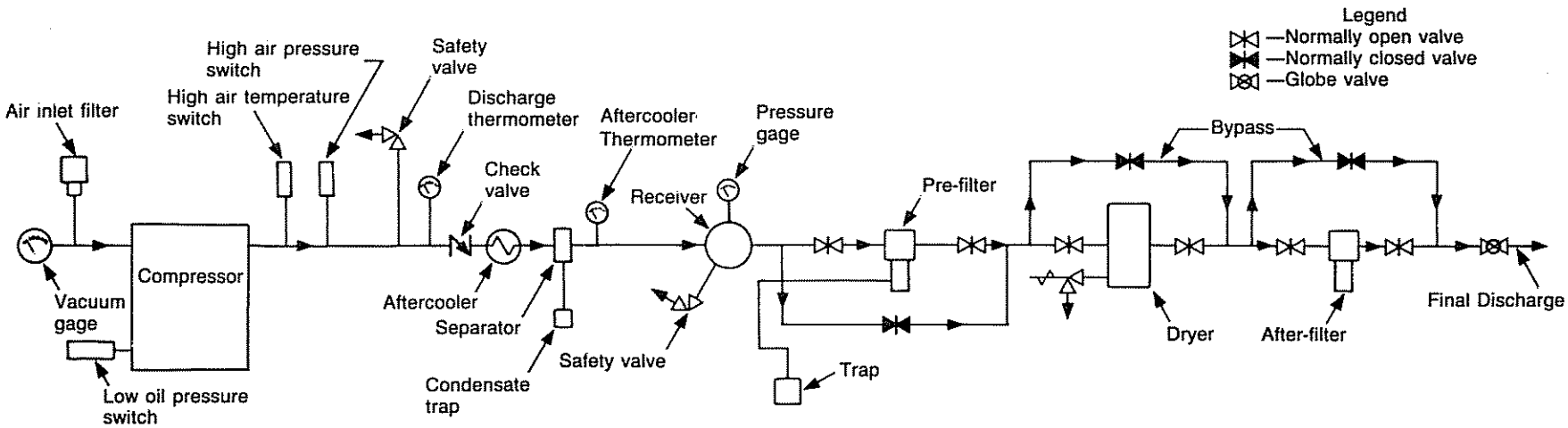
D.2.3 Damaged threaded holes in castings may be mechanically repaired by shoulder studs or bushings

D.3 Test

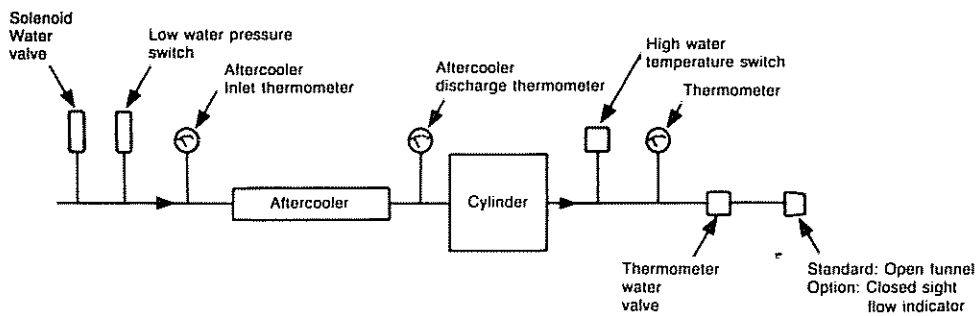
After any part is repaired in accordance with D.2.1, D.2.2, or D.2.3, the part must be subjected to a hydrostatic test at two times the maximum allowable working pressure.

APPENDIX E

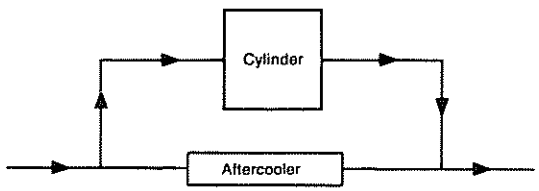
TYPICAL AIR AND WATER PIPING SCHEMATICS FOR COMPRESSORS



TYPICAL AIR PIPING SCHEMATIC



Standard series water piping

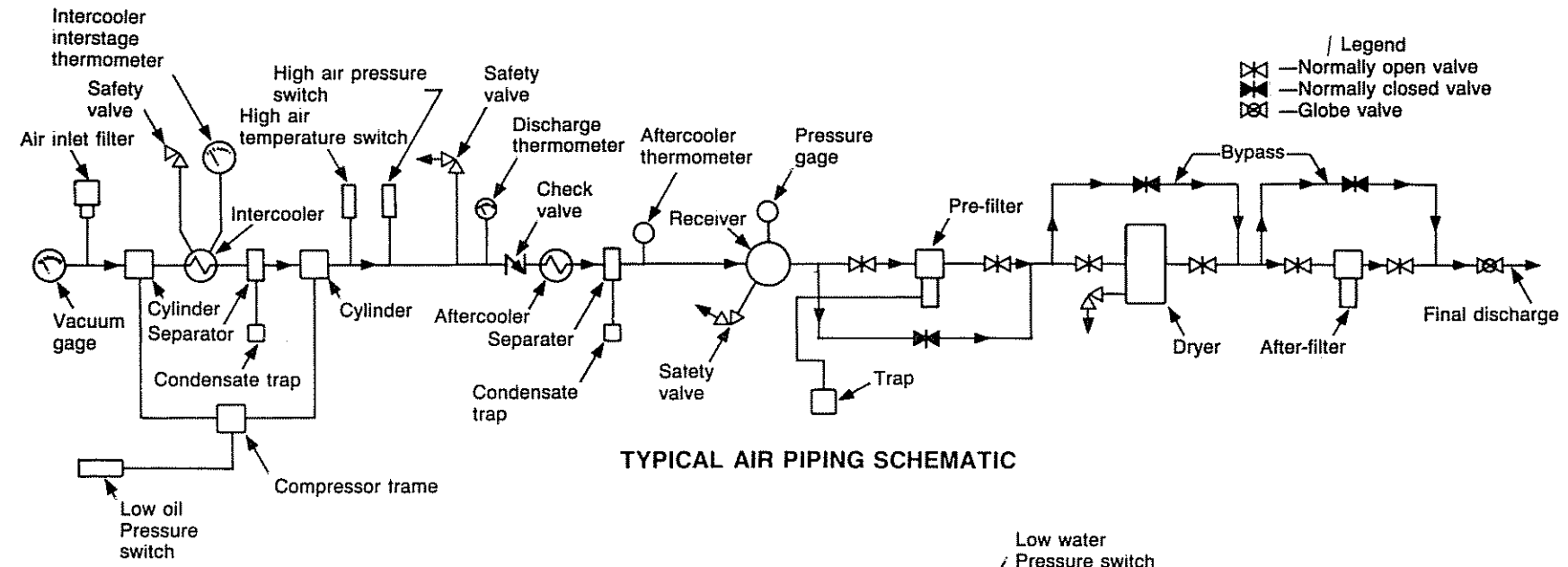


Optional parallel water piping

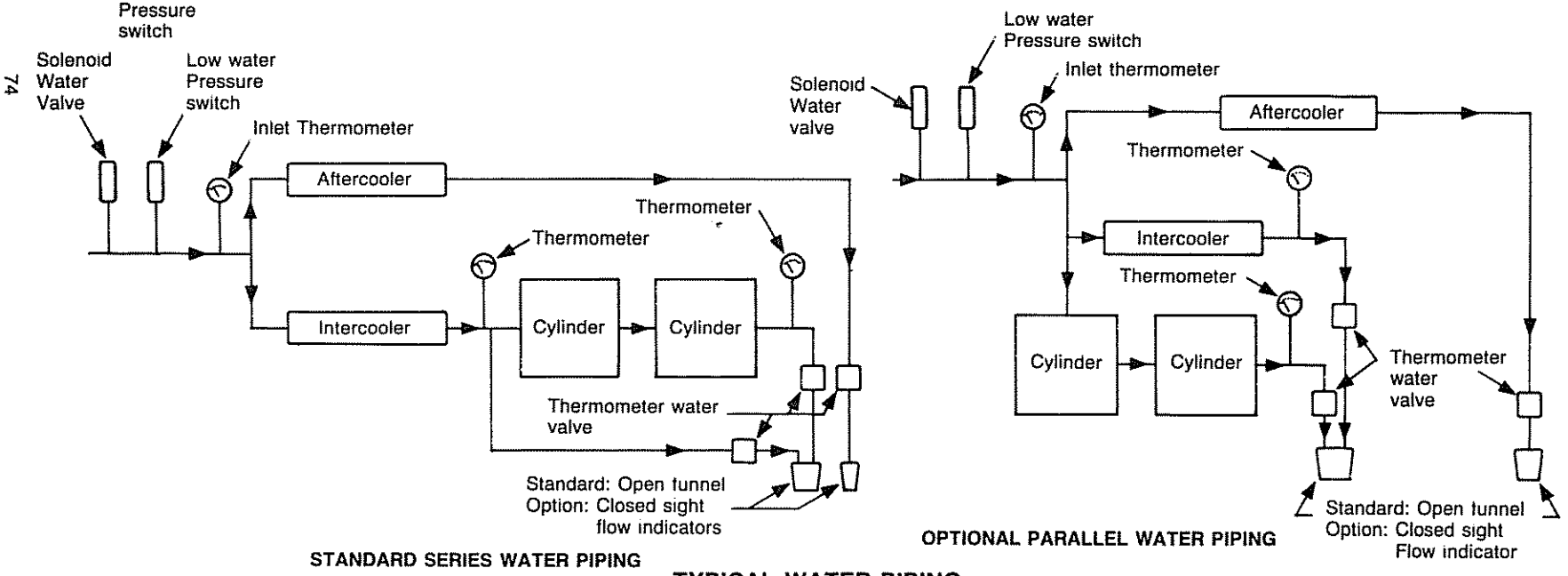
TYPICAL WATER PIPING

NOTE: Instrumentation and identifications are consistent with Instrument Society of America, *Instrumentation Symbols and Identification*, 1981.

Figure E-1—Typical Air and Water Piping Schematics for Single Stage Compressors



TYPICAL AIR PIPING SCHEMATIC



STANDARD SERIES WATER PIPING

OPTIONAL PARALLEL WATER PIPING

TYPICAL WATER PIPING

NOTE: Instrumentation and identifications are consistent with Instrument Society of America, *Instrumentation Symbols and Identification*, 1981.

Figure E-2—Typical Air and Water Piping Schematic for Two Stage Compressors

APPENDIX F

SIZING AIR RECEIVERS

Table F-1—Air Receiver Volume as a Function of Air Compressor Capacity

Air Receiver Size Diameter × Length (inches × feet)	Approximate Volume (cubic feet)	Approximate Volume (cubic meters effective)	Compressor Capacity (see note) (ACFM free air)	Compressor Capacity (cubic meters minimum effective)
18 × 6	11	0 31	110	3 1
24 × 6	19	0 54	190	5 4
30 × 7	34	0.96	340	9 6
36 × 8	57	1 61	570	16 1
42 × 10	96	2 72	960	27 2
48 × 12	151	4.27	2,115	59 9
54 × 14	222	6 28	3,120	88 3
60 × 16	315	8 91	4,400	124 5

NOTE: For compressors discharging at pressures of 40 to 125 pounds per square inch gage.

APPENDIX G

RECIPROCATING PLANT AND INSTRUMENT AIR COMPRESSOR VENDOR DRAWING AND DATA REQUIREMENTS

This appendix consists of a sample distribution record (schedule).

RECIPROCATING PLANT AND INSTRUMENT AIR COMPRESSOR VENDOR DRAWING AND DATA REQUIREMENTS

JOB NO _____ ITEM NO _____
PURCHASE ORDER NO. _____ DATE _____
REQUISITION NO _____ DATE _____
INQUIRY NO _____ DATE _____
PAGE _____ OF _____ BY _____
REVISION _____
UNIT _____
NO REQUIRED _____

FOR _____
SITE _____
SERVICE _____

Proposal[a] Bidder shall furnish ____ copies of data for all items indicated by an X.

Review[b] Vendor shall furnish _____ copies and _____ transparencies of drawings and data indicated.

Final[b] Vendor shall furnish _____ copies and _____ transparencies of drawings and data indicated.
Vendor shall furnish _____ operating and maintenance manuals.

DISTRIBUTION RECORD

Final — Received from vendor	Final — Due from vendor[c]	Review — Returned to vendor	Review — Received from vendor	Review — Due from vendor[c]	DESCRIPTION	Final — Received from vendor	Final — Due from vendor[c]	Review — Returned to vendor	Review — Received from vendor	Review — Due from vendor[c]
					1. Certified dimensional outline drawing and list of connections					
					2. Foundation plan showing anchor bolt location					
					3. Allowable flange loading					
					4. Unbalanced forces and moments					
					5. Cross-sectional drawings and bill of materials					
					6. Center of gravity, vertical and plan location					
					7. Lube oil schematics and bill of materials					
					8. Lube oil assembly drawings and list of connections					
					9. Lube oil component drawings and data					
					10. Cylinder lubrication schematics and bill of materials					
					11. Cylinder lubrication assembly drawing					
					12. Cylinder lubrication component drawings and data					
					13. Coolant schematics and bill of materials					
					14. Coolant assembly drawings and list of connections					
					15. Coolant component drawings and data					
					16. Distance piece vent, drain and purge schematic, and list of connections					
					17. Capacity control schematics and bill of materials					
					18. Electrical and instrumentation schematics and bill of materials					
					19. Electrical and instrumentation arrangement drawing and list of connections					
					20. Combined rod load data					
					21. Acoustical response analysis data					
					22. Pulsation suppression device sectional drawings					
					23. Hydrostatic test logs					
					24. Weld procedures					
					25. Driver outline					
					26. Driver performance characteristics					
					27. Dimensional outlines for all major accessory equipment					
					28. "As-built" data sheets					
					29. Operating and maintenance manuals					
					30. Parts list with sectional drawings					
					31. Special tools list					
					32. Spare parts recommendation					

[a]Proposal drawings and data do not have to be certified or "as-built."

[b]Purchaser will indicate in this column the time for submission of desired materials using the nomenclature given at the end of the form.

[c]Bidder shall complete these two columns to reflect his actual distribution schedule and include this form with his proposal.

NOTES:

1 Send all drawings and data to _____

_____

2. All drawings and data must show project, appropriation, purchaser order, and item numbers in addition to plant location and unit. One set of drawings/instructions necessary for field installation must be forwarded with shipment in addition to copies specified above.
3. All of the requested information indicated above shall be received before final payment will be made.

Nomenclature:

_____S—number of weeks prior to shipment

_____F—number of weeks after firm order

_____D—number of weeks after receipt of approved drawings

Vendor _____

Data _____ Vendor Reference _____

Signature _____

(Signature acknowledges receipt of all instructions)