E-05-01

Specification for Packaged Reciprocating Compressors for Oil and Gas Production Services

API SPECIFICATION 11P (SPEC 11P)
SECOND EDITION, NOVEMBER 1, 1989

American Petroleum Institute
1220 L Street, Northwest
Washington, DC 20005

Issued by
AMERICAN PETROLEUM INSTITUTE
Production Department

FOR INFORMATION CONCERNING TECHNICAL CONTENTS OF
THIS PUBLICATION CONTACT THE API PRODUCTION DEPARTMENT,
2535 ONE MAIN PLACE, DALLAS, TX 75202 — (214) 748-3841.
SEE BACK SIDE FOR INFORMATION CONCERNING HOW TO OBTAIN
ADDITIONAL COPIES OF THIS PUBLICATION.

Users of this publication should become familiar with its scope and content,
including any provisions it may have regarding marking of manufactured products.
This document is intended to supplement rather than
replace individual engineering judgment.

OFFICIAL PUBLICATION

REG. U.S. PATENT OFFICE

TABLE OF CONTENTS

Attention Users of This Publication: Portions of this publication have been changed from the previous edition. The location of changes has been marked with a bar in the margin. In some cases the changes are significant, while in other cases the changes reflect minor editorial adjustments. The bar notations in the margins are provided as an aid to users to identify those parts of this publication that have been changed from the previous edition, but API makes no warranty as to the accuracy of such bar notations.

Note:

This edition supersedes the first edition dated February 1975. It includes changes adopted by special letter ballot dated January 5, 1988.

POLICY

API PUBLICATIONS NECESSARILY ADDRESS PROBLEMS OF A GENERAL NATURE. WITH RESPECT TO PARTICULAR CIRCUMSTANCES, LOCAL, STATE AND FEDERAL LAWS AND REGULATIONS SHOULD BE REVIEWED.

API IS NOT UNDERTAKING TO MEET DUTIES OF EMPLOYERS, MANUFACTURERS OR SUPPLIERS TO WARN AND PROPERLY TRAIN AND EQUIP THEIR EMPLOYEES, AND OTHERS EXPOSED, CONCERNING HEALTH AND SAFETY RISKS AND PRECAUTIONS, NOR UNDERTAKING THEIR OBLIGATIONS UNDER LOCAL, STATE, OR FEDERAL LAWS.

NOTHING CONTAINED IN ANY API PUBLICATION IS TO BE CONSTRUED AS GRANTING ANY RIGHT, BY IMPLICATION OR OTHERWISE, FOR THE MANUFACTURE, SALE, OR USE OF ANY METHOD, APPARATUS, OR PRODUCT COVERED BY LETTERS PATENT. NEITHER SHOULD ANYTHING CONTAINED IN THE PUBLICATION BE CONSTRUED AS INSURING ANYONE AGAINST LIABILITY FOR INFRINGEMENT OF LETTERS PATENT.

GENERALLY, API STANDARDS ARE REVIEWED AND REVISED, REAFFIRMED, OR WITHDRAWN AT LEAST EVERY FIVE YEARS. SOMETIMES A ONE-TIME EXTENSION OF UP TO TWO YEARS WILL BE ADDED TO THIS REVIEW CYCLE. THIS PUBLICATION WILL NO LONGER BE IN EFFECT FIVE YEARS AFTER ITS PUBLICATION DATE AS AN OPERATIVE API STANDARD OR, WHERE AN EXTENSION HAS BEEN GRANTED, UPON REPUBLICATION. STATUS OF THE PUBLICATION CAN BE ASCERTAINED FROM THE API AUTHORING DEPARTMENT (TEL. 214-748-3841). A CATALOG OF API PUBLICATIONS AND MATERIALS IS PUBLISHED ANNUALLY AND UPDATED QUARTERLY BY API, 1220 L ST., N.W., WASHINGTON, DC 20005.

FOREWORD

a. This Specification is under the jurisdiction of the API Committee on Standardization of Production Equipment.

b. American Petroleum Institute (API) Specifications are published as aids to the procurement of standardized equipment and materials, as well as instructions to manufacturers of equipment or materials covered by an API Specification. These Specifications are not intended to obviate the need for sound engineering, nor to inhibit in any way anyone from purchasing or producing products to other specifications.

c. The formulation and publication of API Specifications and the API monogram program is not intended in any way to inhibit the purchase of products from companies not licensed to use the API monogram.

d. API Specifications may be used by anyone desiring to do so, and diligent effort has been made by the Institute to assure the accuracy and reliability of the data contained therein. However, the Institute makes no representation, warranty or guarantee in connection with the publication of any API Specification and hereby expressly disclaims any liability or responsibility for loss or damage resulting from their use, for any violation of any federal, state, or municipal regulation with which an API Specification may conflict, or for the infringement of any patent resulting from the use of an API Specification.

e. Any manufacturer producing equipment or materials represented as conforming with an API Specification is responsible for complying with all the provisions of that Specification. The American Petroleum Institute does not represent, warrant or guarantee that such products do in fact conform to the applicable API standard or specification.

f. The purpose of API Standards on Production Equipment is to establish minimum requirements relating primarily to mechanical considerations. This limitation in scope is one of charter as opposed to interest or 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, packager and purchaser during these steps. Alternative approaches which may result in improved energy utilization should be thoroughly investigated and brought forth. This is especially true of new equipment proposals, as the evaluation of purchase options will be increasingly based on the total life costs versus low initial cost. Equipment manufacturers and packagers, in particular, are encouraged to suggest alternatives to those specified when these approaches achieve improved energy effectiveness and reduced total life costs without sacrifice of safety, quality, or reliability.

This standard is based upon the accumulated knowledge and experience of manufacturers, packagers and purchasers of reciprocating compressors. The objective of this publication is to provide a purchase specification to facilitate the manufacture and procurement of reciprocating compressor packages for oil and gas production services.

This standard requires the purchaser to specify certain details and features. A bullet (•) in the margin indicates that a decision by the purchaser is required. These decisions should be indicated clearly on the data sheets. 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 incorporating sections thereof into another complete standard.

Suggested revisions are invited and should be submitted to the Chairman, Committee on Standardization of Production Equipment, American Petroleum Institute, Production Department, 2535 One Main Place, Dallas TX 75202-3904.

g. This Standard shall become effective on the date printed on the cover but may be used voluntarily from the date of distribution.

h. The current editions of the following standards, codes, and specifications 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 packager.

RELATED CODES AND STANDARDS ARE AS FOLLOWS:

AFBMA:	Anti-Friction Bearing Manufacturers Association, 1235 Jefferson Davis Highway, Arlington, Virginia 22202.
AFBMA STD 11:	Load Ratings and Fatigue Life for Roller Bearings
ANSI:	American National Standards Institute, 1430 Broadway, New York, New York 10018.
ANSI B1.1:	Unified Screw Threads.
ANSI B1.20.1:	Pipe Threads, General Purpose (Inch).
ANSI B16.1:	Cast Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250, and 800.
ANSI B16.5:	Pipe Flanges and Flanged Fittings, Steel Nickel Alloy and Other Special Alloys.

ANSI B16.42:	Ductile Iron Pipe Flanges and Flanged Fittings, Class 150 and 300.
API:	American Petroleum Institute, Production Department, 211 N. Ervay, Suite 1700, Dallas, Texas 75201.
API STD 1B:	Specification for Oil-Field V-Belting.
API RP 14F:	Recommended Practice for Design and Installation of Electrical Systems for Offshore Production Platforms.
API RP 500B:	Recommended Practice for Classification of Locations for Electrical Installations at Drilling Rigs and Production Facilities on Land and on Marine Fixed and Mobile Platforms.
API RP 520:	Recommended Practice for the Design and Installation of Pressure-Relieving Systems in Refineries, Part I — Design and Part II — Installation.
ASME:	American Society of Mechanical Engineers, 345 East 47th Street, New York, New York 10017.
ANSI/ASME B31.3:	Chemical Plant and Petroleum Refinery Piping, A Section of the ASME Code for Pressure Piping.
ASME SEC II:	Boiler and Pressure Vessel Code, Material Specifications.
ASME SEC VIII:	Boiler and Pressure Vessel Code, Rules for Construction of Pressure Vessels.
ASME SEC IX:	Boiler and Pressure Vessel Code, Welding and Brazing Qualifications.
ASTM:	American Society for Testing and Materials, 1916 Race Street, Philadelphia, Pennsylvania 19103.
ASTM A-53:	Material Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
ASTM A-106:	Seamless Carbon Steel Pipe for High-Temperature Service.
ASTM A-192:	Seamless Carbon Steel Boiler Tubes for High-Pressure Service.
ASTM A-193:	Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service.
ASTM A-216:	Carbon-Steel Castings Suitable for Fusion Welding for High-Temperature Service.
ASTM A-269:	Seamless and Welded Austenitic Stainless Steel Tubing for General Service.
ASTM A-278:	Gray Iron Castings for Pressure-Containing Parts for Temperatures Up To 650 Deg. F.
ASTM A-307:	Carbon Steel Externally Threaded Standard Fasteners.
ASTM A-312:	Seamless and Welded Austenitic Stainless Steel Pipe.
ASTM A-320:	Alloy-Steel Bolting Materials for Low-Temperature Service.
ASTM A-358:	Electric-Fusion-Welded Austenitic Chromium-Nickel Alloy Steel Pipe for High-Temperature Service.
ASTM A-395:	Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures.
ASTM A-487:	Steel Castings Suitable for Pressure Service.
ASTM A-503:	Ultrasonic Examination of Large Forged Crankshafts.
ASTM A-536:	Ductile Iron Castings.
ASTM A-668:	Steel Forgings, Carbon and Alloy, for General Industrial Use.
ASTM A-703:	Steel Castings, General Requirements for Pressure Containing Parts.
ASTM A-781:	Castings, Steel and Alloy, Common Requirements for General Industrial Use.
ASTM E-709:	Practice for Magnetic Particle Examination.
GPSA:	Gas Processors Suppliers Association, P.O. Box 35584, Tulsa, Oklahoma 74153.
NACE:	National Association of Corrosion Engineers, P.O. Box 218340, Houston, Texas 77218.
NACE MR-01-75:	Material Requirements — Sulfide Stress Cracking Resistant Metallic Materials for Oil Field Equipment.
NEMA:	National Electrical Manufacturers Association, 2101 L Street N.W., Washington, D.C. 20210.

NEMA MG-1:	Motors and Generators.
NFPA:	National Fire Protection Association, Batterymarch Park, Quincy, Massachusetts 02269.
NFPA 70:	National Electrical Code, Articles 500 and 501.
OSHA:	Occupational Safety and Health Administration, U.S. Department of Labor, 200 Constitution Avenue N.W., Washington, D.C. 20210.
SSPC:	Steel Structures Painting Council, 4400 Fifth Avenue, Pittsburgh, Pennsylvania 15213.
SSPC SP3:	Power Tool Cleaning.
SSPC SP6:	Commercial Sandblast.
TEMA:	Tubular Exchanger Manufacturers Association, 25 North Broadway, Tarrytown, New York 10591.

SECTION 1
GENERAL

1.1 Scope. This standard covers the minimum requirements for a packager supplied, designed and fabricated, skid-mounted, reciprocating, separable or integral compressor with lubricated cylinders and its prime movers used in oil and gas production services. It also includes all necessary auxiliary equipment such as water and gas coolers, exhaust silencer, emission control equipment, inlet air filter, scrubbers, control panel, piping, etc. Required to install an operable unit in compliance with the purchase specifications and with a minimum of field construction and field purchased equipment.

Compressors intended for refinery, chemical or petrochemical services as covered in API 618 — Reciprocating Compressors for General Refinery Services, compressors that are block-mounted, compressors that are non-lubricated, compressors with single-acting, trunk-type (automotive-type) pistons that also serve as crossheads, and either utility or instrument air compressors that discharge at 125 pounds per square inch (PSIG) or below are specifically excluded from this specification. Diesel engine, gas turbine and steam turbine prime movers are also specifically excluded.

1.2 Data Sheets. Service and operating conditions, material requirements and sub-vendors are set out on the 'API Packaged Compressor Data Sheets — Part 1.' The packager shall indicate the specifics of their offering by completing the 'API Packaged Compressor Data Sheets — Part 2.' One copy of the completed data sheets shall accompany each copy of a quotation. One complete set of 'as-built' 'API Packaged Compressor Data Sheets' shall be included in each copy of the data book furnished by the packager.

• **1.3 Compressor Package Performance Curves.** When specified, compressor package performance curves shall cover the range of operating conditions indicated by the purchaser. Any limitations such as rod load, available driver horsepower, additional clearance required to meet the range of operating conditions, etc., shall be marked on the performance curves.

1.4 Package Arrangement. The arrangement of the package components shall be developed by the compressor packager to provide reasonable access for operation and maintenance.

• **1.5 Drawings.** The packager shall furnish plan and elevation drawings. Pre-fabrication approval or additional drawings may be specified by the purchaser in the 'API Packaged Compressor Data Sheets — Part 1.'

• **1.6 Sound Pressure Level.** Control of the sound pressure level of all equipment furnished shall be the joint effort of the purchaser and the packager. When specified, the equipment furnished by the packager shall conform to the maximum allowable sound pressure level required by the purchaser.

1.7 Electrical Location Classification. All electrical • installations shall be in accordance with NFPA 70 except those in Outer Continental Shelf (OCS) areas which shall be in accordance with API RP 14F, with all locations classified in accordance with API RP 500B and so specified by the purchaser on the 'API Packaged Compressor Data Sheets — Part 1.'

1.8 Package Installation. The purchaser shall specify • the site conditions (altitude, ambient temperature, etc.) on the 'API Packaged Compressor Data Sheets — Part 1' and whether the installation is indoors (heated or unheated) or outdoors (with or without a roof) and the weather or environmental conditions in which the equipment must operate (including maximum and minimum temperatures, unusual humidity or dust problems). The unit and its auxiliaries shall be suitable for operation in these specified conditions. Purchaser shall specify size limitations, if any.

1.9 Torsional Analysis. The compressor packager will • assume responsibility for a torsionally sound system consisting of prime mover, coupling, compressor and flywheel, if required. If the purchaser requires a torsional analysis report, the compressor packager will be responsible to coordinate with the compressor and prime mover manufacturers to produce such a report.

1.10 Definition of Terms. Use of the word 'Design' in any term (such as design horsepower, design pressure, design temperature, or design speed) should be avoided in the purchaser's specifications. This terminology should only be used by the equipment designer and the manufacturer. Terms used in this standard are defined by the following paragraphs:

1.10.1 Maximum Allowable Operating Rod Load. The maximum allowable operating rod load (manufacturer's published rating calculated by manufacturer's standard methods) is the highest force that a manufacturer will permit for continuous operation.

1.10.2 Combined Rod Loading. The 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 that force resulting from the acceleration of the 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.

1.10.3 Rod Reversal. Rod reversal is a change in direction of force in the piston rod loading (tension to compression, or vice-versa), which results in a load reversal at the crosshead pin during each revolution. The duration of rod reversal is usually expressed in degrees of crankcase rotation.

1.10.4 Maximum Allowable Working Pressure. Maximum allowable working pressure (MAWP) is the maximum continuous pressure for which the manufacturer has designed the equipment (or any part to which the term is referred) when handling the specified fluid at the maximum specified temperature. See Paragraph 2.5.1.1 for definition of compressor cylinder maximum allowable pressure rating.

1.10.5 Rated Discharge Pressure. Rated discharge pressure is the highest pressure required to meet the conditions specified by the purchaser for the intended service.

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

1.10.7 Maximum Allowable Speed. Maximum allowable speed in revolutions per minute is the highest speed at which the manufacturer's design will permit continuous operation.

1.10.8 Minimum Allowable Speed. Minimum allowable speed in revolutions per minute is the lowest speed at which the manufacturer's design will permit continuous operation.

1.10.9 Standard Cubic Feet Per Minute or Million Standard Cubic Feet Per Day. Standard cubic feet per minute (SCFM) or million standard cubic feet per day (MMSCFD) refers to the capacity at 14.7 pounds per square inch absolute and 60 deg. F.

1.10.10 Required Capacity. Required capacity is the capacity specified by the purchaser to meet process conditions.

1.10.11 Quoted Capacity. The quoted capacity is the capacity used by the packager to size the compressor at conditions specified by the purchaser. See Paragraph 2.1.1.

1.10.12 Rated Power. Rated power is the highest power required for any of the specified operating conditions.

1.10.13 Normal Operating Point. The normal operating point is the point at which the packager certifies that the quoted capacity and power consumption is met.

1.10.14 Data Book. The data book is a book containing the manufacturer's instructions, parts lists, data sheets, 'as-built' plan and elevation package drawings, 'as-built' 'API Packaged Compressor Data Sheets — Part 2', and other pertinent data.

SECTION 2
COMPRESSOR

2.1 General.

2.1.1 Quoted Capacity. The compressor shall be sized to handle the quoted capacity with the gas analysis, suction pressures, suction temperatures, discharge pressures and site conditions specified in the 'API Packaged Compressor Data Sheets — Part 1.' The number of stages of compression shall accommodate pressure limitations and gas additions or withdrawals as set forth by the purchaser. The package design shall also allow for all pressure drops through the scrubbers, pulsation bottles (if any), coolers and piping from the inlet flange to the outlet flange on the skid.

2.1.2 Performance Calculations. The compressor packager shall use the gas analysis, suction pressures, suction temperature, discharge pressures and site conditions as specified by the purchaser to calculate molecular weight, ratio of specific heats (Cp/Cv), and compressibility factor (Z). The compressor packager shall indicate his values on the 'API Packaged Compressor Data Sheets — Part 2', provide them with the quotation and use them to calculate performance data.

2.1.3 Compressor Size. When specified, the compressor frames shall be furnished with cylinders which, when operating at the specified operating condition(s), shall, as far as practical, load the gas engine to the limit specified in Paragraph 4.2.1 or electric motor to the limit specified in Paragraph 4.3.2.

NOTES: *Compressors driven by induction motors shall be sized at the motor operating speed.*

2.1.4 Forces and Couples. When specified by the purchaser, the compressor manufacturer shall furnish values for the un-balance primary and secondary forces and couples in the horizontal and vertical planes for the quoted compressor.

2.2 Maximum Allowable Speeds. The maximum allowable average piston speed (in feet per minute) and the maximum allowable speed (in revolutions per minute) may be specified by the purchaser.

2.3 Maximum Allowable Discharge Temperature. The compressor shall be provided with sufficient compression stages and interstage cooling to limit the actual discharge temperature of each stage to 350 deg. F. unless otherwise specified by purchaser. This limit shall hold for all specified operating and load conditions. When specified, the compressor packager shall provide the purchaser with both the estimated actual and the calculated adiabatic discharge temperature rise.

2.4 Rod Loadings.

2.4.1 Maximum Allowable Rod Loading. The maximum operating rod load (gas or combined) shall not exceed the maximum allowable operating rod loading for the compressor or any rod load limitation specified by the purchaser at any specified operating condition. The packager shall quote gas rod load unless specified otherwise by the purchaser. If other than operating rod load calculations are specified, the purchaser will provide operating parameters to the packager for making these calculations.

2.4.2 Piston Rod Load Reversal. For all specified operating load conditions, the axial component of the combined rod loading shall reverse enough to ensure adequate lubrication between the crosshead pin and bushing during each complete turn of the crankshaft.

2.5 Compressor Cylinders.

2.5.1 General.

2.5.1.1 Cylinder Maximum Allowable Working Pressure. The maximum allowable working pressure of the cylinder shall exceed the rated discharge pressure by at least 10 percent or 25 psig, whichever is greater.

2.5.1.2 Cylinder Orientation. Horizontal cylinders shall have bottom discharge connections except where side or top discharge connections are acceptable by the purchaser.

2.5.1.3 Cylinder Maintenance. Cylinders shall be spaced and arranged to permit access and removal for normal maintenance of all components (including covers, packing, valves, or unloaders mounted on the cylinder) without removing the cylinder, major piping or pulsation bottles.

2.5.2 Cylinder/Frame Appurtenances.

2.5.2.1 Cylinder Supports. The cylinder support shall be designed to avoid misalignment or excessive rod run-out during the warm-up period and at actual operating temperature. The cylinder support shall not be attached to the outboard cylinder head. The pulsation bottle, if furnished, shall not be used to support the compressor cylinder unless approved by the compressor manufacturer.

2.5.2.2 Cylinder Body. Cylinders may be non-cooled (no provision for coolant jackets) or cooled (coolant jacket around cylinder bore and cylinder head).

2.5.2.3 Cylinder Bolting. Cylinder heads, stuffing boxes for pressure packing, clearance pockets, and valve covers shall be fastened with either cap-

screws or studs. Studded connections shall be furnished with studs installed. Tapped holes for studs or capscrews in gray iron or ductile iron castings should be designed to provide a nominal engagement of 1½ times the major diameter of the stud or capscrew.

Bolting shall be furnished as follows:

1. Details of threading shall conform to ANSI B1.1 — unified screw threads.

2. Capscrew or stud material, as a minimum, shall be ASTM A-193 Grade B7 for steel and ductile iron cylinders. ASTM A-193 Grade B7 or ASTM A-307 Grade B may be used for gray iron cylinders. ASTM A-320 shall be used for temperatures of -50 deg. F and below.

3. Hex-head bolting is preferred. Adequate clearance shall be provided at bolting locations to permit the use of socket or box type wrenches.

2.5.3 Cylinder Connections.

2.5.3.1 Gas Connections. Main inlet, outlet and clearance bottle gas connections shall either be flanges or faced bosses to accommodate a flange suitable for the working pressure of the cylinder as specified in Paragraph 2.5.1.1. The bolting of flanges or machined bosses shall conform to the dimensional requirements of ANSI B16.1, B16.42, or B16.5 as applicable. Special connections shall conform to the applicable API, ASME, or ANSI Specification.

• **2.5.3.2 Indicator Connections.** When specified by the purchaser, each cylinder end shall be provided with a ½-inch, threaded and plugged indicator tap for cylinder performance analysis.

2.6 Valves.

2.6.1 Inlet Valve Average Gas Velocity. Inlet valve average gas velocity shall be computed as follows:

$$V = 288 * \frac{D}{A}$$

Where:

V = Average gas velocity, feet per minute.

D = Piston displacement per cylinder, cubic feet per minute.

A = Product of the actual lift and the valve-opening periphery; total for all inlet valves per cylinder, square inches.

NOTES:

1. Valve lift area used in the above equation shall be shown on data sheets. If lift area is not the smallest area in flow path of valve, it shall be so noted on the data sheet, and velocity shall be computed on basis of the smallest area.

2. Velocities calculated from this formula should be treated only as a general indication of valve performance, and should not be confused with effective velocities based on crank angle, degree of valve lift, unsteady flow, etc. The velocity computed from the above formula is not necessarily a representative index for valve power loss or disc/plate impact.

2.6.2 Valve Designs. Valve designs shall be suitable for operation with any gas specified on the data sheet.

2.6.3 Non-Reversible Valves. The valve design shall be such that valve assemblies cannot be inadvertently interchanged or reversed, for example, fitting a suction valve assembly into a discharge port or inserting a valve assembly upside down.

2.6.4 Valve Guard and Bolting. The valve and cylinder designs shall be such that the valve guard or the assembly bolting (or both) cannot fall into the cylinder even if the valve assembly bolting breaks or unfastens.

2.6.5 Valve Plates or Discs. Valve discs or plates shall be suitable for installation with either side sealing.

2.7 Pistons, Piston Rods, and Piston Rings.

2.7.1 Piston and Rod Locking. Pistons which are removable from the rod shall be attached to the rod by shoulder and lock nut design. All nuts must be secured in place. Locking nuts attaching the piston rod to the piston and to the crosshead shall be tightened in accordance with the compressor manufacturer's torque standards.

2.7.2 Hollow Pistons. Hollow pistons (single or multi-piece) when used shall be self venting.

2.7.3 Piston Wear Bands. Non-metallic wear bands, • if required by the manufacturer or specified by the purchaser, shall not overrun valve ports or counterbores by more than one-half the axial width of the wear band.

2.7.4 Piston Rod Hardness. A surface hardness of Rockwell C50 minimum is required on piston rods in the area that passes through the packing. For piston rods in corrosive gas service, see Section 15 — Corrosive Gases — H_2S and CO_2.

2.7.5 Piston Rod Threads. Piston rods shall be furnished with rolled threads.

2.7.6 Coated Piston Rods. When coated rods are • specified, the coating material and base material shall be mutually agreed upon by the purchaser and the manufacturer. The coating material must be properly sealed to prevent corrosion of the base material and subsequent failure of the coating. High velocity and high impact thermal plating, porous electroplating, or suitable plasma spraying are acceptable for coating of piston rods. Metal spray techniques requiring roughening of the surface of the base metal are not permitted because of the potentially destructive stress risers left in the surface. Use of subcoating under main coating is not permitted.

2.8 Crankshafts, Connecting Rods, Bearings & Crossheads.

2.8.1 Crankshafts. Crankshafts shall be of the compressor manufacturer's standard material and design and shall be heat treated and machined on all working surfaces and fits. They shall be free of sharp corners. Drilled holes or changes in section shall be finished with radii and shall be polished. Forced lubrication passages in crankshafts shall be drilled.

2.8.2 Bearings. Main bearings shall be replaceable sleeve type or anti-friction of the tapered or spherical roller type. Roller bearing selection shall be based on an L10 rating equivalent to 44,000 hours or greater (see AFBMA Std 11) at rated compressor speed and maximum allowable operating rod load. Cylindrical roller or ball type anti-friction bearings are unacceptable.

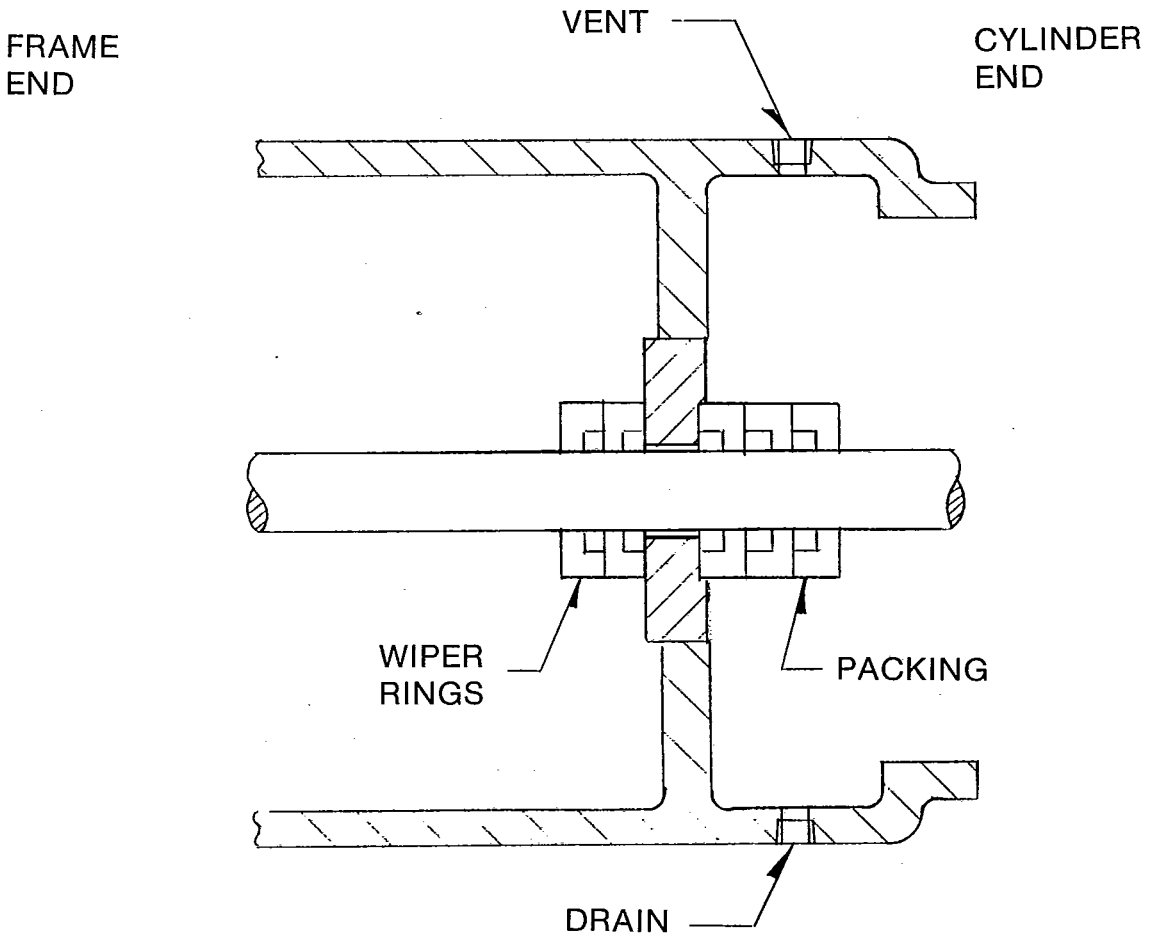
2.8.3 Connecting Rods. Connecting rods shall be of compressor manufacturer's standard material with removable cap. They shall be free of any sharp corners. Forced lubrication passages shall be drilled. Crank pin bearings shall be replaceable sleeve type.

2.8.4 Crossheads. Crossheads shall be compressor manufacturer's standard material and design. Adequate openings for removal of crosshead shall be provided.

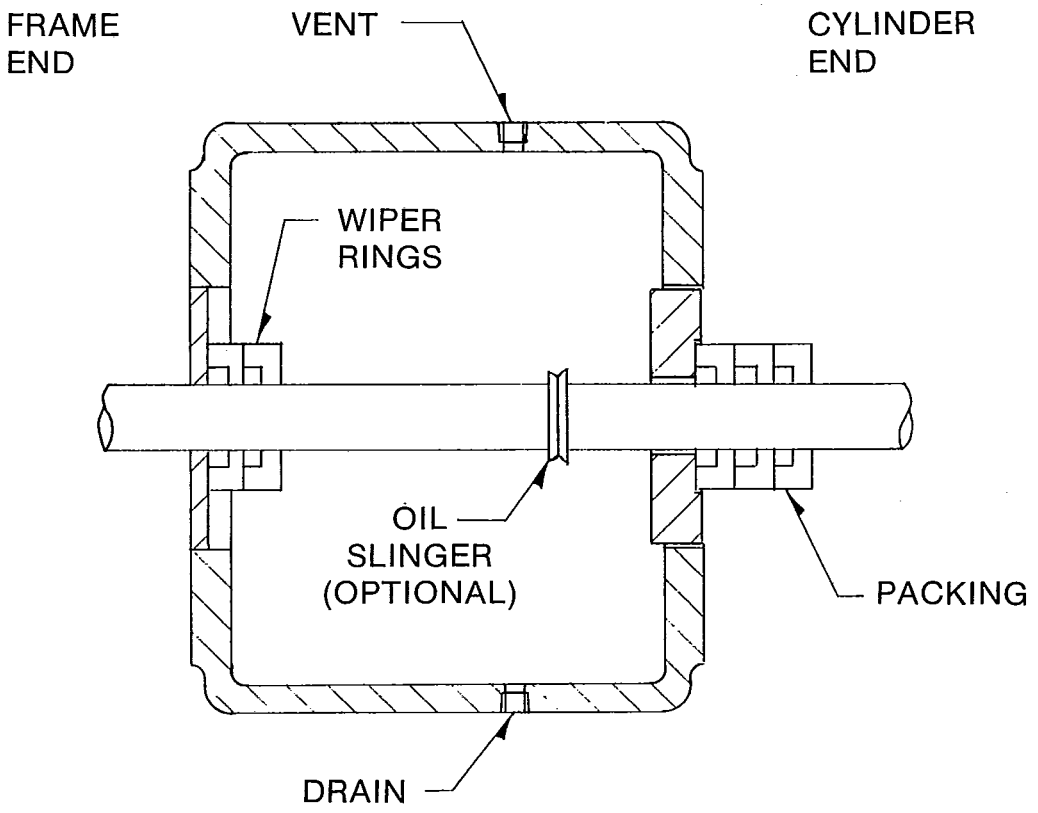
2.9 Distance Pieces.

2.9.1 Design. If distance pieces are provided, they shall conform to types '1', '2', or '3' as specified by the purchaser. •

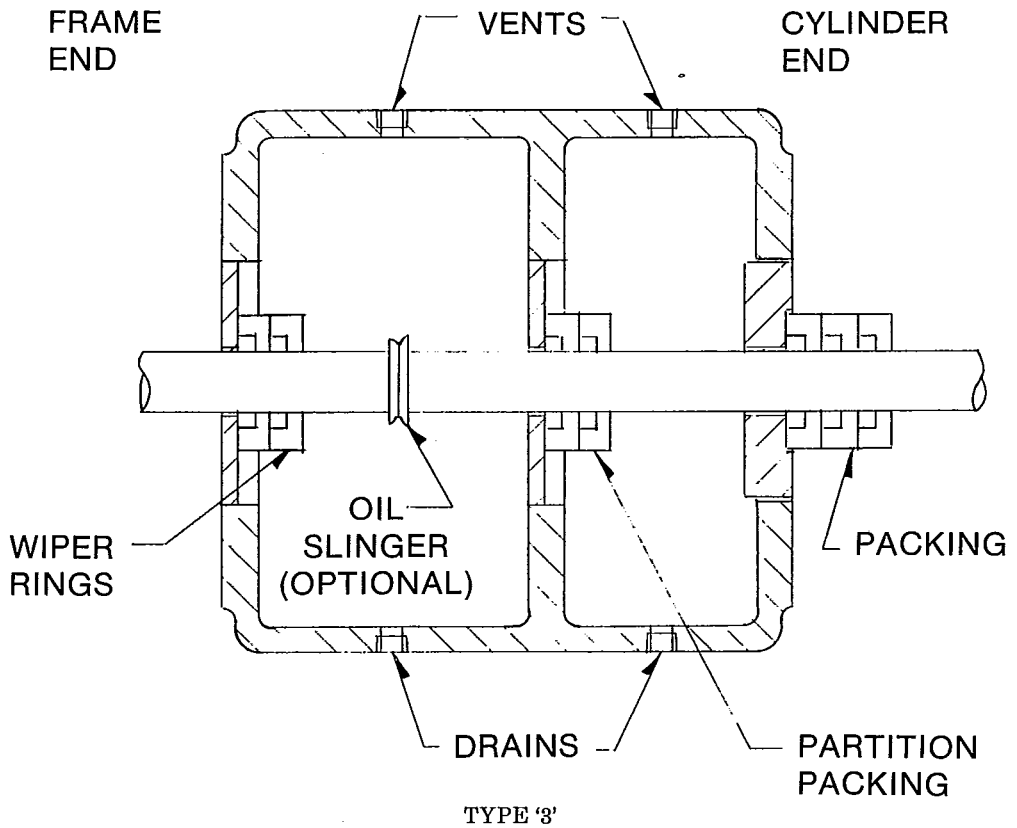
NOTES: *Short, close-coupled, single compartment (type '1') and long, single compartment (Type '2') are utilized in the majority of oil and gas field applications. Type '1' is used where it is desired to keep overall width of the compressor to a minimum for ease of highway transportation of the package. Type '2' is used when physical separation of the pressure and wiper packing is desired. Type '3' provides double compartments for varying degrees of purging when required. Slinger rings may be added to types '2' or '3' to prevent migration and mixing of oil between the crankcase and the compressor cylinders.*



TYPE '1'



TYPE '2'



TYPE '3'

2.9.2 Openings. Openings of adequate size to permit servicing of the packing case shall be provided and shall have bolted access covers, a bottom drain connection, and a top vent connection. Refer to Paragraph 7.19 for drain and vent specifications.

• **2.9.3 Explosion Relief Door(s).** When specified by the purchaser, explosion relief door(s) shall be furnished on the compressor frame or distance piece(s).

2.10 Packing Cases and Pressure Packing.

2.10.1 Type. All oil wiper, intermediate, and gas cylinder pressure packings shall be segmental rings with stainless steel garter springs.

2.10.2 Flanges. Packing case flanges shall be bolted to the cylinder head or to the cylinder with no less than four bolts. Packing case assembly shall have positive alignment features, e.g., cup-to-cup pilot fits and/or sufficient body-fitted tie bolts.

2.10.3 Services. For flammable, hazardous, toxic, or wet gas service the pressure packing case shall be provided with a common vent and drain below the piston rod tubed to the outside of the distance piece. Refer to Paragraph 7.19 for drain and vent specifications and Section 15 for corrosive gas applications.

2.10.4 Wiper Packing. Crosshead wiper packing shall be provided to minimize oil leakage from the crankcase.

2.11 Compressor Frame Lubrication System.

2.11.1 Frame Lubrication. The frame lubrication system shall be pressurized and shall have sufficient capacity to provide adequate lubrication at all speeds required to meet the specified operating conditions. Splash systems may be used on horizontal compressors with anti-friction journal bearings operating at 600 rpm or below.

2.11.2 Gauges and Connections. The frame shall have sight oil level gauge and oil filling connection.

2.11.3 Frame Oil Pump. The frame oil pump shall be crankshaft driven either directly, through gears or a chain.

2.11.4 Pressurized System. The pressurized frame lubrication system shall contain a pre-lubrication pump (on motor drive units with sleeve bearings and gas engine drive units with sleeve bearings over 300 bhp), suction strainer, full-flow filter(s) with inlet and outlet pressure gages and replaceable element(s), system relief valve and, if necessary, a system oil cooler. Filter cases and heads shall be suitable for operation at the maximum discharge pressure of the frame oil pump. Full-flow filters with replaceable elements shall be supplied with filtration of 25 microns (nominal) or finer for babbitt and anti-friction bearings and 10 microns (nominal) or finer for aluminum or microbabbitt bearings. The filters shall be located downstream of the cooler. Filters shall not be equipped with a relief valve or automatic by-pass. Filter cartridge materials shall be corrosion resistant. Metal-mesh or sintered-metal filter elements shall not be used. The design of the filter-cartridge assembly shall assure that internal by-passing cannot occur due to filter-to-cartridge or cartridge-to-cartridge misalignment, inadequate end cover sealing design, or other sealing deficiencies. Additionally, the cartridge collapse differential pressure shall be at least 50 psi and the clean differential pressure shall not exceed 5 psi at design temperature and flow.

2.11.5 Materials. All parts in the crankcase and lubricating oil system shall be of materials suitable for the site environment. For corrosive gas services, refer to Section 15 for material requirements.

2.11.6 Oil Level Control. A compressor frame oil level control device shall be furnished by the compressor packager. A storage tank with level gage shall be furnished if specified by the purchaser. •

2.11.7 Lube Oil Heater. When specified by the purchaser, a lube oil heater shall be furnished by the packager. •

2.12 Compressor Cylinder Lubrication.

2.12.1 Cylinder Lubrication. Either block distribution lubrication systems or pump-to-point lubrication systems may be furnished for lubrication of compressor cylinder ring travel bore and piston rod packing. The force feed lubricator shall be variable flow and of weather-proof construction and shall be frame mounted, direct, chain or gear driven, and be equipped with a reservoir level indicator. Block distribution lubrication systems shall be complete with no-flow shutdown, rupture relief discs, check valves and carbon steel or Series 300 stainless steel tubing. Line filters, lube meter and fault indicators may be specified by the purchaser for block distribution lubrication systems. For pump-to-point lubrication systems, a sight indicator for each point, check valves and carbon steel or Series 300 stainless steel tubing shall be furnished. •

2.12.2 Oil Supply. The force feed lubrication system shall be complete with automatic oil replacement via a gravity feed source, pressurized source, or filtered oil from the compressor crankcase.

2.12.2.1 Oil Level Control. A lubricator reservoir oil level control device shall be furnished by the compressor packager on units with pump-to-point lubrication systems and on block distribution systems when the lubricator pump is not pressure fed. A storage tank with level gage shall be furnished if specified by the purchaser. •

2.13 Materials.

2.13.1 General.

2.13.1.1 Materials of Construction. Materials of construction of the compressor and auxiliaries shall be the compressor manufacturer's standard for the

specified operating conditions except as required by the 'API Packaged Compressor Data Sheets — Part 1.'

2.13.1.2 Steel Heads. Steel compressor cylinders shall be equipped with steel heads.

• **2.13.1.3 Cylinder Material.** Materials for pressure containing cylinder parts will be the compressor manufacturer's standard or as specified by the purchaser. The maximum allowable working pressure for various compressor cylinder materials shall not exceed:

Material	Maximum Allowable Working Pressure, psig	
	Thru 8" Cyl Diameter	Over 8" Cyl Diameter
Gray Iron	1,600	1,000
Ductile Iron	2,500	1,500
Cast/Fab Steel	2,500	2,500
Forged Steel	7,500	—

2.13.1.4 ASME Code. Materials, casting factors, and the quality of any welding shall be equal to that required by Section VIII, Division I, of the ASME code. The manufacturer's data report forms, as specified in the code, are not required.

2.13.2 Castings and Forgings.

2.13.2.1 Casting Quality. Castings shall be sound and meet the applicable ASTM quality specifications for the material utilized. Surfaces of castings shall be cleaned by sandblasting, shotblasting, pickling, or any other standard method. All mold-parting fins and remains of gates and risers shall be chipped, filed or ground flush.

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

2.13.2.3 Casting Standard — Gray Iron. Unless otherwise specified by the purchaser, gray iron castings shall be produced in accordance with ASTM Reference Standard A-278 for Pressure Containing Castings. Class shall be specified by the compressor manufacturer.

2.13.2.4 Casting Standard — Ductile Iron. Unless otherwise specified by the purchaser, ductile iron castings shall be produced in accordance with the ASTM Reference Standard A-395 or ASTM A-536 for Pressure Containing Castings. Grade shall be specified by the compressor manufacturer.

2.13.2.5 Casting Standard — Steel. The minimum quality standard allowed for steel castings shall be ASTM A-216, A-487, A-703, and A-781. Grade shall be specified by the compressor manufacturer.

2.13.2.6 Standard — Forgings. The minimum quality standard allowed for forgings for pressure containing parts shall be ASTM A-668. Grade shall be specified by the compressor manufacturer.

2.13.3 Repair.

2.13.3.1 Casting Repair. Pressure containing gray iron or ductile iron castings shall not be repaired by peening, by burning-in or by welding.

2.13.3.2 Repair by Plugs. Gray iron or ductile iron castings may be repaired by plugging within the limits specified in ASTM A-395. However, unless otherwise agreed upon by the purchaser and the compressor manufacturer, plugs shall not be used in the gas pressure containing wall sections, including the bore under the liner, if any. The drilled hole for a plug shall be subjected to a liquid penetrant examination to ensure that all defective material has been removed.

2.13.3.3 Repairs by Welding. All welding of steel cylinders shall be performed by operators and procedures qualified in accordance with Section IX of the ASME Code.

2.13.3.4 Repair Testing. The compressor manufacturer shall be responsible for the review of all repairs and repair welds to ensure that they are properly heat treated and non-destructively examined for soundness and compliance with applicable qualified procedures.

2.13.4 Material Inspection.

2.13.4.1 Material Samples. Chemical analysis of an as-cast sample from each ladle is not required unless otherwise specified.

2.13.4.2 Inspection Codes. When radiographic, • ultrasonic, magnetic particle or liquid penetrant inspection is required or specified, radiography shall be in accordance with Section VIII, Division I, UW-52 of the ASME code; ultrasonic inspection shall be in accordance with Section VIII, Division I, Appendix 12 of the ASME code; magnetic particle inspection shall be in accordance with Section VIII, Division I, Appendix 6 of the ASME code; and liquid penetrant inspection shall be in accordance with Section VIII, Division I, Appendix 8 of the ASME code. When specified, forged parts shall be ultrasonically inspected in accordance with ASTM A-503.

2.13.4.3 Magnetic Particle Inspection. When magnetic particle inspection 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 following limits:

TYPE	DEGREE
I	1
II	2
III	2
IV	1
V	1
VI	1

Defects that exceed the limits imposed above shall be cleaned out to meet the quality standards cited above, as determined by additional magnetic particle inspection before repair welding.

2.14 Power Transmission.

2.14.1 Gears. Speed increasing or reducing gears shall not be used unless otherwise specified by the purchaser.

2.14.2 Couplings. Shaft couplings shall be non-lubricated, flexible, steel disc type with steel or stainless steel disc pack as specified by the purchaser except when torsional analysis requires a torsionally soft coupling. Couplings shall be selected for the maximum continuous horsepower rating of the prime mover plus the coupling manufacturer's standard service factor for reciprocating compressor applications.

2.14.3 V-Belt Drives. V-belt drives for compressor applications shall be in accordance with API Std 1B — Specification for Oil Field V-Belting.

2.14.4 Clutches. A clutch power take-off shall not be used unless otherwise specified by the purchaser.

2.14.5 Guards. Flywheels, sheaves, belts, shafts, couplings and similar moving parts shall have removable safety guards that meet occupational safety and health (OSHA) standards.

2.14.5.1 Guard Tolerance. Safety guards shall protect to within ½ inch of stationary housings and shall be sufficiently rigid to withstand deflection and prevent rubbing as a result of bodily contact.

SECTION 3
CAPACITY CONTROL

3.1 General. The compressor capacity may be controlled on the basis of the suction pressure, discharge pressure, flow, or some combination of these parameters. The required capacity variation will be specified by the purchaser. The control system may be mechanical, pneumatic, hydraulic, electric or any combination thereof. The purchaser will specify the parameter to be used for control. If the control signal is from a source furnished by the purchaser, then the purchaser will specify the source, sensitivity and range of the control signal to be utilized by the packager.

3.2 Method of Capacity Control. Capacity control can be obtained by speed variation, clearance variation, bypass, single acting of double acting compressor cylinders, valve unloaders, suction pressure control or any combination thereof. Control operation shall either be automatic with manual over-ride or manual as specified by the purchaser on the 'API Packaged Compressor Data Sheets — Part 1.' Some of these methods require unit shutdown and depressuring to effect a change. The purchaser will specify if such unit shutdowns are acceptable.

3.2.1 Speed Variation. When specified by the purchaser, capacity control can be achieved by prime mover speed variation.

3.2.2.1 Clearance Variation. Clearance variation may be achieved by clearance pockets, valve spacers, cylinder head spacers, clearance plugs, and other methods. These methods may be used alone or in combination. In all cases where clearance volume is added to a compressor cylinder end, the volumetric efficiency must be at least 15%.

NOTE: *Volumetric efficiencies less than 15% may cause excessive temperature rise, valve plate flutter, valve plate breakage and possible physical damage to the compressor cylinder.*

3.2.2.2 Clearance Pockets. Clearance pockets may be specified by the purchaser and be either the fixed type (pocket clearance is fixed and the pocket is either open or closed) or the variable type (pocket clearance is variable over the range from fully open to closed).

3.2.2.2.1 Variable Pocket Vents. Manually variable volume clearance pockets shall have a non-restricted vent line provided to vent the back side of the variable pocket piston to the suction port of the compressor cylinder, to the suction piping or to the vent system.

3.2.2.3 Valve Spacers. Valve spacers (high clearance assemblies or split valve yokes) used to raise the valve a pre-determined distance above the cylinder valve port may if specified by the purchaser be provided by the compressor manufacturer to meet an operating condition.

3.2.2.4 Clearance Bottles. Clearance bottles for capacity control may be added to the compressor cylinder. They should be designed for the maximum allowable working pressure of the compressor cylinder and hydrotested to 1½ times the MAWP rating and constructed as piping for hydrocarbons (ANSI B31.3) or as ASME code vessels as specified by the purchaser.

3.2.2.5 Cylinder Head Spacer(s). Spacer(s) may be placed between the compressor cylinder body and cylinder head to add clearance volume. This method of capacity control must be approved by the compressor manufacturer to ensure that proper bolting and head gasketing requirements are met.

3.2.2.6 Clearance Plugs. The compressor cylinder head may be furnished with clearance plugs.

NOTES: *Clearance plugs usually have two clearance steps. When the plug is inserted into the head or cylinder bore, the clearance is minimum. When the plug is placed outside the head or cylinder bore, the clearance is maximum. Clearance steps between minimum and maximum can be achieved by different length plugs.*

3.2.3 Bypass Systems. Bypass systems can be either hot or cold gas and either manual or automatic. Bypass systems shall be equipped for purging before start-up. A pressure relief valve shall be installed to protect equipment which has a pressure rating lower than the pressure of the bypass gas.

3.2.3.1 Start-Up Bypass. A bypass for start-up only is usually a hot gas bypass (from the discharge of the final stage to the inlet side of the compressor with no cooling of the gas) and manually operated. This type of bypass system shall not be utilized for capacity control. It will be specified by the purchaser when required.

3.2.3.2 Capacity Control Bypass. When specified by the purchaser, a manual or automatic cold gas (from downstream of the aftercooler or discharge scrubber, if furnished, back to the inlet scrubber) bypass system for capacity control shall be furnished.

3.2.4 Valve Removal or Unloading.

3.2.4.1 Valve Removal. Removal of all the suction valves from the head-end of a double acting compressor cylinder is permitted to completely unload that end of the cylinder. Suction or discharge valves shall not be removed from the crank-end of a compressor cylinder without specific approval of the compressor manufacturer.

3.2.4.2 Valve Unloaders. Compressor cylinder capacity control can be accomplished with valve

depressors or plug-type unloaders. Valve depressors, when used, shall be installed on all suction valves of the cylinder end involved.

NOTES: *Where plug-type unloaders are used, the number of unloaders is determined by the area per plug opening, the total of which must be equal to or greater than one-half of the total free lift area (or least flow area) of all suction valves on that end.*

When valve depressors are used only for start-up, and never for capacity control, the compressor manufacturer may approve a reduced number of unloaders. For start-up with plug unloaders, only one per cylinder end is needed.

3.2.4.3 Automatic Valve Unloading. When specified, the packager shall provide a system of properly sequenced unloader operation. Pneumatically operated unloaders with no manual over-rides shall be piped by the packager in such a manner that inadvertent non-sequenced operation shall not occur.

3.2.4.4 Unloader Operator. Pneumatically operated unloaders shall be suitable for operation with any gas specified on the 'API Packaged Compressor Data Sheets — Part 1', and if air operated, they shall be designed so that the air used for unloading cannot be mixed with the gas being compressed even in the event of failure of the diaphragm or another part.

3.2.5 Suction Pressure Control. When specified by the purchaser, a suction pressure reducing valve shall be used to limit the suction pressure to a set value in order to control capacity of the unit.

SECTION 4
PRIME MOVER

• **4.1 General.** The type of prime mover (gas engine or electric motor) will be specified by the purchaser. The prime mover shall be sized to meet the maximum specified operating conditions and shall be in accordance with applicable specifications as stated in the inquiry.

4.2 Spark Ignited Gas Engines.

4.2.1 Rated Brake Horsepower. Unless otherwise specified by the purchaser, the gas engine shall be sized for the greatest horsepower required for any of the compressor operating conditions plus accessory horsepower, for the specific location, without exceeding the engine manufacturer's standard published rating criteria for continuous duty service. The engine manufacturer's continuous duty service is defined as the load and speed which can be applied without interruption after taking into consideration site conditions of altitude, temperature and fuel gas composition as listed on the data sheets.

4.2.2 Operating Speed. The packager shall not apply an engine at an operating speed either greater or less than the manufacturer's recommended continuous duty speed range.

• **4.2.3 Starting Systems.** Electric, air or gas starting systems for the engine driver will be specified by the purchaser.

4.2.3.1 Air or Gas Starting System. Unless otherwise specified, the packager's air or gas starting system shall include the following:

1. Manual block valve to isolate the system.

• 2. If required, a regulator to provide proper starter pressure. Purchaser will specify source and minimum/maximum pressure of air or gas available for the starting system.

3. Safety relief valve. See Paragraph 7.20 for sizing, setting criteria, and venting.

4. Spring loaded (spring to close) quick opening valve.

5. Air or gas starter with lubricator and strainer.

6. The starter vent piping (sized for at least the same diameter as the starter exhaust connection) shall be piped to skid edge unless otherwise specified by the purchaser.

NOTES: *The safe disposition of the starter vent gas must be considered in the installation and is the responsibility of the purchaser.*

4.2.3.2 Electric Starting Systems. Electric starting systems shall not be used in classified locations as defined by API RP 500B. When the packager provides electric starting systems for un-classified locations, they shall include the following:

1. Electric starting motor with starting control.

2. If specified, a battery set with ampere-hour capacity sufficient to start the engine at the lowest specified ambient temperature. •

3. If specified, a charging alternator of sufficient capacity to charge the battery set furnished. •

4.2.4 Air Filters. The engine manufacturer's standard dry-type air intake filter, suitable for outdoor service, shall be provided unless the purchaser has specified otherwise. Air shall not be taken from inside enclosed buildings not adequately ventilated in accordance with API RP 500B.

4.2.4.1 Other Air Filters. Other types of air filters, when specified by the purchaser, shall conform to the following minimum criteria: •

1. The micron particle rating shall be that as recommended by the engine manufacturer.

2. Site environmental conditions (blowing sand, ice, snow, etc.) shall be taken into consideration.

3. The filter shall be oriented to allow in-service maintenance.

4.2.4.2 Minimum Design Requirements. The following features shall be considered in the design of an air intake system:

1. Piping and supports for remote mounted air filters will be furnished by the purchaser unless otherwise specified.

2. Remote mounted air filters shall have internal surface corrosion protection of inlet piping.

3. Remote mounted air filters shall be placed so that ground dust or snow will not clog the filter.

4. All ducting, including air cleaner-to-manifold connections, must be air-tight to avoid the intake of unfiltered air.

5. Restricted inlets, sharp or numerous bends, and undersized piping shall be avoided. Maximum pressure drop shall not exceed engine manufacturer's recommendation.

6. Pressure drop indicator when specified by the purchaser. •

4.2.5 Exhaust System. A standard industrial type exhaust muffler/silencer shall be provided by the packager unless the purchaser has specified otherwise.

4.2.5.1 Other Muffler/Silencers. Other types of exhaust muffler/silencers, when specified by the purchaser, shall conform to the following minimum criteria as specified on the 'API Packaged Compressor Data Sheets — Part 1':

1. Sound attenuation.

2. Personnel protection.

3. Spark arresting capability.

4.2.5.2 Minimum Design Requirements. The following features shall be considered in the design of an exhaust system:

1. The exhaust system shall be properly anchored and supported, include all interconnecting piping, and direct the expansion of the piping involved away from the engine. If an expansion joint is required, it shall be stainless steel.

2. Muffler/silencer shall be painted with high temperature resistant aluminum paint or equal.

3. Exhaust piping shall not exceed the engine manufacturer's back pressure limitations.

4. Provisions shall be made to prevent rain water from entering the system.

4.2.5.3 Insulation and guarding. Insulation and/or guarding of hot metal surfaces shall not be provided unless specified otherwise by the purchaser.

4.2.6 Engine Shutdowns. See Section 10 — Shutdowns, Alarms and Annunciators.

4.2.7 Engine Ignition Systems. The engine shall be equipped with a low tension capacitor discharge ignition system, non-shielded, unless otherwise specified by the purchaser. The system shall include generator, high tension coils, low and high tension cables and spark plugs. All components shall be of weather-protected design or fitted with weather-covers to prevent rain from directly contacting or accumulating in system components.

4.2.8 Engine Emissions. Compliance with local, state, and federal air emission regulations is the responsibility of the purchaser. To assist the purchaser in the selection of equipment as well as supplying the applicable regulatory body with accurate emissions data, the packager will provide either manufacturer's performance data or actual stack test data if specified by the purchaser. The purchaser will furnish the fuel composition and the known emission level limits for the installation on the 'API Packaged Compressor Data Sheet — Part 1' when requesting emissions data.

4.2.8.1 Required Data. When specified, emissions data shall be supplied for the following compounds at specified engine load conditions:

Nitrous Oxides
Carbon Monoxide
Non-Methane Hydrocarbons
Sulfur Dioxide

The basis for obtaining the amounts of these compounds will be:

1. The quoted engine shall be loaded to either the rated horsepower shown on the quotation or the manufacturer's nameplate rating as specified by the purchaser.

2. The fuel composition used for the test shall be shown and effects, if any, related to the differences in the test and actual fuel shall be noted.

3. The air:fuel ratio shall be specified within the manufacturer's recommended range.

4. Units of grams per horsepower-hour or tons per year shall be used.

4.2.8.2 Emission Control Device. If a catalytic converter or other external device is quoted to meet the air emissions requirements specified by the purchaser, the rated horsepower quoted shall reflect the effects, if any, of the additional back-pressure or heat loads placed on the driver by the device. Any special operational considerations, fuel composition, air:fuel ratio or lubrication specifications shall be clearly stated in the packager's quotation.

4.2.9 Engine Lubrication System. Engines shall be equipped with the engine manufacturer's standard lube oil system unless otherwise specified.

4.2.10 Oil Level Control. A crankcase oil level control device shall be furnished by the packager. A storage tank with level gage shall be furnished by the packager if specified by the purchaser.

4.2.11 Fuel Gas System. Unless otherwise specified, the fuel system shall include:

1. Pressure-reducing regulator with downstream pressure gage and isolating valve.

2. Relief valve sized for maximum output capacity of pressure-reducing regulator based on maximum supply pressure and orifice installed in regulator. See Paragraph 7.20 for sizing, setting criteria and venting.

3. Fuel system manual block valve.

4. Automatic valve in fuel system to shut off fuel to the engine and vent engine side of fuel system when engine is shut down.

5. Fuel filter/separator, if specified, shall be installed downstream of the high pressure regulator.

4.2.12 Fuel Gas Composition. The fuel gas composition and pressure, if different than the compressed gas, shall be as set forth in the 'API Packaged Compressor Data Sheets — Part 1'. Any contaminants are to be listed by the purchaser in 'Part 1' and the

engine manufacturer shall be consulted for fuel treatment requirements and special precautions.

4.2.13 Crankcase Explosion Door(s). Crankcase explosion relief door(s) shall be furnished on the engine crankcase when specified by the purchaser.

4.3 Electric Motors.

4.3.1 Motor Description. The purchaser will specify on the 'API Packaged Compressor Data Sheets — Part 1', the motor description including electrical data, starting conditions, type of enclosure, area classification, type of insulation, service factor, ambient temperature, elevation, and accessories such as temperature detectors, vibration sensors, heaters and instrumentation.

4.3.2 Rated Brake Horsepower. The motor power rating including service factor, if any, shall be a minimum of 110% of the greatest horsepower required for any of the specified compressor operating conditions and the design of the motor shall conform to the NFPA 70 and NEMA MG-1 specifications.

4.3.3 Motor Current Variations. The inertia of the rotating parts of the combined motor/compressor installation shall be sufficient to limit motor current variations to a value not exceeding 66% of the full load current in accordance with Paragraph 20.82 of NEMA MG-1 for induction motors and Paragraph 21.84 of MG-1 for synchronous motors for all specified compressor operating conditions.

4.4 Guards. Flywheels, sheaves, belts, shafts, couplings and similar moving parts shall have removable safety guards that meet occupational safety and health (OSHA) standards.

4.4.1 Guard Tolerance. Safety guards shall protect to within ½ inch of stationary housings and shall be sufficiently rigid to withstand deflection and prevent rubbing as a result of bodily contact.

SECTION 5
COOLING SYSTEM

5.1 General. API 661 — Air cooled heat exchangers for General Refinery Services are not included in the scope of this specification.

5.2 Engine. An engine cooling system shall include the following features, as appropriate:

1. Engine coolant section(s) as required by the engine manufacturer for engine lube oil, engine turbocharger air aftercooler (if required) and engine jacket cooling.

2. Elevated deaerating type reservoir with gage glass, vent line, coolant level switch, overflow, filling connection, and drain. Gage glasses are not required on engine radiators.

3. Thermostatic coolant temperature control per engine manufacturer's recommendation.

4. Plugged manual drain connection(s) to completely drain equipment and system.

5.3 Compressor.

5.3.1 Circulated Coolant. When coolant cooled cylinders are furnished, a compressor cylinder jacket cooling system shall be provided either separate or integral with the engine cooling system to provide coolant to the compressor cylinders within the temperature limits recommended by the compressor manufacturer for the specified compression services. The cylinder cooling system piping shall be equipped with vents and low point drains. Manual block valves to permit working on the compressor unit or auxiliary equipment without draining the engine cooler shall be furnished.

5.3.1.1 Cylinder Jacket System. When furnished, the cylinder jacket system must be designed to positively prevent leakage of gas into the coolant.

NOTES: *The purchaser is cautioned regarding the following:*

1. *Coolant inlet temperatures less than 10 deg. F. greater than gas inlet temperatures may cause gas constituent condensation.*

2. *Insufficient coolant flow or low coolant velocity may cause fouling of the cylinder jacket system.*

3. *Coolant exit temperatures more than 30 deg. F. above gas inlet temperature may cause capacity reduction.*

• **5.3.1.2 Sight Flow and Temperature Indicators.** Sight flow and temperature indicators shall be furnished when specified by the purchaser.

5.3.2 Thermo-Siphon and Static Cooling. When applicable, the compressor cylinder jacket cooling system may be either static or thermo-siphon type where the compressor discharge temperatures are within the temperature limits recommended by the compressor manufacturer for the intended compressor cylinders and gas compression services.

5.3.3. Rod Packing Cooling. Unless otherwise specified on the 'API Packaged Compressor Data Sheets — Part 1', the following pressure packing case cooling criteria shall be followed:

1. The compressor manufacturer's standard design may be used for packing pressures up to 2500 psig on piston rods 2½ inches in diameter or less.

2. Cooled packing cases are required for packing pressures above 2500 psig. Internal tubing of Series 300 stainless steel and forged fittings shall be furnished by the compressor manufacturer.

3. When packing cooling is required, the compressor manufacturer is responsible for advising the compressor packager of minimum requirements such as flow and pressure, pressure drop, temperature, filtration, corrosion protection and type of coolant.

5.3.4 Frame Lube Oil. A compressor frame oil cooling system when required by the compressor manufacturer shall be provided either separate (with thermostat) or integral with the engine cooling system to provide coolant to the compressor frame shell and tube lube oil cooler.

• **5.3.5 Gas Cooling.** Gas intercooling shall be provided as required and gas aftercooling shall be provided as specified by the purchaser.

5.4 Types of Coolers.

5.4.1 Air Exchange Coolers. Units which require air cooling of several streams shall be equipped with finned tube exchangers mounted in one compact cooler assembly.

5.4.2 Radiator. Units requiring air cooling of only engine jacket coolant may be equipped with a radiator type (automotive type) cooler sized for the site conditions.

5.5 Air Exchange Cooler Design Criteria.

5.5.1 Properties. Physical and thermal properties of the fluids to be cooled shall be obtained from recognized sources, TEMA Standards or GPSA Data Books.

5.5.2 Glycol/Water. The coil sections intended for cooling engine and compressor cylinder jackets, if any, shall be designed to cool a fifty percent (50%) solution of ethylene glycol in water or other special solutions as required by the engine or compressor manufacturer at maximum design ambient temperature.

5.5.3 Pressure. The maximum allowable working pressure of gas sections shall be at least the maximum operating discharge pressure plus 50 psi or 10 percent of the maximum operating discharge pressure, whichever is greater, at an assumed temperature of 350 deg. F. The maximum allowable working pressure of the oil or coolant sections shall be 150 psig minimum.

5.5.3.1 Code. An ASME code stamp on the gas cooler sections shall be supplied unless otherwise specified by the purchaser.

5.5.4 Heat Rejection and Flow Rate. Heat transfer equipment for packaged compressor units shall have the following design flow rates and heat loads:

1. Gas Cooler — 100 percent of calculated rates based on the compressor normal operating point including the latent heat for water/hydrocarbon saturated gases with a minimum fouling factor of 0.002.

2. Engine Jacket Coolant, Oil and Auxiliary Coolers — Equipment manufacturer's recommended excess capacity but not less than 110 percent of equipment manufacturer's estimate of heat rejection and a minimum fouling factor of 0.0005 for coolant and 0.001 for oil.

5.5.5 Design Assumptions. Unless otherwise specified by the purchaser, the following criteria shall be used for design:

1. Ambient temperature = 100 deg. F.
2. Site Elevation = 1500 feet
3. Suction gas temperature = 90 deg. F.
4. Intercooler gas outlet temperature = 130 deg. F.
5. Aftercooler gas outlet temperature = 120 deg. F.
6. Specific Gravity = 0.65
7. 'K' Value = 1.26
8. Allowable Pressure Drop

   Operating Pressure

   35 psia and below — 5% not to exceed 1 psi
   36 psia to 250 psia — 3% not to exceed.5 psi
   251 to 1000 psia — 2% not to exceed 10 psi
   1001 psia and above — 1%

9. Parasitic Fan HP = 5% of engine bhp.

NOTES: *Caution should be exercised in applying air cooled heat exchangers because of their susceptibility to pulsation induced vibration in systems and structures. Mechanical natural frequencies and acoustic (organ-pipe) frequencies should not be coincident with pulsation frequencies generated by the compressor.*

5.6 Arrangement and Construction.

5.6.1 Cooler Air Flow. Air cooled exchangers with fans 48 inches in diameter or larger shall be arranged so that air is not drawn from or directed toward the prime mover.

5.6.1.1 Fan Tip Speed. Fan tip speed shall not exceed 14,000 feet per minute unless otherwise specified by the purchaser.

5.6.2 Draft. Either induced draft or forced draft air circulation may be used with cooler assemblies other than radiators.

5.6.3 Fins. The ends of fins shall be stapled or brazed unless otherwise specified by the purchaser.

5.6.4 Tube Material. Steel tubes shall be used unless specified otherwise by the purchaser.

5.6.4.1 Admiralty. If admiralty tubes are specified, they shall comply with ASME SB-III UNS Number 44300, 44400, or 44500 (inhibited) with thickness as follows:

1. 0.042 inch or 19 bwg minimum for tubes smaller than ¾ inch OD.

2. 0.049 inch or 18 bwg minimum for tubes ¾ inch OD and larger.

5.6.4.2 Steel. Steel tubes shall comply with ASME SA-179 for seamless tubes or ASME SA-214 for welded tubes.

1. 0.060 inch or 16 bwg minimum for all size tubes.

5.6.5 Cleanouts. Air cooled exchangers, other than radiator type, shall have header plugs to facilitate cleanout and replacement of each tube.

5.6.6 Air Flow Control. For air cooled exchangers • in services and/or plant sites subject to freezing, hydrate formation, high viscosity, etc., the minimum fluid temperature shall be limited by control of air circulation by means of louvers, automatic variable pitch fan blades, re-circulation system, etc. Automatic control shall be furnished when specified by the purchaser.

5.6.6.1 Louver Operators. Operating levers for manual louvers shall be at an elevation accessible from ground level and have position indicators on any louvers which can not be seen from ground level.

5.6.7 Screens and Guards. When specified by the • purchaser, bug screens and hail guards shall be furnished. Bug screens shall be of #10, mesh galvanized hardware cloth and hail guards shall be ½ inch - ¾ inch expanded metal. Screens and guards shall be designed sufficiently large to minimize any pressure drop into the cooler and be easily removable for cleaning.

5.6.8 Fan Support. Fans for air cooled exchangers, other than standard engine radiators, shall be supported by a tripod, or equal structure.

5.6.9 V-Belts. V-Belt drives shall be designed and constructed in accordance with API Std 1B — Specification for Oil-Field V-Belting.

5.6.10 Lubrication. Lubrication supply lines of the fan drive system shall be piped to a location to permit lubrication safely without shutting the unit down and without guard removal.

5.6.11 Piping Supports. Piping supports shall be attached to the cooler structure and not welded to the cooler sheet metal.

5.6.12 Guards. Sheaves, belts, shafts, couplings and similar moving parts shall have removable safety guards that meet occupational safety and health (OSHA) standards.

5.6.12.1 Guard Tolerance. Safety guards shall protect to within ½ inch of stationary housings and shall be sufficiently rigid to withstand deflection and prevent rubbing as a result of bodily contact.

SECTION 6
PRESSURE VESSELS

6.1 General.

6.1.1 Code. Pressure vessels handling compressed gas shall be constructed in accordance with ASME Boiler and Pressure Vessel Code, Section VIII, Division I (latest edition), and code stamped if the working pressure is 15 psig or greater and with an internal diameter greater than six inches.

6.1.2 Material. Pressure vessels shall be fabricated from pipe or rolled plate in accordance with material specifications contained in the ASME Boiler and Pressure Vessel Code, Section VIII.

• **6.1.3 Corrosion Allowance.** Corrosion allowance for pressure vessels will be specified by the purchaser.

6.1.4 Flanges. Weldneck raised face flanges shall be used unless specified otherwise. Ring type joints or spiral wound metallic gaskets with centering ring shall be employed for ANSI Class 900 flanges or higher. Slip-on flanges, when used, shall be installed with full fillet welds and full internal fillets.

6.1.5 Connection Size. Connections up to 2 inch diameter may be threaded. Only manufactured threadolets shall be used. For connections above 2 inch nominal diameter, only welded connections will be acceptable.

6.1.6 Small Connections. Connections 1½ inches in diameter and smaller shall be designed in accordance with Paragraph 7.2.

6.2 Scrubbers.

6.2.1 Internals. Internals shall be designed to ensure that the inlet stream is not deflected toward the upper portion of the vessel.

6.2.2 Arrangement. Spacing of the inlet nozzle, mist extractors, liquid level controls and high liquid level shutdowns shall be such that the scrubber functions to prevent liquid from reaching the compressor cylinders.

6.2.3 Safety Switch. Provision shall be made to keep internal safety switch floats out of high velocity areas.

6.2.4 Mist Extractor. 300 series stainless steel or monel, vane or mesh type mist extractors shall be furnished unless otherwise specified by the purchaser. Mesh type mist extractors, when furnished, shall be supported both above and below the mesh material.

• **6.2.5 Equipment.** Equipment furnished on scrubbers shall be manual drain, automatic drain valve with liquid level controller, and high level safety shutdown switch. When specified, a reflex type liquid level gage with cocks and check valves and a pressure indicator with isolating valve shall be furnished.

• **6.2.6 Diameter.** The required scrubber diameter shall be based on the scrubber class specified and determined using the procedure as follows unless otherwise specified by the purchaser:

1. 'K' factors for determining maximum allowable superficial velocity for vertical compressor scrubbers are listed for each scrubber service class described as follows:

Scrubber Service Class 'A', K = 0.35

Scrubbing for design conditions only. No capacity for liquid slugs from inlet piping, or condensation mists produced by inlet valve throttling. No capacity for gas flow increases due to start-up surges, pressure changes, or compressor clearance adjustments. No capacity for changes in gas and liquid densities and temperature.

Scrubber Service Class 'B', K = 0.25

Scrubbing for design conditions plus moderate additional scrubber capacity. Generally used only for interstage scrubbers without sidestreams.

Scrubber Service Class 'C', K = 0.18

Scrubbing for design conditions plus substantial additional scrubber capacity. Generally used only for suction scrubbers.

2. Maximum allowable superficial velocity, the gas actual volume flow rate, and the minimum scrubber diameter required shall be calculated by the following formulas:

$$V_a = K\sqrt{\frac{d_l - d_g}{d_g}}$$

$$d_g = \frac{P_o * S_g * 28.96 \text{ lbs. of air/mol}}{T_o * Z * 10.73 \text{ psia-scf/mol-deg. R}}$$

$$Q_a = \frac{Q_s * S_g * 28.966 \text{ lbs. of air/mol}}{379.5 \text{ scf/mol} * 86{,}400 \text{ sec./day} * d_g}$$

$$D = \sqrt{\frac{Q_a * 144}{V_a * 0.7854}}$$

Where:

V_a = Maximum allowable superficial velocity through scrubber (ft./sec.).

d_l = Density of the liquid at operating conditions (lbs./cu. ft.)

d_g = Density of the gas at operating conditions (lbs./cu. ft.).

P_o = Operating pressure (psia)

T_o = Operating temperature (Deg. R)

Z = Compressibility factor

K = A constant depending on the scrubber service class.

Q_a = Gas actual volume flow rate at operating conditions (cu. ft./sec.).

Q_s = Gas flow rate (scf/day).

SG = Gas specific gravity (air = 1.000).

D = Minimum inside diameter of scrubber (inches).

6.3 Pulsation/Volume Bottles.

6.3.1 Pulsation Control. Pulsation control and pulsation studies will be as specified by the purchaser and shall be quoted separately by the packager.

6.3.2 Size. If volume bottles are specified by the purchaser, and a special pulsation dampening design is not specified, then volume bottles shall be furnished on the suction and discharge of each stage. Their volume shall be based upon a multiple of the compressor cylinder(s) swept volume as specified in Appendix 'A'. See Appendix 'A', an extraction from Section 13, 'Compressors and Expanders', in the current edition of 'The Gas Processor Suppliers (GPSA) Engineering Data Book'.

6.3.3 Drains. Easily accessible plugged drains, ¾ inch diameter minimum size, shall be provided. Where baffle plates are utilized, a drain shall be provided in each chamber.

6.3.4 Internal Risers. Internal nozzle risers on suction and discharge bottles, when used, shall be slotted to prevent an accumulation of liquids in the pulsation bottle.

6.3.5 Code. Pulsation/Volume bottles larger than 12.75 inches outside diameter shall be defined as pressure vessels as defined in Paragraph 6.1.1. Smaller pulsation/volume bottles shall either be constructed as piping for hydrocarbons (ANSI Code — B31.3) or as ASME Code Vessels as specified by the purchaser.

6.3.6 Minimum Pipe Diameter. When pulsation/volume bottles are not utilized, the minimum piping diameter to or from the compressor cylinders shall be at least equal to the diameter of the compressor cylinder nozzles. When pulsation/volume bottles are utilized, the inlet piping to the suction bottle shall be at least equal to the diameter of the compressor cylinder suction nozzle.

6.3.7 Reinforced Connections. When specified by the purchaser, flanged connections shall have mechanical reinforcement in the form of weld pads or saddles at least equal to the cut-a-way area.

6.3.8 Insulation and/or Guarding. Insulation and/or guarding of hot metal surfaces shall not be provided unless otherwise specified by the purchaser.

SECTION 7
PIPING AND APPURTENANCES

7.1 General.

7.1.1 Code. Unless otherwise specified, gas piping (process, fuel and starter) design, fabrication, inspection, and testing shall be in accordance with ANSI B31.3.

7.1.2 System. Piping systems shall include carbon steel or stainless steel piping, isolating valves, control valves, relief valves, pressure reducers, orifices, thermowells, pressure gages, sight flow-indicators, and all related vents and drains.

7.1.3 Scope. The packager shall furnish all piping systems, including mounted appurtenances, for all equipment mounted on the skid. Piping for connection to the purchaser's system shall terminate with flanged or threaded union connections at the edge of the skid or to a readily accessible location.

• **7.1.4 Gas Piping.** The extent of gas piping to be supplied by the packager shall be specified by the purchaser. When specified by the purchaser, piping, pulsation suppression devices, knockout vessels and thermowells at the initial and interstage suction points shall be designed and arranged for the future installation of heat tracing and insulation.

7.1.4.1 Threaded Connections. Threaded piping connections may be used on 2 inch nominal pipe size and below unless otherwise specified by the purchaser.

• **7.1.5 Drawings.** When specified, the purchaser will review the arrangement drawings of all piping and appurtenances (pulsation suppression devices, intercoolers, after-coolers, separators, knockouts, air intake filters, expansion joints, and vessels) immediately upstream or downstream of the compressor prior to fabrication.

7.2 Connections. Connections 1½ inches and smaller shall be designed to minimize overhung weight and shall be braced back to the main pipe in at least two planes to avoid breakage due to vibration. Bracing shall be arranged to occupy minimum space.

7.3 Design. Design of piping systems shall achieve the following:

1. Proper support and protection to prevent damage from vibration or from shipment, operation and maintenance.

2. Proper flexibility and normal accessibility for operation, maintenance, and thorough cleaning.

3. Installation in a neat and orderly arrangement adapted to the contour of the machine and not obstructing access openings.

4. Elimination of air pockets.

5. Complete drainage through low-points without piping disassembly.

6. Elimination of low points in the inlet process piping that could trap liquid.

7. Utilize pipe clamps on all gas piping and on all piping 2 inches in diameter and larger.

8. Supports should not be welded directly to gas piping.

7.4 Fabrication. Welding fittings, flanges, and threaded connections shall be held to a minimum. Pipe bushings shall not be used to change diameter in a piping run. Break-out flanges or unions shall be included when packages need disassembly for transportation.

7.5 Threaded Joints. Pipe threads shall be taper threads in accordance with ANSI B1.20.1. All thread nipples shall not be used.

7.6 Threaded Fittings. All threaded connections shall be made with 3000 psi minimum forged steel fittings.

7.7 Flanged Joints. Flanges shall be in accordance with ANSI B16.5. Weldneck raised face flanges shall be used unless specified otherwise. Ring type joints or spiral wound metallic gaskets with centering ring shall be employed for ANSI class 900 flanges or higher. Slip-on flanges, when used, shall be installed with full fillet welds and full internal fillets.

7.8 Sealing. When specified by the purchaser, threaded piping joints for all flammable or toxic fluids shall be seal welded. However, seal welding is not required on instruments, or where disassembly is required for maintenance. Seal welding is not permitted on cast iron equipment. Seal weld metal shall cover all exposed threads, and undercutting is not permitted. Any threads to be seal welded shall be made up without the use of thread lubricants or sealants. •

7.9 Sizes. Connections, pipe, valves and fittings of 1¼ inches, 2½ inches, 3½ inches, 5 inches, 7 inches, or 9 inches, shall not be used.

7.10 Pipe Material. Piping systems containing flammable or toxic fluids shall be seamless carbon steel manufactured in accordance with ASTM A-53 Grade B or ASTM A-106 Grade B or a purchaser approved equivalent. When specified, screwed, flanged, or welded piping can be ERW steel. Stainless steel shall be seamless or welded austenitic in accordance with ASTM A-312 or electric-fusion-welded in accordance with ASTM A-358. Unless otherwise specified, the following minimum schedules for welded piping apply: •

	Schedules	Sizes
Carbon Steel	160	¾ inch and smaller
Carbon Steel	80	1 inch through 2 inch
Carbon Steel	40	3 inch through 10 inch
Carbon Steel	Standard	10 inch and larger
Stainless Steel	40S	1½ inch and smaller
Stainless Steel	10S	2 inch and larger

Threaded piping up to 2 inch nominal diameter shall be scheduled 80 as a minimum.

• **7.11 Alternate Material.** Unless otherwise specified in this standard, ERW steel, seamless steel tubing conforming to ASTM A-192 or series 300 stainless steel tubing conforming to ASTM A-269 may be furnished. Minimum tubing wall thickness shall be as follows:

Tubing O.D. Inches	Wall Thickness Inches
¼	0.035
⅜	0.049
½	0.065
¾	0.095
1	0.109

Steel fittings or 300 series stainless steel fittings, when specified by the purchaser, shall be used with stainless steel tubing. Cast fittings shall not be used. Make and model of fittings shall be subject to approval of purchaser.

• **7.12 Valves.** Valves in flammable or toxic service shall be steel and when specified, valves shall have bolted or welded bonnets, bolted glands and/or be 'Fire-Safe' (metal-to-metal seated).

7.13 Supports. Piping systems furnished by the packager 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.

7.14 Plugs. Tapped openings shall be plugged with solid steel, long-shank or hex-head plugs. Threads shall be coated with a non-locking pipe thread sealant. TFE tape shall not be applied to threads of plugs inserted into oil passages.

• **7.15 Start-Up Screens.** When compressor gas inlet piping and pulsation equipment are furnished by the packager, provisions shall be made for the insertion of temporary start-up screens at each purchaser inlet connection or, when specified by the purchaser, at the suction bottle. The design of the piping system, the suction bottle, and the temporary start-up screens shall afford easy removal and re-insertion of the screens without the necessity of pipe springing. When it is specified that the screens be furnished by the packager, the design, location, and orientation of the screen shall be submitted to the purchaser for approval prior to manufacture or purchase by the packager. When specified, the packager shall supply the removable spool piece(s) that accommodate temporary start-up screen(s). Each spool piece shall be fitted with ¾ inch pressure taps arranged to allow monitoring of pressure drop across the screen.

7.16 Frame Lubricating Oil Piping Requirements.

7.16.1 Lube Oil Piping System. The packager shall supply a complete compressor lubricating oil piping system with its mounted appurtenances when applicable.

7.16.2 Material. When specified, pressurized lubricating oil lines downstream of the filter (with the exception of cast-in-frame lines or passages) shall be made of series 300 stainless steel. For either tubing or piping, bends shall be used to minimize the number of fittings wherever possible. Unless otherwise specified, stainless steel piping may be fabricated with carbon steel slip-on flanges with full fillet welds and full internal fillets in accordance with ANSI B31.3. Steel fittings shall be furnished with stainless steel tubing. Pressure piping downstream of oil filters shall be free of internal obstructions or pockets (such as those created by socket weld fittings) that could accumulate dirt at pipe joints. Non-consumable back-up rings and sleeve type joints shall not be used. Other piping fittings shall be of the socket weld or butt weld type. When butt welds are necessary, such precautions as internal grinding of joints and use of gas tungsten arc welding for the first weld pass shall be taken to prevent weld splatter inside the lines. After fabriction, oil lines shall be thoroughly cleaned. Carbon steel oil lines shall be pickled, passivated, and immediately coated with a rust inhibitor. Carbon steel tubing need not be pickled, passivated or coated.

7.17 Coolant Piping Requirements.

7.17.1 Coolant Piping. When coolant piping on liquid-cooled compressor cylinders is specified to be furnished by the packager, the packager shall supply a piping system for all equipment mounted on the skid. The piping shall be arranged to provide a single inlet connection on the bottom and a single outlet connection on the top for each coolant circuit operating at different inlet temperature levels and shall include a coolant control valve.

7.17.2 Coolant Vents and Drains. Coolant piping on liquid-cooled compressor cylinders shall be arranged so that air cannot be trapped. Where air traps cannot be avoided, venting equipment shall be provided. All low points shall have drains. All liquid-cooled compressor cylinders shall be equipped with valved coolant drains.

7.18 Instrument Piping Requirements.

7.18.1 System. The packager shall supply all necessary piping, valves, and fittings for all instruments and instrument panels.

7.18.2 Connections. Connections on equipment and piping for pressure instruments and test points shall conform to Paragraph 7.4. A common connection for remotely mounted instruments measuring the same pressure may be used where convenient.

7.18.3 Tubing. Instrument and control tubing shall be 300 series stainless steel.

7.19 Drain and Vent Piping.

7.19.1 Drain and Vent Specifications. External drain and vent piping shall be schedule 80 carbon steel not less than ¾ inch nominal size. However, vent connections in the packing case and interconnecting tubing within or from the distance piece shall be in accordance with Paragraph 7.11.

• **7.19.2 Common Distance Piece Vent Header.** When specified by the purchaser, a common distance piece vent header terminating at the edge of the skid shall be furnished by the packager.

• **7.19.3 Common Distance Piece Drain Header.** When specified by the purchaser, a common distance piece drain header terminating at the edge of the skid shall be furnished by the packager.

• **7.19.4 Common Packing Vent Header.** When specified by the purchaser, a common packing vent header terminating at the edge of the skid shall be furnished by the packager.

7.20 Relief Valves.

7.20.1 Required Relief Valves. Relief valves must be located in each continuous system including but not limited to the compressor suction system, each interstage system and final discharge system. When gas coolers are present in any system, relief valves must be located upstream of the cooler.

• **7.20.2 Relief Valve Sizing.** When specified, the packager shall furnish relief valves that are to be installed on equipment or in piping that the packager is supplying. Relief valve sizing shall be in accordance with API RP 520 and ASME Boiler and Pressure Vessel Code, Section VIII, Division 1 and be based upon the maximum quoted capacity of the unit, including accumulation, and shall take into consideration all possible types of equipment failure on the package. The purchaser must specify if additional suction relief valve capacity is required to protect the package for upset conditions other than the rated capacity. The packager shall determine the size and the set pressure of all relief valves related to the package. The packager's proposal shall list all relief valves and shall clearly indicate those to be furnished by the packager.

7.20.3 Relief Valve Setting. Relief valve setting shall take into consideration all possible types of equipment failure and the protection of the lowest pressure rated component in any continuous system. Relief valves shall be set to operate at not more than the maximum allowable working pressure but not less than the values following:

System Discharge Pressure psig	Relief Valve Margin Above System Discharge Pressure
—14.7 to 150	15 PSI
151 to 2500	10%
2501 to 3500	8%
3501 to 5000	6%

NOTE: *For system discharge pressures above 5000 psig, the relief valve setting shall be agreed upon between the purchaser and the packager.*

7.20.4 Relief Valve Venting. Each relief valve shall • be connected to a vent pipe. The vent pipe shall vent released gas either upward into the atmosphere or into a common vent header terminating at the edge of the skid as specified by the purchaser. Atmospheric vents shall have weep holes at the lowest point near the relief valve and shall discharge at a safe height above the package and away from the engine air intake.

NOTES: *The effect of back pressure should be considered when selecting and sizing relief valves to discharge into a common vent header. Conventional relief valves should be specified with care as built-up back pressure may prevent low pressure valves from relieving at a low enough pressure to protect the equipment.*

7.21 Blowdown Valve. When specified by the pur- • chaser, a package blowdown valve shall be furnished by the packager. The vent pipe shall vent released gas either upward into the atmosphere or into a common vent header terminating at the edge of the skid or elsewhere as specified by the purchaser.

7.22 Thermowells. See Paragraph 9.3.2.2.

7.23 Insulation and/or Guarding. Insulation and/or guarding of hot metal surfaces shall be provided unless otherwise specified by the purchaser.

SECTION 8
ELECTRICAL SYSTEMS

8.1 Codes. Unless otherwise specified by the purchaser, all electrical installations shall conform to the latest edition of the National Electrical Code of the National Fire Protection Association. See Paragraph 1.7.

• **8.2 Power Supply.** When electrical equipment is to be supplied by the packager, electrical power supply data for motors, heaters, and instrumentation will be specified by the purchaser.

8.3 Wiring. All power and control wiring within the confines of the main unit base area, any console base area, or any auxiliary skid area shall be resistant to heat, moisture, and abrasion. Stranded copper conductors shall be used within the confines of the skid and other areas subject to vibration. All wiring shall be suitable for environmental temperatures.

8.4 Maintenance. To facilitate maintenance, adequate clearances shall be provided for all energized components (such as terminal blocks and relays) on all equipment.

• **8.5 Insulation.** All electrical materials including insulation shall be corrosion-resistant and nonhygroscopic insofar as possible. When specified for tropical locations, all materials shall be given the following treatments:

1. All parts (such as coils and windings) shall be protected against fungus attack.

2. Unpainted ferrous metal surfaces shall be protected against corrosion by plating or other suitable coating.

8.6 Conduits and Cable Runs. All wiring (including power and instrumentation leads) within limits of any skid area shall be installed in accordance with the area classification as specified by the purchaser and be properly supported to minimize vibration, and isolated or shielded to prevent interference between voltage levels. Conduits may terminate (and in the case of temperature sensing elements shall terminate) with a flexible metallic conduit of sufficient length to permit access to the unit for maintenance without removal of the conduit. A minimum 16 AWG wire shall be used unless smaller wire is required for compatibility with end devices.

8.7 Location. For Class I, Division 2 locations, flexible metallic conduits shall have a liquid-tight, thermosetting or thermoplastic outer jacket. For a Division 1 location, and NFPA approved connector shall be provided.

8.8 Grounding Conductor. A grounding conductor shall be provided between the prime mover/compressor and the control panel. A grounding lug shall be provided on the skid for connection to the main electrical grounding system.

SECTION 9
INSTRUMENTS AND CONTROLS

• **9.1 General.** Package control systems (start, shutdown, capacity, speed) may be pneumatic, hydraulic, electrical or electronic and may be operated either manually or automatically. The purchaser will specify the control signal, manual or automatic control system, the control range and sensitivity. The purchaser will specify which process sensing lines, if any, handle flammable, toxic, corrosive or high temperature fluids and also those which require transduced signals to the instrumentation system.

9.1.1 Location. Unless otherwise specified, all controls and instrumentation shall be suitable for outdoor locations.

9.1.2 Codes and Standards. See Paragraph 1.7.

9.1.3 Visibility and Accessibility. All controls and instruments shall be located and arranged for visibility and easy access by operators and for accessibility for tests and maintenance.

9.1.4 Instrumentation Mounting. All instrumentation shall be securely supported to eliminate vibration and undue force on instrument piping and to prevent damage during shipment, storage, operation, and maintenance.

9.1.5 Pneumatic Supply. Filtered and regulated, sweet, dry natural gas or dry, oil-free air shall be used as the medium to operate pneumatic instruments and controls unless otherwise specified by the purchaser. Purchaser will state the available pressure of a separate pneumatic supply. If natural gas is used, all vents shall be tubed to a common header. Gas operated pneumatic instruments that vent but that do not have vent connections shall not be installed in enclosed control panels.

9.2 Instrument and Control Panel. A panel shall be provided for the compressor package. The panel shall be designed and fabricated in accordance with the purchaser's description. See Section 10.

• **9.2.1 Panel Construction.** Unless otherwise specified by the purchaser, panels shall be steel plate, 16 gauge minimum, reinforced, self-supporting, and closed on the top and sides. When specified, the backs of panels shall be enclosed to minimize electrical hazards, to protect equipment from tampering, or to allow purging and venting for safety and corrosion prevention. All flush-mounted instruments shall be mounted on the front of the panel and all fasteners shall be of corrosion resistant material. Each panel-mounted instrument shall be identified by an engraved name plate. See Section 15, Corrosive Gases — H_2S and CO_2.

• **9.2.2 Panel Mounting.** Control and instrument panels shall be free-standing, skid-mounted or off-skid as specified by the purchaser. Any skid-mounted instrument panel must be securely supported to minimize vibration, to prevent undue forces on piping, and to prevent damage during shipment, storage, operation and maintenance. The mounting location shall not block access doors or covers that must be removed for inspection or maintenance. Lifting rings shall be provided on panels weighing in excess of 100 pounds.

• **9.2.3 Remote Panel Wiring.** If separately mounted control panels are used, all connections shall be brought to one point on the skid with provision for ease of access. Wiring shall be installed in conduits, enclosures or armored cable as specified by the purchaser. All leads and posts on terminal strips, switches, and instruments shall be tagged for identification. Splicing of wiring inside conduits shall not be allowed.

9.2.4 Panel Instrument Tubing. Panel instrument tubing shall be 300 series stainless steel unless specified otherwise by the purchaser.

9.2.5 Maximum Operating Limits. All instrument and controls shall be designed to withstand 125% of the maximum anticipated operating temperature and pressure.

9.3 Instrumentation.

• **9.3.1 Tachometers.** A tachometer shall be provided in the panel when specified. The type, range and indicator provisions shall be stated by the purchaser on the 'API Packaged Compressor Data Sheets — Part 1.' Digital readout tachometers with continuous readout may be utilized. The minimum tachometer speed range shall be from the lowest speed control point to 115% of maximum continuous speed.

• **9.3.2 Temperature Measurement.** Temperature indicators shall be furnished and mounted locally or on a panel as specified on the 'API Packaged Compressor Data Sheets — Part 1.' Locally mounted dial type temperature gages shall be heavy duty and corrosion resistant mounted in stainless steel thermowells. When specified by the purchaser, liquid filled gages shall be furnished by the packager. Black printing on a white background is standard for gages. Metal case, glass-front, stem-type mercury or bi-metallic thermometers shall be furnished in locations subject to vibration. RTD's are acceptable as a temperature sensing device.

9.3.2.1 Required Temperature Indicators. Temperature indicators are required, as a minimum, at the engine coolant outlet and at the gas discharge of each compressor cylinder.

9.3.2.2 Thermowells. All temperature sensing instruments shall be provided with stainless steel thermowells located in the main flow of the fluid. Thermowells shall be 300 series stainless steel and a minimum of ¾ inch NPT diameter.

9.3.2.3 Thermowell Alignment. Wells for 3½ inch OD and smaller pipes or other locations where adequate immersion cannot be obtained by installing them perpendicular to the pipe shall be installed in elbows or in a short enlargement section in the pipe.

- **9.3.2.4 Temperature Transducers.** Grounded or ungrounded thermocouple installations may be specified by the purchaser and shall have continuous runs of extension wire from the head to the terminal or receiver device. The extension wire and terminals shall be the same material type as the thermocouple.

- **9.3.3 Pressure Measurement.** Pressure indicators shall be furnished and mounted locally or on a panel as specified on the 'API Packaged Compressor Data Sheets — Part 1.' Pressure gages shall be furnished with Type 316 stainless steel bourdon tubes and stainless steel movements unless low pressure applications require the use of a bellows for proper operation. In this case, the packager and the purchaser shall mutually agree on the materials to be used. Black printing on a white background is standard for gages. If specified, liquid filled gages shall be furnished. Gage ranges shall be selected so that the normal operating pressure is at the middle third 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. Pressure limiting devices shall be used to protect pressure gages which have a normal operating range much lower than the relief valve setting e.g., propane refrigeration applications.

9.3.3.1 Isolation Valves. All pressures gages shall be furnished with isolation valves. A pulsation dampening isolation valve shall be furnished for all gages utilized in compressed gas service. The isolation valve shall have male by female ends so as to eliminate nipples and overhang.

9.3.3.2 Required Pressure Gages. Pressure gages shall be required for the following as a minimum:

1. Engine Oil
2. Compressor Oil
3. 1st Stage Suction Gas
4. Each Interstage Discharge Gas
5. Final Discharge Gas

SECTION 10
SHUTDOWNS, ALARMS AND ANNUNCIATORS

10.1 General. Shutdown or alarm systems may function hydraulically, pneumatically, electrically or in any combination unless otherwise specified by purchaser.

10.2 Annunciators. Each component which actuates shutdown of equipment or of the entire packaged unit shall also actuate an annunciating device which will indicate first-out cause of shutdown. Annunciators will be by-passed only for the purpose of a preset time lockout for use on certain shutdown devices during startup and manual test.

• **10.2.1 Specified Shutdowns, Alarms and Annunciators.** Shutdown, alarms and annunciators will be specified by the purchaser in the 'API Packaged Compressor Data Sheets — Part 1.' The annunciator panel shall contain space for a minimum of two spare points.

10.2.2 Installation. Alarm, shutdown, and automatic-start switches (except vibration switches) shall be installed so that the normal vibration of the equipment will not cause the switch to falsely trip.

10.3 Required Shutdowns. The following functions on the packaged unit, as a minimum, shall be equipped with shutdown devices that will automatically shut the unit down.

1. Prime Mover

   Engine
   - Low manifold vacuum or high manifold pressure
   - High jacket water temperature
   - Low lube oil pressure
   - Low crankcase lube oil level
   - Overspeed
   - High vibration

   Motor
   - High stator winding temperature — larger than NEMA frame motors
   - High vibration

2. Compressor
   - Low suction gas pressure — first stage
   - High suction gas pressure — each stage
   - High discharge gas pressure — final stage
   - Lubricator no-flow
   - Low frame lube oil pressure
   - Low frame lube oil level
   - High discharge gas temperature — each cyl.
   - High vibration

3. Other
   - High cooler vibration
   - High scrubber liquid level on inlet and interstage scrubbers
   - Low coolant level

10.3.1 Additional Requirements. In addition to the devices previously listed, the packaged unit shall include:

1. On gas engine driven units, an automatic engine fuel shutoff and vent valve.

2. A timed lockout device to by-pass certain shutdown devices to permit starting of the prime mover.

3. A manual test feature with a 0-5 minute timer to test the shutdown devices while the unit is still running without causing a shutdown.

10.4 Compressor Temperature Sensors. High temperature shutdown sensors shall be installed as close to each compressor cylinder discharge connection as practical.

10.5 Compressor Oil Pressure. The pressure sensing element of the lube oil low pressure switch in contact with the lubricating oil shall be resistant to corrosion attack by the compressed gas which may enter the compressor frame and dissolve in the oil and shall be located to sense oil pressure at the end of the bearing oil header.

10.6 Vibration Sensors. The prime mover and compressor high vibration shutdown sensor and switch shall be located at crankshaft level. The cooler high vibration sensor shall be mounted at the centerline of the fan shaft.

10.7 Engine Emergency Shutdown. The engine emergency shutdown shall act to close the fuel valve and vent lines between the fuel valve and carburetor(s) as well as grounding the ignition.

10.8 Shutdown/Alarm Settings. Shutdown/alarm settings shall be as mutually agreed upon by the purchaser and the packager.

SECTION 11
SKIDS

11.1 General. Structural steel, pre or post stressed concrete or concrete filled structural steel skids shall be of sufficient strength for transportation and installation, and to transmit equipment generated forces and couples to the purchaser's foundation.

11.2 Design.

11.2.1 Lifting. Skid shall have provisions for winching and/or lifting.

11.2.2 Members. On structural steel skids, load bearing components shall be full depth members and of sufficient strength to prevent excess deflection that would damage installed equipment when the skid is moved or installed.

11.2.3 Mechanical Equipment. The compressor and prime mover shall be mounted on full depth, load bearing structural members and secured by bolting, grouting or sole plate/rail mounting. Two plane horizontal jackscrews shall be provided on prime movers weighing in excess of 250 pounds. All bolts and nuts shall be accessible for maintenance using standard tooling.

11.2.4 Shims. Provisions for shims shall be made where alignment is critical. Shims shall be made of a corrosion resistant material such as stainless steel. Provisions shall be made for a field vertical alignment of plus or minus 0.125 inches.

11.2.5 Size. Skid shall be of sufficient width and length for installation of equipment.

11.2.6 Screws and Bolts. On non-concrete filled structural steel skids, leveling screws and anchor bolt holes are to be provided with a minimum of three per side, and be provided with a sufficient number of leveling screws to support the total weight of the skid and installed equipment.

11.2.7 Floor Plate. Open areas on structural steel skids shall be covered with $^{3}/_{16}$ inch minimum solid raised-pattern floor plate welded or bolted in place. Provisions shall be made for facilitating grout placement. Floor plate is not required on concrete or concrete filled structural steel skids.

11.2.8 Braces. Supports and braces shall not be attached to unsupported floor plate.

11.2.9 Scrubbers. On structural steel skids, scrubbers shall be supported by full depth structural skid members and not the floor plate. They shall be welded or bolted to the members as specified by the purchaser. •

11.3 Construction. Structural steel skids shall be of welded construction. Abutting beams shall be welded on both sides. Splicing flanges of load bearing members is not acceptable. Contact between webs at perpendicular joints shall be a minimum of one-third of the depth of the smallest member.

11.4 Walkways, Stairs and Platforms. Walkways, stairs and platforms, when specified by the purchaser, shall be provided with handrails on both sides except that they are required on only one side when the walkways and platforms are within two feet of grade or when one side is bounded by equipment not presenting a safety hazard. Handrails shall be complete with midrail and toeplate. •

SECTION 12
PAINT AND PAINTING

12.1 Surface Preparation. As specified by the purchaser in the 'API Packaged Compressor Data Sheets — Part 1', surfaces should be prepared for painting in accordance with the following schedule:

	Method of Surface Preparation	
Component	Normal Environment	Severe Corrosive Environment
Engine, Compressor, Radiator and Exhaust Silencer	Manufacturer's Standard	Manufacturer's Standard
Gas and Jacket Water Cooling Unit	Manufacturer's Standard	Manufacturer's Standard
Skids, Scrubbers, Bottles, Piping and Valves	SSPC-SP3	SSPC-SP6

12.2 Application. Paint should always be applied by spray to obtain a minimum dry film thickness of 1½ mils per coat. Paint shall be applied in accordance with the paint manufacturer's specifications. The total dry film thickness of the primer and a finish coat should be 3 mils with the exception that aluminum paints may require a thinner coat. This should be checked with the paint manufacturer.

12.3 Items Not To Be Painted. Hoses, ignition wire, name plates, finish painted instruments, nonmetallic products, rotating parts of machinery, finned tubes surfaces, v-belts, sheave grooves and temporary closures shall not be painted.

12.4 Prime and Finish Coat. Paint used for primer coat shall be manufacturer's or packager's standard. Paint used for finish coat shall be packager's standard unless otherwise specified by the purchaser.

12.5 Air-Cooled Exchanger. Siding and structure of the air-cooled exchanger may be hot-dipped galvanized in lieu of painting for a severely corrosive environment. Header may be galvanized or painted as specified by the purchaser. See Paragraph 16.4.1.1.

SECTION 13
INSPECTION, TESTING AND PREPARATION FOR SHIPMENT

13.1 General.

13.1.1 Notice to Vendors. The packager shall be responsible for notifying all vendors of the purchaser's inspection and testing requirements.

• **13.1.2 Purchaser Participation.** The purchaser will specify the extent of his participation in the inspection and testing program prior to any fabrication.

13.1.2.1 Witnessed. Witnessed means that a hold shall be applied to the production schedule and that the inspection or test shall be carried out with the purchaser or his representative in attendance. It usually implies a double test.

13.1.2.2 Observed. Observed means that the purchaser shall be notified of the timing of the inspection or test; however, the inspection or test shall be performed as scheduled, and if the purchaser or his representative is not present, the packager shall proceed to the next step.

NOTE: *Since only one inspection or test is scheduled, the purchaser should expect to be in the plant longer than for a witnessed inspection or test.*

13.1.3 Required Equipment. Equipment required for specified inspections or tests shall be provided by the packager.

13.2 Inspection.

13.2.1 Historical Data. The packager shall keep the following data available for at least 3 years from date of shipment for examination by the purchaser or his representative upon request:

1. All necessary certification of material, such as mill test reports when required.

2. Purchase orders for serial numbered items on the bill of materials.

• 3. Results of quality-control tests, hydrostatic tests, mechanical run tests and other tests as specified by the purchaser.

4. Weld procedures and welder qualifications.

• **13.2.2 Types of Inspection.** The purchaser shall specify the type of inspection.

• **13.2.3 Quality Control.** When specified by the purchaser, the purchaser's representative shall have access to the packager's quality control program for review prior to the start of fabrication.

13.2.4 Cleaning. During fabrication and assembly of the system each component and all piping and appurtenances shall be cleaned to remove foreign materials, corrosion products, and mill scale. After cleaning, open ends of piping and vessels shall be suitably covered to prevent contamination.

13.3 Testing.

13.3.1 Hydrostatic and Pressure Tests.

13.3.1.1 Pressure Retaining Parts. The compressor cylinder(s) shall be hydrotested separately with water or solvent by the manufacturer to 1½ times the maximum allowable working pressure, but not less than 100 psig. The compressor cylinder cooling jackets, if any, shall be hydrotested separately with water or solvent by the manufacturer to at least 75 psig. The gas piping, pressure vessels and other welded pressure retaining components shall be hydrotested separately with water or solvent by the packager to 1½ times the maximum allowable working pressure or in accordance with applicable code, but not less than 50 psig. When specified by the purchaser, the assembled package shall be tested for piping leaks using air to approximately 100 psig. Details of this test shall be as mutually agreed upon between purchaser and packager.

13.3.1.2 Test Period. Hydrostatic tests shall be maintained for a sufficient period of time to permit complete examination of parts under pressure. The hydrostatic tests shall be satisfactory when no leaks are observed for a period of 30 minutes or a period as required by code.

13.4 Mechanical Running Tests.

13.4.1 Compressor and Prime Movers. All compressors and prime movers shall be given the manufacturer's standard shop tests.

13.4.2 Engine-Driven Package Units. The engine-driven packaged unit, including all auxiliaries, shall receive the packager's standard shop running test prior to shipment. The test shall prove mechanical operation of the compressor, engine, mechanical accessory equipment, instruments, control system and skid-mounted cooler as a complete unit. The compressor does not have to be pressure-loaded for this test.

13.4.3 Motor-Driven Package Units. Details of motor-driven package unit mechanical running tests will be as mutually agreed upon between the purchaser and the packager.

13.5 Preparation for Shipment.

13.5.1 Preparation. Equipment shall be suitably prepared for the type of shipment or storage as specified by the purchaser. If a storage period is specified, the purchaser will consult with the packager regarding recommended procedures to be followed. Proper storage of the unit is the responsibility of the purchaser.

13.5.2 Crating. When specified by the purchaser, the equipment shall be crated for export shipment. Lifting, load-out, and handling instructions shall be

securely attached to the exterior of the largest package in a well-marked weatherproof container. When specified by the purchaser, all special lifting devices and rigging shall be supplied with the unit. Upright position, lifting points, weight, and dimensions shall be clearly marked on each package.

13.5.3 Equipment Fluid Drainage. All equipment (including compressor, engine, cooler, etc.) shall be completely free of coolant and oil prior to any shipment preparation unless otherwise specified by the purchaser.

13.5.4 Prior to Shipment. Preparation for shipment shall be made after all testing and inspection of the equipment has been accomplished, and approved by the purchaser if required. The preparation shall include that specified in 13.5.4.1 through 13.5.4.4 as a minimum.

13.5.4.1 Exterior Surfaces. All exterior surfaces not finished painted, except for machined surfaces, shall be given at least one coat of the packager's standard primer. Machined exterior surfaces shall be coated with a rust preventative.

13.5.4.2 Flanged Openings. All flanged openings shall be provided with metal or wood closures.

13.5.4.3 Threaded Openings. All threaded openings shall be provided with metallic or non-metallic closures.

13.5.4.4 Beveled Openings. All openings that have been beveled for welding shall be provided with closures designed to prevent entrance of foreign materials and damage to the bevel.

13.5.4.5 Data Book. One copy of the packager's standard data book shall be packed and shipped with the package.

13.5.4.6 Loose Parts. Component parts, loose parts, and spare parts associated with a specific major item of equipment shall be separately crated for shipment, and shall not be mixed with similar parts associated with another major item of equipment. For example, parts for the compressor shall not be mixed in the same crate with similar parts for the prime mover.

13.5.4.7 Temporary Closures and Plugs. Temporary closures and plugs must be identified by tagging or bright color coding.

SECTION 14
MARKING

14.1 Rotation Arrows. Rotation arrows shall be cast in or attached to each major item of rotating equipment.

14.2 Material. Name plates and rotation arrows shall be of the manufacturer's standard material (aluminum, stainless steel or monel) and attached with corrosion resistant fasteners.

14.3 Package Name Plate. Package name plates shall include packager's name, date of fabrication, serial number and be securely affixed in a conspicuous place on the packaged compressor unit. A manufacturer's name plate shall be securely attached at an easily accessible point on the compressor frame, to each compressor cylinder, the prime mover, the air cooled exchanger, ASME code vessels and to any other piece of major auxiliary equipment.

14.4 Compressor Frame Name Plate. The frame name plate shall contain compressor manufacturer's name, serial number, frame size/model and type, stroke, minimum and maximum rpm and maximum allowable rod load.

14.4.1 Compressor Cylinder Name Plate. Name plates on each compressor cylinder shall include bore, stroke, maximum allowable working pressure (MAWP), serial number, class/type, and minimum clearances for each end as a % of the displacement of that end.

14.5 Engine Name Plate. Name plates on engine drivers shall include the engine manufacturer's name, serial number, model, rated bhp, rated rpm, displacement, power cylinder diameter and stroke.

14.6 Motor Name Plate. Name plates on motor drivers shall include the motor manufacturer's name, serial number, model, rated bhp, rated rpm, service factor (if any), temperature rise of coils, voltage and full load amperage or as indicated in NEMA MG-1.

14.7 Cooler Name Plate. Name plates on coolers shall include the cooler manufacturer's name, serial number and model.

14.7.1 Cooler Section Name Plate. Each gas, oil or water cooling section name plate shall include the maximum allowable working pressure, hydrostatic test pressure, ASME code stamp unless not required, serial number and number of passes.

14.8 API Monogram. Packaged compressor units fabricated in accordance with this specification shall be identified by an API name plate as shown in Figure 14.1. Markings in addition to those shown in Figure 14.1 may be included on the API name plate by agreement between the purchaser and the packager. The API name plate shall be securely affixed in a conspicuous place on the packaged compressor unit. Markings shall be either raised or stamped and shall be at least ⅛ inch high.*

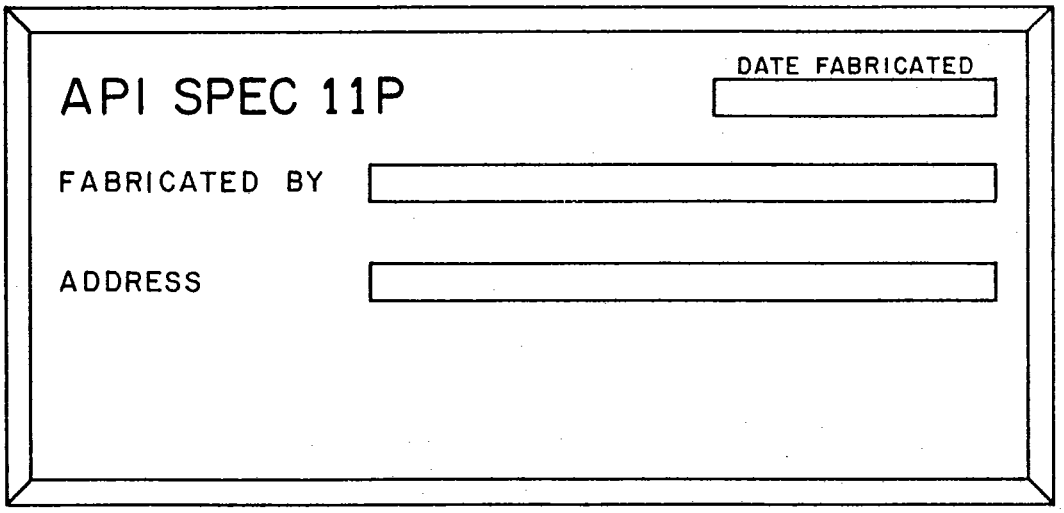


FIG. 14.1
NAME PLATE

*Users of this specification should note that there is no longer a requirement for marking a product with the API monogram. The American Petroleum Institute continues to license use of the monogram on products covered by this specification but it is administered by the staff of the Institute separately from the specification. Forms necessary to submit an API monogram application package are available from the API Dallas office.

SECTION 15
CORROSIVE GASES — H_2S AND CO_2

• **15.1 General.** When corrosive gases are specified by the purchaser, the items covered in this section are required as a minimum in addition to items required in Sections 1 thru 14. The guidelines and specific requirements in this section are based upon field experience with the materials listed for specific components. Utilization of an appropriate corrosion inhibitor may increase the life of materials subject to corrosion by the sour gas. NACE MR-01-75 covers metallic material requirements for resistance to sulfide stress cracking and may be specified, in part or in total, based upon the field experience of the purchaser.

15.2 Hydrogen Sulfide and Carbon Dioxide Gas Mixtures.

15.2.1 General. Material requirements for gas mixtures containing both hydrogen sulfide and carbon dioxide should be based upon Paragraph 15.3 and Paragraph 15.4 as applicable to each component in the gas mixture.

15.3 Hydrogen Sulfide.

15.3.1 Concentrations of H_2S of Up To 2% By Volume.

15.3.1.1 General. Unless otherwise specified by the purchaser, the manufacturer's standard materials will be utilized in the compressor, cooling system and package. All metal gaskets shall be soft iron and all 'O'-Rings shall be suitable for the intended service. See Paragraph 4.2.11.1 for engine fuel gas specifications.

15.3.2 Concentrations of H_2S From Greater Than 2% and Up To 5% By Volume.

15.3.2.1 General. All the requirements of Paragraph 15.3.1 shall be followed plus the requirements in Paragraphs 15.3.2.2 thru 15.3.2.9.

15.3.2.2 Carbon Steel Parts. Unless otherwise specified by the purchaser, the hardness of carbon, low alloy and 12 CR steel parts which come in contact with the process gas stream shall not exceed Rockwell C22. The yield strength of these parts shall not exceed 90,000 psi.

• **15.3.2.3 Piston Rod.** A precipitation hardened stainless steel piston rod or 4140 steel piston rod annealed to C22 with hardening in the packing area either by chrome plating or tungston carbide coating shall be provided. A NACE material equivalent piston rod shall be provided when specified by the purchaser.

15.3.2.4 Compressor Valves. Compressor valves will be of the manufacturer's standard material.

15.3.2.5 Packing and Piston Rings. Packing and piston ring material shall either be non-metallic or contain no copper bearing metals.

15.3.2.6 Distance Piece. Unless specified otherwise by the purchaser, the manufacturer's standard distance (Type 1 or Type 2 — See Paragraph 2.9.1) shall be furnished.

15.3.2.7 Piping and Vessels. All process piping, pulsation drums, scrubbers and coolers will comply with NACE MR-01-75 and shall have a minimum $1/16$" corrosion allowance.

15.3.2.8 Instrumentation. All instrumentation that comes in contact with the process stream (liquid level controls, shutdowns, bourdon tubes, process valving, relief valves, etc.) shall be suitable for corrosive gas service.

15.3.2.9 Vents and Drains. All vents (including crankcase breather) and drains shall be piped to the edge of the skid.

15.3.3 Concentrations of H_2S From 5% By Volume and Greater.

15.3.3.1 General. All the requirements of Paragraphs 15.3.1 and 15.3.2 shall be followed plus the requirements in Paragraphs 15.3.3.2 thru 15.3.3.8.

15.3.3.2 Compressor Valves. Compressor valve seats and guards shall be stainless steel or ductile iron. Metallic plates shall be stainless steel.

15.3.3.3 Distance Piece. Unless specified otherwise by the purchaser, a long distance piece (Type 3 — See Paragraph 2.9.1) with pressure packing between the distance piece and the compressor frame shall be furnished.

15.3.3.4 Compressor Bolting. All compressor cylinder and distance piece bolting which comes in contact with the process gas stream shall conform to ASTM A-193-B7M.

15.3.3.5 Piping and Vessels. Unless otherwise specified by the purchaser, all process piping, pulsation drums, scrubbers and cooler headers will be 100% radiographed and post heat-treated and shall have a minimum ⅛ inch corrosion allowance. Threaded connections over ¾ inch are not allowed. 100% ASME inspection criteria is to be used.

15.3.3.6 Instrumentation. All instrumentation that comes in contact with the process stream (liquid level controls, shutdowns, bourdon tubes, process valving, relief valves, etc.) shall meet the full requirements of NACE MR-01-75 except stainless steel tubing fittings.

15.3.3.7 Purge Systems. Packing cases shall be purged with inert gas or sweet natural gas. The distance piece (Type 2 with partition packing or Type 3 if specified by the purchaser) shall be evacuated with a vacuum pump system or purged with

inert gas or sweet natural gas. The purchaser should provide for a sweet gas purge of the process gas piping system.

15.3.3.8 Cooler Tubes. When water is present in the process gas stream, the gas cooler tubes shall be furnished in 304 or 316 stainless steel.

• **15.3.4 Stainless Steel Parts.** When specified by the purchaser, austenitic or 12 CR stainless steel will be utilized in the gas piping, vessels and instrumentation components which come in contact with the process gas stream.

15.4 Carbon Dioxide.

15.4.1 General. The following chart and material requirements assume a wet gas phase.

15.4.2 Concentrations of CO_2 From 5% at 1200 psig to 50% at 400 psig — 'A'.

15.4.2.1 General. Unless otherwise specified by the purchaser, the manufacturer's standard material will be utilized in the compressor, cooling system and package. All metal gaskets shall be soft iron and all 'O'-Rings shall be suitable for the intended service.

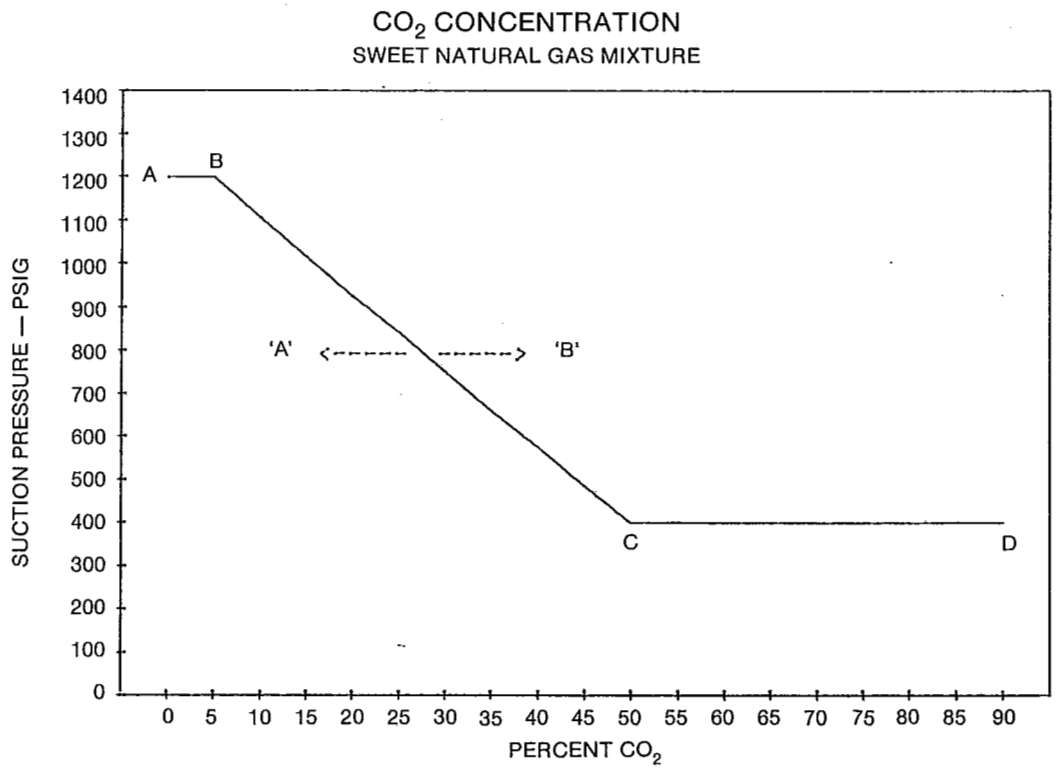
15.4.3 Concentrations of CO_2 Above 5% at 1200 psig to Above 50% at 400 psig — 'B'.

15.4.3.1 General. All the requirements of Paragraph 15.4.2 shall be followed plus the requirements found in Paragraphs 15.4.3.2 thru 15.4.3.4.

15.4.3.2 Piston Rod. A precipitation hardened stainless steel piston rod or 4140 steel piston rod annealed to C22 with hardening in the packing area either by chrome plating or tungston carbide coating shall be provided.

15.4.3.3 Compressor Valves. Compressor valve seats and guards shall be stainless steel or ductile iron. Metallic plates shall be stainless steel.

15.4.4 Stainless Steel Parts. When specified by the purchaser, austenitic or 12 CR stainless steel will be utilized in the gas cooling sections, gas piping, vessels and instrumentation components which come in contact with carbon dioxide and water. •



SECTION 16
OFFSHORE AND/OR MARINE ENVIRONMENT

16.1 General. Items covered in this section are required as a minimum in addition to items required in Sections 1 thru 15.

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

16.1.2 Minor Parts. Minor parts not identified (nuts, springs, washers, gaskets, etc.) shall have equal corrosion resistance to specified parts in the same environment.

16.1.3 Corrosive Agents. Purchaser will specify the presence of corrosive agents in the environment.

16.1.4 Intergranular Corrosion. Parts exposed to conditions which promote intergranular corrosion shall be made of low carbon or stabilized grades of austenitic stainless steels if they are fabricated, hard faced, overlaid or repaired by welding.

16.1.5 Electrical Installations. All electrical components and installations shall be in compliance with API RP 500B, API RP 14F and NFPA 70. Where differences exist between NFPA 70 and API RP 14F, API RP 14F shall apply.

16.2 Prime Mover.

16.2.1 Natural Gas Engine. The natural gas engine shall be furnished with a shielded or non-shielded, low tension magneto ignition system as specified by the purchaser.

16.2.1.1. Oil Level Regulators. Engine crankcase oil level regulators shall be fire safe.

16.3 Compressor.

16.3.1 Oil Level Regulators. Compressor frame or lubricator oil level regulators shall be fire safe.

16.4 Cooling System.

16.4.1 Air Cooled Heat Exchangers.

16.4.1.1 Cooler Header and Structure. The cooler structure shall be hot-dipped galvanized. The cooler header shall be galvanized or painted as specified by the purchaser.

16.5 Skid.

16.5.1 Drip Lip. Unless specified otherwise by the purchaser, the skid shall be furnished with a 3 inch minimum drip-lip and shall be furnished with a 1½ inch NPT drain connection in each corner.

16.5.2 Seal Welding. All steel skids shall be seal welded throughout. Concrete filled, steel skids shall be seal welded except in concrete filled areas.

16.5.3 Lifting Lugs. Lifting lugs with a 2 inch minimum eye, each designed to support the entire weight of the package, shall be furnished at each corner of the skid.

16.6 Control and Shutdown System.

16.6.1 Gas Shutdowns. All gas pressure shutdowns shall have individual block and bleed valves. All sensing devices shall be mounted on the skid. The following shutdowns shall be furnished in addition to those normally specified:

1. Low level — each scrubber
2. High/low suction pressure — first stage
3. High/low discharge pressure — each stage

16.7 Instrumentation.

16.7.1 General. Unless specified otherwise by the purchaser, the panel and on-skid instrumentation shall be pneumatic.

16.7.2 Weather-Proofing. All component devices shall be suitable for an offshore and/or marine environment.

16.7.3 Panel Components. Unless otherwise specified by the purchaser, the panel shall be weatherproof NEMA 4 classification and include a stop/run valve, class 'B' time delay, explosion-proof ignition grounding switch and class 'C' lockout. The panel shall be equipped with a platform emergency shutdown (ESD) annunciator with signal being furnished by others and a pneumatic signal for remote run/stop indication.

16.7.4 Panel Construction. Unless otherwise specified by the purchaser, the panel shall be stainless steel.

16.7.5 Panel Control Circuit. Unless specified otherwise by the purchaser, series 300 stainless steel tubing with series 300 stainless steel fittings and ferrules shall be used in the control circuit.

16.8 Gas Piping, Tubing, Pulsation Bottles and Scrubbers.

16.8.1. Bushings. Hex head bushings shall not be used in any services.

16.8.2 Gas Piping. Gas piping 2 inch and larger shall be buttwelded and flanged except for threaded connections furnished by the engine and starter manufacturers.

16.8.3 Tubing and Fittings. Tubing shall be welded or seamless series 300 stainless steel with series 300 stainless steel fittings and ferrules. Fittings over ½ inch shall be cadmium plated steel. Forged steel fittings shall be Class 3000# as a minimum.

16.8.4 Insulation. When specified by the purchaser, discharge gas piping and discharge volume bottles shall be insulated when their predicted stabilized temperature is over 200° F. Zinc based primers shall not be used under the insulation.

16.8.5 Gaskets. Gaskets for raised face flanges shall be spiral wound metallic with centering ring.

16.8.6 Scrubber Level Shutdowns. Unless specified otherwise by the purchaser, scrubber level shutdowns (high and low) shall be external type, bridle-mounted with 1 inch NPT isolation valves with ½ inch NPT plugged vent and drain valves.

16.9 Painting.

16.9.1 Surface Preparation. The prime mover, compressor, valves and utility piping 2 inches in diameter and smaller shall be mechanically cleaned. Unless specified otherwise by the purchaser, the skid, vessels, process piping, utility piping over 2 inches in diameter, exhaust system, and panel shell if other than stainless steel shall be given a near white metal sandblast.

16.9.2 Manufactured Components. Components which are mechanically cleaned and have the manufacturers standard primer shall receive a 2-3 mil D.F.T. tie coat of vinyl alkyd and a 1½ mil D.F.T. finish coat of aliphatic acrylic polyurethane, Zinc based primers are not acceptable.

16.9.3 Small Utility Piping. The prime coat on utility piping 2 inches in diameter and smaller shall receive a 5 mil D.F.T. prime coat of self priming aluminum epoxy mastic and a 1½ mil D.F.T. finish coat of aliphatic acrylic polyurethane.

16.9.4 Near White Metal Sandblasted Steel. Except for the exhaust silencer and exhaust piping, all near white metal sandblasted steel shall receive a 2-3 mil D.F.T. prime coat of inorganic zinc silicate, a 4-6 mil D.F.T. intermediate coat of epoxy polyamide and a 1½ mil D.F.T. finish coat of aliphatic acrylic polyurethane.

16.9.5 Exhaust System. The engine exhaust system shall have a 1⅕ mil D.F.T. finish coat of aluminum silicone rated at 1000° F.

16.9.6 Painting Repairs. Repairs to any finished painting shall be made with self priming aluminum epoxy mastic and top coat.

16.9.7 Concrete Filled Skids. Exposed concrete shall receive the prime coat only.

16.10 Valves in Gas Service.

16.10.1 Valve Material. Valves 1½ inches and smaller in gas service shall be carbon steel with stainless steel stem and trim.

16.10.2 Blowdown Valve. The blowdown valve shall be arranged to open automatically upon shut-down on units over 1000 horsepower.

16.10.3 Block Valves. When specified by the purchaser, the packager shall furnish the suction and discharge block valves. The purchaser shall also specify type and whether manual or pilot operated.

16.10.4 Discharge Check Valve. When specified by the purchaser, a piston type discharge check valve shall be furnished by the packager.

16.10.5 Relief Valves. All relief valves shall be pilot operated with external test connection and back-flow preventer or a conventional relief valve with in-service test device. Relief valve tubing to be 316 stainless steel with 316 stainless steel fittings.

16.10.6 Suction Relief Valve. Unless specified otherwise, the suction relief valve shall be furnished by the purchaser.

APPENDIX A
EXCERPT FROM THE GPSA ENGINEERING DATA BOOK — CURRENT EDITION

Gas Pulsation Control.

Pulsation is inherent in reciprocating compressors because suction and discharge valves are open during only part of the stroke.

Pulsation must be damped (controlled) in order to:

a. provide smooth flow of gas to and from the compressor,

b. prevent overloading or underloading of the compressors, and

c. reduce overall vibration.

There are several types of pulsation chambers. The simplest one is a volume bottle, or a surge drum, which is a pressure vessel, unbaffled internally and mounted on or very near a cylinder inlet or outlet.

A manifold joining the inlet and discharge connections of cylinders operating in parallel can also serve as a volume bottle.

Performance of volume bottles is not normally guaranteed without an analysis of the piping system from the compressor to the first process vessel.

Volume bottles are sized empirically to provide an adequate volume to absorb most of the pulsation. Several industry methods were tried in an effort to produce a reasonable rule-of-thumb for their sizing. Fig. 13-25 may be used for approximate bottle sizing.

Example 13-3

Indicated suction pressure = 600 psia

Indicated discharge pressure = 1,400 psia

Cylinder bore = 6 in.

Cylinder stroke = 15 in.

Swept volume = $\pi\left(\frac{6^2}{4}\right)(15) = 424$ cu in.

From the Chart:

At 600 psia inlet pressure, the suction bottle multiplier is approximately 7.5. Suction-bottle volume = (7.5) (424) = 3,180 cu in.

At 1,400 psi discharge pressure, the discharge bottle multiplier is approximately 8.5. Discharge-bottle volume = (8.5) (424) = 3,600 cu in.

NOTE: *When more than one cylinder is connected to a bottle, the sum of the individual swept volumes is the size required for the common bottle.*

For more accurate sizing, compressor manufacturers can be consulted. Organizations which provide designs and/or equipment for gas-pulsation control are also available.

Having determined the necessary volume of the bottle, the proportioning of diameter and length to provide this volume requires some ingenuity and judgement. It is desirable that manifolds be as short and of as large diameter as is consistent with pressure conditions, space limitations, and appearance.

A good general rule is to make the manifold diameter 1½ times the inside diameter of the largest cylinder connected to it, but this is not always practicable, particularly where large cylinders are involved.

Inside diameter of pipe must be used in figuring manifolds. This is particularly important in high-pressure work and in small sizes where wall thickness may be a considerable percentage of the cross sectional area. Minimum manifold length is determined from cylinder center distances and connecting pipe diameters. Some additions must be made to the minimum thus determined to allow for saddle reinforcements and for welding of caps.

It is customary to close the ends of manifolds with welding caps which add both volume and length. Fig. 13-26 gives approximate volume and length of standard caps.

Pulsation Dampeners (Snubbers)

A pulsation dampener is an internally-baffled device. The design of the pulsation dampening equipment is based on acoustical analog evaluation which takes into account the specified operating speed range, conditions of unloading, and variations in gas composition.

Analog evaluation is accomplished with an active analog that simulates the entire compressor, pulsation dampeners, piping and equipment system and considers dynamic interactions among these elements.

Pulsation dampeners also should be mounted as close as possible to the cylinder, and in large volume units, nozzles should be located near the center of the chamber to reduce unbalanced forces.

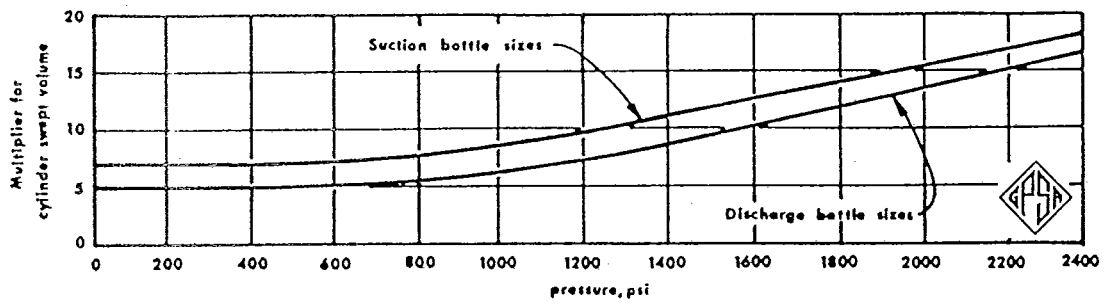
Pulsation dampeners are typically guaranteed for a maximum residual peak-to-peak pulsation pressure of 2% of average absolute pressure at the point of connection to the piping system, and pressure drop through the equipment of not more than 1% of the absolute pressure. This applies at design condition and not necessarily for other operating pressures and flows. A detailed discussion of recommended design approaches for pulsation suppression devices is presented in API Standard 618, Reciprocating Compressors for General Refinery Services.

As pressure vessels, all pulsation chambers (volume bottles and dampeners) are generally built to Section VIII of ASME Code and suitable for applicable cylinder relief valve set pressure.

Suction pulsation chambers are often designed for the same pressure as the discharge units, or for a minimum of ⅔ of the design discharge pressure.

APPENDIX A
EXCERPT FROM THE GPSA ENGINEERING DATA BOOK — CURRENT EDITION

Approximate Bottle Sizing Chart



Welding Caps

Pipe size	Standard weight Volume, cu in.	Standard weight Length, in.	Extra strong Volume, cu in.	Extra strong Length, in.	Double Extra strong Volume, cu in.	Double Extra strong Length, in.
4″	24.2	2 1/2	20.0	2 1/2	15	3
6″	77.3	3 1/2	65.7	3 1/2	48	4
8″	148.5	4 11/16	122.3	4 11/16	120	5
10″	295.6	5 3/4	264.4	8 3/4		
12″	517.0	6 7/8	475.0	6 7/8		
14″	684.6	7 13/16	640.0	7 13/16		
16″	967.6	9	911.0	9		
18″	1432.6	10 1/16	1363.0	10 1/16		
20″	2026.4	11 1/4	1938.0	11 1/4		
24″	3451.0	13 7/16	3313.0	13 7/16		

APPENDIX B
LIST OF AUTHORIZED PACKAGERS

NOTE: Contact the API Dallas Office for a list of companies authorized to use the API monogram on packaged reciprocating compressors manufactured in accordance with API Spec 11P.

APPENDIX C
USE OF API MONOGRAM

C.1 API Monogram. Forms necessary to submit an API monogram application package are available from the API Dallas Office.

C.2 Marking. The packaged reciprocating compressor shall be marked in accordance with Par. 14.1 through 14.7.1 of this specification and Par. C.3.

C.3 API Monogram. Packaged compressor units fabricated in accordance with this specification shall be identified by an API name plate as shown in Figure C.1. Markings in addition to those shown in Figure C.1 may be included on the API name plate by agreement between the purchaser and the packager. The API name plate shall be securely affixed in a conspicuous place on the packaged compressor unit. The API monogram is a registered trademark of the American Petroleum Institute. Markings shall be either raised or stamped and shall be at least ⅛ inch high. The API monogram shall be at least ½ inch high.

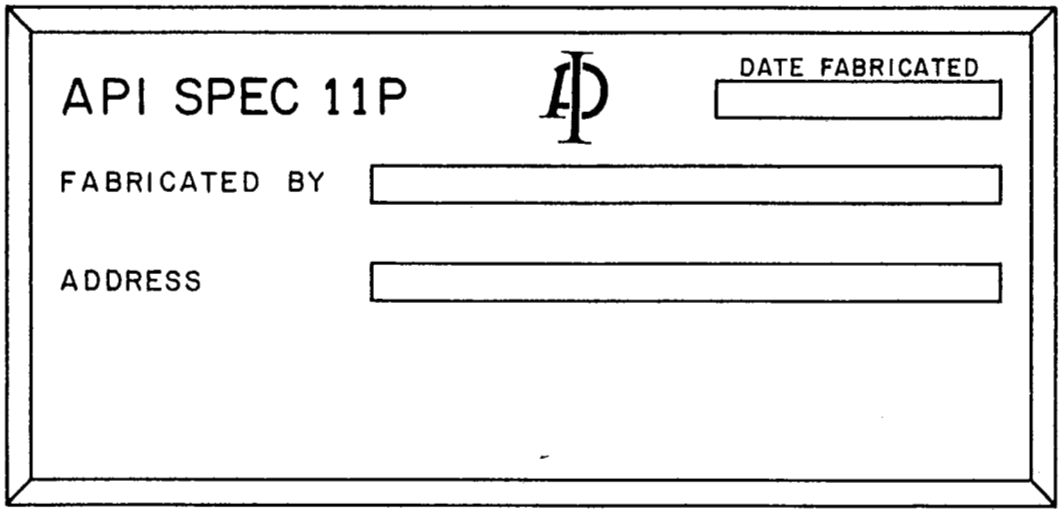


FIG. C.1
NAME PLATE

APPENDIX D
API PACKAGED COMPRESSOR DATA SHEETS
PART 1 — SERVICE CONDITIONS

GENERAL INFORMATION

	PURCHASER	PACKAGER
COMPANY	:	:
BUILDING	:	:
SUITE #	:	:
STREET	:	:
P.O. BOX	:	:
CITY	:	:
STATE	:	:
ZIP	:	:
COUNTRY	:	:
TELEPHONE	:	:
TELEX	:	:
FAX	:	:
CONTACT 1	:	:
CONTACT 2	:	:

COST ESTIMATE ONLY [ ] FOR PURCHASE [ ]

INQUIRY NUMBER: _____ INQUIRY DATE: _____

PROJECT NAME: _____ DUE DATE: _____

SERVICE: _____ PROJECT NUMBER: _____

SHIPMENT REQUIRED: _____ NUMBER OF UNITS REQUIRED: _____

SITE INFORMATION

NEAREST CITY/TOWN: _____ COUNTY: _____

STATE: _____ COUNTRY: _____

1.6 — SITE MAXIMUM ALLOWABLE SOUND PRESSURE LEVEL: _____ DECIBELS

1.7 — SITE ELECTRICITY: YES [ ] NO [ ] VOLTS: _____ PHASE: _____ HERTZ: _____

HAZARDOUS: YES [ ] NO [ ] NON-HAZARDOUS: YES [ ] NO [ ]

ELECTRICAL CLASSIFICATION: CLASS: _____ GROUP: _____ DIVISION: _____

1.8 — AMBIENT TEMP: MAX _____ °F MIN _____ °F DESIGN _____ °F

ELEVATION: _____ FEET BAROMETER: _____ PSIA RELATIVE HUMIDITY: _____ %

8.5 — TROPICAL [ ] INLAND [ ] DESERT [ ] SAND [ ] DUST [ ] ARCTIC [ ]
COASTAL [ ] INLET WATER [ ] OFFSHORE [ ]

INDOORS [ ] HEATED [ ] UNHEATED [ ] OUTDOORS [ ] PLATFORM [ ]
TOTALLY ENCLOSED [ ] SHED ROOF [ ] NO ROOF [ ] PARTIAL SIDES [ ]

ATTENDED [ ] PARTIALLY ATTENDED [ ] UNATTENDED [ ]

SIZE LIMITATION: LENGTH: _____ FT WIDTH: _____ FT HEIGHT: _____ FT

FUEL GAS: SWEET [ ] SOUR [ ] DRY [ ] RICH [ ] LHV: _____ BTU/CF

PROPOSAL REQUIREMENTS

FURNISH COPIES INDICATED: PROPOSAL _____ REPORTS _____ DRAWINGS _____

DATA BOOKS _____ CURVES _____ MISC: _____

1.3 — PERFORMANCE CURVES: YES [ ] NO [ ] INDICATE RANGE: _____

1.5 — APPROVAL DRAWINGS: YES [ ] NO [ ] AS BUILT DRAWINGS: YES [ ] NO [ ]

MISC. DRAWINGS: YES [ ] NO [ ] TYPE: _____

1.9 — TORSIONAL REPORT: YES [ ] NO [ ]

GAS ANALYSIS

2.1.1 — 2.1.2

SERVICE						FUEL GAS
				MOLE %		
METHANE	— CH_4					
ETHYLENE	— C_2H_2					
ETHANE	— C_2H_6					
PROPYLENE	— C_3H_6					
PROPANE	— C_3H_8					
ISO-BUTANE	— C_4H_{10}					
NORMAL BUTANE	— C_4H_{10}					
ISO-PENTANE	— C_4H_{12}					
NORMAL PENTANE	— C_4H_{12}					
HEXANE	— C_6H_{14}					
HEPTANE+	—					
HEPTANE+ MW/SG	—					
_____	—					
_____	—					
AMMONIA	— NH_3					
AIR	—					
WATER VAPOR	— H_2O					
OXYGEN	— O_2					
NITROGEN	— N_2					
HYDROGEN	— H_2					
HYDROGEN SULFIDE	— H_2S					
CARBON MONOXIDE	— CO					
CARBON DIOXIDE	— CO_2					
_____	—					
_____	—					
TOTAL	— 100%					
MIXTURE MW OR SG	—					
C_p/C_v @ 150 °F	—					
REL HUMIDITY, %	—					

GAS CONDITIONS

2.1.1 — 2.1.2

		NORMAL OPERATING POINT			
CASE 1					
SERVICE					
NUMBER OF STAGES					
SUCTION TEMPERATURE	— °F				
SUCTION PRESSURE *	— PSI				
DISCHARGE PRESSURE *	— PSI				
UNIT REQUIRED CAPACITY	— MMSCFD				
CASE 2					
SERVICE					
NUMBER OF STAGES					
SUCTION TEMPERATURE	— °F				
SUCTION PRESSURE *	— PSI				
DISCHARGE PRESSURE *	— PSI				
UNIT REQUIRED CAPACITY	— MMSCFD				
CASE 3					
SERVICE					
NUMBER OF STAGES					
SUCTION TEMPERATURE	— °F				
SUCTION PRESSURE *	— PSI				
DISCHARGE PRESSURE *	— PSI				
UNIT REQUIRED CAPACITY	— MMSCFD				
SIDESTREAM					
SERVICE					
NUMBER OF STAGES					
SUCTION TEMPERATURE	— °F				
SUCTION PRESSURE *	— PSI				
DISCHARGE PRESSURE *	— PSI				
UNIT REQUIRED CAPACITY	— MMSCFD				

MAXIMUM ALLOWABLE CYLINDER DISCHARGE TEMPERATURE: _____ °F

MAXIMUM ALLOWABLE AFTERCOOLER DISCHARGE TEMPERATURE: _____ °F

UNIT CAPACITY — MMSCFD: MEASURED AT _____ PSIA and 60 °F

* — PRESSURES MEASURED AT INLET AND OUTLET FLANGES OF PACKAGE

PART 1 — MATERIAL REQUIREMENTS

COMPRESSOR

2.1.3 — PRIME MOVER LOADING? YES [ ] NO [ ]

2.1.4 — FURNISH VALUES OF FORCES AND COUPLES? YES [ ] NO [ ]

2.2 — PURCHASER'S MAXIMUM ALLOWABLE COMPRESSOR PISTON SPEED: _____ FPM

— PURCHASER'S MAXIMUM ALLOWABLE PRIME MOVER SPEED: _____ RPM

2.3 — FURNISH ESTIMATED ACTUAL [ ] AND/OR CALCULATED ADIABATIC [ ] COMPRESSOR CYLINDER DISCHARGE TEMPERATURES

2.4.1 — MAXIMUM ALLOWABLE OPERATING ROD LOAD?
COMPRESSOR MANUFACTURER'S [ ] OR PURCHASER'S [ ]

IF PURCHASER'S, EXPLAIN: _____

OTHER THAN OPERATING ROD LOAD CALCULATIONS? YES [ ] NO [ ]

IF YES, PROVIDE PARAMETERS: _____

2.5.3.2 — FURNISH PLUGGED ½" INDICATOR CONNECTIONS? YES [ ] NO [ ]

2.7.3 — FURNISH NON-METALLIC PISTON WEAR BANDS? YES [ ] NO [ ]

2.7.6 — FURNISH COATED PISTON RODS?

BASE MATERIAL: _____ COATING MATERIAL: _____

2.9.1 — FURNISH TYPE 1 [ ] OR TYPE 2 [ ] OR TYPE 3 [ ] DISTANCE PIECES?

2.9.3 — FURNISH EXPLOSION RELIEF DOORS? YES [ ] NO [ ]

2.11.6 — FURNISH _____ GALLON FRAME OIL STORAGE TANK? YES [ ] NO [ ]

2.11.7 — FURNISH FRAME OIL HEATER? YES [ ] NO [ ]

2.12.1 — IF A BLOCK CYLINDER LUBRICATION SYSTEM IS FURNISHED, THE PURCHASER MAY SPECIFY: LINE FILTERS: YES [ ] NO [ ]

LUBE METER: YES [ ] NO [ ] FAULT INDICATORS: YES [ ] NO [ ]

2.12.2.1 — FURNISH _____ GALLON LUBRICATOR OIL STORAGE TANK? YES [ ] NO [ ]

2.13.1.3 — FURNISH STANDARD COMPRESSOR CYLINDER MATERIAL? YES [ ] NO [ ]

OR PURCHASER'S SPECIFIED CYLINDER MATERIAL: _____

2.13.4.2 — FURNISH MATERIAL INSPECTION AS SPECIFIED? YES [ ] NO [ ]

COMPONENT: _____ TYPE INSPECTION: _____

COMPONENT: _____ TYPE INSPECTION: _____

COMPONENT: _____ TYPE INSPECTION: _____

COMPONENT: _____ TYPE INSPECTION: _____

2.14.2 — WHEN A DISC TYPE COUPLING IS FURNISHED, THE DISC PACK SHALL BE STEEL [ ] OR STAINLESS STEEL [ ]

CAPACITY CONTROL

3.1 — FURNISH CAPACITY CONTROL? YES [ ] NO [ ]
IF YES, THE CONTROLLED PARAMETER WILL BE: SUCTION PRESSURE [ ] OR

DISCHARGE PRESSURE [ ] WITH PRESSURE RANGE _____ PSIG

TO _____ PSIG OR CAPACITY [ ]

WITH CAPACITY VARIATION: _____ % TO _____ %

WHEN FURNISHED, THE CONTROL SYSTEM WILL
BE: MECHANICAL [ ] PNEUMATIC [ ]
HYDRAULIC [ ] ELECTRICAL [ ] WITH SIGNAL BY
PACKAGER [ ] OR BY PURCHASER [ ] IF BY PURCHASER, INDICATE

SOURCE: _____ RANGE: _____ SENSITIVITY: _____

3.2 — CAPACITY CONTROL OPERATION WILL BE: AUTOMATIC WITH MANUAL OVERRIDE [ ] OR MANUAL [ ]

IF MANUAL, ARE UNIT SHUTDOWNS ACCEPTABLE? YES [ ] NO [ ]

3.2.1 — FURNISH PRIME MOVER SPEED VARIATION? YES [ ] NO [ ]

3.2.2.1 — FURNISH CLEARANCE POCKETS? YES [ ] NO [ ] IF YES, FURNISH: FIXED CLEARANCE POCKETS [ ] OR VARIABLE CLEARANCE POCKETS [ ]

3.2.2.2 — FURNISH VALVE SPACERS, IF REQUIRED, TO MEET AN OPERATING CONDITION: YES [ ] NO [ ]

3.2.2.3 — FURNISH CLEARANCE BOTTLES, IF REQUIRED? YES [ ] NO [ ]

IF YES, ANSI B31.3 PIPE CODE [ ] OR ASME VESSEL CODE [ ]

3.2.3.1 — FURNISH START-UP BYPASS? YES [ ] NO [ ]

3.2.3.2 — FURNISH A CAPACITY CONTROL BYPASS? YES [ ] NO [ ]

IF YES: MANUAL [ ] OR AUTOMATIC [ ]

3.2.4.3 — FURNISH AUTOMATIC VALVE UNLOADING? YES [ ] NO [ ]

3.2.5 — FURNISH SUCTION PRESSURE REDUCING VALVE? YES [ ] NO [ ]

IF YES, BY PURCHASER [ ] OR BY PACKAGER [ ]

FOR A MAXIMUM UPSTREAM PRESSURE OF _____ PSIG

PRIME MOVER

4.1 — THE PRIME MOVER WILL BE GAS ENGINE [ ] OR ELECTRIC MOTOR [ ]

4.2.3 — THE GAS ENGINE SHALL BE PROVIDED WITH AN ELECTRIC [ ] OR AN AIR [ ] OR GAS [ ] STARTING SYSTEM

4.2.3.1.2 — WHEN AN AIR OR GAS STARTING SYSTEM IS FURNISHED, THE AIR OR GAS WILL BE FURNISHED FROM (SOURCE): _____

AT _____ PSIG MINIMUM [ ] OR _____ PSIG MAXIMUM [ ]

4.2.3.2.2 — A _____ AMPERE-HOUR BATTERY SET WILL BE FURNISHED WHEN AN ELECTRIC STARTING SYSTEM IS SPECIFIED? YES [ ] NO [ ]

4.2.3.2.3 — A CHARGING ALTERNATOR WILL BE PROVIDED WHEN A BATTERY SET IS FURNISHED? YES [ ] NO [ ]

4.2.4.1 — FURNISH AN ENGINE AIR FILTER OTHER THAN THE MANUFACTURER'S STANDARD DRY TYPE? YES [ ] NO [ ]

IF YES, EXPLAIN: _____

PRIME MOVER Continued

4.2.4.2.6 — FURNISH AIR FILTER PRESSURE DROP INDICATOR? YES [ ] NO [ ]

4.2.5.1 — FURNISH AN EXHAUST MUFFLER/SILENCER OTHER THAN THE MANUFACTURER'S STANDARD INDUSTRIAL TYPE? YES [ ] NO [ ]

IF YES, SPARK-ARRESTING [ ] OR NON SPARK-ARRESTING [ ]

SOUND ATTENUATION (EXPLAIN): _____

PERSONNEL PROTECTION (EXPLAIN): _____

4.2.8 — FURNISH ENGINE EMISSIONS LEVEL BY MANUFACTURER'S PERFORMANCE DATA [ ] OR BY ACTUAL STACK TEST [ ]? YES [ ] NO [ ]

4.2.8.1 — KNOWN SITE EMISSION LEVEL LIMITS: NITROUS OXIDE: _____ GM/BHP/HR

CARBON MONOXIDE: _____ GM/BHP/HR SULFUR DIOXIDE: _____ GM/BHP/HR

NON-METHANE HYDROCARBONS: _____ GM/BHP/HR

4.2.8.1.1 — THE BASIS FOR THE MANUFACTURER'S EMISSION DATA WILL BE THE RATED BHP SHOWN ON THE QUOTATION [ ] OR THE MANUFACTURER'S NAMEPLATE RATING OF THE ENGINE [ ]

4.2.10 — FURNISH _____ GALLON CRANKCASE OIL STORAGE TANK? YES [ ] NO [ ]

4.2.11.5 — FURNISH A FUEL FILTER/SEPARATOR? YES [ ] NO [ ]

4.2.12 — FUEL GAS SUPPLIED AT _____ PSIG

4.2.13 — FURNISH CRANKCASE EXPLOSION RELIEF DOORS? YES [ ] NO [ ]

4.3.1 — FURNISH MAIN PRIME MOVER ELECTRIC MOTOR(S) AS FOLLOWS:

TYPE: SYNCHRONOUS [ ] OR INDUCTION [ ]

ELECTRICAL: VOLTS: _____ PHASE: _____ HERTZ: _____

SERVICE FACTOR: _____ STARTING CONDITIONS: _____

TYPE OF ENCLOSURE: _____ TYPE INSULATION: _____

AREA CLASSIFICATION: CLASS: _____ GROUP: _____ DIVISION: _____

FULL VOLTAGE [ ] OR REDUCED VOLTAGE [ ] MOTOR STARTER FURNISHED BY PACKAGER [ ] OR PURCHASER [ ]

SPACE HEATER FURNISHED BY PACKAGER? YES [ ] NO [ ]

COOLING SYSTEM

5.3.1.2 — FURNISH SIGHT FLOW INDICATORS [ ] AND/OR TEMPERATURE INDICATORS [ ] IN THE COMPRESSOR CYLINDER JACKET WATER SYSTEM? YES [ ] NO [ ]

5.3.5 — FURNISH GAS AFTERCOOLING TO _____ °F? YES [ ] NO [ ]

5.6.6 — AUTOMATIC CONTROL OF COOLER AIR CIRCULATION? YES [ ] NO [ ]
IF YES, BY: LOUVERS [ ] VARIABLE PITCH FAN [ ]

RE-CIRCULATION [ ] OTHER [ ] (EXPLAIN): _____

5.6.7 — COOLER BUG SCREENS [ ] AND/OR HAIL GUARDS? [ ] YES [ ] NO [ ]

PRESSURE VESSELS

6.1.3 — FURNISH PRESSURE VESSEL CORROSION ALLOWANCE? YES [ ] NO [ ]

IF YES, _____ INCHES

6.2.5 — IN ADDITION TO STANDARD SCRUBBER EQUIPMENT, FURNISH REFLEX TYPE LIQUID LEVEL GAGE WITH COCKS AND CHECK VALVES? YES [ ] NO [ ]

AND A PRESSURE INDICATOR WITH ISOLATING VALVE? YES [ ] NO [ ]

6.2.6 — FURNISH SUCTION SCRUBBER WITH DIAMETER BASED UPON:
SERVICE CLASS A [ ] SERVICE CLASS B [ ] SERVICE CLASS C [ ]

FURNISH INTERSTAGE SCRUBBER(S) WITH DIAMETER BASED UPON:
SERVICE CLASS A [ ] SERVICE CLASS B [ ] SERVICE CLASS C [ ]

FURNISH DISCHARGE SCRUBBER? YES [ ] NO [ ]
IF YES, DIAMETER BASED UPON:
SERVICE CLASS A [ ] SERVICE CLASS B [ ] SERVICE CLASS C [ ]

6.3.1 — FURNISH PULSATION CONTROL AND PULSATION STUDIES? YES [ ] NO [ ]

IF YES, SPECIFY TYPE: _____ AND SCOPE: _____

6.3.2 — FURNISH SUCTION AND DISCHARGE VOLUME BOTTLES? YES [ ] NO [ ]

6.3.5 — IF VOLUME BOTTLES ARE SPECIFIED BY THE PURCHASER AND THEY ARE 12.75 INCHES IN DIAMETER OR LESS, THEY SHALL BE CONSTRUCTED AS ANSI B.31.3 PIPE CODE [ ] OR AS ASME PRESSURE VESSEL CODE [ ]

6.3.7 — FURNISH MECHANICAL RE-INFORCEMENT (WELD PADS OR SADDLES) OF FLANGED CONNECTIONS? YES [ ] NO [ ]

PIPING AND APPURTENANCES

7.1.4 — THE EXTENT OF THE GAS PIPING SUPPLIED BY PACKAGER SHALL BEGIN AT THE PACKAGE SUCTION FLANGE AND BE CONTINUOUS THROUGH THE SYSTEM TO THE PACKAGE DISCHARGE FLANGE? YES [ ] NO [ ]

OR THE GAS PIPING SHALL BEGIN AS FOLLOWS:

SUCTION: FLANGE AT SUCTION SCRUBBER [ ]
FLANGE AT SUCTION BOTTLE [ ] OR FLANGE AT COMPRESSOR NOZZLE [ ]

OTHER (EXPLAIN): [ ] _____

INTERSTAGE: FLANGE AT INTERSTAGE SCRUBBER [ ]
FLANGE AT SUCTION BOTTLE [ ] OR COMPRESSOR NOZZLE [ ]
SIDESTREAM CONNECTION [ ] COMPLETE INTERSTAGE PIPING SYSTEM [ ]

OTHER (EXPLAIN): [ ] _____

DISCHARGE: FLANGE AT COOLER DISCHARGE [ ]
FLANGE AT DISCHARGE BOTTLE [ ] OR COMPRESSOR NOZZLE [ ]
SPOOL PIECE FROM FINAL DISCHARGE COOLER TO DISCHARGE SCRUBBER [ ]

OTHER (EXPLAIN): [ ] _____

FURNISH PIPING, BOTTLES, IF ANY, VESSELS AND THERMOWELLS DESIGNED AND ARRANGED FOR HEAT TRACING AND/OR INSULATION? YES [ ] NO [ ]

7.1.5 — REVIEW ARRANGEMENT DRAWING PRIOR TO FABRICATION? YES [ ] NO [ ]

7.8 — FURNISH SEAL WELDED, THREADED PIPING JOINTS IN ALL FLAMMABLE OR TOXIC SERVICE? YES [ ] NO [ ]

7.10 — SCREWED, FLANGED OR WELDED PIPING FOR ERW STEEL? YES [ ] NO [ ]

7.11 — TUBING FITTINGS MAY BE STEEL [ ] OR 300 SERIES S.S. [ ]

PIPING AND APPURTANCES Continued

7.12 — WHEN VALVES ARE FURNISHED IN FLAMMABLE OR TOXIC SERVICE, THEY SHOULD BE FITTED OUT WITH BOLTED OR WELDED BONNETS [ ] BOLTED GLANDS [ ] AND BE 'FIRE-SAFE' (METAL-TO-METAL SEATED) [ ]

FURNISH MOUNTED IN PIPING: SUCTION BLOCK VALVE [ ] DISCHARGE BLOCK VALVE [ ] CHECK VALVE [ ] BLOWDOWN VALVE [ ]

7.15 — FURNISH TEMPORARY START-UP SCREENS? YES [ ] NO [ ]
IF YES, THE SCREEN SHALL BE LOCATED AT EACH PURCHASER INLET CONNECTION [ ] LOCATED AT SUCTION BOTTLE OF EACH SEPARATE GAS STREAM [ ] INSTALLED IN A REMOVABLE SPOOL PIECE [ ]

7.16.2 — FURNISH STEEL [ ] OR 300 SERIES S.S. [ ] OIL LINE DOWNSTREAM OF THE OIL FILTER?

7.17.1 — FURNISH A COMPLETE ON-SKID COOLANT PIPING SYSTEM WHEN LIQUID COMPRESSOR CYLINDERS ARE UTILIZED? YES [ ] NO [ ]

7.19.2 — FURNISH A COMMON DISTANCE PIECE VENT HEADER TERMINATING AT THE EDGE OF THE SKID? YES [ ] NO [ ]

7.19.3 — FURNISH A COMMON DISTANCE PIECE DRAIN HEADER TERMINATING AT THE EDGE OF THE SKID? YES [ ] NO [ ]

7.19.4 — FURNISH A COMMON PACKING VENT HEADER TERMINATING AT THE EDGE OF THE SKID? YES [ ] NO [ ]

7.20.2 — FURNISH RELIEF VALVE FOR INSTALLATION IN PURCHASER PIPING OR AT SUCTION SCRUBBER? YES [ ] NO [ ]

IF YES, ADVISE ADDITIONAL SUCTION RELIEF VALVE CAPACITY REQUIRED TO PROTECT THE PACKAGE FOR UPSET CONDITIONS OTHER THAN RATED CAPACITY:

(EXPLAIN) _____

7.20.4 — FURNISH RELIEF VALVE VENT PIPES WHICH DISCHARGE VENT GAS? UPWARD TO ATMOSPHERE [ ] OR INTO A COMMON HEADER TERMINATING AT SKID EDGE [ ]

7.21 — IF A PACKAGE BLOWDOWN VALVE IS FURNISHED, THE RELEASED GAS SHALL BE VENTED UPWARD TO ATMOSPHERE [ ] OR INTO A COMMON HEADER TERMINATING AT SKID EDGE [ ] OR ELSEWHERE [ ]:

(EXPLAIN) _____

ELECTRICAL SYSTEMS

8.2

ELECTRICAL POWER	AC VOLTS	AC PHASE	AC HERTZ	DC VOLTS
MAIN PRIME MOVER				
AUXILIARY MOTORS				
HEATERS				
INSTRUMENTATION				
ALARMS AND SHUTDOWNS				

INSTRUMENTS AND CONTROLS

9.1 — IN ADDITION TO THE INSTRUMENT AND CONTROL PANEL (SEE PARAGRAPH 9.2) AND TO ANY CAPACITY CONTROL (SEE SECTION 3), THE FOLLOWING CONTROL SYSTEMS ARE REQUIRED:

PURPOSE OR FUNCTION	CONTROL SIGNAL SOURCE	CONTROL SIGNAL RANGE	MANUAL OR AUTOMATIC	SENSITIVITY

9.2.1 — FURNISH PANELS WITH ENCLOSED BACKS? YES [ ] NO [ ]

9.2.2 — PANELS SHALL BE FREE-STANDING, SKID-MOUNTED [ ] OR OFF-SKID MOUNTED [ ]

9.2.3 — WIRING TO REMOTE PANELS SHALL BE INSTALLED IN CONDUITS [ ] OR ENCLOSURES [ ] OR ARMORED CABLE [ ]

9.3.1 — FURNISH TACHOMETER IN PANEL? YES [ ] NO [ ]

IF YES, SPECIFY: TYPE: _____ RANGE: _____ TO _____ RPM

9.3.2 — FURNISH LIQUID FILLED, DIAL TEMPERATURE GAGES? YES [ ] NO [ ]

9.3.2.4 — FURNISH GROUNDED [ ] OR UNGROUNDED [ ] THERMOCOUPLE TEMPERATURE INDICATORS? YES [ ] NO [ ]

IF YES, SPECIFY LOCATION: _____ _____ _____

9.3.3 — FURNISH LIQUID FILLED PRESSURE GAGES? YES [ ] NO [ ]

SHUTDOWNS, ALARMS AND ANNUNCIATORS

10.1 — SHUTDOWNS, ALARMS AND ANNUNCIATORS SHALL BE PNEUMATIC [ ] OR ELECTRIC [ ]

9.3.2 — 9.3.3 — 10.2.1

NOTE:

[X] INDICATES THE DESIRED ACTION, TYPE AND LOCATION OF ANNUNCIATION AND LOCATION OF THE SENSING DEVICE. MARK EACH BOX FOR MULTIPLE REQUIREMENTS.

	DESIRED ACTION			TYPE LOCATION ANNUNCIATION				SENSING DEVICE LOCATION	
	SHUTDOWN	ALARM	INDICATOR	VISUAL	AUDIBLE	PANEL	REMOTE	PANEL	LOCAL
COMPRESSOR									
SUCTION GAS PRESSURE — FIRST STAGE			[X]						
LOW	[X]	[ ]	[ ]	[X]	[ ]	[ ]	[ ]	[ ]	[ ]
HIGH	[X]	[ ]	[ ]	[X]	[ ]	[ ]	[ ]	[ ]	[ ]
SUCTION GAS PRESSURE — INTERSTAGE			[ ]						
LOW	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
HIGH	[X]	[ ]	[ ]	[X]	[ ]	[ ]	[ ]	[ ]	[ ]
DISCHARGE GAS PRESSURE — INTERSTAGE			[X]						
LOW	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
HIGH	[X]	[ ]	[ ]	[X]	[ ]	[ ]	[ ]	[ ]	[ ]

SHUTDOWNS, ALARMS AND ANNUCIATORS Continued

NOTE: [X] INDICATES THE DESIRED ACTION, TYPE AND LOCATION OF ANNUCIATION AND LOCATION OF THE SENSING DEVICE. MARK EACH BOX FOR MULTIPLE REQUIREMENTS.	DESIRED ACTION			TYPE LOCATION ANNUNCIATION				SENSING DEVICE LOCATION	
	SHUTDOWN	ALARM	INDICATOR	VISUAL	AUDIBLE	PANEL	REMOTE	PANEL	LOCAL
DISCHARGE GAS PRESSURE — FINAL STAGE			[X]						
LOW	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
HIGH	[X]	[ ]	[ ]	[X]	[ ]	[ ]	[ ]	[ ]	[ ]
LUBE OIL PRESSURE									
IN — FILTER	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
OUT — FILTER	[ ]	[ ]	[X]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
LOW	[X]	[ ]	[ ]	[X]	[ ]	[ ]	[ ]	[ ]	[ ]
LUBE OIL TEMPERATURE									
IN	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
OUT	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
HIGH	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
GAS TEMPERATURE — EACH STAGE									
SUCTION	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
DISCHARGE — EACH CYLINDER	[ ]	[ ]	[X]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
HIGH — EACH CYLINDER	[X]	[ ]	[ ]	[X]	[ ]	[ ]	[ ]	[ ]	[ ]
LUBE OIL LEVEL									
LOW — FRAME	[X]	[ ]	[ ]	[X]	[ ]	[ ]	[ ]	[ ]	[ ]
LOW — LUBRICATOR	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
LUBRICATOR									
NO-FLOW	[X]	[ ]	[ ]	[X]	[ ]	[ ]	[ ]	[ ]	[ ]
VIBRATION									
HIGH	[X]	[ ]	[ ]	[X]	[ ]	[ ]	[ ]	[ ]	[ ]
CYLINDER COOLANT TEMPERATURE									
IN	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
OUT — EACH CYLINDER	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
HIGH	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
NATURAL GAS ENGINE — IF FURNISHED									
HIGH/LOW MANIFOLD PRESSURE/VACUUM	[X]	[ ]	[ ]	[X]	[ ]	[ ]	[ ]	[ ]	[ ]
COOLANT TEMPERATURE									
IN	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
OUT	[ ]	[ ]	[X]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
HIGH	[X]	[ ]	[ ]	[X]	[ ]	[ ]	[ ]	[ ]	[ ]
LUBE OIL TEMPERATURE									
IN	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
OUT	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
HIGH	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
LUBE OIL PRESSURE									
IN — FILTER	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
OUT — FILTER	[ ]	[ ]	[X]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
LOW	[X]	[ ]	[ ]	[X]	[ ]	[ ]	[ ]	[ ]	[ ]
COOLANT PRESSURE									
IN	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
OUT	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
LOW	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
FUEL GAS PRESSURE	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
STARTING AIR/GAS PRESSURE	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]

SHUTDOWNS, ALARMS AND ANNUCIATORS Continued

NOTE:

[X] INDICATES THE DESIRED ACTION, TYPE AND LOCATION OF ANNUCIATION AND LOCATION OF THE SENSING DEVICE. MARK EACH BOX FOR MULTIPLE REQUIREMENTS.

	DESIRED ACTION			TYPE LOCATION ANNUNCIATION				SENSING DEVICE LOCATION	
	SHUTDOWN	ALARM	INDICATOR	VISUAL	AUDIBLE	PANEL	REMOTE	PANEL	LOCAL
VIBRATION									
HIGH	[X]	[ ]	[ ]	[X]	[ ]	[ ]	[ ]	[ ]	[ ]
LUBE OIL LEVEL									
LOW	[X]	[ ]	[ ]	[X]	[ ]	[ ]	[ ]	[ ]	[ ]
OVERSPEED	[X]	[ ]	[ ]	[X]	[ ]	[ ]	[ ]	[ ]	[ ]
_____	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
_____	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
_____	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
_____	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
ELECTRIC MOTOR — IF FURNISHED									
STATOR WINDING TEMPERATURE									
HIGH	[X]	[ ]	[ ]	[X]	[ ]	[ ]	[ ]	[ ]	[ ]
VIBRATION									
HIGH	[X]	[ ]	[ ]	[X]	[ ]	[ ]	[ ]	[ ]	[ ]
_____	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
_____	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
_____	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
_____	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
_____	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
OTHER									
COOLER VIBRATION									
HIGH	[X]	[ ]	[ ]	[X]	[ ]	[ ]	[ ]	[ ]	[ ]
COOLER COOLANT LEVEL									
LOW	[X]	[ ]	[ ]	[X]	[ ]	[ ]	[ ]	[ ]	[ ]
SCRUBBER LIQUID LEVEL									
HIGH	[X]	[ ]	[ ]	[X]	[ ]	[ ]	[ ]	[ ]	[ ]
LOW	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
_____	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
_____	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
_____	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
_____	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
_____	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]

SKID

11.2.9 — ON STRUCTURAL STEEL SKIDS, SCRUBBERS WILL BE BOLTED [ ] OR WELDED [ ] TO THE STRUCTURAL SKID MEMBERS

11.4 FURNISH WALKWAYS, STAIRS AND PLATFORMS? YES [ ] NO [ ]

PAINT AND PAINTING

12.1 — THE UNIT ENVIRONMENT IS NORMAL [ ] OR SEVERELY CORROSIVE [ ]

COMPRESSOR:

PACKAGER'S/MANUFACTURER'S STANDARD [ ] SPECIAL (EXPLAIN) [ ]

PRIME MOVER:

PACKAGER'S/MANUFACTURER'S STANDARD [ ] SPECIAL (EXPLAIN) [ ]

PACKAGE:

PACKAGER'S/MANUFACTURER'S STANDARD [ ] SPECIAL (EXPLAIN) [ ]

12.5 — AIR EXCHANGER:

SIDING/STRUCTURE: PACKAGER'S/MANUFACTURER'S STANDARD [ ]
HOT-DIPPED GALVANIZING [ ] SPECIAL (EXPLAIN) [ ]

HEADERS: PACKAGER'S/MANUFACTURER'S STANDARD [ ]
HOT-DIPPED GALVANIZING [ ] SPECIAL (EXPLAIN) [ ]

INSPECTION, TESTING, AND PREPARATION FOR SHIPMENT

13.1.2 — PURCHASER PARTICIPATION IN INSPECTION AND TESTS? YES [ ] NO [ ]

IF YES, EXPLAIN:

13.2.1.3 — OTHER TESTS? YES [ ] NO [ ]

IF YES, EXPLAIN:

INSPECTION, TESTING, AND PREPARATION FOR SHIPMENT Continued

13.2.2 — PURCHASER'S INSPECTION? YES [ ] NO [ ]

IF YES, SPECIFY TYPE: _____

_____

13.2.3 — PURCHASER REVIEW OF QUALITY CONTROL PROGRAM? YES [ ] NO [ ]

13.3.1.1 — FURNISH ASSEMBLED UNIT AIR TEST? YES [ ] NO [ ]

13.5.1 — FURNISH SPECIAL PREPARATION FOR SHIPMENT? YES [ ] NO [ ]

IF YES, EXPLAIN: _____

_____

FURNISH SPECIAL PREPARATION FOR STORAGE? YES [ ] NO [ ]

IF YES, EXPLAIN: _____

_____

_____ TERM: _____ MONTHS

13.5.2 — FURNISH EXPORT BOXING? YES [ ] NO [ ]

IF YES, FURNISH SPECIAL LIFTING DEVICES: YES [ ] NO [ ]

CORROSIVE GASES

COMPLETE THIS SECTION ONLY IF THE COMPRESSED GAS STREAM CONTAINS THE CORROSIVE COMPONENTS — H_2S AND/OR CO_2

15.1 — CORROSIVE GAS? YES [ ] NO [ ]

IF YES, THE PERCENTAGES OF EACH COMPONENT SHOULD BE LISTED ON PAGE 2 OF PART 1 — 'API PACKAGED COMPRESSOR DATA SHEETS'

WILL A CORROSION INHIBITOR BE UTILIZED? YES [ ] NO [ ]

IF YES, SPECIFY TYPE: _____

15.3.2.3 — H_2S

FURNISH PRECIPITATION HARDENED STAINLESS STEEL PISTON ROD [ ] OR 4140 STEEL PISTON ROD ANNEALED TO C22 [ ] WITH HARDENING IN THE PACKING AREA EITHER BY CHROME PLATING [ ] OR TUNGSTON CARBIDE COATING [ ] OR NACE MATERIAL EQUIVALENT PISTON ROD [ ]

15.3.3.7 — H_2S

PACKING CASES WILL BE PURGED WITH SWEET NATURAL GAS [ ] OR INERT

GAS [ ] TYPE: _____

THE DISTANCE PIECE WILL BE TYPE 2 [ ] OR TYPE 3 [ ] AND SHALL BE EVACUATED WITH A VACUUM PUMP [ ] OR PURGED WITH SWEET NATURAL

GAS [ ] OR INERT GAS [ ] TYPE: _____

15.3.4 — H_2S

FURNISH AUSTENITIC [ ] OR 12CR [ ] STAINLESS STEEL ON ALL PARTS THAT COME IN CONTACT WITH THE PROCESS GAS STREAM:

CORROSIVE GASES Continued

PROCESS GAS PIPING	CARBON STEEL	STAINLESS STEEL	OTHER
COLD SIDE PIPING	[ ]	[ ]	[ ] _____
HOT SIDE PIPING	[ ]	[ ]	[ ] _____
BYPASS PIPING	[ ]	[ ]	[ ] _____
VENT LINES	[ ]	[ ]	[ ] _____
DRAIN LINES	[ ]	[ ]	[ ] _____
PULSATION BOTTLES			
SUCTION	[ ]	[ ]	[ ] _____
DISCHARGE	[ ]	[ ]	[ ] _____
SCRUBBERS			
SUCTION	[ ]	[ ]	[ ] _____
INTERSTAGE	[ ]	[ ]	[ ] _____
DISCHARGE	[ ]	[ ]	[ ] _____
GAS COOLER			
HEADER	[ ]	[ ]	[ ] _____
TUBES	[ ]	[ ]	[ ] _____
VALVES			
SUCTION BLOCK	[ ]	[ ]	[ ] _____
DISCHARGE BLOCK	[ ]	[ ]	[ ] _____
BYPASS VALVES	[ ]	[ ]	[ ] _____
BLOWDOWN VALVE	[ ]	[ ]	[ ] _____
CHECK VALVE	[ ]	[ ]	[ ] _____
UTILITY PROCESS VALVES	[ ]	[ ]	[ ] _____
RELIEF VALVES	[ ]	[ ]	[ ] _____
INSTRUMENTATION			
SCRUBBER CONTROLS	[ ]	[ ]	[ ] _____
PRESSURE SWITCHES	[ ]	[ ]	[ ] _____
TEMPERATURE SWITCHES	[ ]	[ ]	[ ] _____
TUBING	[ ]	[ ]	[ ] _____
FITTINGS	[ ]	[ ]	[ ] _____

15.4.3.2 — CO_2

FURNISH PRECIPITATION HARDENED STAINLESS STEEL PISTON ROD [ ] OR 4140 STEEL PISTON ROD ANNEALED TO C22 [ ] WITH HARDENING IN THE PACKING AREA EITHER BY CHROME PLATING [ ] OR TUNGSTON CARBIDE COATING [ ]

15.4.4 — CO_2

FURNISH AUSTENITIC [ ] OR 12CR [ ] STAINLESS STEEL ON ALL PARTS THAT COME IN CONTACT WITH THE PROCESS GAS STREAM:

PROCESS GAS PIPING	CARBON STEEL	STAINLESS STEEL	OTHER
COLD SIDE PIPING	[ ]	[ ]	[ ] _____
HOT SIDE PIPING	[ ]	[ ]	[ ] _____
BYPASS PIPING	[ ]	[ ]	[ ] _____
VENT LINES	[ ]	[ ]	[ ] _____
DRAIN LINES	[ ]	[ ]	[ ] _____
PULSATION BOTTLES			
SUCTION	[ ]	[ ]	[ ] _____
DISCHARGE	[ ]	[ ]	[ ] _____
SCRUBBERS			
SUCTION	[ ]	[ ]	[ ] _____
INTERSTAGE	[ ]	[ ]	[ ] _____
DISCHARGE	[ ]	[ ]	[ ] _____
GAS COOLER			
HEADER	[ ]	[ ]	[ ] _____
TUBES	[ ]	[ ]	[ ] _____

CORROSIVE GASES Continued

PROCESS GAS PIPING	CARBON STEEL	STAINLESS STEEL	OTHER	
VALVES				
SUCTION BLOCK	[ ]	[ ]	[ ]	_____
DISCHARGE BLOCK	[ ]	[ ]	[ ]	_____
BYPASS VALVES	[ ]	[ ]	[ ]	_____
BLOWDOWN VALVE	[ ]	[ ]	[ ]	_____
CHECK VALVE	[ ]	[ ]	[ ]	_____
UTILITY PROCESS VALVES	[ ]	[ ]	[ ]	_____
RELIEF VALVES	[ ]	[ ]	[ ]	_____
INSTRUMENTATION				
SCRUBBER CONTROLS	[ ]	[ ]	[ ]	_____
PRESSURE SWITCHES	[ ]	[ ]	[ ]	_____
TEMPERATURE SWITCHES	[ ]	[ ]	[ ]	_____
TUBING	[ ]	[ ]	[ ]	_____
FITTINGS	[ ]	[ ]	[ ]	_____

OFFSHORE AND/OR MARINE ENVIRONMENT

COMPLETE THIS SECTION ONLY IF THE PACKAGED COMPRESSOR IS TO BE INSTALLED IN AN OFFSHORE AND/OR MARINE ENVIRONMENT

16.1.3 — CORROSIVE ENVIRONMENT? YES [ ] NO [ ]

IF YES, EXPLAIN: _____

_____

_____

16.2.1 — FURNISH SHIELDED [ ] OR NON-SHIELDED [ ] LOW TENSION MAGNETO IGNITION SYSTEM

16.4.1.1 — COOLER HEADERS: PACKAGER'S/MANUFACTURER'S STANDARD PAINT [ ]
HOT-DIPPED GALVANIZING [ ] SPECIAL PAINT (EXPLAIN) [ ]

_____

_____

_____

16.8.4 — FURNISH INSULATION ON ALL DISCHARGE GAS PIPING [ ] AND/OR ALL DISCHARGE VOLUME BOTTLES [ ] WHEN THEIR PREDICTED STABILIZED TEMPERATURE IS OVER 200 °F? YES [ ] NO [ ]

16.10.3 — FURNISH MANUAL [ ] OR PILOT-OPERATED [ ] SUCTION [ ] AND/OR DISCHARGE [ ] BLOCK VALVES? YES [ ] NO [ ]

16.10.4 — FURNISH PISTON TYPE DISCHARGE CHECK VALVE? YES [ ] NO [ ]

PART 1 — ACCEPTABLE VENDOR LIST

NOTE: A BLANK ENTRY INDICATES 'NO PREFERENCE' BY THE PURCHASER

NATURAL GAS ENGINE — _____
AIR/GAS STARTER — _____
ENGINE EXHAUST SILENCER — _____
ELECTRIC MOTOR — _____
COMPRESSOR — _____
EXPLOSION RELIEF DOORS — _____
LUBE OIL HEATER — _____
COUPLING — _____
AIR EXCHANGE COOLER — _____
TEMPERATURE CONTROL:
  COOLER LOUVERS — _____
V-BELTS — _____
PRESSURE GAGES — _____
DIAL THERMOMETERS — _____
GAGE GLASSES — _____
LIQUID LEVEL CONTROL:
  SCRUBBERS — _____
  ENGINE/COMPRESSOR OIL — _____
PRESSURE REGULATORS — _____
PRESSURE RELIEF VALVES — _____
SHUTDOWN SWITCH/VALVE:
  GAS PRESSURE — _____
  WATER PRESSURE — _____
  OIL PRESSURE — _____
  COOLANT TEMPERATURE — _____
  GAS TEMPERATURE — _____
  LIQUID LEVEL:
    SCRUBBERS — _____
    COOLANT SURGE TANK — _____
    ENGINE/COMPRESSOR OIL — _____
  LUBRICATOR NO-FLOW — _____
  VIBRATION — _____
  OVERSPEED — _____
SHUTDOWN ANNUCIATORS — _____
VALVES: —
  GATE — _____
  PLUG — _____
  GLOBE — _____
  NEEDLE — _____
  BALL — _____
  BUTTERFLY — _____
PAINT:
  WASH PRIMER — _____
  METAL PRIMER — _____
  FIRST COAT — _____
  FINAL COAT — _____
  HIGH TEMPERATURE — _____
_____ — _____
_____ — _____
_____ — _____

PART 1 — OTHER REQUIREMENTS

REMARKS

APPENDIX E
API PACKAGED COMPRESSOR DATA SHEETS
PART 2 — PACKAGER'S DESIGN

GENERAL INFORMATION

	PACKAGER	PURCHASER
COMPANY		
BUILDING		
SUITE #		
STREET		
P.O. BOX		
CITY		
STATE		
ZIP		
COUNTRY		
TELEPHONE		
TELEX		
FAX		
CONTACT 1		
CONTACT 2		

COST ESTIMATE ONLY [ ] FOR PURCHASE [ ]

PROJECT NAME: _____ PROPOSAL DATE: _____

PROJECT NUMBER: _____ PROPOSAL NUMBER: _____

SERVICE: _____ INQUIRY NUMBER: _____

SHIPMENT QUOTED: _____ # UNITS QUOTED: _____

COMPRESSOR

MANUFACTURER: _____ MODEL: _____

RATED HORSEPOWER: _____ BHP RATED SPEED: _____ RPM STROKE: _____ INCHES
RATED PISTON SPEED: _____ FPM PISTON ROD DIAMETER: _____ INCHES
RATED ROD LOAD-COMPRESSION: _____ # RATED ROD LOAD-TENSION: _____ #

			PRIMARY	SECONDARY
2.1.4	— UNBALANCED FORCES AND COUPLES:			
	HORIZONTAL FORCE	— POUNDS		
	VERTICAL FORCE	— POUNDS		
	HORIZONTAL COUPLE	— FOOT POUNDS		
	VERTICAL COUPLE	— FOOT POUNDS		

2.9.1 — DISTANCE PIECES: TYPE 1 [ ] TYPE 3 [ ] TYPE 3 [ ]

2.9.3 — EXPLOSION RELIEF DOORS: YES [ ] NO [ ]

2.11.6 — FRAME LUBRICATION SYSTEM: _____ GALLON FRAME OIL STORAGE TANK WITH LEVEL GAGE: YES [ ] NO [ ]

2.11.7 — LUBE OIL HEATER: YES [ ] NO [ ]

2.12.1 — CYLINDER LUBRICATION SYSTEM IS BLOCK TYPE: YES [ ] NO [ ]

WITH LINE FILTERS: YES [ ] NO [ ] LUBE METER: YES [ ] NO [ ]

FAULT INDICATORS: YES [ ] NO [ ] OR PUMP-TO-POINT TYPE: YES [ ] NO [ ]

COMPRESSOR Continued

2.12.2.1 — CYLINDER LUBRICATOR: _____ GALLON LUBRICATOR OIL STORAGE TANK WITH LEVEL GAGE: YES [ ] NO [ ]

2.14.2 — COUPLING TYPE: _____ MFG: _____ MODEL _____
WITH STEEL [ ] OR STAINLESS STEEL [ ] DISC PACK

COMPRESSOR CONSTRUCTION FEATURES

2.5.3.2 — 2.7.3 — 2.7.6 — 2.13.1.3

SERVICE				
STAGE				
CYLINDER BORE — INCHES				
COOLED/NON-COOLED CYLINDER				
	MATERIALS			
CYLINDER				
CYLINDER LINER (IF FURNISHED)				
PISTON				
PISTON RINGS				
WEAR BANDS				
PISTON ROD				
PISTON ROD HARDNESS (BASE) — R_c				
PISTON ROD COATING				
PISTON ROD COATING HARDNESS — R_c				
VALVE SEATS				
VALVE GUARDS (STOPS)				
VALVE PLATES				
VALVE SPRINGS				
ROD PACKING CASE				
ROD PRESSURE PACKING RINGS				
ROD WIPER PACKING RINGS				
CRANKSHAFT				
CRANKSHAFT MAIN JOURNAL BEARINGS				
CONNECTING ROD				
CONNECTING ROD BEARINGS				
CROSSHEAD				
CROSSHEAD PIN				
CROSSHEAD PIN BUSHING				
CROSSHEAD SHOES (IF FURNISHED)				
CYLINDER INDICATOR CONNECTIONS				

COMPRESSOR PERFORMANCE

2.1.2 — 2.1.3 — 2.3 — 2.4.1

CASE					
SERVICE					
STAGE					
NUMBER OF CYLINDERS					
CYLINDER BORE	— INCHES				
RATED DISCHARGE PRESSURE	— PSIG				
ALLOWABLE WORKING PRESSURE	— PSIG				
ALLOWABLE WORKING TEMP	— °F				
NOZZLE SIZE AND RATING	— INCH-#				
CYLINDER ACTION — (DA/SACE/SAHE)					
PISTON DISPLACEMENT/CYL	— CFM				
SPECIFIC GRAVITY					
C_p/C_v (K) VALUE					
CRITICAL PRESSURE	— PSIA				
CRITICAL TEMPERATURE	— °R				
COMPRESSIBILITY (Z) AT SUCTION					
COMPRESSIBILITY (Z) AT DISCHARGE					
GAS SUCTION PRESSURE *	— PSI				
GAS DISCHARGE PRESSURE *	— PSI				
GAS SUCTION TEMP	— °F				
GAS DISCHARGE TEMP — ADB	— °F				
GAS DISCHARGE TEMP — EST ACT	— °F				
REQUIRED CAPACITY	— MMSCFD				
QUOTED CAPACITY	— MMSCFD				
GAS HORSEPOWER/STAGE	— BHP				
GAS HORSEPOWER — TOTAL	— BHP				
HORSEPOWER — ACCESSORIES	— BHP				
UNIT HORSEPOWER — TOTAL	— BHP				
BHP-TOTAL/BHP-SITE X 100	— %				
ACTUAL SPEED	— RPM				
ACTUAL PISTON SPEED	— FPM				
CYLINDER CLEARANCE — H.E.	— %				
CYLINDER CLEARANCE — C.E.	— %				
VOLUMETRIC EFF — H.E.	— %				
VOLUMETRIC EFF — C.E.	— %				
ROD LOAD (GAS) — COMP	— POUNDS				

COMPRESSOR PERFORMANCE Continued

ROD LOAD (GAS) — TENS	— POUNDS				
ROD LOAD (GAS+INRT) — COMP	— POUNDS				
ROD LOAD (GAS+INRT) — TENS	— POUNDS				
CLEARANCE POCKET TRAVEL	— % OPEN				
VALVE SPACERS INSTALLED	— #/CYL				
VALVE VELOCITY — AVERAGE	— FPM				
VALVES/CORNER—SUCTION/DISCHARGE					
VALVE TYPE AND SIZE	— INCHES				
VALVE LIFT	— INCHES				
VALVE LIFT AREA	— SQINCH				

ALTITUDE: _____ FEET BAROMETRIC PRESSURE: _____ PSIA AIR TEMP: _____ °F
UNIT CAPACITY — MMSCFD — IS MEASURED AT _____ PSIA AND 60 °F
* — PRESSURES MEASURED AT INLET AND OUTLET FLANGES OF COMPRESSOR CYLINDERS

2.1.2 — 2.1.3 — 2.3 — 2.4.1

CASE					
SERVICE					
STAGE					
NUMBER OF CYLINDERS					
CYLINDER BORE	— INCHES				
RATED DISCHARGE PRESSURE	— PSIG				
ALLOWABLE WORKING PRESSURE	— PSIG				
ALLOWABLE WORKING TEMP	— °F				
NOZZLE SIZE AND RATING	— INCH-#				
CYLINDER ACTION — (DA/SACE/SAHE)					
PISTON DISPLACEMENT/CYL	— CFM				
SPECIFIC GRAVITY					
C_p/C_v (K) VALUE					
CRITICAL PRESSURE	— PSIA				
CRITICAL TEMPERATURE	— °R				
COMPRESSIBILITY (Z) AT SUCTION					
COMPRESSIBILITY (Z) AT DISCHARGE					
GAS SUCTION PRESSURE *	— PSI				
GAS DISCHARGE PRESSURE *	— PSI				
GAS SUCTION TEMP	— °F				
GAS DISCHARGE TEMP — ADB	— °F				
GAS DISCHARGE TEMP — EST ACT	— °F				
REQUIRED CAPACITY	— MMSCFD				
QUOTED CAPACITY	— MMSCFD				
GAS HORSEPOWER/STAGE	— BHP				

COMPRESSOR PERFORMANCE Continued

GAS HORSEPOWER — TOTAL	— BHP				
HORSEPOWER — ACCESSORIES	— BHP				
UNIT HORSEPOWER — TOTAL	— BHP				
BHP-TOTAL/BHP-SITE X 100	— %				
ACTUAL SPEED	— RPM				
ACTUAL PISTON SPEED	— FPM				
CYLINDER CLEARANCE — H. E.	— %				
CYLINDER CLEARANCE — C. E.	— %				
VOLUMETRIC EFF — H. E.	— %				
VOLUMETRIC EFF — C. E.	— %				
ROD LOAD (GAS) — COMP	— POUNDS				
ROD LOAD (GAS) — TENS	— POUNDS				
ROD LOAD (GAS+INRT) — COMP	— POUNDS				
ROD LOAD (GAS+INRT) — TENS	— POUNDS				
CLEARANCE POCKET TRAVEL	— % OPEN				
VALVE SPACERS INSTALLED	— #/CYL				
VALVE VELOCITY — AVERAGE	— FPM				
VALVES/CORNER-SUCTION/DISCHARGE					
VALVE TYPE AND SIZE	— INCHES				
VALVE LIFT	— INCHES				
VALVE LIFT AREA	— SQINCH				

ALTITUDE: _____ FEET BAROMETRIC PRESSURE: _____ PSIA AIR TEMP: _____ °F

UNIT CAPACITY — MMSCFD — IS MEASURED AT _____ PSIA AND 60 °F

* — PRESSURES MEASURED AT INLET AND OUTLET FLANGES OF COMPRESSOR CYLINDERS

2.1.2 — 2.1.3 — 2.3 — 2.4.1

CASE					
SERVICE					
STAGE					
NUMBER OF CYLINDERS					
CYLINDER BORE	— INCHES				
RATED DISCHARGE PRESSURE	— PSIG				
ALLOWABLE WORKING PRESSURE	— PSIG				
ALLOWABLE WORKING TEMP	— °F				
NOZZLE SIZE AND RATING	— INCH—#				
CYLINDER ACTION — (DA/SACE/SAHE)					
PISTON DISPLACEMENT/CYL	— CFM				
SPECIFIC GRAVITY					

COMPRESSOR PERFORMANCE Continued

C_p/C_v (K) VALUE					
CRITICAL PRESSURE	— PSIA				
CRITICAL TEMPERATURE	— °R				
COMPRESSIBILITY (Z) AT SUCTION					
COMPRESSIBILITY (Z) AT DISCHARGE					
GAS SUCTION PRESSURE *	— PSI				
GAS DISCHARGE PRESSURE *	— PSI				
GAS SUCTION TEMP	— °F				
GAS DISCHARGE TEMP — ADB	— °F				
GAS DISCHARGE TEMP — EST ACT	— °F				
REQUIRED CAPACITY	— MMSCFD				
QUOTED CAPACITY	— MMSCFD				
GAS HORSEPOWER/STAGE	— BHP				
GAS HORSEPOWER — TOTAL	— BHP				
HORSEPOWER — ACCESSORIES	— BHP				
UNIT HORSEPOWER — TOTAL	— BHP				
BHP-TOTAL/BHP-SITE X 100	— %				
ACTUAL SPEED	— RPM				
ACTUAL PISTON SPEED	— FPM				
CYLINDER CLEARANCE — H. E.	— %				
CYLINDER CLEARANCE — C. E.	— %				
VOLUMETRIC EFF — H. E.	— %				
VOLUMETRIC EFF — C. E.	— %				
ROD LOAD (GAS) — COMP	— POUNDS				
ROD LOAD (GAS) — TENS	— POUNDS				
ROD LOAD (GAS+INRT) — COMP	— POUNDS				
ROD LOAD (GAS+INRT) — TENS	— POUNDS				
CLEARANCE POCKET TRAVEL	— % OPEN				
VALVE SPACERS INSTALLED	— #/CYL				
VALVE VELOCITY — AVERAGE	— FPM				
VALVES/CORNER-SUCTION/DISCHARGE					
VALVE TYPE AND SIZE	— INCHES				
VALVE LIFT	— INCHES				
VALVE LIFT AREA	— SQINCH				

ALTITUDE: _____ FEET BAROMETRIC PRESSURE: _____ PSIA AIR TEMP: _____ °F

UNIT CAPACITY — MMSCFD — IS MEASURED AT _____ PSIA AND 60 °F

* — PRESSURES MEASURED AT INLET AND OUTLET FLANGES OF COMPRESSOR CYLINDERS

COMPRESSOR PERFORMANCE Continued

2.1.2 — 2.1.3 — 2.3 — 2.4.1

CASE					
SERVICE					
STAGE					
NUMBER OF CYLINDERS					
CYLINDER BORE	— INCHES				
RATED DISCHARGE PRESSURE	— PSIG				
ALLOWABLE WORKING PRESSURE	— PSIG				
ALLOWABLE WORKING TEMP	— °F				
NOZZLE SIZE AND RATING	— INCH-#				
CYLINDER ACTION — (DA/SACE/SAHE)					
PISTON DISPLACEMENT/CYL	— CFM				
SPECIFIC GRAVITY					
C_p/C_v (K) VALUE					
CRITICAL PRESSURE	— PSIA				
CRITICAL TEMPERATURE	— °R				
COMPRESSIBILITY (Z) AT SUCTION					
COMPRESSIBILITY (Z) AT DISCHARGE					
GAS SUCTION PRESSURE *	— PSI				
GAS DISCHARGE PRESSURE *	— PSI				
GAS SUCTION TEMP	— °F				
GAS DISCHARGE TEMP — ADB	— °F				
GAS DISCHARGE TEMP — EST ACT	— °F				
REQUIRED CAPACITY	— MMSCFD				
QUOTED CAPACITY	— MMSCFD				
GAS HORSEPOWER/STAGE	— BHP				
GAS HORSEPOWER — TOTAL	— BHP				
HORSEPOWER — ACCESSORIES	— BHP				
UNIT HORSEPOWER — TOTAL	— BHP				
BHP-TOTAL/BHP-SITE X 100	— %				
ACTUAL SPEED	— RPM				
ACTUAL PISTON SPEED	— FPM				
CYLINDER CLEARANCE — H. E.	— %				
CYLINDER CLEARANCE — C. E.	— %				
VOLUMETRIC EFF — H. E.	— %				
VOLUMETRIC EFF — C. E.	— %				
ROD LOAD (GAS) — COMP	— POUNDS				

COMPRESSOR PERFORMANCE Continued

ROD LOAD (GAS) — TENS	— POUNDS				
ROD LOAD (GAS+INRT) — COMP	— POUNDS				
ROD LOAD (GAS+INRT) — TENS	— POUNDS				
CLEARANCE POCKET TRAVEL	— % OPEN				
VALVE SPACERS INSTALLED	— #/CYL				
VALVE VELOCITY — AVERAGE	— FPM				
VALVES/CORNER—SUCTION/DISCHARGE					
VALVE TYPE AND SIZE	— INCHES				
VALVE LIFT	— INCHES				
VALVE LIFT AREA	— SQINCH				

ALTITUDE: _____ FEET BAROMETRIC PRESSURE: _____ PSIA AIR TEMP: _____ °F
UNIT CAPACITY — MMSCFD — IS MEASURED AT _____ PSIA AND 60 °F
* — PRESSURES MEASURED AT INLET AND OUTLET FLANGES OF COMPRESSOR CYLINDERS

COMPRESSOR CAPACITY CONTROL

PART LOAD OPERATION

CASE					
SERVICE					
STAGE					
CYLINDER ACTION — (DA/SACE/SAHE)					
GAS SUCTION TEMPERATURE	— °F				
GAS SUCTION PRESSURE	— PSI				
GAS DISCHARGE PRESSURE	— PSI				
REQUIRED CAPACITY	— MMSCFD				
QUOTED CAPACITY	— MMSCFD				
GAS HORSEPOWER/STAGE	— BHP				
GAS HORSEPOWER — TOTAL	— BHP				
HORSEPOWER — ACCESSORIES	— BHP				
UNIT HORSEPOWER — TOTAL	— BHP				
BHP-TOTAL/BHP-SITE X 100	— %				
ACTUAL SPEED	— RPM				
CYLINDER CLEARANCE — H. E.	— %				
CYLINDER CLEARANCE — C. E.	— %				
CLEARANCE POCKET TRAVEL	— % OPEN				
VALVE SPACERS INSTALLED	— #/CYL				
CLEARANCE PLUG	— YES/NO				
CLEARANCE BOTTLE	— YES/NO				
VALVE UNLOADERS	— YES/NO				
CAPACITY CONTROL BYPASS	— YES/NO				

COMPRESSOR CAPACITY CONTROL Continued

PART LOAD OPERATION

CASE					
SERVICE					
STAGE					
CYLINDER ACTION — (DA/SACE/SAHE)					
GAS SUCTION TEMPERATURE	— °F				
GAS SUCTION PRESSURE	— PSI				
GAS DISCHARGE PRESSURE	— PSI				
REQUIRED CAPACITY	— MMSCFD				
QUOTED CAPACITY	— MMSCFD				
GAS HORSEPOWER/STAGE	— BHP				
GAS HORSEPOWER — TOTAL	— BHP				
HORSEPOWER — ACCESSORIES	— BHP				
UNIT HORSEPOWER — TOTAL	— BHP				
BHP-TOTAL/BHP-SITE X 100	— %				
ACTUAL SPEED	— RPM				
CYLINDER CLEARANCE — H. E.	— %				
CYLINDER CLEARANCE — C. E.	— %				
CLEARANCE POCKET TRAVEL	— % OPEN				
VALVE SPACERS INSTALLED	— #/CYL				
CLEARANCE PLUG	— YES/NO				
CLEARANCE BOTTLE	— YES/NO				
VALVE UNLOADERS	— YES/NO				
CAPACITY CONTROL BYPASS	— YES/NO				

PART LOAD OPERATION

CASE					
SERVICE					
STAGE					
CYLINDER ACTION — (DA/SACE/SAHE)					
GAS SUCTION TEMPERATURE	— °F				
GAS SUCTION PRESSURE	— PSI				
GAS DISCHARGE PRESSURE	— PSI				
REQUIRED CAPACITY	— MMSCFD				
QUOTED CAPACITY	— MMSCFD				
GAS HORSEPOWER/STAGE	— BHP				
GAS HORSEPOWER — TOTAL	— BHP				
HORSEPOWER — ACCESSORIES	— BHP				

COMPRESSOR CAPACITY CONTROL Continued

UNIT HORSEPOWER — TOTAL	— BHP				
BHP-TOTAL/BHP-SITE X 100	— %				
ACTUAL SPEED	— RPM				
CYLINDER CLEARANCE — H. E.	— %				
CYLINDER CLEARANCE — C. E.	— %				
CLEARANCE POCKET TRAVEL	— % OPEN				
VALVE SPACERS INSTALLED	— #/CYL				
CLEARANCE PLUG	— YES/NO				
CLEARANCE BOTTLE	— YES/NO				
VALVE UNLOADERS	— YES/NO				
CAPACITY CONTROL BYPASS	— YES/NO				

PART LOAD OPERATION

CASE					
SERVICE					
STAGE					
CYLINDER ACTION — (DA/SACE/SAHE)					
GAS SUCTION TEMPERATURE	— °F				
GAS SUCTION PRESSURE	— PSI				
GAS DISCHARGE PRESSURE	— PSI				
REQUIRED CAPACITY	— MMSCFD				
QUOTED CAPACITY	— MMSCFD				
GAS HORSEPOWER/STAGE	— BHP				
GAS HORSEPOWER — TOTAL	— BHP				
HORSEPOWER — ACCESSORIES	— BHP				
UNIT HORSEPOWER — TOTAL	— BHP				
BHP-TOTAL/BHP-SITE X 100	— %				
ACTUAL SPEED	— RPM				
CYLINDER CLEARANCE — H. E.	— %				
CYLINDER CLEARANCE — C. E.	— %				
CLEARANCE POCKET TRAVEL	— % OPEN				
VALVE SPACERS INSTALLED	— #/CYL				
CLEARANCE PLUG	— YES/NO				
CLEARANCE BOTTLE	— YES/NO				
VALVE UNLOADERS	— YES/NO				
CAPACITY CONTROL BYPASS	— YES/NO				

COMPRESSOR CAPACITY CONTROL Continued

3.2.1 — SPEED VARIATION: YES [ ] NO [ ] RANGE _____ TO _____ RPM
MANUAL [ ] AUTOMATIC [ ]

3.2.2.2 — CLEARANCE POCKETS: YES [ ] NO [ ] FIXED (OPEN/CLOSED) [ ]
VARIABLE [ ] MANUAL [ ] AUTOMATIC [ ]
CYL 1 [ ] CYL 2 [ ] CYL 3 [ ] CYL 4 [ ]

3.2.2.3 — VALVE SPACERS: HEAD-END: YES [ ] NO [ ] NUMBER: _____
CYL 1 [ ] CYL 2 [ ] CYL 3 [ ] CYL 4 [ ]
CRANK-END: YES [ ] NO [ ] NUMBER: _____
CYL 1 [ ] CYL 2 [ ] CYL 3 [ ] CYL 4 [ ]

3.2.2.4 — CLEARANCE BOTTLES: YES [ ] NO [ ]
CYL 1 [ ] CYL 2 [ ] CYL 3 [ ] CYL 4 [ ]
CLEARANCE PLUGS: YES [ ] NO [ ]
CYL 1 [ ] CYL 2 [ ] CYL 3 [ ] CYL 4 [ ]

3.2.3.1 — BY-PASS SYSTEMS: START-UP [ ] CAPACITY CONTROL [ ]
MANUAL [ ] AUTO [ ] HOT [ ] COLD [ ]

3.2.4.3 — VALVE UNLOADERS: YES [ ] NO [ ] PLATE DEPRESSORS [ ]
PLUG [ ] MANUAL [ ] AUTOMATIC [ ]
CYL 1 [ ] CYL 2 [ ] CYL 3 [ ] CYL 4 [ ]

3.2.5 — PRESSURE CONTROL: YES [ ] NO [ ] SUCTION [ ] DISCHARGE [ ]

PRIME MOVER — GAS ENGINE

MANUFACTURER: _____ MODEL: _____

SITE RATED POWER: _____ BHP RATED SPEED: _____ RPM MIN SPEED: _____ RPM
BORE: _____ INCHES STROKE: _____ INCHES DISPLACEMENT: _____ CU. INCH
NUMBER OF POWER CYLINDERS: _____ TURBOCHARGED [ ] NATURALLY ASPIRATED [ ]
COMPRESSION RATIO: _____ FUEL CONSUMPTION: _____ BTU/BHP-HR

4.2.3 — STARTING SYSTEM: ELECTRIC [ ] AIR [ ] OR GAS [ ] IF ELECTRIC,
4.2.3.2.2 — _____ AMPERE-HOUR BATTERY SET: YES [ ] NO [ ]

4.2.3.2.3 — AND CHARGING ALTERNATOR: YES [ ] NO [ ]

4.2.4 — AIR FILTER: MANUFACTURER'S STANDARD DRY TYPE: YES [ ] NO [ ]

4.2.4.1 — OR OTHER: YES [ ] NO [ ] IF YES, EXPLAIN: _____

4.2.4.2.6 — AIR FILTER PRESSURE DROP INDICATOR: YES [ ] NO [ ]

4.2.5 — MFG'S STANDARD INDUSTRIAL TYPE SILENCER: YES [ ] NO [ ]

4.2.5.1 — OR OTHER: YES [ ] NO [ ] IF YES, SPARK-ARRESTING [ ]

NON SPARK-ARRESTING [ ] SOUND ATTENUATION: _____

PERSONNEL PROTECTION [ ] (EXPLAIN): _____

_____

4.2.8 — QUOTED EMISSION DATA (GM/BHP/HR) IS FROM MFG'S PAST PERFORMANCE

4.2.8.1 — DATA [ ] OR ACTUAL STACK TEST [ ] AND IS BASED ON QUOTED BHP [ ] OR ENGINE NAMEPLATE RATING [ ]:

NITROUS OXIDE: _____ NON CH_4 HYDROCARBONS: _____

CARBON MONOXIDE: _____ SULFUR DIOXIDE: _____

4.2.10 — _____ GALLON CRANKCASE OIL STORAGE TANK: YES [ ] NO [ ]

4.2.11.5 — FUEL FILTER/SEPARATOR: YES [ ] NO [ ]

4.2.12 — CRANKCASE EXPLOSION DOORS: YES [ ] NO [ ]

PRIME MOVER — ELECTRIC MOTOR

4.3.1
MANUFACTURER: _____ MODEL: _____
SYNCHRONOUS [ ] INDUCTION [ ] SITE RATED POWER: _____ RATED SPEED: _____ RPM
NEMA RATING: _____ FRAME TYPE: _____ ENCLOSURE TYPE: _____ S.F.: _____
VOLTS: _____ PHASE: _____ HERTZ: _____ CLASS: _____ GROUP: _____ DIVISION: _____
INSULATION: _____ TEMPERATURE RISE: _____ °C ABOVE _____ °C
SPACE HEATER: YES [ ] NO [ ] IF YES, VOLTS _____ PHASE: _____ HERTZ: _____
MOTOR STARTER AND CONTROLS: YES [ ] NO [ ] IF YES, NEMA RATING: _____
MANUFACTURER: _____ FULL VOLTAGE [ ] REDUCED VOLTAGE [ ]

COOLING SYSTEM

MANUFACTURER: _____ MODEL: _____
VERTICAL [ ] HORIZONTAL [ ] ELECTRIC MOTOR DRIVE [ ] ENGINE V-BELT [ ]
MOUNTED ON ENGINE/COMPRESSOR SKID [ ] MOUNTED ON SEPARATE COOLER SKID [ ]

5.3.1.2 — SIGHT FLOW [ ] AND/OR TEMPERATURE INDICATORS [ ] YES [ ] NO [ ]

5.3.5 — GAS AFTERCOOLER TO _____ °F: YES [ ] NO[ ]

WATER SECTION MAWP : _____ # FIRST STAGE GAS MAWP : _____ #
SECOND STAGE GAS MAWP : _____ # THIRD STAGE GAS MAWP : _____ #
FOURTH STAGE GAS MAWP : _____ # AFTERCOOLER GAS MAWP : _____ #

FANS: NUMBER: _____ DIAMETER: _____ FEET TIP SPEED: _____ FPM

5.6.6 — AUTOMATIC [ ] OR MANUAL [ ] CONTROL OF COOLER AIR CIRCULATION ON INTERSTAGE GAS [ ] AND/OR FINAL DISCHARGE GAS [ ] YES [ ] NO [ ]
IF YES, BY: LOUVERS [ ] VARIABLE PITCH FAN [ ] RE-CIRCULATION [ ] OTHER [ ] (EXPLAIN): _____

5.6.7 — COOLER BUG SCREENS [ ] AND/OR HAIL GUARDS [ ]: YES [ ] NO [ ]

PRESSURE VESSELS

6.1.3 — 6.2.5 — 6.2.6 — 6.3.5 — 6.3.7

6.3.2 — PULSATION STUDY: YES [ ] NO [ ] IF YES, EXPLAIN: _____

SCRUBBERS		STAGE 1	STAGE 2	STAGE 3	DISCHARGE
DESIGN CLASS					
INSIDE DIAMETER	— INCHES				
SEAM-TO-SEAM LENGTH	— INCHES				
DESIGN PRESSURE	— PSIG				
DESIGN TEMPERATURE	— °F				
MESH PAD/VANE MIST EXTRACTOR					
MIST EXTRACTOR MATERIAL					
MANUAL DRAIN	— YES/NO				
TYPE AUTOMATIC DRAIN CONTROL					
TYPE AUTOMATIC DRAIN VALVE					
LIQUID LEVEL GAGE GLASS	— YES/NO				
PRESSURE INDICATOR	— YES/NO				
TYPE AND SIZE INLET FLNG	— INCHES				
TYPE AND SIZE OUTLET FLNG	— INCHES				
CORROSION ALLOWANCE	— INCHES				
WELD PADS/SADDLES	— YES/NO				

PRESSURE VESSELS Continued

SUCTION PULSATION/VOLUME BOTTLES

VOLUME	— CU INCH				
SWEPT VOLUME MULTIPLIER					
INSIDE DIAMETER	— INCHES				
SEAM-TO-SEAM LENGTH	— INCHES				
DESIGN PRESSURE	— PSIG				
DESIGN TEMPERATURE	— °F				
TYPE AND SIZE INLET FLNG	— INCHES				
TYPE AND SIZE OUTLET FLNG	— INCHES				
CORROSION ALLOWANCE	— INCHES				
ASME CODE OR B31.3					
TYPE DRAIN OPENING					
WELD PADS/SADDLES	— YES/NO				

DISCHARGE PULSATION/VOLUME BOTTLES

VOLUME	— CU INCH				
SWEPT VOLUME MULTIPLIER					
INSIDE DIAMETER	— INCHES				
SEAM-TO-SEAM LENGTH	— INCHES				
DESIGN PRESSURE	— PSIG				
DESIGN TEMPERATURE	— °F				
TYPE AND SIZE INLET FLNG	— INCHES				
TYPE AND SIZE OUTLET FLNG	— INCHES				
CORROSION ALLOWANCE	— INCHES				
ASME CODE OR B31.3					
TYPE DRAIN OPENING					
WELD PADS/SADDLES	— YES/NO				

PIPING AND APPURTENANCES

7.1.4 — THE EXTENT OF THE GAS PIPING SUPPLIED SHALL BEGIN AT THE PACKAGE SUCTION FLANGE AND BE CONTINUOUS THROUGH THE SYSTEM TO THE PACKAGE DISCHARGE FLANGE? YES [ ] NO [ ]

OR THE GAS PIPING SHALL BEGIN AS FOLLOWS:

SUCTION:
FLANGE AT SUCTION BOTTLE [ ]
FLANGE AT SUCTION SCRUBBER [ ]
OR FLANGE AT COMPRESSOR NOZZLE [ ]

OTHER (EXPLAIN): [ ] _____

_____

_____

INTERSTAGE:
FLANGE AT SUCTION BOTTLE [ ]
SIDESTREAM CONNECTION [ ]
FLANGE AT INTERSTAGE SCRUBBER [ ]
OR COMPRESSOR NOZZLE [ ]
COMPLETE INTERSTAGE PIPING SYSTEM [ ]

PIPING AND APPURTANCES Continued

OTHER (EXPLAIN): [ ] _____

_____

_____

DISCHARGE: FLANGE AT COOLER DISCHARGE [ ]
FLANGE AT DISCHARGE BOTTLE [ ] OR COMPRESSOR NOZZLE [ ]
SPOOL PIECE FROM FINAL DISCHARGE COOLER TO DISCHARGE SCRUBBER [ ]

OTHER (EXPLAIN): [ ] _____

_____

_____

PIPING, BOTTLES (IF ANY), VESSELS AND THERMOWELLS DESIGNED AND ARRANGED FOR HEAT TRACING AND/OR INSULATION: YES [ ] NO [ ]

7.12 — 7.20.2 — 7.21		SUCTION	1ST INTER STAGE	2ND INTER STAGE	3RD INTER STAGE	DISCHARGE
PIPING I.D.	— INCHES					
DESIGN PRESSURE	— PSIG					
DESIGN TEMPERATURE	— °F					
RELIEF VALVE SIZE	— INCHES					
RELIEF VALVE SETTING	— PSIG					
RELIEF VALVE ORIFICE	— INCHES					
BLOCK VALVE SIZE	— INCHES					
BLOCK VALVE RATING	— PSIG					
BLOWDOWN VALVE SIZE	— INCHES					
BLOWDOWN VALVE RATING	— PSIG					
CHECK VALVE SIZE	— INCHES					
CHECK VALVE RATING	— PSIG					

7.8 — SEAL WELDED, THREADED PIPING JOINTS: YES [ ] NO [ ]

7.10 — ERW STEEL USED FOR SCREWED, FLANGED OR WELDED PIPING: YES [ ] NO [ ]

7.11 — STEEL [ ] OR 300 SERIES STAINLESS STEEL [ ]
TUBING FITTINGS: YES [ ] NO [ ]

7.12 — VALVES IN FLAMMABLE OR TOXIC SERVICE SHALL HAVE BOLTED OR WELDED BONNETS [ ] BOLTED GLANDS [ ] AND BE 'FIRE-SAFE' [ ]

7.15 — TEMPORARY START-UP SCREENS: YES [ ] NO [ ]
REMOVABLE SPOOL-PIECE: YES [ ] NO [ ]

7.16.2 — STEEL [ ] OR 300 STAINLESS STEEL [ ] OIL LINES DOWNSTREAM OF THE OIL FILTER: YES [ ] NO [ ]

7.17.1 — COMPLETE ON-SKID COOLANT PIPING SYSTEM FOR LIQUID COOLED CYLINDERS: YES [ ] NO [ ]

7.19.2 — COMMON DISTANCE PIECE VENT HEADER: YES [ ] NO [ ]

7.19.3 — COMMON DISTANCE PIECE DRAIN HEADER: YES [ ] NO [ ]

7.19.4 — COMMON PACKING VENT HEADER: YES [ ] NO [ ]

7.20.4 — RELIEF AND BLOWDOWN VALVES VENT TO ATMOSPHERE [ ] OR

7.21 — INTO COMMON HEADER [ ]
OR OTHER (EXPLAIN): [ ] _____

ELECTRICAL SYSTEMS

8.2

SERVICE	_____	_____	_____	_____
ELECTRIC MOTOR MANUFACTURER	_____	_____	_____	_____
MODEL	_____	_____	_____	_____
SPEED	_____	_____	_____	_____
NEMA RATING	_____	_____	_____	_____
FRAME TYPE	_____	_____	_____	_____
DC VOLTS	_____	_____	_____	_____
AC PHASE/HERTZ/VOLTS	_____	_____	_____	_____
ENCLOSURE TYPE	_____	_____	_____	_____
SERVICE FACTOR	_____	_____	_____	_____
MOTOR CONTROL MANUFACTURER	_____	_____	_____	_____
NEMA RATING	_____	_____	_____	_____

8.5 — ELECTRICAL MATERIAL SUITABLE FOR TROPICAL LOCATION: YES [ ] NO [ ]

INSTRUMENTS AND CONTROLS

9.1 — IN ADDITION TO ANY INSTRUMENT AND CONTROL PANELS AND TO ANY CAPACITY CONTROL, THE FOLLOWING CONTROL SYSTEMS ARE INCLUDED:

FUNCTION:	_____	_____	_____
MANUAL/AUTO:	_____	_____	_____

9.1.5 — PNEUMATIC INSTRUMENT SUPPLY: GAS [ ] OR INSTRUMENT AIR [ ]

9.2.1 — INSTRUMENT PANEL WITH ENCLOSED BACK: YES [ ] NO [ ]

9.2.2 — FREE-STANDING, SKID-MOUNTED [ ] OR OFF-SKID MOUNTED [ ] PANEL

9.2.3 — WIRING TO REMOTE PANELS INSTALLED IN CONDUITS [ ] OR ENCLOSURES [ ] OR ARMORED CABLE [ ]

9.3.1 — PANEL MOUNTED DIGITAL [ ] OR ANALOG [ ] TACH: YES [ ] NO [ ]

9.3.2 — LIQUID FILLED TEMPERATURE INDICATORS: YES [ ] NO [ ]

9.3.2.4 — GROUNDED [ ] OR UNGROUNDED [ ] THERMOCOUPLES: YES [ ] NO [ ]

9.3.3 — LIQUID FILLED PRESSURE INDICATORS: YES [ ] NO [ ]

SHUTDOWNS, ALARMS AND ANNUNCIATORS

10.1 — SHUTDOWNS, ALARMS AND ANNUNCIATORS — PNEUMATIC [ ] OR ELECTRIC [ ]

PART 1 — MATERIAL REQUIREMENTS

SHUTDOWNS, ALARMS AND ANNUNICIATORS

9.3.2 - 9.3.3 - 10.2.1

NOTE:

[X] INDICATES THE DESIRED ACTION, TYPE AND LOCATION OF ANNUNCIATION AND LOCATION OF THE SENSING DEVICE. MARK EACH BOX FOR MULTIPLE REQUIREMENTS.

	DESIRED ACTION			TYPE LOCATION ANNUNCIATION				SENSING DEVICE LOCATION	
	SHUTDOWN	ALARM	INDICATOR	VISUAL	AUDIBLE	PANEL	REMOTE	PANEL	LOCAL
COMPRESSOR									
SUCTION GAS PRESSURE — FIRST STAGE			[X]						
LOW	[X]	[ ]	[ ]	[X]	[ ]	[ ]	[ ]	[ ]	[ ]
HIGH	[X]	[ ]	[ ]	[X]	[ ]	[ ]	[ ]	[ ]	[ ]
SUCTION GAS PRESSURE — INTERSTAGE			[ ]						
LOW	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
HIGH	[X]	[ ]	[ ]	[X]	[ ]	[ ]	[ ]	[ ]	[ ]
DISCHARGE GAS PRESSURE — INTERSTAGE			[X]						
LOW	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
HIGH	[X]	[ ]	[ ]	[X]	[ ]	[ ]	[ ]	[ ]	[ ]
DISCHARGE GAS PRESSURE-FINAL STAGE			[X]						
LOW	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
HIGH	[X]	[ ]	[ ]	[X]	[ ]	[ ]	[ ]	[ ]	[ ]
LUBE OIL PRESSURE									
IN — FILTER	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
OUT — FILTER	[ ]	[ ]	[X]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
LOW	[X]	[ ]	[ ]	[X]	[ ]	[ ]	[ ]	[ ]	[ ]
LUBE OIL TEMPERATURE									
IN	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
OUT	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
HIGH	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
GAS TEMPERATURE — EACH STAGE									
SUCTION	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
DISCHARGE — EACH CYLINDER	[ ]	[ ]	[X]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
HIGH — EACH CYLINDER	[X]	[ ]	[ ]	[X]	[ ]	[ ]	[ ]	[ ]	[ ]
LUBE OIL LEVEL									
LOW — FRAME	[X]	[ ]	[ ]	[X]	[ ]	[ ]	[ ]	[ ]	[ ]
LOW — LUBRICATOR	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
LUBRICATOR									
NO-FLOW	[X]	[ ]	[ ]	[X]	[ ]	[ ]	[ ]	[ ]	[ ]
VIBRATION									
HIGH	[X]	[ ]	[ ]	[X]	[ ]	[ ]	[ ]	[ ]	[ ]
CYLINDER COOLANT TEMPERATURE									
IN	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
OUT — EACH CYLINDER	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
HIGH	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
NATURAL GAS ENGINE — IF FURNISHED									
HIGH/LOW MANIFOLD PRESSURE/VACUUM	[X]	[ ]	[ ]	[X]	[ ]	[ ]	[ ]	[ ]	[ ]
COOLANT TEMPERATURE									
IN	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
OUT	[ ]	[ ]	[X]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
HIGH	[X]	[ ]	[ ]	[X]	[ ]	[ ]	[ ]	[ ]	[ ]

SHUTDOWNS, ALARMS AND ANNUNCIATORS Continued

NOTE:

[X] INDICATES THE DESIRED ACTION, TYPE AND LOCATION OF ANNUCIATION AND LOCATION OF THE SENSING DEVICE. MARK EACH BOX FOR MULTIPLE REQUIREMENTS.

	SHUTDOWN	ALARM	INDICATOR	VISUAL	AUDIBLE	PANEL	REMOTE	PANEL	LOCAL
LUBE OIL TEMPERATURE									
IN	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
OUT	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
HIGH	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
LUBE OIL PRESSURE									
IN — FILTER	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
OUT — FILTER	[ ]	[ ]	[X]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
LOW	[X]	[ ]	[ ]	[X]	[ ]	[ ]	[ ]	[ ]	[ ]
COOLANT PRESSURE									
IN	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
OUT	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
LOW	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
FUEL GAS PRESSURE	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
STARTING AIR/GAS PRESSURE	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
VIBRATION									
HIGH	[X]	[ ]	[ ]	[X]	[ ]	[ ]	[ ]	[ ]	[ ]
LUBE OIL LEVEL									
LOW	[X]	[ ]	[ ]	[X]	[ ]	[ ]	[ ]	[ ]	[ ]
OVERSPEED	[X]	[ ]	[ ]	[X]	[ ]	[ ]	[ ]	[ ]	[ ]
_____	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
_____	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
_____	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
_____	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
ELECTRIC MOTOR — IF FURNISHED									
STATOR WINDING TEMPERATURE									
HIGH	[X]	[ ]	[ ]	[X]	[ ]	[ ]	[ ]	[ ]	[ ]
VIBRATION									
HIGH	[X]	[ ]	[ ]	[X]	[ ]	[ ]	[ ]	[ ]	[ ]
_____	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
_____	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
_____	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
_____	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
_____	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
OTHER									
COOLER VIBRATION									
HIGH	[X]	[ ]	[ ]	[X]	[ ]	[ ]	[ ]	[ ]	[ ]
COOLER COOLANT LEVEL									
LOW	[X]	[ ]	[ ]	[X]	[ ]	[ ]	[ ]	[ ]	[ ]
SCRUBBER LIQUID LEVEL									
HIGH	[X]	[ ]	[ ]	[X]	[ ]	[ ]	[ ]	[ ]	[ ]
LOW	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
_____	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
_____	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
_____	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
_____	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
_____	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]

SKID

11.1 — CONSTRUCTION: STRUCTURAL STEEL [ ] PRE/POST STRESSED CONCRETE [ ] CONCRETE FILLED STRUCTURAL STEEL [ ] OTHER (EXPLAIN): _____

BEAM: FLANGE _____ INCHES WEIGHT: _____ POUNDS

DECK PLATE: YES [ ] NO [ ]

11.2.3 — FRAME MOUNTING: BOLTED [ ] GROUTED [ ] SOLE PLATE/RAIL [ ]

11.2.3 — PRIME MOVER MOUNT: BOLTED [ ] GROUTED [ ] SOLE PLATE/RAIL [ ]

11.2.4 — SHIM MATERIAL: _____

11.2.6 — FOUNDATION BOLTS: NUMBER OF FOUNDATION BOLTS PER SIDE: _____

11.2.9 — SCRUBBER MOUNTING: BOLTED [ ] WELDED TO STRUCTURAL MEMBERS [ ]

11.4 — WALKWAYS/STAIRS: PROVIDED WITH WALKWAYS: YES [ ] NO [ ]

OVERALL SHIPPING DIMENSIONS AND WEIGHT

	MAIN SKID		
HEIGHT — FEET	_____	_____	_____
WIDTH — FEET	_____	_____	_____
LENGTH — FEET	_____	_____	_____
WEIGHT — POUNDS	_____	_____	_____

PAINT AND PAINTING

12.1 — PACKAGE: PACKAGER'S STANDARD [ ] SPECIAL (EXPLAIN):

[ ] _____

12.1 — COMPRESSOR: PACKAGER'S STANDARD [ ] SPECIAL (EXPLAIN):

[ ] _____

12.1 — PRIME MOVER: PACKAGER'S STANDARD [ ] SPECIAL (EXPLAIN):

[ ] _____

12.5 — AIR EXCHANGER: SIDING/STRUCTURE: PACKAGER'S STANDARD [ ]
HOT-DIP GALVANIZING [ ] SPECIAL (EXPLAIN):

[ ] _____

HEADERS: PACKAGER'S STANDARD [ ]
HOT-DIP GALVANIZING [ ] SPECIAL (EXPLAIN):

[ ] _____

INSPECTION, TESTING, AND PREPARATION FOR SHIPMENT

13.2.1.3 — TESTS PERFORMED: REVIEW OF QUALITY CONTROL [ ] HYDROSTATIC [ ]
13.2.3 MECHANICAL RUN [ ] AIR PRESSURE TEST OF
13.3.1.1 ASSEMBLED PACKAGE [ ]

OTHER (EXPLAIN): [ ] _____

_____

_____

13.2.2 — INSPECTIONS: BY PURCHASER: TYPE (EXPLAIN):

_____

_____

_____

INSPECTION, TESTING, AND PREPARATION FOR SHIPMENT Continued

13.5.1 — SHIPMENT: EXPORT CRATED: YES [ ] NO [ ]
13.5.2 PACKAGER STORAGE: YES [ ] NO [ ]
SPECIAL SHIPMENT PREPARATION YES [ ] NO [ ]

IF YES, EXPLAIN: _____

_____

SPECIAL LIFTING LUGS, ETC. YES [ ] NO [ ]

IF YES, EXPLAIN: _____

CORROSIVE GASES

15.1 — CORROSIVE GAS COMPRESSED: YES [ ] NO [ ]

15.3.2.3 — PRECIPITATION HARDENED STAINLESS STEEL PISTON ROD [ ] OR
15.4.3.2 4140 STEEL PISTON ROD ANNEALED TO C22 [ ] WITH HARDENING IN THE PACKING AREA EITHER BY CHROME PLATING [ ] OR TUNGSTON CARBIDE COATING [ ] OR NACE MATERIAL EQUIVALENT PISTON ROD [ ]

15.3.3.7 — PURGED PACKING CASES: YES [ ] NO [ ] IF YES, WITH SWEET NATURAL GAS [ ] OR INERT GAS [ ] TYPE: _____

15.3.3.7 — DISTANCE PIECE: TYPE 1 [ ] OR TYPE 2 [ ] OR TYPE 3 [ ]
EVACUATED WITH A VACUUM PUMP: YES [ ] NO [ ]
OR PURGED YES [ ] NO [ ] WITH SWEET NATURAL GAS [ ]

OR INERT GAS [ ] TYPE: _____

15.3.4 — H_2S AND/OR CO_2:

FURNISH AUSTINITIC [ ] OR 12CR [ ] STAINLESS STEEL ON ALL PARTS THAT ARE IN CONTACT WITH THE PROCESS GAS STREAM:

PROCESS GAS PIPING	CARBON STEEL	STAINLESS STEEL	OTHER	
COLD SIDE PIPING				
HOT SIDE PIPING	[ ]	[ ]	[ ]	_____
BYPASS PIPING	[ ]	[ ]	[ ]	_____
VENT LINES	[ ]	[ ]	[ ]	_____
DRAIN LINES	[ ]	[ ]	[ ]	_____
PULSATION BOTTLES				
SUCTION	[ ]	[ ]	[ ]	_____
DISCHARGE	[ ]	[ ]	[ ]	_____
SCRUBBERS	[ ]	[ ]	[ ]	_____
SUCTION	[ ]	[ ]	[ ]	_____
INTERSTAGE	[ ]	[ ]	[ ]	_____
DISCHARGE	[ ]	[ ]	[ ]	_____
GAS COOLER				
HEADER	[ ]	[ ]	[ ]	_____
TUBES	[ ]	[ ]	[ ]	_____
VALVES				
SUCTION BLOCK	[ ]	[ ]	[ ]	_____
DISCHARGE BLOCK	[ ]	[ ]	[ ]	_____
BYPASS VALVES	[ ]	[ ]	[ ]	_____
BLOWDOWN VALVE	[ ]	[ ]	[ ]	_____
CHECK VALVE	[ ]	[ ]	[ ]	_____
UTILITY PROCESS VALVES	[ ]	[ ]	[ ]	_____
RELIEF VALVES	[ ]	[ ]	[ ]	_____
INSTRUMENTATION				
SCRUBBER CONTROLS	[ ]	[ ]	[ ]	_____
PRESSURE SWITCHES	[ ]	[ ]	[ ]	_____
TEMPERATURE SWITCHES	[ ]	[ ]	[ ]	_____
TUBING	[ ]	[ ]	[ ]	_____
FITTINGS	[ ]	[ ]	[ ]	_____

OFFSHORE AND/OR MARINE ENVIRONMENT

16.1.3 — CORROSIVE ENVIRONMENT: YES [ ] NO [ ]

16.2.1 — SHIELDED [ ] OR NON-SHIELDED [ ] LOW TENSION MAGNETO IGNITION SYSTEM

16.4.1 — COOLER HEADERS: PACKAGER'S MANUFACTURER'S STANDARD PAINT [ ]
HOT-DIPPED GALVANIZING [ ] SPECIAL PAINT (EXPLAIN): [ ]

16.8.4 — DISCHARGE PIPING INSULATION: YES [ ] NO [ ]
DISCHARGE BOTTLE INSULATION: YES [ ] NO [ ]

16.10.3 — BLOCK VALVES: MANUAL [ ] OR PILOT-OPERATED [ ] SUCTION [ ]
AND/OR DISCHARGE [ ] BLOCK VALVE: YES [ ] NO [ ]

16.10.4 — PISTON TYPE DISCHARGE CHECK VALVE: YES [ ] NO [ ]

MISCELLANEOUS

FURNISH COPIES INDICATED: PROPOSAL _____ REPORTS _____ DRAWINGS _____

DATA BOOKS _____ CURVES _____ MISC: _____

1.3 — PERFORMANCE CURVES: YES [ ] NO [ ]
INDICATE RANGE: _____

1.5 — APPROVAL DRAWINGS: YES [ ] NO [ ]
AS BUILT DRAWINGS: YES [ ] NO [ ]
MISCELLANEOUS DRAWINGS: YES [ ] NO [ ]

IF YES, EXPLAIN: _____

1.9 — TORSIONAL REPORT: YES [ ] NO [ ]

EXCEPTIONS TO API SPECIFICATION 11P