

**RECIPROCATING COMPRESSORS FOR GENERAL REFINERY SERVICE****API-618****FOURTH EDITION 1995**

(COMMENTS AND CLARIFICATIONS FOR BLACKMER HD VERTICAL COMPRESSORS)

**SECTION 2 - BASIC DESIGN****2.1 GENERAL**

2.1.2 The sound level as measured by a sound level meter is expected to be less than 85 dba at one meter for the typical application. The actual sound level and its frequency distribution is widely variable and depends on the compression application, piping arrangement and mounting. No standard guarantee is offered in regard to sound level generation or control. See the proposal details for response to the specific inquiry requirements.

2.1.9 Doweling of cylinder / distance piece / crankcase is available as an option.

2.1.13 Certified power tolerance is as follows:

inlet pressure <0 psig +/- 5%

inlet pressure =0 psig +/- 5%

inlet pressure >0 psig +/- 3%

2.3.2 Discharge temperature switches are proposed as optional equipment.

**2.4 ROD LOADINGS**

2.4. 4 This applies only to compressors which use a crosshead pin and bushing arrangement. The Blackmer compressor has a needle bearing at the crosshead pin which ensures adequate lubrication even with non-reversing rod loads.

**2.6 COMPRESSOR CYLINDERS**

2.6.1.2 Vertical cylinders are offered.

2.6.1.3 Packing maintenance requires cylinder removal. This is easily accomplished due to the small size and vertical arrangement of the machine. Rings can be replaced by removing the cylinder head.

2.6.1.4 The HD vertical compressor has needle bearings at the wrist pins and is designed to operate with non-reversing rod loads.

**2.6.2 CYLINDER APPURTENANCES**

2.6.2.1 Vertical cylinders are offered. Cylinder supports are not required. Vertical rod run-out requirements are not applicable to the stacked, vertical assembly of the Blackmer compressor. Also, the short, light-weight, vertical piston and rod are unaffected by gravity which affects the run-out of the larger, heavier, horizontal assemblies for which this specific item is intended.

The Blackmer piston rod is affixed to the crosshead and finish machined as an assembly to assure concentricity and perpendicularity. The extra long crosshead guide includes the packing case retainer. This is mounted atop the compressor crankcase. During compressor buildup, the assembled packing case is centered on the rod, secured in the crosshead guide and the entire guide and packing assembly then tightened to the crankcase. The cylinder is then mounted atop the crosshead and the piston installed on the rod and centered in the bore. The cylinder is then tightened on the crosshead guide.

2.6.2.3 Non-linered cylinders are offered,. The ready availability and low price of cylinders make replacement a practical alternative to liners or reborring. The HD is a non-lube compressor with less than 10 inch bore.

2.6.2.4 Reborring is not permitted.

2.6.2.5 The Blackmer compressor does not require wear bands. Cylinder bore finish is 16 microinches RMS.

2.6.2.7 Bolts and capscrews are used instead of studs.

2.6.2.10 Hex head bolts ASTM A307 Grade 5. Socket head bolts are ANSI B18.2.1.

2.6.2.11.5 Lock nuts are used on the connecting rods. Nylon locking inserts are used on the piston to rod nuts.

**2.6.3 CYLINDER COOLING**

2.6.3.3 Coolant water supply (if applicable) is not included nor regulated in the compressor scope of supply unless stated otherwise in the body of the proposal.

2.6.3.5.3 The scope of supply is as specifically detailed in the body of the proposal.

2.6.4 CYLINDER CONNECTIONS

2.6.4.1 The model HD 942 compressor has 2" ANSI 300# studed faces. The model HDL342C has 1-1/2" ANSI 600# studed faces. The model HDL362C has 1-1/2" ANSI 300# studed faces. The other HD models have connections as follows. Standard connection is bolted with companion flange provided for NPT or optional slip-on weld. HD16x and HD17x have tapped NPT in cylinder head. (D.I. denotes Ductile Iron; Stl is Steel)

<u>model</u>	<u>standard NPT</u>	<u>option FF with 4 bolt slip-on weld companion flange</u>
HD16x	3/4" NPT, tapped	not available
HD17X	3/4" NPT, tapped	not available
HD36X	1-1/4" in, out	Stl 1-1/2 NPT, Steel weld 1-1/4", 1-1/2"
HD37X	1-1/4" NPT, tapped in	
	Stl, 3/4" NPT interstage	Stl 1"NPT; Steel weld 3/4", 1"
	1" NPT, tapped out	
HD60X	D.I. 2" in	D.I. 1-1/2" NPT, Stl weld 1-1/2", 2"
	D.I. 1-1/2", out	D.I. 2" NPT, Stl weld 1-1/2", 2"
HD61X	D.I. 2" in	D.I. 1-1/2" NPT, Stl weld 1-1/2", 2"
	D.I. 1-1/2", out	D.I. 2" NPT, Stl weld 1-1/2", 2"

2.6.4.4 Serrated finishes are not used on the machined flange boss.

2.6.4.5 NPT connections are used up to and including 2 inch nominal. All 2 inch connections, however, are available in weld flange as an option.

2.6.4.6 Cylinder indicator connections are not available.

2.7 VALVES AND UNLOADERS

2.7.2 Unloader indication is by pressure gauge in each supply line. Control panel light is also provided to indicate solenoid position.

2.7.3 Non-interchangeable ( cannot put suction valve in discharge port ) valves are available as a priced option. It is possible to put a discharge valve in a suction port.

2.7.4 Valve cap and cover gaskets are "O" ring type.

2.7.5 Models 16X/17X do not comply.

2.7.9 A computer valve dynamics optimization analysis is not included.

2.7.13 Refer to the body of the proposal to determine if included and optional price.

2.8 PISTONS, PISTON RODS, AND PISTON RINGS

2.8.1 Rod is permanently attached to the crosshead. Piston locknut does have a positive locking plug.

2.8.2 Single acting cylinders have no piston gas pockets. Double acting pistons are hollow but do not trap gas.

2.8.4 Piston rod material is 4140 Steel, black surface and hardened to Rockwell 60C. Surface finish is 8 RMS. Rods are not magnafluxed but available as a priced option. Chrome Oxide coating is available as a priced option.

2.9 CRANKSHAFTS, CONNECTING RODS, BEARINGS, AND CROSSHEADS

2.9.1 Crankshafts are cast ductile iron. No ultrasonic testing is provided.

2.9.5 Connecting rods are not forged. They are ductile iron. Bolts and nuts are not retained with cotter pins or lock wire. Lubrication passages are cast-in tubing.

2.9.6 Crossheads do not have replaceable, shim adjustable shoes. Bushings are secured with a press fit and not otherwise locked in place. Crosshead assembly is serviced from the top after cylinder removal.

2.10 DISTANCE PIECES

2.10.1.3 Packing rings are one piece, non-segmental (the HD 942 also uses radial / tangential rings in its upper packing case).

2.10.1.4 Packing rings are one piece, non-segmental

2.10.2 The crosshead guide has an inspection opening to assist in removal of the assembled packing case which is accomplished after cylinder removal. On type C two-compartment distance pieces the outboard compartment is accessed by cylinder removal.

2.10.5 Vent and drain connections are 1/4" NPT. External piping and equipment are supplied only if specifically noted in the body of the proposal. The crosshead guide and separate distance piece(if offered) are pressure containing parts and designed for the MAWP on the cylinder. No relief device for distance piece is required.

2.11 PACKING CASES AND PRESSURE PACKING

2.11.1 Packing varies according to the application and model and may include segmented radial or tangential or one piece, V-ring, non-segmental. Refer to the proposal details.

2.11.2 Packing cases are retained by a concentric, threaded, retainer ring. This provides the required positive alignment feature.

2.11.4.2 Liquid cooled packing cases are not available.

- 2.11.4.2.1 Liquid cooled packing cases are not available
- 2.11.4.2.2 Liquid cooled packing cases are not available
- 2.11.4.3 Liquid cooled packing cases are not available
- 2.11.4.4 Liquid cooled packing cases are not available
- 2.11.5 Liquid cooled packing cases are not available
- 2.11.7 V-ring packing functions as both a pressure seal and oil wiper.
- 2.11.8 This is available on HD942 only.
- 2.12 COMPRESSOR FRAME LUBRICATION
- 2.12.3.4 The frame oil system operates at a nominal 30 psig. Rated pressure is approximately 60 psig.
- 2.12.4 A frame oil cooler is not required to maintain 130 deg.F oil supply.
- 2.12.5 An oil temperature control valve is not required.
- 2.12.6 A full flow oil filter is standard. This is a pump mounted, spin-on design. A crankcase oil heater can be provided as a priced option. Dual filter systems are not available.
- 2.12.7 A steam heating element is not included in the scope of supply unless specifically noted in the body of the proposal.
- 2.12.8 A bayonet type dip stick is included to determine oil level. A sight glass is available as a priced option.
- 2.13 CYLINDER AND PACKING LUBRICATION
- All Compressor cylinders and packing are non-lubricated.
- 2.14 MATERIALS
- 2.14.1 Materials of construction will be as stated in the body of the proposal. Material certifications are not provided unless specifically noted in the body of the proposal.
- 2.14.2.1 ASTM A536 Grade 65-45-12 is used for Nodular Iron cylinder components. Grade 60-40-18 is used for connecting rods, ASTM A-48 class 40-B for the crosshead.
- 2.14.3.5.1 Material specimens and tests are not standard but could be available at a price and delivery to be determined at the appropriate time.
- 2.14.3.5.2 Each cylinder lot is accompanied with a test certificate noting tensile, yield, hardness, chemical composition and a microscopic photo from the examination.
- 2.14.3.5.4 These specifics are not done at the foundry. These hardness tests and readings can be done prior to cylinder assembly as a priced option.
- 2.14.7 WELDING
- The base compressor and standard accessories do not have welded components. Refer to the proposal details for specific comments as they apply to the scope of supply.
- 2.14.8 LOW TEMPERATURE
- The minimum design metal temperature for the ductile iron casting is -20 degrees fahrenheit.
- 2.15 NAMEPLATES AND ROTATION ARROWS
- 2.15.2 Rotation arrows are provided only on 2-stage air cooled units for proper cooling fan air direction. The compressor itself may rotate in either direction and so a direction arrow is not otherwise required. Standard arrow is a vinyl decal or aluminum nameplate. Stainless steel nameplate is available at additional price and delivery.
- 2.15.4 The standard nameplate contains the model #, serial # and ID # from which significant information can be obtained from review of the unit manual. A special name tag can be provided as a priced option.
- 2.15.5 Special auxiliary nameplates do not apply to belt driven compressors.

### SECTION 3 - ACCESSORIES

- 3.1 DRIVERS
- 3.1.2.1 If included, standards API 541, Part 2 or API 546 will be so noted on the motor data sheets.
- 3.1.2.8 Does not apply to belt driven units as proposed here.
- 3.1.2.9 Does not apply to belt driven units as proposed here.
- 3.1.2.10 Does not apply to belt driven units as proposed here.
- 3.1.2.11 Does not apply to belt driven units as proposed here.
- 3.1.2.12 Does not apply to belt driven units as proposed here.
- 3.2 COUPLINGS AND GUARDS
- 3.2.2.1 Guards are removable for access and barring by hand. An access panel is available as a priced option.
- 3.2.2.2 Guards fully enclose the flywheel and belt and are easily removable. A weather proof access door is not offered.
- 3.5 MOUNTING PLATES
- 3.5.1.2.2 Top of skid is not machined. Top of compressor standard baseplate is not machined. Details of the structural baseplate proposed are stated in the body of the proposal.
- 3.5.1.2.3 Does not apply.
- 3.5.1.2.4 Does not apply.

- 3.5.1.2.5 Does not apply.
- 3.5.1.2.7 Does not apply.
- 3.5.1.2.13 Does not apply.
- 3.5.1.2.15 Specially coated grout surfaces, compatible with epoxy grout, are not included unless specifically stated in the body of the proposal.
- 3.5.2.8 Lifting lugs are offered as a priced option.
- 3.6 CONTROLS AND INSTRUMENTATION
- 3.6.1 GENERAL
- 3.6.1.1 Only those controls and instruments specifically stated in the body of the proposal are included.
- 3.6.1.3 Unless otherwise stated in the proposal, controls will meet API RP 550, Part I.
- 3.6.1.7 Isolation valves for instruments and controls are offered as priced options. Only those valves specifically noted will be provided.
- 3.6.2 CONTROL SYSTEMS
- 3.6.3 INSTRUMENT AND CONTROL PANELS
- 3.6.3.1 Only those panels, controls and instruments specifically stated in the body of the proposal are included
- 3.6.4 INSTRUMENTATION
- 3.6.4.2.2 Temperature gauges are offered as a priced option.
- 3.6.4.3.2 Standard pressure gauges are 2-1/2" dial, 1/4" stainless steel bourdon tube with 1/4" NPT. 4-1/2 inch dial type are offered as a priced option. Machinery connection remains 1/4" NPT.
- 3.6.4.4 RELIEF VALVES
- 3.6.4.4.1 The standard relief valve does not comply with RP 520 Parts I and II, API 526. These are offered as priced options.
- 3.6.5 ALARMS AND SHUTDOWNS
- 3.6.5.2 All alarms and shutdowns are offered as priced options. Individual cylinder temperature switches are available only on two-stage units. Cylinder lubricator systems do not apply to these non-lube machines. High filter differential pressure switches are not available. See proposal for details of offering.
- 3.6.6 ELECTRICAL SYSTEMS
- 3.6.6.1 Unless otherwise stated, all electrical will comply with Class I, Group D, Div. 2.
- 3.7 PIPING AND APPURTENANCES
- 3.7.1.6 Only those items specified by the purchaser and noted in the body of the proposal are included. In general, the equipment baseplate is sufficiently small that process piping can terminate at the terminal connection on the equipment, tubing is brought to a bulkhead and vents, drains to one end of baseplate. See proposal for details.
- 3.7.1.8 The standard line and vessel sizes are small and do not have hand-holes or inspection / service openings. These will be priced as optional extras if stated in the body of the proposal as a part of our scope of supply.
- 3.7.1.12.2 The series 360/370 model compressors have 1-1/4" NPT cylinder connections.
- 3.7.1.12.9 Seal welding can not be provided on machinery connections. Seal welding of piping is addressed in the body of the proposal.
- 3.7.2 FRAME LUBRICATING OIL PIPING REQUIREMENTS
- 3.7.2 The frame oil system is internal to the copressor.
- 3.7.3 FORCE-FEED LUBRICATOR TUBING REQUIREMENTS
- 3.7.3 The BLACKMER HD compressor is non-lubricated.
- 3.7.4 COOLANT PIPING REQUIREMENTS
- 3.7.4.2 The low flow coolant system used in the HD compressor does not require valves and flow meters and none are recommended. Only those valves called for in the customer data sheet and specification are proposed. See body of the proposal for scope and content offered in the package.
- 3.7.5 INSTRUMENT PIPING REQUIREMENTS
- 3.7.5.1 Only those items specifically requested in the purchaser data sheets are offered. See the body of the proposal for offer details.
- 3.7.6 PROCESS PIPING
- 3.7.6.3 A temporary startup screen and piping will be offered as a priced option if specified by the customer.
- 3.8 INTERCOOLERS AND AFTERCOOLERS
- 3.8.3 Exchangers to the specified codes and standards will be offered as priced options to the standard heat exchangers.
- 3.8.7 The standard air cooler does not comply with API 661. Compliance will be offered as a priced option.
- 3.8.8 Automatic temperature control will be offered if specifically requested by the purchaser.
- 3.9 PULSATION AND VIBRATION CONTROL REQUIREMENTS
- 3.9.1 GENERAL
- 3.9.1 The low power and pressure levels of the HD compressor line make acoustic pulsation concerns extremely unlikely. No pulsation devices nor studies, analyses are included.

- 3.9.2 3.10 AIR INTAKE FILTERS  
Intake air filter, if required, is proposed as an option.
- 3.11 TOOLS
- 3.11.1 Tools are offered as a priced option.
- 3.11.3 If specifically requested, boxing and tagging will be proposed as a priced option.

#### SECTION 4 - INSPECTION, TESTING, AND PREPARATION FOR SHIPMENT

- 4.1 GENERAL
- 4.1.1 Sub-vendor inspection is available only when agreed in advance by all parties.
- 4.1.4.1 Only those special tests and inspections requested by the purchaser and specifically stated in the body of the proposal are agreed.
- 4.2.2.3.3 No ultrasonic testing is provided.
- 4.2.5 Chemical cleaning is not proposed unless stated in the body of the proposal.
- 4.2.3.2 API 614 does not apply to the compressor oil system which is internal, self contained.
- 4.3.2.2 Helium leak testing is available as a priced option.
- 4.3.2 MECHANICAL RUNNING TESTS
- 4.3.3.2 A four hour mechanical running test of the completed package may be available as a priced option, depending upon specifics of the offering. Please refer to the body of the proposal for the specific response.
- 4.3.3.6 Inspection dismantling , if specified, is available as a priced option.
- 4.3.3 OTHER TESTS
- 4.3.4.1 A bar-over test and measurement of piston end clearances is performed as a standard assembly procedure. Repeat or witness of this is available as a priced option if specified by the purchaser. "Run-out" is not a factor in the vertical design of the Blackmer compressor. See comments under 2.6.2.1.
- 4.3.4.2 Fit up tests are a priced option.
- 4.3.4.3 Compress valve leak tests are a priced option.
- 4.4 PREPARATION FOR SHIPMENT
- 4.4.1 Blackmer's standard compressor preparation for shipment is proposed. It is adequate for the typical storage, transport and installation process. Purchaser must advise any special requirements.
- 4.4.3.4 The compressor components are washed with a rust preventive after machining and prior to assembly. Please refer to the body of the proposal to determine what additional steps, if any, are offered for the package.
- 4.4.3.6 Commercial plastic flange covers are provided as standard.
- 4.4.3.10 Refer to the proposal for details of compliance.
- 4.4.4 Can be provided as a priced option.

#### SECTION 5

- 5.1 PROPOSALS
- 5.2.2 This is interpreted to mean drawings and data readily available and standard vendor and sub-vendor practice. No special drawings are proposed in this regard. Blackmer will attempt to be fully responsive to specific requirements in the proposal stage. Document, data, and drawing requirements will be deliverables defined in the order.
- 5.2.2 CURVES AND TABULATIONS  
Blackmer will attempt to be fully responsive to specific requirements in the proposal stage. Document, data, and drawing requirements will be deliverables defined in the order.
- 5.3.3.2 Rod-load charts can be provided as a priced option.
- 5.3.3.4 Speed - torque curves are not applicable.

#### APPENDIX H

Crankshaft and connecting rods are cast Ductile Iron  
Cylinder liners are not provided  
Steel valve plates may be offered  
Ductile Iron packing cases may be offered

