## COMPRESSOR

1 Ariel JGK-2, two throw, horizontally balanced-opposed compressor frame equipped with the following accessory equipment:

- full-flow canister type oil filter
- force-feed lubricator with block distribution system and cycle indicator
- lube oil cooler, shell and tube type.

**Compressor to be equipped with the following items for (future) high sour gas service:**

- **No yellow metals in the compressor crankcase**
- Long two compartment distance piece, API type 3
- Cylinder bolting per NACE MR0175, 22HRC maximum
- Piston rod packing arranged for purge
- Cylinder flushing oil system
- Top & bottom lubrication points
- Stainless steel tubing
- Stainless steel (17-4 PH) piston rods
- Tungsten Carbide LW-15, 8mc finish in the packing area of the above piston rods.

**Compressor equipment to be supplied with the following additional items:**

- U.T. of compressor crankshaft
- Witnessed cylinder hydro testing
- Cylinder material MTR's (chemical analysis only)
- Crankshaft MTR's (chemical analysis only)
- Connecting rod MTR's (chemical analysis only)
- Piston rod MTR's (chemical analysis only)
- Piston rod MPI

**Stage 1 :**

1 14-1/8" class, 13.625 " bore cylinder, non-cooled, double acting cylinder, equipped with steel piston rod with rolled threads, Special France rod packing and Hoerbiger non-metallic plate valves.

| | |
|---|---|
| Cylinder MAWP: | 635 psig |
| NACE MAWP: | 430 psig |

1 Variable volume clearance pocket for the above cylinder.

**Stage 2 :**

1 8-3/8" class, 7.875" bore cylinder, non-cooled, double acting cylinder, equipped with steel piston rod with rolled threads, Special France rod packing and Hoerbiger non-metallic plate valves.

Cylinder MAWP: 1895 psig
NACE MAWP: 1315 psig

1 Mechanical balancing equipment for each set of opposing cylinders.

4 Stainless steel Kienne valves for HE and CE of each cylinder

2 Special Talisman gasket material from cylinder to bottle

## COMPRESSOR EQUIPMENT AND CONTROLS

1 ARO Pneumatically operated prelube pump assembly, diaphragm type PN# ARO-CPQ2187 c/w

- discharge check valve
- suction and discharge block ball valves
- y-strainer
- Fisher 67 AFR supply regulator
- ¼" supply and vent tubing

1 Oil drain ball valve, 1" NPT, regular port, with latching handle.

1 Amot thermostatic valve, 1" NPT, 180 °F, cast iron body (lube oil control)

2 Compressor level controller, Kenco LCE-9 (Crankcase and Lubricator supply)

1 Oil tank, integral with overhead crane rail (split design for Crankcase/Lubricator) c/w:

- gauge glass
- level gauge
- block/drain ball valves (1" NPT with latching handle)
- fill ball valve, (1" NPT with latching handle)
- lube oil transfer pump, ARO PN# ARO-CPQ2187, c/w
  - isolation ball valves and
  - Fisher 67 AFR supply regulator
  - ¼" supply and vent tubing

Notes:

1. Compressor lube oil supply lines shall be SS tubing and/or carbon steel piping with butt-welded fittings.
2. Compressor lube oil drain lines are socket welded fittings, valves and unions are NPT.

1 Compressor oil flow meter, Ren "slow flow"

1 Compressor drive coupling, Thomas CMR-425 type with steel hub.

1 Coupling guard, fabricated steel.

1 Electric oil heater, immersion style, 480V, 3ph, 60hz

Compressor purge packing vent and drain assembly

4 Cylinder flushing oil check valve, ¼" x ¼", 304 stainless steel, NACE certified

4 Cylinder flushing oil thermowell, ¾" NPT, 316 stainless steel/

4 3/8" tubing pressure purge packing vent and drain line to drain header

2 1-1/2" vent header piped to vent tank

1 Sweet gas purge isolation ball valve, ¾" NPT, Nutron, R.P., NACE

1 Regulator, Fisher 67AFT, c/w PI and mounting bracket

4 Packing / purge vent temperature thermocouple(s) c/w SS thermowell

4 Packing / purge differential pressure switch gauge, Orange Research.

**Note: The above distance piece packing vent and drain assembly is designed for bolt-in installation of future seal pot assembly. Seal pot and vacuum pump assembly not included but available as options.**

**Future (not currently included) Talisman seal pot assembly would include two (2) of the following for each of the vent and drain :**

- (2) 1-1/2" vent header piped to seal pot
- (1) Sweet gas purge isolation ball valve, ¾" NPT, WKM, R.P., NACE
- (2) rotameter flow meter to measure packing vent header flow.
- (1) Regulator, Fisher 67AFR, c/w PI and mounting bracket
- (2) Distance piece/packing vent and drain seal pot, c/w
  - liquid level gauge, Penberthy, C.S., reflex type, NACE
  - gauge valves, Penberthy, NACE
  - low liquid level switch, SOR, 2" NPT, NACE
  - high liquid level switch, SOR, 2" NPT, NACE
  - manual drain ball valve, 1-1/2" NPT, WKM, R.P., NACE

Note: The above seal pot packing vent and drain tank is sized to 7 days at 24 hours/day of packing lube oil flow rates.

- (2) Packing and purge vent temperature thermocouple(s), c/w SS thermowell.

## ENGINE

1 Customer Free Issued Waukesha model L7042G, natural gas fueled engine, V-12 four cycle engine with specifications as per the enclosed engine brochure and the following standard engine accessories:

- air cleaner, intermediate duty with service indicator
- hydraulic lever type governor, with friction type speed control.
- Altronic DISN Ignition Module, 24 volt DC power required, CSA approved for Class I, div II area classification.

Notes:

1. Engine power rating is 993 BHP at 1200 RPM.
2. Refurbishment and accessories not included in quotation, cost extra.
3. At this time it is unknown if the customer supplied engine includes the following items, which have not been included with this bid :
    - Ignition System
    - Altronic air fuel ratio system consisting of EPC-100 Controller, stepper motors with 50' cable assemblies, oxygen sensors with 50' cable assemblies, k-type thermocouples with thermocouple adapters
    - Microspin filter complete with stand, assembly, and tubing
    - Other items not listed above may be required or replaced for operation.

## ENGINE EQUIPMENT AND CONTROLS

Fuel / start gas system assembly for 150 psi customer supply at skid edge

1 Inlet isolation block ball valve, 2" NPT, regular port.

1 Start gas strainer, Y-type, 2" NPT.

1 Fuel gas filter/separator, 8-5/8" diameter, 275 psig MWP, CHS stock separator design c/w PECO filter elements, with the following instrumentation:

- (2) 1" NPT, drain ball valve, Nutron, regular port.
- SOR high levels switch (future option)
- Differential pressure indicator, c/w ½" isolation needle valves
- (1) Level gauge, Kenco, P/N EPG-50-10-55, c/w ½" NPT isolation valves
- (1) Gauge glass drain ball valve, ½" NPT, Nutron, R.P., c/w locking handle

- (1) Drain check valve, 1" NPT, Durable, SCV316-8305
- Scrubber drain lines, 1" NPT to skid edge.
- High pressure fuel/start gas relief valve, set at 165 psig.

1 High pressure fuel gas relief valve, 1" NPT, set 165 psig.

1 Low pressure fuel gas relief valve, 1" NPT, set 75 psig.

1 Gas supply shut-off valve, 2" NPT, Murphy M5-5108P, 2-way.

Start gas system assembly for 150 psi (branch take off from fuel line)

2 Start gas block valve, 2" NPT, regular port, with latching handle.

1 Start gas strainer, Y-type, 2" NPT.

1 Start gas assembly, including:

- Air-gas starter, Ingersoll-Rand vane type.
- Ingersoll-Rand SRV-150 relay gas valve
- Ingersoll-Rand HDL-2 lubricator.
- supply line braided steel hose, 1-1/2" NPT
- exhaust line braided steel hose, 2" NPT

Engine cooling system accessories

1 Surge tank, single compartment c/w

- gauge glass, clear acrylic tubing with gauge valves
- low point drain ball valves
- glycol transfer pump, ARO, c/w:
  - isolation ball valves and
  - Fisher 67 AFR supply regulator
  - ¼" supply and vent tubing

Engine cooling system service piping

- 6" jacket water piping between engine jacket, surge tank and cooler
- 6" Flexmaster sleeve couplings.
- steel tubing surge tank balance line between surge tank and cooler

Engine air intake system

2 Air intake lines, 8" diameter from engine to building exterior c/w

- air filter adapter box
- rubber flexible connectors
- bird screen, air inlet

Engine exhaust system

1 Exhaust muffler, Critical Grade Silex SileNOX combined silencer catalytic converter, model#: SE-JB-14-12-TP-2I-2O-T2-2S-X70-36-SI6-S15.5-LL-AL-A, which includes the following:
- Combined catalytic converter and silencer
- 12" flange connections
- Test points : 2 inlet, 2 outlet
- Side in, End out design
- Lifting lugs
- Aluminized finish

1 Flexible exhaust connection, 12" –150#, carbon steel

1 Exhaust tail pipe to 1.5 times building eave height, shipped loose.

1 Exhaust line, 12" diameter from engine to building exterior c/w insulation, aluminum clad cerewool silicate fiber 8#/ft with galvanized steel liner and 2" air space through building wall.

1 Four-point exhaust support structure, 4" WF, mounted beside skid.

Miscellaneous engine equipment

1 ARO Pneumatically operated prelube pump assembly, diaphragm type PN# ARO-CPQ2187 c/w

- discharge check valve
- suction and discharge block ball valves
- y-strainer
- Fisher 67 AFR supply regulator
- ¼" supply and vent tubing

1 Oil drain ball valve, 1" NPT, regular port, with latching handle.

1 Oil drain ball valve, 2" NPT, regular port, with latching handle.

1 Oil filter drain ball valve, 1" NPT, regular port, with latching handle.

1 Oil tank, integral with overhead crane rail c/w:
- gauge glass
- make-up oil filter (1" NPT canister type)
- level gauge
- block/drain ball valves (1" NPT with latching handle)

- fill ball valve, (1" NPT with latching handle)

## COOLER

The existing Air-X-Changers process cooler cannot be used in this application. The cooler does not attain the necessary cooling required for the process conditions or engine supplied. The existing cooler box is too small for increased coil size required. Please refer to enclosed cooler datasheet for evidence, spec sheet no. 758540Z. A new process cooler has been included in this quotation as follows:

1 Air-X-Changers 120EH forced draft cooler in accordance with attached spec. sheet no. 012612

1 Engine jacket water glycol cooling section to 170 °F, 14 psig MAWP at -20 °F/ 300 °F

1 IC-1, process gas cooling section to 120 °F, 215 psig MAWP at -40 °F/ 350 °F

1 AC, process gas cooling section to 120 °F, 645 psig MAWP at -40 °F/ 350 °F

**Design and construction features:**

- Mounted slide-type idler
- SA214 steel tubes in the utility coils
- SA179 tubes in the gas coils
- Low temperature (-40F) material on gas headers
- 100% RT of the nozzle butt welds and UT of all header welds on the gas sections
- UT of gas header plate prior to fit-up
- Mag particle test all gas header welds
- 1-1/2" flange opposite each gas outlet nozzle
- ASME code stamp and Canadian registration for AB on each gas section
- One set of manual louvers on the utility sections
- One set of manual louvers downstream of the gas section
- One set of louvers with one Fisher 656-30 actuator with positioner upstream of the gas section
- Hardness test (200 BHN Max)
- Caged access ladder
- 316SS grease tubing
- Hailguard over the air outlet
- Soft bugscreens over the air inlet
- Air-X-Changers standard paint (Talisman specified color)

## COOLER EQUIPMENT AND CONTROLS

1 Cooler drive system assembly for driving the cooler from the front of the engine via. Jackshaft consisting of:

- Set of v-belts, aerial cooler drive system assembly, (3) Browning C section gripnotch
- (1) jackshaft, 3-7/8" dia. (length subject to engineering review)
- (2) non-expansion type pillow blocks, Browning of equal
- (2) pillow block tensioned system for adjusting belt tension
- (1) idler assembly
- (2) 3C Browning sheaves

1 Manual louver, EJW water sections

1 Garzo louvers actuator for the above gas sections.

1 Louver actuator controller, Kimray T-12 c/w SS thermowell and supply regulator.

Cooler warm air re-circulation assembly

1 Auto warm air re-circulation system (ships loose from unit, installation in field by others)

1 Re-circulation actuator, Fisher 656-40 c/w positioner, Fisher 67AFR supply regulators, c/w isolation needle valve

1 Cooler warm air re-circulation temperature controller, Foxboro 43AP

## PRESSURE VESSELS

1 Stage 1 Suction scrubber, 30" dia. x 84" S/S, rated for 734 psig MAWP @ 110° F, 304LSS, Vane Pack type mist eliminator, flanged process, instrumentation and drain connections, full supporting skirt and base plate.

| Shell | 0.75" thick | | SA516-70N |
|---|---|---|---|
| Head (SE 2:1) | 0.75" thick | | SA516-70N |
| Connection | Qty | Size | Rating |
| Inlet | 1 | 8" | 300# RFLWN |
| Outlet | 1 | 8" | 300# RFLWN |
| LC | 1 | 3" | 300# Studding O'let |
| LSHH | 1 | 3" | 300# Studding O'let |
| LG | 2 | 2" | 300# Studding O'let |
| Inspection | 2 | 3" | 300# Studding O'let |
| Dump | 1 | 2" | 300# Studding O'let |
| Drain | 1 | 2" | 300# RFWN |

1 Stage 2 1 Suction scrubber, 24" dia. x 72" S/S, rated for 734 psig MAWP @ 110° F, 304LSS, Vane Pack type mist eliminator, flanged process, instrumentation and drain connections, full supporting skirt and base plate.

| Shell | 0.625" thick | | SA516-70N |
|---|---|---|---|
| Head (SE 2:1) | 0.625" thick | | SA516-70N |
| Connection | Qty | Size | Rating |
| Inlet | 1 | 6" | 300# RFLWN |
| Outlet | 1 | 6" | 300# RFLWN |
| LC | 1 | 3" | 300# Studding O'let |
| LSHH | 1 | 3" | 300# Studding O'let |
| LG | 2 | 2" | 300# Studding O'let |
| Inspection | 2 | 3" | 300# Studding O'let |
| Dump | 1 | 2" | 300# Studding O'let |
| Drain | 1 | 2" | 300# RFWN |

Notes:

1. The above mesh pad type mist extractor is guaranteed to remove 99% of all entrained liquid particles contained in the gas stream 10 microns and larger. This performance is maintained at any flow rate up to the maximum design rate for the particular unit. Scrubbers have been sized with a 0.22 K-factor.

2. **The above inlet separators will be close coupled to the suction bottles**. This eliminates the possibility of a liquid trap in the piping from the separator to the compressor cylinders.

Special Note: Bid documentation specifically instructed Collicutt Hanover to utilize the following suction and discharge bottles. Upon final design review, sizes may be subject to change.

1 Stage 1 suction bottle, 22" dia. x 38" seam to seam, rated for 734 psig MWP @ 110° F

| **Shell** | 0.625" thick | | SA516-70N |
|---|---|---|---|
| **Head (SE 2:1)** | 0.625" thick | | SA516-70N |
| **Connection** | Qty | Size | Rating |
| Inlet | 1 | 6" | 300# RFLWN |
| Outlet | 1 | 10" | 300# RFLWN |
| TI | 1 | 2" | 300# Studding O'let |
| PI | 1 | 2" | 300# Studding O'let |
| Inspection | 1 | 3" | 300# Studding O'let |
| Flushing Oil | 1 | 1" | 300# RFLWN |

1 Stage 1 discharge bottle, 20" dia. x 98" seam to seam, rated for 734 psig MWP @ 110° F

| **Shell** | 0.50" thick | | SA516-70N |
|---|---|---|---|
| **Head (SE 2:1)** | 0.625" thick | | SA516-70N |
| **Connection** | Qty | Size | Rating |
| Inlet | 1 | 10" | 300# RFLWN |
| Outlet | 1 | 3" | 300# RFLWN |
| TI | 1 | 2" | 300# RFLWN |
| TSHH | 1 | 2" | 300# RFLWN |
| PI | 1 | 2" | 300# Studding O'let |
| Inspection | 1 | 3" | 300# Studding O'let |

1 Stage 2 suction bottle, 18" dia. x 36" seam to seam, rated for 734 psig MWP @ 110° F

| **Shell** | 0.625" thick | | SA516-70N |
|---|---|---|---|
| **Head (SE 2:1)** | 0.625" thick | | SA516-70N |
| **Connection** | Qty | Size | Rating |
| Inlet | 1 | 6" | 300# RFLWN |
| Outlet | 1 | 6" | 900# RFLWN |
| TI | 1 | 2" | 300# Studding O'let |
| PI | 1 | 2" | 300# Studding O'let |
| Inspection | 1 | 3" | 300# Studding O'let |
| Flushing Oil | 1 | 1" | 300# RFLWN |

1 Stage 2 discharge bottle, 18" dia. x 90" seam to seam, rated for 1292 psig MWP @ 350° F

| **Shell** | 1.000" thick | | SA516-70N |
|---|---|---|---|
| **Head (SE 2:1)** | 0.750" thick | | SA516-70N |
| **Connection** | Qty | Size | Rating |
| Inlet | 1 | 6" | 900# RFLWN |
| Outlet | 1 | 6" | 600# RFLWN |
| TI | 1 | 2" | 600# RFLWN |
| TSHH | 1 | 2" | 600# RFLWN |
| PI | 1 | 2" | 600# Studding O'let |
| PSV | 1 | 2" | 600# Studding O'let |
| Inspection | 1 | 3" | 600# Studding O'let |

**Design and construction features:**

- Internal and external sandblasting of the above vessel(s).
- full (RT-1) radiography of the above vessel(s)
- PWHT of the above vessel(s)
- ultrasonic examination of all accessible category "D" welds on the above vessels
- repads on all main process nozzles on the above vessel(s).
- RFLWN for main inlet/outlet and instrument connections, drain connection shall be RFWN Butt-weld
- vessel(s) will be registered with the Alberta Boiler's Branch
- vessels will be built in accordance with the latest ASME Section VIII codes
- SA106 grade B seamless material (SA516 grade 70N rolled shell above 20" diameter)
- 1/8" corrosion allowance,
- surge bottle(s) are sized in accordance with API derived data, based on a 2% peek to peek, note pulsation levels are not guaranteed

1 **(Optional, not included in quotation)** Acoustical study of compression and off-skid piping system by EDI, USA, in accord with API 618, Fourth Edition, June 1995, Design Approach 3, including Appendix M1 thru M8, options provided for M9, M10, and M11.

The following is the design approach taken by Collicutt Hanover in compressor pulsation design.

**This study and all necessary changes as a result of this study are included in the package price.**

- Initial pulsation bottle sizing is done using API 618, fourth edition, design approach 1 and sized for a maximum 2% peak to peak pulsation level.

- Pulsation bottle and acoustic filters (choke tubes, baffle plates etc) are designed to ensure that the acoustic filter cut-off frequency is less than 1x run speed or 2x run speed. This would account for the worst case scenario of a single acting or double acting cylinder.

- If necessary, pulsation bottle and acoustic filter design is modified, up to and including adjusting bottle diameters, lengths and in some cases adding a secondary volume.

- Bottle pressure drops are checked to ensure that there is no significant adverse effect on compressor performance. Pressure drop calculations include: nozzles, choke tubes, entrance and exit losses and orifice plates (if applicable).

- The acoustical design process as outlined above is iterative. This process is repeated as necessary until all acoustical design criteria are satisfied.

- The mechanical and process system, including pulsation bottle wedge supports, pipe clamping locations and methods, frame and distance piece support system is reviewed for dynamic force suitability.

- The acoustical and mechanical design and construction is verified to be within industry acceptable standards and remedied if necessary by Collicutt Hanover personnel at start-up.

Scrubber equipment and controls:

2 Pneumatic dump valve, Fisher, 357 control valve, NACE
- (1) 2"-300# RF
- (1) 2"-600# RF
- (2) Fisher 67AFR supply regulators, c/w isolation needle valve.
- (2) ASCO or equal solenoid valves for scrubber dump control, XP, stainless steel.

4 Dump valve isolating ball valves, regular port, Nutron, carbon steel body, NACE
- (2) 2"-300# RF
- (2) 2"-600# RF

2 Penberthy "Multiview" magnetic liquid level instrument bridle, c/w:
- **316L Stainless steel** construction
- **Titanium Float** (standard length)
- (1) 2"-150# RF instrument connections, 270 psig MAWP
- (1) 2"-300# RF instrument connections, 705 psig MAWP
- (1) 2"-600# RF instrument connections, 1292 psig MAWP
- (1) 2"-900# RF instrument connections, 1935 psig MAWP
- 150 °F Maximum process temperature
- 20" (center to center) indication dimension
- 0.7 Minimum liquid specific gravity
- Flipper style indicator (black w/ gold flips)
- Dual hi/low XP snap acting level switches (dump control and high level shutdown)
- NACE MR-01-75 Certification

4 Instrument bridle isolating ball valves, regular port, Nutron, carbon steel body, NACE
- (2) 2"-300# RF
- (2) 2"-600# RF

2 Manual drain gate valve, carbon steel body, NACE.
- (1) 2"-300# RF
- (1) 2"-600# RF

2 Drain check valve, 2"-1500# RF, carbon steel body, NACE.

2 Instrument bridle drain ball valve, ½" NPT, regular port, Nutron, carbon steel body, NACE.

2 Instrument bridle purge/vent three way needle valve, 3/8" NPT, stainless steel body.

2 Instrument bridle drain bleed ring, 2"-150 #RF, 316SS (located in scrubber liquid drain line upstream of check valve.

2 Scrubber drain, 2"-150# ANSI, to drain header to skid edge.

## PROCESS VALVING

1 Relief valve, Consolidated, 1905Lc, orifice, 2.853", stage 1 discharge, set at 215 psig.

1 Relief valve, Consolidated, 1910Hc, orifice, 0.785", stage 2 discharge, set at 500 psig.

1 Automatic suction pressure control valve, 6"-300# Fisher 1051-V200 as follows:

- WCC steel body
- TCM ball seal, 317 SST chrome plated v-ball
- Nitronic 50 shaft
- PEEK bearings
- Graphite laminate gasket
- TFE packing
- Complies to NACE MR-01-75

Fisher 1051K size 60 actuator
- Fail closed

Fisher 3610J positioner
- 3-15 psi input

1 Fisher 4150KR-247 suction pressure controller
- 0-100 psi
- 30-6 psi output, reverse acting
- Fisher 67CFR-362 supply regulator

1 Automatic capacity control (70%) bypass valve, Fisher 657-ET-40, 3"- 600# RF, NACE

1 Fisher 657 size 34 actuator
- Fail open
- Air 0-35 psi

2 Isolation block ball valves around the above automatic bypass valve, 3"-600# RF, Nutron, full port.

1 Manual bypass ball valves around the above automatic bypass valve, 3"-600# RF, Nutron, regular port.

1 Manual blowdown ball valve, 2"-600# RF, regular port, carbon steel bolted body, c/w provisions for future 1" NPT auto-blowdown control.

1 Discharge piston check valve, 4"-600# RF, Daniel. Subject to Engineering review.

Note: The quoted Daniel piston check valve requires a 1.0 psi differential drop to keep the valve in the fully opened position. A full line size 6" NPS ANSI valve does not meet this criteria, and may result in chattering at lower suction pressures (see enclosed sizing criteria).

1 8"-300# RF, Cone strainer, carbon steel, 150% flow area, 316SS, 40 mesh screen located at suction nozzle, stage 1.

1 6"-300# RF, Cone strainer, carbon steel, 150% flow area, 316SS, 40 mesh screen located at suction nozzle, stage 2.

## PROCESS PIPING

1 8"-300# ANSI, STD, spool from skid edge to inlet scrubber, stage 1.

1 8"-300# ANSI, STD, spool from suction scrubber, stage 1, to suction bottle.

1 6"-300# ANSI, STD, spool from discharge bottle to gas cooler, stage 1.

1 6"-300# ANSI, STD, spool from gas cooler to interstage scrubber, stage 2.

1 6"-300# ANSISTD, spool from interstage scrubber to suction bottle, stage 2.

1 6"-600# ANSI, Sched 80, spool from discharge bottle to gas cooler, stage 2.

1 6"-600# ANSI, Sched 80, spool from gas cooler to compressor end of skid, stage 2.

1 4"-600# ANSI, bypass line between final discharge, stage 2 and initial suction, stage 1.

1 2"-600# ANSI, s80, blowdown line to PSV vent header.

1 3"-150# ANSI, STD, relief valve vent header.

**Design and construction features:**

- Internal and external sandblasting of the above spool(s).

- Full (100%) radiography of the above spool(s)
- PWHT of the above spool(s)
- All flanged instrument connections.
- Spools design and construction in general accordance with ANSI B31.3
- 1/8" corrosion allowance
- Interior piping will be SA106 grade B seamless pipe.
- Exterior piping will be SA 333 grade 6 seamless pipe.
- All interior process piping 2" and over will utilize SA105GrI raised face weld neck flanges, 316 stainless steel gaskets, B7M studs and 2HM nuts.
- All exterior process piping 2" and over will utilize SA350-LF2 raised face weld neck flanges, 316 stainless steel gaskets, B7M studs and 2HM nuts.

## SERVICE PIPING

- tubing from scrubber level controllers to instrument air/gas supply.
- tubing from louver actuators and temperature controllers to instrument air/gas supply.
- tubing from instrument gas regulator diaphragm vents to low pressure vent header.
- tubing from gauge glass drain to scrubber drain header.
- Process tubing is 316 stainless steel with 316 stainless steel fittings and stainless steel ferrules.

## CONTROL PANEL

One (1) PLC Compressor Control Panel and related engineering and configuration services.

1. Engineering services will include the following items.
   - Drawings and Documentation.
   - PLC programming.
   - Staging and testing of the control panel at Spartan Controls Integration Center in Calgary.
2. Control panel design and wiring practices will be in accordance with CSA Cl 1, Div. 2, Grp D.
3. Shop run, commissioning and start-up assistance available at our standard per diem rates.
4. A programmable microprocessor based Allen-Bradley SLC500 system will be programmed to safely start, stop and sequence one Waukesha 7042G engine driven Ariel JGK/2 2-stage reciprocating compressor. This automatic sequence will be based on standard engine and reciprocating compressor control practices and recommendations by the packager.

### *Assumptions*

The assumptions mentioned below were considered in the formulation of this proposal.

1. Adequate power and grounding will exist at the site to support the control system.
2. The area classification in the facility will be Class 1, Div. 2, Group D. The panel will be built in accordance with CSA Class 1, Div. 2, Group D.
3. All end devices will be explosion proof.

### *Exclusions*

The exclusions mentioned below were considered in the formulation of this proposal.

1. The supply of communications cabling to connect the PLC control panel to the customer DCS or plant PLC.
2. The supply of transmitters, sensor switches and pneumatic components that will be connected to the PLC control panel, except those listed in the BOM and the Pricing Summary.
3. Installation, wiring and tubing of the control panel to the compressor skid.
4. No formal training courses are included.
5. Shop run, commissioning and start-up assistance are not included, but are available at Spartan Controls published rates.

### *Codes and Standards*

All equipment used will fully comply to the Canadian Electrical Code and all North American Codes and Standards relating to Instruments and Control Panels. The Control Panel will be built to the Canadian Electrical Code and will be provided with Canadian Standards Association (C.S.A.) certification for a Class 1, Div. 2, Group D.

## PLC Control Panel Bill of Materials

### Base Panel

| Qty | Model P/N | Description |
|---|---|---|
| 1 | | Spartan Mod III Wall Mount Cabinet |
| 1 | 1747-L541 | A-B SLC 5/04 Processor |
| 1 | 1746-A13 | A-B 13-Slot Rack |
| 1 | 1746-P3 | A-B 24VDC Power Supply |
| 1 | 1746-IB32 | A-B 32pt Discrete Input Card |
| 1 | 1746-OB16 | A-B 16pt Discrete Output Card |
| 1 | 1746-NI16I | A-B 16pt Analog Input Card |
| 1 | 1746-NO4I | A-B 4pt Analog Output Card |
| 3 | 1746-NT8 | A-B 8pt Thermocouple Input Card |
| 1 | 2711-T10G8L1 | A-B PanelView 1000 Touch Screen |
| 1 | 250T | Acromag Frequency Transmitter |
| 3 | 800T | A-B Pushbuttons (start/stop/reset) |
| Lot | | Terminal Blocks |
| Lot | | Fused Terminal Blocks |
| Lot | | Ceramic Fuses |
| Lot | | Interface Relays |
| 1 | | Spartan Standard PLC Program |

### Instrument Rack/Regulators/Isolation Valve

| Qty | Model P/N | Description |
|---|---|---|
| 1 | | Instrument Rack (instruments and cabinet to be mounted on rack) |
| 2 | 67CFR-362 | Fisher Regulator |
| 1 | | Whitey Isolation Valve |

**Process Pressure Transmitters**

| Qty | Model P/N | Description |
|---|---|---|
| 3 | 2088G | Honeywell Pressure Transmitters (mounted/tubed/wired on rack) |

**Speed Control**

| Qty | Model P/N | Description |
|---|---|---|
| 1 | 546-64 | Fisher I/P Transducer (mounted/tubed/wired on rack) |

**Bypass Valve Control**

| Qty | Model P/N | Description |
|---|---|---|
| 1 | 546-65 | Fisher I/P Transducer (mounted/tubed/wired on rack) |

**Suction Valve Control**

| Qty | Model P/N | Description |
|---|---|---|
| 1 | 546-65 | Fisher I/P Transducer (mounted/tubed/wired on rack) |

**Solenoid Valve**

| Qty | Model P/N | Description |
|---|---|---|
| 4 | EF8320G202-24 | Asco Solenoid Valves (mounted/tubed/wired on rack) |

***Cabinet Design***

The PLC control system will be housed in a wall mount cabinet c/w:

- Single front access door
- Cabinet dimensions of 30" wide x 36" high x 20" deep
- NEMA 12
- ASA61 Grey

***Instrument Rack Design(optional)***

The wall mount cabinet and instruments will be mounted on a freestanding instrument rack c/w:

- Rack dimensions of 30" wide x 72" high
- ASA61 Grey

***Auxiliary Equipment***

- Installation and wiring of PLC equipment
- Supply and installation of feed through terminal blocks for PLC inputs and outputs
- Lot-miscellaneous mounting hardware
- Lot-Panduit wireway for panel and field wiring
- Engineering and CADD drawings
- Functional Testing/Staging

**Documentation**

The compressor system will be completely documented as per Spartan Controls standard. Documentation will include **one set** of the following:

- Panel drawings
- PLC I/O list

- HMI (operator interface) mapping list
- Operating Philosophy
- Factory acceptance test document
- Copy of the PLC and HMI programs.

**Six sets** of operating manuals and instructions will be included for the project.

## SHUTDOWN SWITCHES / END DEVICES

| | |
|---|---|
| 1 | Special Talisman lube oil shutdown system |
| | Compressor Equipment & Controls |
| 1 | Compressor oil temperature thermocouple, c/w thermowell |
| 1 | Compressor oil pressure transmitter, Wika |
| 1 | Compressor vibration transmitter, Metrix |
| 2 | Compressor lubricator no-flow switch, DNFT-TO-PRG-RB-B |
| 2 | Compressor crankcase/lubricator level controller with low level switch, Kenco LCE-9. |
| 2 | Packing and purge vent temperature thermocouple(s), c/w thermowell, each cylinder |
| | Engine equipment & controls |
| 8 | Engine cylinder temperature thermocouple, c/w thermowell |
| 1 | Engine air intake thermocouple, c/w thermowell |
| 1 | Engine exhaust thermocouple, c/w thermowell |
| 1 | Engine jacket water coolant thermocouple, c/w thermowell |
| 1 | Engine vibration transmitter, Metrix |
| 1 | Engine jacket water level switch, Murphy L-1200, 2" NPT |
| 1 | Engine auxiliary water level switch, Murphy L-1200, 2" NPT |
| 1 | Engine oil thermocouple, c/w thermowell |
| 1 | Engine oil pressure transmitter, Wika |

1 Engine crankcase level controller with low level switch, Kenco LCE-17.

Cooler Equipment & Controls

1 Vibration transmitter, Metrix.

Process Equipment & Controls

2 Honeywell, smart accuracy PROCESS GAS differential pressure transmitter as follows:

- STD930-F1A-00000-CR,MB,SM,TC,2J
- STD930-0-5 to 0-100 psi span
- 316 stainless steel body and hast C diaphragm
- silicone filled fluid
- 1/2" NPT process connection
- NACE rated
- Transmitter configuration
- 2" pipe mounting bracket
- LCD digital indicator with range switch (local display)
- CSA explosion proof
- ½" isolation block/purge needle valve, 316SS body
- 5-valve PGI manifold, NACE rated, 316 SST body, c/w mounting bracket

Note: The above differential pressure transmitter is used to measure DP across the suction screens.

3 Honeywell, smart accuracy PROCESS GAS pressure transmitter as follows:

- 316 stainless steel body and hast C diaphragm
- silicone filled fluid
- 1/2" NPT process connection
- NACE rated
- Transmitter configuration
- 2" pipe mounting bracket
- LCD digital indicator with range switch (local display)
- CSA explosion proof
- ½" isolation block/purge needle valve, 316SS body
- 5-valve PGI manifold, NACE rated, 316 SST body, c/w mounting bracket

Note: The above process gas pressure transmitters are installed on suction, stage 1 discharge, and stage 2 discharge

2 Process gas temperature thermocouple, c/w 1-1/2" flanged thermowell:

Notes:
1. Suction pressure and temperature transmitters will be rack mounted near the control panel to minimize vibration and for local indication.

2. Cooler RTD's mounted on back of header box.
3. RTD's to be located as close to the compressor cylinder port as possible.

## LOCAL PRESSURE AND TEMPERATURE INDICATORS

1 Fuel gas pressure indicator, 2-1/2" dial, liquid filled, bottom mount, ¼" NPT, dual scale c/w isolating needle valve.

1 Start gas pressure indicator, 2-1/2" dial, liquid filled, bottom mount, ¼" NPT, dual scale c/w isolating needle valve.

2 Engine jacket water temperature indicator, back mount, 3" dial c/w 304 SS screwed thermowell.

1 Engine oil pressure indicator, 2-1/2" dial, liquid filled, bottom mount, ¼" NPT, dual scale c/w isolating needle valve.

1 Engine oil temperature indicator, back mount, 3" dial c/w 304 SS screwed thermowell.

1 Engine air intake temperature indicator, back mount, 3" dial c/w 304 SS screwed thermowell.

2 Compressor oil temperature indicator, back mount, 3" dial c/w 304 SS screwed thermowell

## SKID BASE

1 Fabricated steel skid, 24' wide by 40' long.

**Design and construction features:**

- main runners of 24"-76# WF beam
- waste oil drainage tanks c/w heat coil located under cooler with secondary containment.
- **gussets on both sides of the I-beam at each foot print supporting point for major equipment. A Maximum of 80 gussets will be provided**
- open spaces covered with heavy duty 1-1/4" grating.
- concrete with nelson studs installed between main members from the compressor end of the skid up to the front of the driver and under all scrubbers
- major components (including scrubbers) mounted on full depth structural members
- low pressure control system vent header running the entire length of the skid, vented to the building eave height
- sandblasting and priming after completion of skid welding.
- Lifting roll cooler end of skid, lifting lugs compressor end of skid

- drip lip around engine and compressor, c/w drain connection and valve to waste oil storage tank(s)
- suitable for 3-way installation (piles, gravel pad or concrete pad)
- skid complete with **engineering beam deflection calculations to L/360**
- P.Eng. stamped skid drawings (computerized printouts and graphical drawings for bending moments and shear stress shall be generated).

Note: Foundation design is the responsibility of the end user; CHC will provide details of the compressor package including "As-built" dimensions, weights and unbalanced forces, center of gravity, etc. to facilitate this design.

Notes:

1. The quoted process cooler is mounted on skid.
2. Foundation design is the responsibility of the end user; CHC will provide details of the compressor package including "As-built" dimensions, weights and unbalanced forces, center of gravity, etc. to facilitate this design.

## BUILDING AND BUILDING ACCESSORIES

1 Self framing gable type metal building as follows:

| | |
|---|---|
| Building Size | : 24' (Width) x 32' (Length) x 10' (Eave), 4:12 roof slope. |
| Roof Exterior | : 22 Ga. Exterior: ***Pre-painted, color: Customer Spec.*** |
| Roof Interior | : 20 Ga. Fluted aluminum interior: ***White liner*** |
| Wall Exterior | : 22 Ga. Exterior: ***Pre-painted, color: Customer Spec.*** |
| Wall Interior | : 20 Ga. Fluted aluminum interior, color: ***White liner (perforated above 3' from floor), per customer spec.*** |
| Insulation | : R-12 |
| Vapour | : 4-mill poly |
| Framed Openings | : Framed opening for cooler opening c/w flashing and sealant, required building wall /roof penetrations flashing and sealant. |
| Doors | : (2) Double man doors 6' x 7' c/w frame, hinges, weather-stripping, threshold, check chain & sweep, locking panic hardware, single glazed fixed I.W.G. glazing, hydraulic closure and canopy |
| Windows | : (4) 40" x 40" Glazed slide window c/w ½ screen. |
| Louvers | : (2) 18" x 24" Manually adjustable wall louvers. |
| Roof Ridge Vent | : (1) 6" chain operable ridge vent for 100% of the building length. |
| Fan | : (2) Wall mounted "XP" building fan, 12 ac/hr c/w storm hood screen |
| Accessories | : Ice rakes, eavestroughs, downspouts and door canopies, gas detection ports |

Note: Exhaust fan is good for Class 1, Div 1, Group C & D.

2 Catadyne BX-24 x 48 catalytic heaters, 45000 BTU, 24 volt, c/w safety shut-off valve, thermostat (shipped loose), gas supply regulator protection grill and mounting bracket

1 Three ton over head bridge crane structure with intergral lube oil tank(s) and the following accessories:

- (1) Three ton bridge
- (4) Crowned steel wheel, 6" diameter, 6000# capacity
- (2) Crowned steel drive wheel with set screw, 6000# capacity
- (1) Three ton manual chain hoist, Ingersoll Rand
- (1) three ton ball bearing trolley, Ingersoll Rand
- P.Eng. engineering certification

## ELECTRICAL

Control wiring

1 Wiring of all intrinsically safe shutdown switches to the control panel.

120 Volt Wiring

6 150 watt incandescent pendant mounted fixtures, c/w on/off switch, indoor installation

2 70 watt wall mounted, high pressure sodium, globe and guard light, c/w on/off switch, outdoor installation.

1 HOA and on/off switch for the exhaust fans.

1 X/P junction box is provided to house the power supply and relay for the fire and gas detection.

Fire and Gas Detection

1 Fire controller is Net Safety Model #UIF-UV single channel display module c/w a UVC 120 Ultraviolet (UV) Fire Detector.

1 Gas controller is Net Safety Model # U1G-LEL-24-100 single channel display module c/w UT-B-SC1100-100-R Uni-tran basic LEL detector c/w TX-UNI-TRAN-B-LEL Transmitter and SC1100 sensor and JB3 junction box.

1 Calibration cup #CCS-1.

Notes:
1. LEL sensors are mounted over the compressor as a rule down off the ceiling.
2. Fire and Gas monitors are mounted near the main entry door.

## PAINT

1 Prime paint of all unfinished surfaces.

1 Structural steel, piping and equipment shall be sand blasted to SSPC-SP 6-63. Finish painting of equipment shall be Silver Grey Rustoleum color #906 to TLM specifications.

## MISCELLANEOUS

1 A functional no-load test of the completed package, including the control panel, prior to shipment is included. The following consumables have been included:

- compressor lube oil priming charge : 140 liter(s)
- engine lube oil priming charge : 275 liter(s)
- engine glycol priming charge : 380 liter(s)
- cooler glycol priming charge : 200 liter(s)

1 "Issued for Approval" drawings, "Issued for Construction" drawings and "As-Built" drawings will be issued in either hard copy or on disk. Provisions have been made for one (1) set of drawing reviews (drawing review being the critical path).

4 Parts and Instruction Manuals will be issued, with additional copies available at additional cost.

2 Q.C. data books c/w:

- Weld procedures, Welder qualifications
- Hydrotest charts
- U1A forms
- MTR's
- Non-destructive examination reports, PWHT reports

Additional Notes:
1. Clean-up or overhauling of existing equipment and/or instrumentation has not been included in our base proposal. If steam cleaning is required prior to commencement of work, this shall be an extra to the customer account.

2. The customer is responsible for the purging and draining of liquids prior to the revamp being performed.

3. All surplus equipment shall be come the property of Collicutt Hanover, unless specified elsewhere.

4. Crane requirements shall be billed to the customer at cost (these costs have not been included in our base proposal).

5. Any additional scope of work beyond that listed above shall be billed as a separate work order. An estimate shall be given by the project manager, the customer is expected to sign-off before additional scope is carried out.