

RECIPROCATING COMPRESSOR (API 618-4TH) DATA SHEET U.S. CUSTOMARY UNITS		JOB NO. <u>07423</u> ITEM NO. <u>K-8002 A/B</u>	
		PURCHASE ORDER NO. _____ Drawing No. <u>B80-A-K-29117</u>	
		SPECIFICATION NO. _____	
		REVISION NO. <u>A</u> DATE <u>May 30, 2009</u>	
PAGE <u>1</u> OF <u>8</u> BY <u>JNR</u>			

1 APPLICABLE TO: ☐ PROPOSALS ☐ PURCHASE ☒ AS BUILT	
2 FOR/USER <u>Chevron Canada Ltd.</u>	SITE/LOCATION <u>Burnaby Refinery</u> SERVICE <u>SMR Feed / H₂ Product</u> NO REQ'D <u>2</u>
3 NOTE: ☐ INDICATES INFO. TO BE COMPLETED BY PURCH.	
☐ BY MANUFACTURER WITH PROPOSAL ☒ BY MANUFACTURER AFTER ORDER ☒ BY MANUFACTURER OR PURCHASER AS APPLICABLE	
5 COMPR. MFR: <u>Dresser-Rand</u>	TYPE/MODEL NO(S) <u>2HSE-1-1</u> SERIAL NO(S) <u>X22XGH669 & X22XGH670</u>
6 COMPR THROWS, TOTAL NO. <u>2</u>	NO. WITH CYLS <u>2</u> NOMINAL FRAME RATING <u>193</u> BHP @ RATED RPM OF <u>441</u>
☐ MAX/MIN ALLOWABLE SPEED <u>441</u> / <u>441</u> RPM	
8 DRIVER MFR: <u>TBA</u>	DRIVER NAMEPLATE HP/OPERATING RPM <u>N/A</u> / <u>N/A</u>
9 DRIVE SYSTEM: ☒ DIRECT COUPLED ☐ GEARED & COUPLED ☐ V-BELT	
10 TYPE OF DRIVER: ☒ IND. MOTOR ☐ SYN. MOTOR ☐ STEAM TURBINE ☐ GAS TURBINE ☐ ENGINE ☐ OTHER	
11 NO. NEGATIVE TOLERANCE APPLIES: ☐ YES - PURCHASER TO FILL IN "REQUIRED CAPACITY" LINES ☐ NO - PURCHASER TO FILL IN "MFR'S RATED CAP." LINES	
12 (NNT) ☐ YES - PURCHASER TO FILL IN "REQUIRED CAPACITY" LINES ☐ NO - PURCHASER TO FILL IN "MFR'S RATED CAP." LINES	
13 ☐ MAX ACCEPTABLE AVG PISTON SPEED _____ FT/MIN	

OPERATING CONDITIONS (EACH MACHINE)					
15 ☒ SERVICE OR ITEM NO. 16 ☐ STAGE 17 ☒ NORM OR ALT. CONDITION 18 ☐ CERTIFIED FT. (X) MARK ONE 19 ☒ MOLECULAR WEIGHT 20 ☒ Cp/Cv (K) @ 150°F OR _____ °F	SMR FEED		H ₂ PRODUCT		
	Design		Design		
	16.74		2.04		
	1.28		1.41		
21 INLET CONDITIONS:	AT INLET TO: ☐ PULSE DEVICES ☒ COMPRESSOR CYLINDER FLANGES				
NOTE: ☐ SIDE STREAM TO _____ STAGE(S), THESE INLET PRESS. ARE FIXED					
23 ☐ PRESSURE (PSIA) @ PUL. SUPP. INLET	89.1		274.7		
24 ☒ PRESSURE (PSIA) @ CYL. FLANGE	88.2		272.0		
25 ☒ TEMPERATURE (°F)	60.0		95		
26 ☐ REF. SIDE STREAM TEMPS (°F)					
27 ☒ COMPRESSIBILITY (Z)	0.9867		1.0173		
28 INTERSTAGE: INTERSTAGE Δ P INCL: ☐ PULSE DEVICES ☐ PIPING ☐ COOLERS ☐ SEPARATORS ☐ OTHER					
29 ☒ Δ P BETWEEN STAGES, %/psi	NA / / / / /				
30 DISCHARGE CONDITIONS:	AT OUTLET FROM: ☐ PULSE DEVICE ☒ COMP. CYL. FLANGES ☐ OTHER				
31 ☒ PRESSURE (PSIA) @ CYL. FLANGE	419.2		469.4		
32 ☐ PRESS. (PSIA) @ PUL. SUPP. OUTLET	415.0		464.7		
33 ☐ TEMP., ADIABATIC, °F	265.6		190.3		
34 ☐ TEMP., PREDICTED, °F	281		194.0		
35 ☐ COMPRESSIBILITY (Z ₁ OR Z _{avg})	0.9841		1.0173		
36 * REQUIRED CAPACITY, RATED FOR PROCESS, AT INLET TO COMPRESSOR, NO. NEGATIVE TOLERANCE (-0%)					
37 ☐ LBS/HR CAPACITY SPECIFIED					
38 IS: ☐ WET ☒ DRY					
39 ☒ MMSCFD/SCFM (14.7 PSIA & 60°F)	1/		2.5/		
40 * MFR'S RATED CAPACITY (AT INLET TO COMPRESSOR) & BHP @ CERTIFIED TOLERANCE OF ±3% FOR CAP. & ±3% FOR BHP					
41 ☒ LBS/HR CAPACITY SPECIFIED	1,990.50		576.60		
42 IS: ☐ WET ☒ DRY					
43 ☒ ICFM					
44 ☒ MMSCFD/SCFM (14.7 PSIA & 60°F)	1.06 / 739.4		2.57 / 1,786.4		
45 ☐ BHP STAGE	108		85.0		
46 ☐ TOTAL BHP @ COMPRESSOR SHFT	108		85.0		
47 ☐ TOTAL BHP INCLUDING V-BELT & GEAR LOSSES	193.0				
48					
49 * CAPACITY FOR NNT					
50 MANUFACTURER'S * REQUIRED = 0.97					
51 THEREFORE REQUIRED = MFR'S * 0.97					

REMARKS:

RECIPROCATING COMPRESSOR (API 618-4TH) DATA SHEET U.S. CUSTOMARY UNITS						JOB NO <u>07423</u> ITEM NO <u>K-8002 A/B</u> REVISION <u>A</u> DATE <u>May 30, 2009</u> PAGE <u>2</u> OF <u>8</u> BY <u>JNR</u>	
GAS ANALYSIS AT OPERATING CONDITIONS						REMARKS	
MOLE % (BY VOLUME) ONLY							
☐ SERVICE/ITEM NO. ☐ STAGE ☐ NORMAL OR ALT		SMR Feed		H ₂ Product			
		Nat. Gas		Hydrogen			
		M.W.		16.74			
AIR		28.966					
OXYGEN O ₂		32.000					
NITROGEN N ₂		28.016		1			
WATER VAPOR H ₂ O		18.016					
CARBON MONOX. CO		28.010					
CARBON DIOX. CO ₂		44.010					
HYDRO. SULFIDE H ₂ S		34.076					
HYDROGEN H ₂		2.016		99.9			
METHANE CH ₄		16.042		94			
ETHYLENE C ₂ H ₄		28.052					
ETHANE C ₂ H ₆		30.068		4			
PROPYLENE C ₃ H ₆		42.078		1			
PROPANE C ₃ H ₈		44.094					
I-BUTANE C ₄ H ₁₀		58.120					
n-BUTANE C ₄ H ₁₀		58.120					
I-PENTANE C ₅ H ₁₂		72.146					
n-PENTANE C ₅ H ₁₂		72.146					
HEXANE PLUS							
AMMONIA NH ₃		17.031					
HYDRO. CHLOR. HCl		36.461					
CHLORINE Cl ₂		70.914					
CHLORIDES - TRACES							
■ CALCULATED MGL WT		16.98		2.04			
□ Cp/Cv (K) @ 150°F OR °F		1.28		1.4			
NOTE: IF WATER VAPOR AND/OR CHLORIDES ARE PRESENT, EVEN MINUTE TRACES, IN THE GAS BEING COMPRESSED, IT MUST BE INCLUDED ABOVE							
☐ SITE/LOCATION CONDITIONS							
ELEVATION <u>171</u> FT. BAROMETER <u>14.7</u> PSIA AMBIENT TEMPS: MAX <u>85</u> °F MIN <u>16</u> °F ☒ MIN DESIGN METAL TEMP <u>0</u> °F (214.8) RELATIVE HUMIDITY: MAX <u>100</u> % MIN <u>35</u> % COMPRESSOR LOCATION ☐ INDOOR ☐ HEATED ☒ UNHEATED ☒ AT GRADE LEVEL ☐ ELEVATED: _____ FT. ☐ OUTDOOR ☐ NO ROOF ☒ UNDER ROOF ☐ PARTIAL SIDES ☐ PLATFORM ☒ ON-SHORE ☐ OFF-SHORE ☐ WEATHER PROTECTION REQ ☐ TROPICALIZATION REQ. ☐ WINTERIZATION REQUIRED UNUSUAL CONDITIONS ☐ CORROSIVES ☐ DUST ☐ FUMES ☒ OTHER <u>REFINERY ENVIRONMENT</u>							
ELECTRICAL CLASSIFICATIONS							
HAZARDOUS NON-HAZARDOUS MAIN UNIT ☒ CLASS <u>1</u> GROUP <u>B,C,D</u> DIVISION <u>II</u> ☐ LO CONSOLE ☒ CLASS <u>1</u> GROUP <u>B,C,D</u> DIVISION <u>II</u> ☐ CW CONSOLE ☒ CLASS <u>1</u> GROUP <u>B,C,D</u> DIVISION <u>II</u> ☐							

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PART LOAD OPERATING CONDITIONS							
1	CAPACITY CONTROL BY	☐ MFG'S CAP. CONTROL ☐ PURCHASERS BY-PASS ☒ BOTH ☐ OTHER SEE NOTE 1					
2	FOR	☐ PART LOAD COND. ☐ START-UP ONLY ☒ BOTH					
3	WITH	☐ AUTO LOADING DELAY INTERLOCK (3.6.2.2) ☐ AUTO IMMEDIATE UNLOADING					
4	USING	☒ FIXED VOLUME POCK. ☒ SUCTION VALVE UNLOADERS ☐ FINGER ☒ PLUG ☐ OTHER					
5		ACTION: ☐ DIRECT (AIR-TO-UNLOAD) ☐ REVERSE (AIR-TO-LOAD/FAIL SAFE)					
6		NUMBER OF STEPS: ☐ ONE ☐ THREE ☐ FIVE ☒ OTHER SEE NOTE 1					
7		☐ RAIN COVER REQUIRED OVER UNLOADERS					
8							
9	ALL UNLOADING STEPS BASIS MANUFACTURERS CAPACITY SHOWN ON PAGE 1.						
10	INLET AND DISCHARGE PRESSURE ARE		☒ AT CYLINDER FLANGES ☐ PULSATION SUPPRESSOR FLANGES				
11	☐ SERVICE OR ITEM NO.	SMR Feed			H2 Product		
12	☒ STAGE						
13	☒ NORMAL OR ALTERNATE CONDITION						
14	☐ PERCENT CAPACITY	100%	81%	54%	100%	71%	48%
15	☐ WEIGHT FLOW, LBS./HR.						
16	☒ MMSCFD/SCFM (14.7 PSIA & 60°F)	1.06	0.86	0.57	2.57	1.82	1.23
17	☐ POCKET VALVES OPERATION *	HE/CE	HE-F/CE	HE/CE-S	HE/CE	HE-F/CE	HE/CE-S
18	☐ POCKET CLEARANCE ADDED **	0%	8.33%	0	0%	93.10%	0%
19	☐ TYPE UNLOADERS: PLUG/FINGER	N/A	Plug	Plug	N/A	Plug	Plug
20	☒ INLET TEMPERATURE, °F	60	60	60	95	95	95
21	☒ INLET PRESSURE, PSIA	88.2	88.2	88.2	272	272	272
22	☒ DISCHARGE PRESSURE, PSIA	419.2	419.2	419.2	469.4	469.4	469.4
23	☐ DISCHARGE TEMP., ADIABATIC °F	265.7	265.7	265.7	190.3	190	190.3
24	☐ DISCHARGE TEMP., PREDICTED °F	281	280	287	194	191	188
25	☐ VOLUMETRIC EFF., %	14.4 / 17.7	8.5 / 17.7	0 / 17.7	52.7 / 54.9	23.2 / 54.1	0 / 54.1
26	☐ CALC. GAS ROD LOAD, LBS. C **	-18,582	-18,178	-996	-7,378	-7,338	-1,035
27	☐ CALC. GAS ROD LOAD, LBS. T **	16,744	16,800	16,641	5,127	5,091	4,909
28	☒ COMB. ROD LOAD, LBS. C (GAS & INERTIA)	-12,938	-11,411	-3,394	-8,602	-6,243	-5,232
29	☒ COMB. ROD LOAD, LBS. T (GAS & INERTIA)	12,246	12,317	12,142	5,501	3,759	7,239
30	☒ ROD REV., DEGREES MIN @ X-HD PIN ***	175	170	60	165	165	150
31	☐ SHP/STAGE	108.6	89.5	63.8	85	61.2	43.1
32	☐ TOTAL BHP @ COMPRESSOR SHAFT	108.6	89.5	63.8	85	61.2	43.1
33	☐ TOTAL HP INCL V-BELT & GEAR LOSSES	108.6	89.5	63.8	85	61.2	43.1
34							
35	* SHOW OPERATION WITH THE FOLLOWING SYMBOLS						
36	HEAD END = HE				SUCTION VALVE(S) UNLOADED = S		
37	OR				OR		
38	CRANK END = CE		} PLUS {		FIXED POCKET OPEN = F		
39					OR		
40					VARIABLE POCKET OPEN = V		
41							
42	EXAMPLE: HE-F/CE-S = HEAD END FIXED POCKET OPEN / CRANK END SUCTION VALVE(S) UNLOADED						
43	** C = COMPRESSION T = TENSION *** X - HD = CROSSHEAD						
44	☐ MINIMUM PRESSURE REQUIRED TO OPERATE CYLINDER UNLOADING DEVICES		PSIG				
45	CYLINDER UNLOADING MEDIUM		☒ AIR ☐ NITROGEN ☒ OTHER SEE NOTE 3				
46	☒ PRESSURE AVAILABLE FOR CYLINDER UNLOADING DEVICES, MAX-MIN		75 40 PSIG				
47	REMARKS, SPECIAL REQUIREMENTS, AND/OR SKETCH						
48							
49	NOTE 1: ALL UNLOADERS ARE MANUALLY OPERATED						
50							
51							
52							

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☐ SCOPE OF BASIC SUPPLY			
PURCHASER TO FILL IN: ☐ ☐ ☐ AFTER COMMODITY TO INDICATE: ☐ BY COMPR. MFR. ☐ BY PURCH. ☐ BY OTHERS			
☐ DRIVER: ☐ ☐ ☐ VARIABLE SPEED SPEED RANGE RPM TO RPM ☒ NO DRIVER IN SCOPE ☐ INDUCTION MOTOR ☐ SYNCHRONOUS MOTOR ☐ STEAM TURBINE ☐ ENGINE ☐ OTHER			
☐ API-541 ☐ API-546 ☐ API-611 ☐ API-612 ☐ OUTBOARD BEARING ☐ PROVISION FOR DRY AIR PURGE FOR OUTBOARD BEARING			
☐ SLIDE BASE FOR DRIVER: ☐ ☐ ☐ SOLE PLATE FOR DRIVER: ☐ ☐ ☐			
☐ MOTOR STARTING EQUIPMENT: ☐ ☐ ☐ DEFINE			
☐ GEAR: ☐ ☐ ☐ ☐ BASEPLATE FOR GEAR ☐ API-613 ☐ API-677			
☐ COUPLING(S): ☐ ☐ ☐ ☐ LOW SPD. ☐ HI-SPD ☐ QUILL SHAFT ☐ KEY-LESS DRV. ☐ KEY'D DRV. ☐ OTHER			
☐ API-671			
☐ V-BELT DRIVE: ☐ ☐ ☐ ☐ SHEAVES & V-BELTS: ☐ ☐ ☐ ☐ ☐ STATIC CONDUCTING V-BELTS ☐ BANDED V-BELTS			
☐ DRIVE GUARD(S): ☐ ☐ ☐ ☐ MANUFACTURER'S STD ☐ NON-SPARKING ☐ CALIF CODE ☐ API-671 APPENDIX C			
☐ OTHER			
☐ PULSATION SUPPRESSORS WITH INTERNALS: ☐ ☐ ☐ ☐ ☐ INITIAL INLET & FINAL DISCHARGE ☐ SUPPORTS: ☐ ☐ ☐			
☒ NO PULSATION SUPPRESSORS IN SCOPE ☐ INTERSTAGE ☐ SUPPORTS: ☐ ☐ ☐			
☐ PULSATION SUPPRESSORS WITHOUT INTRNL: ☐ ☐ ☐ ☐ ☐ INITIAL INLET & FINAL DISCHARGE ☐ SUPPORTS: ☐ ☐ ☐			
☐ INTERSTAGE ☐ SUPPORTS: ☐ ☐ ☐			
☐ SUPPRESSOR(S) TO HAVE MOISTURE REMOVAL SECTION: ☐ INITIAL INLET ONLY ☐ ALL INLET SUPPRESSORS			
☐ ACOUSTICAL SIMUL STUDY: ☐ ☐ ☐ ☐ DESIGN ☐ 1. W/SIMPLIFIED ANALYSIS OF PIPING SYSTEM			
☒ DIGITAL ☒ ANALOG APPROACH ☐ 2. SEE 3.9.2.1 AND APPENDIX M			
(Check Only One) ☐ 3. SEE 3.9.2.1 AND APPENDIX M			
NOTE: SEE APPENDIX N FOR STUDY TO: ALL SPECIFIED LOAD COND., INCL. ☐ SINGLE ACT., PLUS			
INFORMATION REQUIRED FOR STUDY CONSIDER: ☐ COMP. OPER. IN PARALLEL ☐ ALTERNATE GASES			
☐ STUDY TO BE WITNESSED ☐ WITH EXISTING COMP. AND PIPING SYSTEMS			
☐ VENDOR REVIEW OF PURCHASER'S PIPING ARRANGEMENT ☐ COMPRESSOR VALVE DYNAMIC RESPONSE			
☐ PIPING SYSTEM FLEXIBILITY			
PACKAGED: ☐ NO ☒ YES ☐ ☐ ☐ DEFINE BASIC SCOPE OF PACKAGING IN REMARKS SECTION, PAGE 5			
☐ SKID ☒ SOLEPLT. ☐ BASEPLT ☐ BOLTS OR STUDS FOR SOLEPLT. TO FRAME ☐ RAILS ☐ CHOCK BLOCKS ☒ SHIMS			
☐ SUITABLE FOR COLUMN MOUNTING (UNDER SKID AND/OR BASEPLATE):			
☒ LEVELING SCREWS ☒ NON-SKID DECKING ☐ SUB SOLEPLATES			
☐ DIRECT GROUTED ☐ CEMENTED/MORTAR GROUT ☒ EPOXY GROUT, MFG TYPE			
☐ INTERCLR(S): ☐ ☐ ☐ ☐ SEPARATOR(S): ☐ ☐ ☐ ☐ AFTERCLR(S): ☐ ☐ ☐ ☐ INTERCOOLERS:			
☐ INTERSTAGE PIP: ☐ ☐ ☐ ☐ PIPING MATCHMARKED ☐ SHOP FITTED ☐ MACHINE MTD			
☐ CONDENSATE SEPARATION & COLLECTION FACILITY SYSTEM PER 3.8.12 ☐ OFF MOUNTED			
☐ INLET STRAINER(S): ☐ ☐ ☐ ☐ INITIAL INLET ☐ SIDESTREAM INLET ☐ SPOOL PIECE FOR INLET STRAINERS			
☐ MANIFOLD PIPING: ☐ DRAINS ☐ VENTS ☐ RELIEF VALVES ☐ AIR/GAS SUPPLY FLANGE FINISH			
☐ RELIEF VALVE(S): ☐ ☐ ☐ ☐ INITIAL INLET ☐ INTERSTAGE ☐ FINAL DISCHARGE ☐ API-612 FLANGE FINISH			
☐ RUPTURE DISC(S): ☐ ☐ ☐ ☐ THRU STUDS IN PIPING FLANGES REF 3.9.3.15 x 125 x 250			
☒ CRANKCASE RAPID PRESSURE RELIEF DEVICE(S): ☒ ☐ ☐ ☐ ☐ FLANGE FINISH PER ANSI 16.5			
☐ SPECIAL PIPING REQUIREMENTS PER 3.7.1.12.24, (DEFINE IN REMARKS SECTION NEXT PAGE) ☐ SPECIAL FINISH			
☐ INITIAL INLET ☐ INTERSTAGE SUCTION PIPING ARR'D FOR: ☐ INSULATION: ☐ ☐ ☐ ☐ HEAT TRACING: ☐ ☐ ☐			
☐ FOR ATMOSPHERIC INLET AIR COMPR. ONLY: ☐ INLET AIR FILTER: ☐ ☐ ☐ ☐ INLET FILTER-SILENCER: ☐ ☐ ☐			
☒ PREFERRED TYPE OF CYLINDER COOLING: ☒ ☐ ☐ ☐ ☐ FORCED ☐ THERMOSYPHON STAGE CYL'S:			
NOTE: MANUFACTURER SHALL RECOMMEND ☐ STATIC (STAND-PIPE) STAGE CYL'S:			
BEST TYPE OF COOLING AFTER ☐ CYL. COOLING WATER PIPING: ☐ ☒ ☐ ☐ MATCH MARKED			
FINAL ENGINEERING REVIEW OF ALL ☐ SINGLE INLET/OUTLET MANIFOLD & VALVES ☒ SIGHT GLASSES			
OPERATING CONDITIONS ☒ INDIVIDUAL INLET/OUTLET PER CYL ☐ VALVE(S)			
☐ CLOSED SYS. WITH WATER PUMP, COOLER, SURGE TANK, & PIPING			
☐ SHOP RUN ☐ ARR'D FOR HEATING JACKET AS WELL AS COOLING			

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1	☐ SCOPE OF BASIC SUPPLY (Con't)	
2	☒ SEPARATE COOLING CONSOLE (☐ ☐ ☐): ☐ ONE FOR EA. UNIT ☒ ONE CMN TO ALL UNITS ☒ DUAL PUMPS (AUX. & MAIN)	
3	☒ ARRANGED FOR HEATING JACKET WATER AS WELL AS COOLING	
4	FRAME LUBE OIL SYSTEM (☐ ☐ ☐): ☒ AUX. PUMP ☒ DUAL FILTERS WITH TRANSFER VALVE ☐ SHOP RUN	
5	☒ CONTINUOUS FLOW IN SENSING LINE TO PRESSURE SWITCHES	
6	☒ SEPARATE LUBE OIL CONSOLE (☐ ☐ ☐): ☐ EXTENDED TO MOTOR OUTBOARD BEARING ☐ SHOP RUN	
7	API 614 APPLIES (REFER TO NOTE OF 2.12.2) ☒ NO ☐ YES	
8	NOTE: PIPING BETWEEN ALL CONSOLES AND COMPRESSOR UNIT BY PURCHASER	
9	☐ CAPACITY CONTROL (☐ ☐ ☐): ☒ SEE DATA SHEET PAGE 3 FOR DETAILS ☐ IN INSTRUMENT & CONTROL PANEL	
10	☐ SEPARATE MACHINE MOUNTED PANEL ☐ SEPARATE FREE STANDING PANEL	
11	☐ PNEUMATIC ☐ ELECTRIC ☐ ELECTRONIC ☐ HYDRAULIC	
12	☐ PROGRAMMABLE CONTROLLER	
13		
14		
15	☐ INSTRUMENT & CONTROL PANEL (☐ ☒ ☐): ☐ ONE FOR EACH UNIT ☐ ONE COMMON TO ALL UNITS	
16	☐ MACHINE MOUNTED ☐ FREE STANDING (OFF UNIT)	
17	SEE INSTRUMENTATION DATA SHEETS FOR DETAILS OF PANEL, ADDITIONAL REMARKS, AND INSTRUMENTATION	
18	NOTE: ALL TUBING, WIRING, & CONNECTIONS BETWEEN OFF-UNIT FREE STANDING PANELS AND COMPRESSOR UNIT BY	
19	PURCHASER.	
20		
21		
22	☒ HEATERS (☐ ☐ ☐): ☒ FRAME LUBE OIL ☒ CYL. LUBRICATORS ☒ COOLING WATER ☐ DRIVER(S) ☐ GEAR OIL	
23	☒ ELECTRIC ☐ STEAM	
24		
25	☐ BARRING DEVICE (☐ ☐ ☐): ☐ MANUAL ☐ PNEUMATIC ☐ ELECTRIC ☐ FLYWHEEL LOCKING DEVICE (☐ ☐ ☐)	
26	☒ ROD PRESSURE PACKING COOLING SYSTEM (☐ ☐ ☐): ☐ SEPARATE CONSOLE ☒ FILTERS	
27	☒ SPECIAL CORROSION PROTECTION: ☐ NO ☒ YES ☐ MFR'S STANDARD ☐ OTHER	
28	☐ HYDRAULIC TENSIONING TOOLS ☐ NO ☐ YES	
29	☒ MECHANICAL RUN TEST ☐ NO ☒ YES ☒ MFG'S STANDARD ☐ OTHER <u>4 (FOUR) HOURS MINIMUM</u>	
30	☐ COMPLETE SHOP RUN TEST OF ALL MACHINE MOUNTED EQUIPMENT, PIPING & APPURT(S)	
31		
32	PAINTING: ☐ MANUFACTURER'S STANDARD ☒ SPECIAL <u>CHEVRON STANDARD</u>	
33	NAMEPLATES: ☒ U.S. CUSTOMARY UNITS ☐ SI UNITS	
34	SHIPMENT: ☐ DOMESTIC ☐ EXPORT ☐ EXPORT BOXING REQUIRED (☐ ☐ ☐)	
35	☒ STANDARD 6 MONTH STORAGE PREPARATION (☐ ☐ ☐) PER SPEC	
36	☐ OUTDOOR STORAGE FOR OVER 6 MONTHS (☐ ☐ ☐) PER SPEC	
37	☐ INITIAL INSTALLATION AND OPERATING TEMP ALIGNMENT CHECK AT JOBSITE BY VENDOR REPRESENTATIVE	
38		
39	☒ COMPRESSOR MANUFACTURER'S USER'S LIST FOR SIMILAR SERVICE	
40	☐ PERFORMANCE DATA REQUIRED PER 5.3.3: ☐ BHP VS. SUCTION PRESSURE CURVES	
41	☐ ROD LOAD/GAS LOAD CHARTS	
42	☐ VALVE FAILURE DATA CHARTED	
43	☐ SPEED/TORQUE CURVE DATA	
44	☐ BHP VS. CAPACITY PERFORMANCE CURVES OR TABLES REQUIRED FOR UNLOADING STEPS AND/OR VARIABLE	
45	SUCTION/DISCHARGE PRESSURES	
46		
47	REMARKS:	
48	All instrumentation and controls wired to existing plant DCS. No local control panels or controllers. Vendor to wire all	
49	items to skid mounted junction boxes. All instrumentation to be analog (HART) no switches.	
50		
51		
52		

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1	UTILITY CONDITIONS		
2	ELECTRICAL POWER:	AC VOLTS / PHASE / HERTZ	DC VOLTS
3	⊗ MAIN DRIVER	480 / 3 / 60	INSTRUMENT 24
4	⊗ AUXILIARY MOTORS	480 / 3 / 60	ALARM & SHUTDOWN 24
5	⊗ HEATERS	120 / 1 / 60	
6			
7			
8			
9	INSTRUMENT AIR NORMAL PRESSURE PSIG MAX/MIN / PSIG		
10	STEAM FOR DRIVERS		HEATERS
11	INLET PRESS PSIG MAX/MIN / PSIG	INLET PRESS PSIG MAX/MIN / PSIG	
12	(NORM.) TEMP °F MAX/MIN / °F	(NORM.) TEMP °F MAX/MIN / °F	
13	EXHST PRESS PSIG MAX/MIN / PSIG	EXHST PRESS PSIG MAX/MIN / PSIG	
14	(NORM.) TEMP °F MAX/MIN / °F	(NORM.) TEMP °F MAX/MIN / °F	
15			
16			
17	COOLING WATER FOR: COMPRESSOR CYLINDERS		COOLERS
18	TYPE WATER		TYPE WATER
19	SUPP. PRESS PSIG MAX/MIN / PSIG	SUPP. PRESS PSIG MAX/MIN / PSIG	
20	(NORM.) TEMP °F MAX/MIN / °F	(NORM.) TEMP °F MAX/MIN / °F	
21	RTRN. PRESS PSIG MAX/MIN / PSIG	RTRN. PRESS PSIG MAX/MIN / PSIG	
22	(NORM.) TEMP °F MAX/MIN / °F	(NORM.) TEMP °F MAX/MIN / °F	
23			
24	COOLING FOR ROD PACKING		
25	TYPE FLUID SEE NOTE 1 SUPPLY PRESS PSIG @ °F RETURN PSIG @ °F		
26	FUEL GAS NORMAL PRESSURE PSIG MAX/MIN / PSIG LHV BTU/FT ³		
27	COMPOSITION		
28			
29	REMARKS/SPECIAL REQUIREMENTS:		
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RECIPROCATING COMPRESSOR (API 618-4TH) DATA SHEET U.S. CUSTOMARY UNITS		JOB NO. 07423 ITEM NO. K-8002 A-B REVISION A DATE May 30, 2009 PAGE 7 OF 8 BY JNR			
☒ CYLINDER DATA AT FULL LOAD CONDITION					
1					
2	SERVICE ITEM NO.	Nat. Gas / SMR Feed		Hydrogen / H ₂ Product	
3	STAGE	1		1	
4	INLET PRESSURE, PSIA	88.2		272.0	
5	DISCHARGE PRESSURE, PSIA	419.2		469.4	
6	CYLINDERS PER STAGE	1		1	
7	SINGLE OR DOUBLE ACTING (SA OR DA)	DA		DA	
8	BORE, INCHES	8.0		6.25	
9	STROKE, INCHES	9.0		9.0	
10	RPM	VFD CONTROLLED		VFD CONTROLLED	
11	PISTON SPEED, FT/MIN	441		441	
12	CYLINDER LINER, YES/NO	YES		YES	
13	LINER NOMINAL THICKNESS, INCHES	0.38		0.625	
14	PISTON DISPLACEMENT, CFM	223.7		133.7	
15	CYLINDER DESIGN CLEARANCE, % AVERAGE	16.37		37.27	
16	VOLUMETRIC EFFICIENCY, % AVERAGE	54.63		78.11	
17	VALVES, INLET/DISCHARGE, QTY PER CYL	1 / 1	/	1 / 1	/
18	TYPE OF VALVES	MAGNUM		MAGNUM	
19	VALVE LIFT, INLET/DISCHARGE, INCHES	0.085 / .060		.030 / .030	/
20	VALVE VELOCITY, API 4TH EDITION, FT/MIN	HE	CE	HE	CE
21	SUCTION VALVE(S)	10.902	10.220	18.967	17.025
22	DISCHARGE VALVE(S)	13.091	12.273	15.980	14.344
23	ROD DIAMETER, INCHES	2.0		2.0	
24	MAX ALLOW. COMBINED ROD LOADING, LBS. C*	-27.600		-27.600	
25	MAX ALLOW. COMBINED ROD LOADING, LBS. T*	27.600		27.600	
26	CALCULATED GAS ROD LOAD, LBS. C*	-18.582		-7.378	
27	CALCULATED GAS ROD LOAD, LBS. T*	16.744		5.127	
28	COMBINED ROD LOAD (GAS + INERTIA), LBS. C*	-12.938		-8.602	
29	COMBINED ROD LOAD (GAS + INERTIA), LBS. T*	12.246		5.501	
30	ROD REV., DEGREES MIN @ X-HD PIN**	175		165	
31	RECIP WT. (PISTON, ROD, X-HD & NUTS), LBS.**	196		130	
32	MAX ALLOW. WORKING PRESSURE, PSIG	900		1100	
33	MAX ALLOW. WORKING TEMPERATURE, °F	350		350	
34	HYDROSTATIC TEST PRESSURE, PSIG	1,350		1,650	
35	HELIUM TEST PRESSURE, PSIG	900		1,100	
36	INLET FLANGE SIZE/RATING	4" / 600	/	4" / 600	/
37	FACING	FF		FF	
38	DISCHARGE FLANGE SIZE/RATING	4" / 600	/	4" / 600	/
39	FACING	FF		FF	
40	DISCHARGE RELIEF VALVE SETTING DATA AT INLET PRESSURES GIVEN ABOVE:				
41	RECOMMENDED SETTING, PSIG	450		500	
42	GAS ROD LOAD, LBS. C*	-21007		-8958	
43	GAS ROD LOAD, LBS. T*	19100		6536	
44	COMBINED ROD LOAD, LBS. C*	-14760		-9041	
45	COMBINED ROD LOAD, LBS. T*	14349		5815	
46	ROD REVERSAL °MIN @ X-HD PIN**	175		165	
47	NOTE: CALCULATED AT INLET PRESSURES				
48	GIVEN ABOVE & RECOMMENDED SETTING				
49	☐ SETTLE-OUT GAS PRESSURE				
50	(DATA REQUIRED FOR STARTING)				
51	*C = COMPRESSION *T = TENSION	**X-HD = CROSSHEAD			
52	NOTES/REMARKS:				

RECIPROCATING COMPRESSOR (API 618-4TH) DATA SHEET U.S. CUSTOMARY UNITS		JOB NO. 07423 ITEM NO. K-8002 A.B REVISION A DATE May 30, 2009 PAGE 8 OF 8 BY JNR	
1 2 SERVICE ITEM NO. 3 STAGE 4 CYLINDER SIZE (BORE DIA), INCHES 5 ROD RUN-OUT, NORMAL COLD VERTICAL 6 (per appendix C) ☒ CONSTRUCTION FEATURES SMR Feed 1 8.0 0.008 H2 Product 1 6.25 0.008			
MATERIALS OF CONSTRUCTION			
8 CYLINDER(S)	ASTM A395	ASTM A395	
9 CYLINDER LINER(S)	ASTM A48	ASTM A48	
10 PISTON(S)	ASTM A370	ASTM A395	
11 PISTON RINGS	Carbon Graphite Filled PTFE		
12 WEAR BANDS ☒ REQUIRED	Carbon Graphite Filled PTFE		
13 PISTON ROD(S), MATERIAL YIELD, PSI	ASTM A193 / 105 ksi	/	/
14 THREAD ROOT STRESS @ MACRL * @ X-HD END			
15 PISTON ROD HARDNESS, BASE MATERIAL, Rc			
16 PISTON ROD COATING ☒ REQUIRED	TUNGSTEN CARBIDE		
17 COATING HARDNESS, Rc	>70 Rc	>70 Rc	
18 VALVE SEATS / SEAT PLATE	ASTM A536	ASTM A536	
19 VALVE SEAT MIN HARDNESS, Rc			
20 VALVE GUARDS (STOPS)	ASTM A536	ASTM A536	
21 VALVE DISCS	PEEK	PEEK	
22 VALVE SPRINGS	17-7 PH SS	17-7 PH SS	
23 ROD PRESSURE PACKING RINGS	Carbon Graphite Filled PTFE		
24 ROD PRESSURE PACKING CASE	Steel	Steel	
25 ROD PRESSURE PACKING SPRINGS	Inconel	Inconel	
26 SEAL / BUFFER PACKING, DISTANCE PIECE	Carbon Graphite Filled PTFE		
27 SEAL / BUFFER PACKING, INTERMEDIATE	Carbon Graphite Filled PTFE		
28 WIPER PACKING RINGS	Bronze	Bronze	
29 MAIN JOURNAL BEARINGS, CRANKSHAFT	Aluminum	Aluminum	
30 CONNECTING ROD BEARING, CRANKPIN	Aluminum	Aluminum	
31 CONNECTING ROD BUSHING, X-HD END	Aluminum	Aluminum	
32 CROSSHEAD (X-HD) PIN BUSHING	Bronze	Bronze	
33 CROSSHEAD PIN	ANSI 4140	ANSI 4140	
34 CROSSHEAD	ASTM A536	ASTM A536	
35 CROSSHEAD SHOES	Aluminum	Aluminum	
36 CYLINDER INDICATOR VALVES ☒	Yes	Yes	
37 INDICATOR CONNECTIONS ABOVE 5000 PSI			
38 FLUOROCARBON SPRAYED CYLINDER ☒			
39 INSTRUMENTATION IN ☒ COLD SIDE			
40 CONTACT W/PROCESS GAS ☒ HOT SIDE			
41 * MAXIMUM ALLOWABLE COMBINED ROD LOAD	USE ☒ IN APPROPRIATE COLUMN WHERE APPLICABLE		
42 ☒ COMPRESSOR CYLINDER ROD PACKING	DISTANCE PIECE(S): ☐ TYPE A ☐ TYPE B ☒ TYPE C ☐ TYPE D Ref: Appendix G, Fig. G.3		
43 ☒ FULL FLOATING PACKING			
44 ☒ VENTED TO: ☒ FLARE @ _____ PSIG ☐ ATMOS	COVERS: ☒ SOLID METAL ☐ SCREEN ☐ LOUVERED		
45 ☐ SUCTION PRESSURE @ _____ PSIG	CYLINDER COMPARTMENT: ☐ VENTED TO _____ PSIG		
46 ☒ FORCED LUBRICATED ☐ NON-LUBE ☐ TFE	(Substrate Distance Piece) ☒ PURGED AT 20 PSIG		
47 ☒ WATER COOLED, _____ STAGE(S), _____ GPM REQ'D	☐ PRESSURIZED TO _____ PSIG		
48 ☒ OIL COOLED, _____ STAGE(S), _____ GPM REQ'D	☐ WITH RELIEF VALVE		
49 ☐ WATER FILTER PROV FUTURE WATER/OIL COOLING	FRAME COMPARTMENT: ☐ VENTED TO _____ PSIG		
50 ☒ VENT/BUFFER GAS SEAL PACKING ARR. Ref: Appendix I, FIG. I-1	(Indicant Distance Piece) ☒ PURGED AT 20 PSIG		
51 ☐ CONSTANT OR ☐ VARIABLE DISPOSAL SYSTEM	☐ PRESSURIZED TO _____ PSIG		
52 ☒ BUFFER GAS PRESSURE 20 PSIG	☐ WITH RELIEF VALVE		
53 ☒ SPLASH GUARDS FOR WIPER PACKING	☒ DISTANCE PIECE MAWP 50 PSIG		

EQUIPMENT DATA					
SERVICE	HYDROGEN COMPRESSOR		P&ID EQUIP. NO.	K-8002 A/B	
MFR.	Dresser -Rand		MFR. SERIAL NO.	X22XGH669 & X22XGH670	
MODEL	2 HSE-1-1		TYPE	RECIPROCATING	
ORDER NO.	090-78202		REFY. EQUIP. NO.	K-8002 A/B	
DWGS.					
SIZE	6.25" + 8.0" X 9" Stroke		CAPACITY PER UNIT @ 60f AND 14.7 PSIA	1.06 MMSCFD (SMR) / 2.57 MMSCFD (H2)	
TYPE OF DRIVER	N/A		NO. OF UNITS	2	
POWER CYL'S. PER UNIT	0		POWER CYL. MAT'L	N/A	
POWER CYL BORE	N/A		POWER CYL. STROKE	N/A	
COMPRESSOR					
		1st STAGE	2nd STAGE	3rd STAGE	4th STAGE
NO. CYL. PER STAGE		1	1		
CYL. BORE	(in.)	6.25	8.0		
CYL. STROKE	(in.)	9.0	9.0		
MATERIALS					
CYLINDER		ASTM A395	ASTM A395		
LINER		ASTM A48	ASTM A48		
PISTON		ASTM A395	ASTM A370		
PISTON RINGS		Carbon Filled PTFE	Carbon Filled PTFE		
PISTON ROD		ASTM A193	ASTM A193		
ROD PACKING		Carbon Filled PTFE	Carbon Filled PTFE		
VALVE DISKS/SPRGs		PEEK / 17-7 PH SS	PEEK / 17-7 PH SS		
DISCHARGE PRESS.	(PSIG)	469.4	419.2		
DISCHARGE TEMP.	(°F)	194.0	281		
SUCTION PRESS.	(PSIG)	274.7	89.1		
SUCTION TEMP.	(°F)	95	60		
MAX. ALLOW. CONTINUOUS ROD LOAD	(LBS)	27.600	27.600		
OPERATING LIMITS					
(CONSULT ENGINEERING BEFORE EXCEEDING THESE LIMITS)					
		1st STAGE	2nd STAGE	3rd STAGE	4th STAGE
MFR. MAX. ALL. WORKING PRESS. ON CYL.		1,100	900		
MIN. INTAKE PRESS.	(PSIG)	Not Evaluated	Not Evaluated		
MAX. DISCHARGE PRESS.	(PSIG)	500	450		
MAX. SAFE OPER. SPEED	(RPM)	441	441		
MIN. ALLOW. SPEED	(RPM)	441	441		
OVERSPEED TRIP SETTING	(RPM)	N/A	N/A		
MIN. LUBE OIL PRESS.	(PSIG)	10	10		
RELIEF VALVE NO. ON DISCHARGE		1	1		
RELIEF VALVE SETTING OF DISCHARGE	(PSIG)	500	450		
RELIEF VALVE LOCATION ON DISCHARGE					
MAX. DISCHARGE TEMP.	(°F)	275	300		
PROHIBITED LOADING MODES		All not evaluated	All not evaluated		
SAFETY PRECAUTIONS					
SEE THE SIS GUIDELINES FOR RECOMMENDATIONS. NOTE BELOW SPECIAL HAZARDS, RECOMMENDATIONS, INSPECTIONS OR TESTS FOR THE ABOVE EQUIPMENT					
DATE	June 1, 2009	PREPARED BY	J. Rodriguez	APPROVED: ENGR.	EDWARD SUNG
				OPER.	
RECIPROCATING COMPRESSOR SAFETY INSTRUCTION SHEET					DWG.
					NO. B80-A-K-29115
CHEVRON BURNABY			PLANT 80 - HYDROGEN PLANT		
(Location)			(Plant)		
					Sheet 1 of 1