DRESSER-RAND

CENTRIFUGAL AND AXIAL COMPRESSOR DATA SHEET (API 617-7TH Chapter 2) SI UNITS (1-1.6.5)

JOB NO.	115550		ITEM NO.	C6000	
REVISION NO.	1		DATE	Thursday, March 29, 2012	
PAGE	1	OF 7	BY	Y.Y.Peignet	

APPLICABLE TO: ○ PROPOSAL ○ PURCHASE ● AS BUILT

FOR	Kinsale Energy	UNIT	C6000
SITE	Kinsale Alpha / Irish Sea	SERIAL NO.	
SERVICE	Gas Injection	NO. REQUIRED	
MANUFACTURER	DRESSER-RAND	DRIVER TYPE (1-3.1.1)	GAS TURBINE / Solar Taurus 60
MODEL	D06R6S	DRIVER ITEM NO.	

INFORMATION TO BE COMPLETED: ○ BY PURCHASER □ BY MANUFACTURER △ MUTUAL AGREEMENT (PRIOR TO PURCHASE)

OPERATING CONDITIONS

(ALL DATA ON PER UNIT BASIS)

	Guaranteed	Early	Mid	End	Max Head	Rated	Max Flow
	D6R6S	D6R6S	D6R6S	D6R6S	D6R6S	D6R6S	D6R6S
	SEC #1	SEC #1	SEC #1	SEC #1	SEC #1	SEC #1	SEC #1
● GAS HANDLED (ALSO SEE PAGE)	C6000 Rich	C6000 Rich	C6000 Rich	C6000 Rich	C6000 Rich	C6000 Rich	C6000 Rich
▲ GAS PROPERTIES (1-2.1.1.4)							
● MMSM3/Day 1.0133 & 15.5 (DRY)	2.548	1.416	1.416	1.416	2.180	2.803	3.114
● WEIGHT FLOW, (Kg/Hr) (WET)	**83 000**	**46 107**	**46 107**	**46 107**	**71 006**	**91 293**	**101 437**
○ RECYCLE WEIGHT FLOW, (Kg/Hr) (WET)	0	0	8 408	14 958	0	0	0
INLET CONDITIONS							
● SPECIFIED PRESSURE (BarA)	**33.00**	**33.00**	**33.00**	**33.00**	**33.00**	**33.00**	**33.00**
○ THROTTLED PRESSURE (BarA)							
● TEMPERATURE (°C)	**16.00**	**21.00**	**21.00**	**21.00**	**16.00**	**16.00**	**16.00**
○ RELATIVE HUMIDITY (%)							
● MOLECULAR WEIGHT	**18.52**	**18.52**	**18.52**	**18.52**	**18.52**	**18.52**	**18.52**
■ Cp/Cv (Kavg)	1.273	1.273	1.267	1.263	1.264	1.273	1.273
■ COMPRESSIBILITY (Z1)	0.9195	0.9238	0.9238	0.9238	0.9195	0.9195	0.9195
■ INLET VOLUME, (M3/Min)(WET)	50.05	28.42	28.42	28.42	42.81	55.05	61.16
DISCHARGE CONDITIONS							
● PRESSURE (BarA)	**96.00**	**73.00**	**96.00**	**111.0**	**121.0**	**96.00**	**84.00**
■ TEMPERATURE (°C)	114.4	93.5	122	137.4	139.4	115	104.9
■ Cp/Cv(Kavg)	1.273	1.273	1.267	1.263	1.264	1.273	1.273
■ COMPRESSIBILITY (ZAvg)	0.9438	0.9354	0.9502	0.9576	0.9587	0.9444	0.941
FLANGE FLOWS							
■ INLET FLANGE WEIGHT FLOW, Kg/Hr (WET)	**83000**	**46 107**	**54515**	**61065**	**71 006**	**91 293**	**101 437**
■ INLET FLANGE VOLUME, (M3/Min)(WET)	50.05	28.42	33.6	37.64	42.81	55.05	61.16
■ DISCHARGE FLANGE WEIGHT FLOW, Kg/Hr (WET)	83 000	46 107	57 205	61065	71 006	91 293	101 437
■ DISCHARGE FLANGE VOLUME, (M3/Min)(WET)	23.67	16.26	15.96	16.18	17.37	26.09	32.15
■ GHP REQUIRED (KW)	4453	1809	3 181	3999	4 894	4942	4933
■ TRAIN BHP REQUIRED EXCL. EXT. LOSSES (KW)	**4489**	**1834**	**3 214**	**4038**	**4 935**	**4980**	**4971**
□ BHP REQ. AT DRIVER INCL. EXT. LOSSES (GEAR, ETC.) (KW)							
■ SPEED (RPM)	**12634**	**10265**	**12 019**	**13057**	**13533**	**12918**	**12807**
□ TURNDOWN (%)							
■ POLYTROPIC HEAD (M Kgf/Kg)	15291	11132	15 641	18216	19347	15314	13195
■ POLYTROPIC EFFICIENCY (%)	77.64	77.3	76.1	75.76	76.48	77.07	73.91
● CERTIFIED POINT	**YES**	NO	NO	NO	NO	NO	NO
○ EXPECTED OPERATION AT EACH CONDITION (%)							
□ PERFORMANCE CURVE NUMBER							

PROCESS CONTROL (1-3.4.2.1)

METHOD ○ SUCTION THROTTLING FROM ____ BarA TO ____ BarA ○ VARIABLE INLET GUIDE VANES (2-2.4.1) ● SPEED VARIATION FROM 105 % 14300 rpm TO 70 % 9533 rpm ○ DISCHARGE BLOWOFF TO ____ ○ COOLED BYPASS FROM ____ TO ____

SIGNAL ○ SOURCE (1-3.4.2.1) ____

TYPE ○ ELECTRONIC ○ PNEUMATIC ○ OTHER ____

RANGE ____ MA ____ BarG ____

● ANTI-SURGE SYSTEM (1-3.4.2.2) ____

REMARKS: **Brake Power is guaranteed per API 617 at 4 387 kW +4% (max 4 562 kW) (refer to TR140151 KE rev0008)**

Design Pressure Rating is 1795psiG / 123.8 barG ; Compressor and piping shall be protected accordingly (relief valve)

NOTE 1: IF GAS ANALYSIS IS GIVEN, MANUFACTURER SHALL SUPPLY DATA, OTHERWISE DATA SHALL BE SUPPLIED BY USER

DRESSER-RAND

CENTRIFUGAL AND AXIAL COMPRESSOR
DATA SHEET (API 617-7TH Chapter 2)
SI UNITS (1-1.6.5)

JOB NO.	115550	ITEM NO.	C6000	
REVISION NO.	1	DATE	Thursday, March 29, 2012	
PAGE	2	OF 7	BY	Y.Y.Peignet

OPERATING CONDITIONS (Continued) (1-2.1.1.1) (1-3.1.2) (1-3.1.3)

GAS ANALYSIS: ● MOL %	MW	C6000 Rich	C6000 Lean					REMARKS:
Methane (C1)	16.043000	**87.429240**	**98.840910**					
Ethane (C2)	30.070000	**6.975876**	**0.594884**					
Propane (C3)	44.097000	**2.191612**	**0.036878**					
n-Butane (n-C4)	58.123000	**0.210232**	**0.013989**					
i-Butane (i-C4)	58.123000	**0.210232**	**0.019585**					
n-Pentane (n-C5)	72.150000	**0.030793**	**0.006762**					
i-Pentane (i-C5)	72.150000	**0.030793**	**0.009016**					
n-Hexane (n-C6)	86.177000	**0.010742**	**0.001887**					
Carbon Dioxide	44.010000	**1.909883**	**0.284552**					
Nitrogen	28.013000	**0.991366**	**0.191570**					
n-Heptane (n-C7)	100.200000	**0.009239**						
Water	**Gas dehydrated to NTS specification of 50mg/m3**							
TOTAL		100.000000	100.000000					**Gas Equation of state : D-R Standard**
AVG. MOL. WT.		**18.515940**	**16.263610**					

LOCATION: (1-2.1.8)

○ INDOOR ○ OUTDOOR ○ GRADE

○ HEATED ○ UNDER ROOF ○ MEZZANINE

○ UNHEATED ○ PARTIAL SIDES ○ _____

○ ELEC. AREA CLASSIFICATION (1-2.1.14) CL ____ GR ____ DIV ____

SITE DATA (1-2.1.8)

● ELEVATION 30.5 m BAROMETER 1.013 BarA

● RANGE OF AMBIENT TEMPS:

		DRY BULB	WET BULB
NORMAL	°C	7	
MAXIMUM	°C	21	
MINIMUM	°C	-8	
	°C		

UNUSUAL CONDITIONS: ○ DUST ○ FUMES

°C

○ OTHER (1-2.1.8) _____

○ COPPER AND COPPER ALLOYS PROHIBITED (1-2.2.1.14)

COATING: (1-2.2.1.16)

○ ROTATING COMPONENTS _____

○ STATIONARY COMPONENTS _____

REMARKS: _____

NOISE SPECIFICATIONS: (1-2.1.9)

○ APPLICABLE TO MACHINE:
SEE SPECIFICATION _____

○ APPLICABLE TO NEIGHBORHOOD:
SEE SPECIFICATION _____

ACOUSTIC HOUSING: ○ YES ○ NO

APPLICABLE SPECIFICATIONS:

API 617, 7TH CHAPTER 1&2

○ VENDOR HAVING UNIT RESPONSIBILITY (1-1.5.52) (1-1.8) (1-2.1.3)

○ GOVERNING SPECIFICATION (IF DIFFERENT)

PAINTING:

○ **MANUFACTURER'S STD.**

○ OTHER _____

SHIPMENT: (1-4.4)

○ DOMESTIC ○ EXPORT ○ EXPORT BOXING REQ'D.

○ OUTDOOR STORAGE MORE THAN 6 MONTHS (1-4.4.1) ____ MO

SPARE ROTOR ASSEMBLY PACKAGE (1-4.4.3.10)

○ HORIZONTAL STORAGE ○ VERTICAL STORAGE

DRESSER-RAND

CENTRIFUGAL AND AXIAL COMPRESSOR DATA SHEET (API 617-7TH Chapter 2) SI UNITS (1-1.6.5)

JOB NO. 115550 ITEM NO. C6000
REVISION NO. 1 DATE Thursday, March 29, 2012
PAGE 3 OF 7 BY Y.Y.Peignet

CONSTRUCTION FEATURES

SPEEDS:
MAX. CONT. 14 300 RPM TRIP 15 015 RPM
MAX. TIP SPEEDS: 244. MPS @ 100% SPEED
256. MPS @ MAX. CONT. SPEED

LATERAL CRITICAL SPEEDS (DAMPED)

FIRST CRITICAL	7540 to 9300	RPM		MODE
SECOND CRITICAL	27660 to 27780	RPM		MODE
THIRD CRITICAL		RPM		MODE
FOURTH CRITICAL		RPM		MODE

○ LATERAL ANALYSIS ADDITIONAL REQUIREMENTS (1-2.6.2.14)
○ TRAIN LATERAL ANALYSIS REQUIRED (1-2.6.2.6)
○ TRAIN TORSIONAL ANALYSIS REQUIRED (1-2.6.7.1)

TORSIONAL CRITICAL SPEEDS:

FIRST CRITICAL	4322	RPM
SECOND CRITICAL	45757	RPM
THIRD CRITICAL		RPM
FOURTH CRITICAL		RPM

○ LIST OF TRAIN UNDESIRABLE SPEEDS (1-2.6.1.4)

VIBRATION:
ALLOWABLE TEST LEVEL 23.3 MICS
(PEAK TO PEAK)

NAMEPLATE (2-2.11.2)
○ US CUSTOMARY ● METRIC

☐ **ROTATION, VIEWED FROM DRIVEN END** ○ CW ● CCW

○ **MATERIALS INSPECTION REQUIREMENTS (1-4.2.2.1)**
○ RADIOGRAPHY REQUIRED FOR
○ ULTRASONIC REQUIRED FOR
○ MAGNETIC PARTICLE REQUIRED FOR
○ LIQUID PENETRANT REQUIRED FOR
○ LOW TEMPERATURE (1-2.2.1.15.3)
MIN.DESIGN METAL TEMPERATURE (°C)
AT CONCURRANT PRESSURE (BarA)
○ OTHER TRAIN COMPONENTS (1-2.2.1.15.2)

CASING:
MODEL D6R6S
CASING SPLIT RADIAL
MATERIAL ASTM A350 Gr LF2 Carbon Steel with -50°F Impact
THICKNESS (mm) 63.50 CORR. ALLOW. (mm) 3.175
MAX. ALLOWABLE PRESS 123 BarG
TEST PRESS (BarG): HYDRO 185
MAX. ALLOWABLE TEMPERATURE (°C) 193
MAX OPER. TEMP. 193 °C MIN. OPER. TEMP. -29 °C
MAX CASING CAPACITY (ICFM) 100
● SYSTEM RELIEF VALVE SET PT. (2-2.3.1.1) 120 BarG
○ Q.C. OF INACCESSIBLE WELDS (1-2.3.1.11.2)

GUIDE VANES
MATERIAL ASTM A36
NO. VANES GUIDE VANE 12
○ IGV EXTERNAL PURGE (2-2.4.2)
○ VANE CONTROL SYSTEM (2-2.4.3)

DIAPHRAGMS:
MATERIAL ASTM A36 Carbon Steel Plate
AXIALLY SPLIT ☐ YES ☐ NO (2-2.4.8)
○ INTERMEDIATE MAIN PROCESS CONNECTIONS (2-2.4.5
DISCH. PRESSURE (BarA) MAX MIN
INLET PRESSURE (BarA) MAX MIN
DIAPHRAGM MAX. Δ P (BarA) 23

IMPELLERS:
NO. 6 DIA (mm) (5)@325.6,(1)@341.9
NO. VANES EA. IMPELLER (4)@19,(2)@17
TYPE (OPEN, ENCLOSED, ETC.) ENCLOSED
TYPE FABRICATION FABRICATED
MATERIAL (1)410,(5)@4330
MIN. YIELD STRENGTH (kPa) 530888
HARDNESS: (Rc) (BRINNEL) MAX 197 MIN 255
SMALLEST TIP INTERNAL WIDTH (mm) 8.707
MAX. MACH. NO. @ IMPELLER EYE 0.39
MAX. IMPELLER HEAD@100% SPD (M Kgf/Kg) 2661.

SHAFT:
■ ONE PIECE ☐ BUILT UP
MATERIAL Grade 4340 Alloy Steel Forging High Strength
DIA @ IMPELLERS (mm) (6)@132.272 DIA @ COUPLING (mm)
SHAFT END: ■ TAPERED ☐ CYLINDRICAL
☐ SPLINED ☐ INTEGRAL FLANGE
MIN. YIELD STRENGTH (kPa) 861 845
SHAFT HARDNESS (BNH)(Rc) 331.0
MAX TORQUE CAPABILITY (N-M) 7000

BALANCE PISTON:
MATERIAL Grade 4140 Alloy Steel Forging AREA 14813 mm²
FIXATION METHOD SHRINK FIT
NORMAL CLEARANCE (mm) 0.29 (radial)
FLOW WITH NORMAL CLEARANCE (Kg/Hr) 3000
FLOW WITH 2x NORMAL CLEARANCE (Kg/Hr) 7000
○ PRESS. CONN. BAL LINE DOWNSTREAM (2-2.5.4.3)

SHAFT SLEEVES:
AT INTERSTG. CLOSE MATL A743
CLEARANCE POINTS
AT SHAFT SEALS MATL A743
○ ACCESSIBLE (2-2.8.3)

ROTOR
○ DISASSEMBLY AND REASSEMBLY (1-2.6.8.2.1.1)
○ AT SPEED BALANCING (1-2.6.8.3)
○ SEQUENTIAL LOW SPEED BAL. PREC. AT SPEED BAL. (1-2.6.8.6)
○ RESIDUAL BALANCE CHECK (1-2.6.8.7)

LABYRINTHS:
INTERSTAGE
TYPE KNIFE EDGE MATERIAL A850
BALANCE PISTON
TYPE KNIFE EDGE MATERIAL A850

DRESSER-RAND

CENTRIFUGAL AND AXIAL COMPRESSOR
DATA SHEET (API 617-7TH Chapter 2)
SI UNITS (1-1.6.5)

JOB NO.	115550		ITEM NO.	C6000	
REVISION NO.	1		DATE	Thursday, March 29, 2012	
PAGE	4	OF 7	BY	Y.Y.Peignet	

CONSTRUCTION FEATURES (CONTINUED)

SHAFT SEALS:

- ● SEAL TYPE (1-2.8.1.3): Tandem with intermediate laby (no buffer injection)
- ● MAX SEALING/SETTLING OUT PRESSURE (1-2.8.1.1) (BarA): See note 1
- ○ MIN.SEALING PRESSURE (BarA)
- ○ SUPPLEMENTAL DEVICE REQUIRED FOR CONTACT SEALS (1-2.8.3.4) TYPE
- ○ BUFFER GAS SYSTEM REQUIRED (1-2.8.1.5)
- ○ TYPE BUFFER GAS (1-2.8.1.5)
  - ☐ PRESSURE (1-2.8.1.6) BarA
  - ☐ FLOWRATE Kg/Hr
  - ☐ FILTRATION
- ○ MANIFOLD (1-2.8.1.7)
- ● METHOD OF CONTROL (1-2.8.1.5): Flow Control

- ○ BUFFER GAS CONTROL SYSTEM SCHEMATIC BY VENDOR
- ○ PRESSURIZING GAS FOR SUBATMOSPHERIC SEALS (1-2.8.2.4)
  - ○ EDUCTOR ○ INJECTION (1-2.8.2.3)
- ■ SEAL MANUFACTURER: **FlowServe**
- ☐ LEAKAGE TO PROCESS (GAL/DAY/SEAL)

BUFFER GAS REQUIRED FOR:

- ☐ AIR RUN-IN ☐ OTHER
- ☐ FLOW (PER SEAL):
  - NORM: lit/Min@ Bar Δ P
  - MAX. lit/Min@ Bar Δ P
- ☐ **BEARING HOUSING CONSTRUCTION:**

TYPE (SEPARATE, INTEGRAL): SEPARATE SPLIT: AXIAL

MATERIAL: ASTM A36 Carbon Steel Plate

AXIAL COMPRESSOR

STAGE	1	2	3	4	5	6	7	8	9
ROTOR									
☐ BLADE MATERIAL									
☐ BLADE ROOT TYPE									
☐ CORD WIDTH (mm)									
☐ OUTER DIAMETER (mm)									
☐ BLADE HEIGHT (mm)									
☐ BLADE QUANTITY									
STATOR									
☐ BLADE MATERIAL									
☐ TYPE (MOVABLE, FIXED, ○ ADJUSTABLE) (2-3.4.2.3)									
☐ CORD WIDTH (mm)									
☐ BLADE QUANTITY									

STAGE	10	11	12	13	14	15	16	17	18
ROTOR									
☐ BLADE MATERIAL									
☐ BLADE ROOT TYPE									
☐ CORD WIDTH (mm)									
☐ OUTER DIAMETER (mm)									
☐ BLADE HEIGHT (mm)									
☐ BLADE QUANTITY									
STATOR									
☐ BLADE MATERIAL									
☐ TYPE (MOVABLE, FIXED, ○ ADJUSTABLE) (2-3.4.2.3)									
☐ CORD WIDTH (mm)									
☐ BLADE QUANTITY									

REMARKS:

Note 1 : Normal Dynamic sealing Pressure = 32 Bar G / Min. Dyn. P = 0.2 barG / Max Dyn. P = 95 barG

Settle Out Pressure (with start up allowed) = 55 Bar G / Max Allowed Static Pressure (without start up): 95 Bar G

Primary seal feeded with fuel gas, No buffer gas into secondary seals

Barrier seal (tertiary) feeded with air : Max Flow per Barrier 530 Std L/mn @ MCoS / 900 Std L/mn @ 0 rpm