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7/27/67

SHEET NO. 30F8 REV. 2

THE FLUOR CORPORATION, LTD.
SPECIFICATION SHEET

JOB NO. 4224 DATE 3-1-66

CENTRIFUGAL COMPRESSOR

BY T.M. CHH CHK'D

CONSTRUCTION FEATURES

SPEEDS (rpm): Max Cont 10,800 Criticals: 1st 4620 2nd 15,900
 ROTATION, Viewed from Coupling End of Compressor C.W
 CASING: Type BARREL Material FORGED STEEL - ASTM-A-286-55-CL1
 Thickness _____ Corrosion Allowance _____
 Max Oper Temp 300 Max Oper Press. 975 PSIA Test Press. 1425 PSIG
 IMPELLERS: Type CLOSED, WELDED Material AISI 4140
 No. 7 Diameters 15.25
 DIAPHRAGMS: Material CAST IRON Cooling UNCOOLED
 LABYRINTHS: Material ALUMINUM Radial Clearance _____
 SHAFT: Material FINGED STL. 4140 Diameter at Impellers 5 1/8"
 BEARING HOUSING CONSTRUCTION CAST STEEL
 RADIAL BEARINGS: Span 59 5/8 Diameter 3 1/2" Length 3"
 Total Clearance _____ Oil Press. 20 - 25
 THRUST BEARING: Type DBL. KINGSBURY Size _____
 Location OUTBOARD Oil Press. 20 - 25
 OTHER COMPONENTS: Material _____

INLET NOZZLE: Size 12" Rating 600" Facing R.F Location UP

Allowable Loads	Force, lb	Moment, ft-lb
Parallel to Shaft		
Vertical		
Horiz 90 deg to Shaft		

DISCHARGE NOZZLE: Size 10" Rating 600" Facing R.F Location UP

Allowable Loads	Force, lb	Moment, ft-lb
Parallel to Shaft		
Vertical		
Horiz 90 deg to Shaft		

2 CASING CONNECTIONS: Vents, No. NONE Type and Size _____
 Suction Nozzle: Pressure Connection NONE Type and Size _____
 Temperature Connection NONE Type and Size _____
 Discharge Nozzle: Pressure Connection NONE Type and Size _____
 Temperature Connection NONE Type and Size _____
 Casing Drains: No. 2 1/2 IN 2' OUTLET VOLUME Type and Size VALVED
 Water Connection: No. _____ Type and Size _____
 Lube-Oil Connection: Inlet Type and Size 300# ASA RF 2'
 Outlet Type and Size 300# ASA RF 5'
 Seal-Oil Connection: Inlet Type and Size _____
 Outlet Type and Size _____
 Other Connection: Service _____
 Type and Size _____

ALL COUPLING GUARDS SHALL MEET CALIF. CODE

COUPLINGS:	Driver-Compressor or Driver-Gear	Gear-Compressor
Make	<u>THOMAS</u>	<u>FAST</u>
Type	<u>SIZE #501 BDZ</u>	<u>GEAR-SPACER #2</u>
Lubrication	<u>NONE</u>	<u>CONTINUOUS LUBRICATED</u>
Mounting	<u>YES</u>	<u>YES</u>

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**ENGINEERING SPECIFICATIONS
M-LINE COMPRESSORS**

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February 14, 1968

User Texaco, Inc.
 Location Wilmington, California
 Contractor The Fluor Corporation, Ltd.
 Application Recycle

Gen. Order LA66-0021 S.O. E-8346 S.N. E-8346
 No. of Units One Frame 25MB7
 Contract Engr. LIB Prelim. Final
 Date of Shipment December, 1967

NOZZLES	Size & Rating	Direction	Location by stage number
Inlet	12" - 600# RF	Up	
Disch.	10" - 600# RF	Up	
IsoCool			bet.
1st SL			ent.
2nd SL			ent.
3rd SL			ent.

CONDITIONS	guar.		
Gas	H ₂ + HC		
K	1.35		
Mole. Wt.	6.8		
Suction flow cfm	714		
Suction temp. °F	100		
Suction pr. psia	660		
Disch. pr. psia	910		
Disch. temp. °F	174		
Shaft HP	1100		
Speed RPM	10800		
1st SL flow			
1st SL temp. °F			
1st SL pr. psia			
2nd SL flow			
2nd SL temp. °F			
2nd SL pr. psia			
3rd SL flow			
3rd SL temp. °F			
3rd SL pr. psia			
Barometer "Hg.	14.7		

STAGE	Designation	Blade D	Shaft D
1	FB-1	15 1/4	5 1/8
2			
3			
4			
5			
6			
7	↓	↓	↓
8			
9			

TEST RESUME
 Hydro test inlet end 1510 psig
 Hydro test disch. end 1510 psig
 Gas test 1005# Helium Vacuum No
 Spin Speed Impellers 12,450 Rotor 11,880
 Performance Test Yes, closed loop
 Underwater

Rot. facing	crit.	book	computer	test
Inlet end	1st		4,300	
<input checked="" type="checkbox"/> CW <input type="checkbox"/> CCW	2nd		13,000	

BEARINGS (dam type journal bearings)
 Journal-drive end 3 1/4 x 2 7/8 (2" shaft end)
 Journal - outboard 3 1/2 x 2 7/8
 Thrust-type Kingsbury area 15.6
 Thrust load max. 150 min. 86

SEALS
 Internal Iso-Sleeve
 External Labyrinth
 Orifice size (iso-seal) None

SPLIT LINE SEALING
 Casing None
 Disch. wall None
 Diaphragms None

MATERIALS	spec.	type
Casing	480A	Forged Steel
Diaphragms & G.V.S.	1 or 2	Cast Iron
Shaft	322A	4140 Bar
Covers & hubs	162H	4140 Forging
Blades	210	Steel Plate
Shaft Sleeves	48	Steel Tubing
1st. piston 7" diam.	162A-1	4140 Forging
Impeller labyrinth	252	Aluminum
Interstage laby.	252	Aluminum
Bal. piston laby.		Lead
Labyrinth shaft seal	Rotating	
	non-rotat.	

DRIVERS	Make-type	S.O.-P.O.	Rated HP	Rated RPM	Max. HP	Max. RPM	Power Conditions
Turbine							
Motor	G.E. - TERC		1250	1786	1250	1800	3/60/2300
Gear	Wes. 140HSA70		1250	1786/10800	1.3 SF	1800/10800	Ratio 6.05:1.0

COUPLINGS	Make-size-type	gap	serial no
x Inboard	Past #2 ASCL	5	866511
Drive thru			
Driver-gear	Thomas 501 DBZ 2 3/4		30911
Continuous lube			

Oil Requirements	gpm	psig	BTU/hr
Compr. bearing	18	20-25	90,000
Compr. seals	9	8 paid	46,500
driver gear	12	20-25	63,600
driver motor	2	20-25	3,000
Totals			

MOUNTING ARRANGEMENT Soleplates

MISCELLANEOUS Impeller yield strength. to be 90,000 psi max.

viscos. 150 SSU @ 100°F system by ECO
 Separate lube and seal systems

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NO.	DATE	BY	CK	APP	DESCRIPTION

For TEXACO INC Site WILMINGTON, CALIFORNIA
 Unit HTU #3 Service HYDROGEN RECYCLE GAS Item No. _____
 Quantity ONE (1) Mfr. LUFKIN IND. Serial No. _____
 Other _____

NOTE: INDICATES INFORMATION TO BE COMPLETED BY PURCHASER; BY MANUFACTURER
 PARAGRAPH NUMBERS WITHIN () REFER TO APPLICABLE PARTS OF API STANDARD 613.

RATING REQUIREMENTS

Driven Equipment BHP: Normal _____ Max. _____
 Driver BHP: Rated _____ Max. _____
 Gear Rated HP (2.2.1) 800 HP
 Torque @ Max. Continuous Speed _____ Lb Ft
 Max. Torque (2.2.1) _____ Lb Ft @ _____ RPM
 Rated Input Speed (1.4) 1785 RPM Specified Nominal
 Rated Output Speed (1.4) 1360 RPM Specified Nominal
 Allowable Variation in Gear Ratio (1.4) (+) (-) _____ %
 Max. Continuous Speed (1.4) _____ RPM
 Trip Speed (1.4) _____ RPM
 Gear Service Factor (2.2.2) 65/55 MINIMUM (min.)
 Shaft Assembly Designation (2.1.16) _____
 H.S. Shaft Rotation Facing Cpl'g. (2.1.17) CW CCW
 L.S. Shaft Rotation Facing Cpl'g. (2.1.17) CW CCW
 Shaft Ends: Cylindrical Tapered Flanged Keyed (1) (2)
 External Loads (2.1.14) _____
 Other Operating Conditions (2.6.1.4) _____

BASIC GEAR DATA (Cont'd.)

Bending Stress Number, "S_t" (2.2.4.2)

Pinion	Gear
Actual <u>22168</u>	<u>20975</u>
Allowable <u>31320</u>	<u>27140</u>

Material Index Number (Fig. 2, Table 3) 216.5
 Anticipated Sound Pressure Level 90 dbA @ 3 ft.
 Journal Static Weight Loads (2.6.2.1)
 Pinion 33 Lbs. Gear 375 Lbs.
 Residual Unbalance (2.6.2.1)
 Pinion 0.018 oz. in. Gear 0.84 oz. in.
 WR² Referred to Low Speed Shaft 217 lb. Ft²
 Breakaway Torque 30 Ft. lb. @ Low Speed Shaft

CONSTRUCTION FEATURES

Type of Gear:
 Reducer Increaser
 (Single) ~~Stage~~ Stage
 (Single) (Double) Helical
 Epicyclic

INSTALLATION DATA

Indoor Heated Under Roof
 Outdoor Unheated Partial Sides
 Grade Mezzanine
 Winterization Req'd. Tropicalization Req'd.
 Electrical Area Class L Gr. B Div. 2
 Required Sound Pressure Level _____ dbA @ _____ ft.
 Elevation 31 Ft. Barometer 14.7 PSIA
 Range of Ambient Temperatures:

Dry Bulb	Wet Bulb
Normal _____ °F	_____ °F
Maximum <u>90</u> °F	_____ °F
Minimum <u>41</u> °F	_____ °F

Teeth

No. of Teeth 43 Pinion 178 Gear
 Gear Ratio 4.140 Center Distance 12 in.
 Pitch Dia. in. 4.670 Pinion 19.330 Gear
 Finish 24 RMS AGMA Geometry Factor, "J" 50/635
 Helix Angle 22.9518 deg. Normal Press. Angle 20 deg.
 Net Face Width, "F" 6.0 in. Pinion L/d 1.61
 Normal Diametral Pitch, "Pnd" 10.0 Backlash 0.00105 in.
 Tooth Plating (2.5.1.4) (None) (Not Recom)

Manufacturing Methods

Teeth Generated by the PRECISION HOBGING Process
 Teeth Finished by the LAPPING OR GRINDING Process
 Teeth Hardening Method THRU
 Gear to Shaft (2.5.3) Integral Shrunk-on
 Rim Attachment (2.5.3) ALLOY STL. FACING INT. W/HUB

SPECIFICATIONS, CODES AND STANDARDS (2.1.1)

API Standard 613 2ND Edition
TEXACO GEMS P-17M

Radial Bearings:

Pinion	Gear
Type <u>HYDRODYNAMIC JOUR</u>	<u>HYDRODYNAMIC JOUR</u>
Di. x Length <u>3.125 in. x 3.125 in.</u>	<u>5.25 in. x 3.5 in.</u>
Jour. Velocity <u>100.8</u> FPS	<u>40.9</u> FPS
Loading <u>151</u> PSI	<u>85</u> PSI
Clearance <u>.005</u> in.	<u>.007</u> in.
Span <u>13.625</u> in.	<u>14</u> in.

BASIC GEAR DATA

Mechanical Rating 2246 HP @ 7389 RPM
 Full Load Horsepower Loss 17.2
 Mechanical Efficiency 97.8 %
 Pitch Line Velocity 9033 FPM
 Tooth Pitting Index, "K" (2.2.3):
 Actual 129.5 Allowable 131.2
 Tangential Load, "W_t" (2.2.3.2) 2921 Lb.

Thrust Bearing(s):
 Location LOW SPEED SHAFT
 Manufacturer/Type KINGSBURY/JHJ
 Size 18 SQ IN JHJ6

	GEAR, SPECIAL PURPOSE (API 613)	SHEET OF <u>2 4</u>	JOB NUMBER <u>6779-1</u>
		DOCUMENT NUMBER <u>DAS-33-RE-18DD-DD2</u>	REV <u>A</u>

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CONSTRUCTION FEATURES (Cont'd.)

Area 18 in.² N/A in.²

Thrust Brg. Loading --- PSI --- PSI

Thrust Brg. Rating --- PSI 212.3 PSI

Int. Thrust Loads (+) (-) --- lb. (+) (-) 0 lb.

Ext. Thrust Loads (+) (-) --- lb. (+) (-) --- lb.

Coupling: H.S. L.S.
 Manufacturer BENDIX BENDIX
 Model ---
 Cplg. Rating, HP/100 RPM ---
 Keyed (1) or (2), or Hyd. fit INTEGRAL FLANGES
 Cplg. Gear Pitch Dia. --- in. --- in.
 Cplg. Press. Angle 0 0
 Shaft Dia. @ Cplg. --- in. --- in.

MATERIALS

Gear Casing CAST IRON Oil Seals ALLIUMAH

Bearings BABBITT Shafts H.S. INT. L.S. 4145

Pinion(s) 4145H Hardness 365 BHN

Gear Rim(s) 4145H Hardness 315 BHN

PIPING CONNECTIONS

SERVICE	NO.	SIZE	TYPE
Lube Oil Inlet	2	1"	150lb ASA RARE
Lube Oil Outlet	2	3"	" " "
Casing Drains	2	1 1/2"	NPT
Vents	1	1"	NPT
Casing Purge	1	1"	NPT

VIBRATION DETECTORS

Radial Position Detectors: (2.8.1)

Type PROXIMITY PROBE Model ---

Mfr. BENTLY-NEVADA

No. at each Shaft Bearing 2 Total No. B

Oscillator - Demodulators Supplied by COMP. VENDOR

Mfr. BENTLY-NEVADA Model ---

Monitor Supplied by ---

Location --- Enclosure ---

Mfr. BENTLY-NEVADA Model ---

Scale Range --- Alarm: Set @ --- mils

Shutdown: Set @ --- mils Time Delay --- sec.

Axial Position Detector: (2.8.1)

Type PROXIMITY PROBE Model ---

Mfr. BENTLY-NEVADA No. Required 4

Location ---

Oscillator - Demodulators Supplied by COMP. VENDOR

Mfr. BENTLY-NEVADA Model ---

Monitor Supplied by ---

Location --- Enclosure ---

Mfr. --- Model ---

Scale Range --- Alarm: Set @ --- mils

Shutdown: Set @ --- mils Time Delay --- sec.

Additional Transducers (2.8.2)

Velocity Acceleration

CASING - EACH BEARING HOUSING.

Mfr. BENTLY-NEVADA Model ---

No. Required 1

COUPLINGS AND GUARDS

	Low Speed	High Speed
Coupling Furnished by	COMP VENDOR	COMP VENDOR
Coupling Type	DIAPHRAGM	DIAPHRAGM
Coupling Lubrication	DRY	DRY
Mount Coupling Halves		
Spacer Required	YES	YES
Limited End Float Req'd.	YES	NO
Idling Adaptor Req'd.		
Cplg. Guard Furnished by	COMP VENDOR	COMP VENDOR
Cplg. Guard Drain Hose Req'd. (3.5.3)		

WEIGHTS AND DIMENSIONS

Net Weight: Gear 2050 lbs. Auxiliaries --- lb.

Max. Maintenance Weight (Identify): LATER lb.

Total Shipping Weight(s) ---

Total Shipping Dimensions SEE LUBRICATION DWG. U120

LUBRICATION REQUIREMENTS

Oil System Furnished by (2.9.2) COMP. VENDOR

Oil System in Accordance with (2.9.3) P-11M

Oil Visc.: 150 SSU @ 100°F. 44 SSU @ 210°F

Minimum Startup Oil Temperature 70 °F

Oil Flow Req'd. 13 GPM (U.S.)

Oil Pressure Req'd. (Nominal) 25 PSIG

ADDITIONAL REQUIREMENTS

Mounting Plates:

Gear Suitable for (Baseplate) (Soleplate) Mounting (3.3.1)

(Soleplates) (Soleplates) Furnished by VENDOR

Equipment on Baseplate (3.3.2) ---

Baseplate suitable for column mounting (3.3.2.10) ---

Grout Type Epoxy ---

Painting:

Manufacturer's Std. ---

Shipment: (4.3.1)

Domestic Export Export Boxing Req'd.

Outdoor Storage over 6 months ---

Miscellaneous:

Rotor Response Analysis (2.6.1.5 Item 2) (Yes) (No)

Spare set of Gear Rotors Req'd. ---

Gear Casing Furnished w/inlet Purge Connection (2.4.1.3) ---

Orientation of Oil Inlet & Drain Connections (2.4.2.1) ---

Vendor's Review of Purchaser's Baseplate and/or Foundation

Drawings Req'd. (2.1.11) ---

Filter Breather Location (2.3.1.10) ---

Thermometers, Thermocouples, RTD's Req'd. (3.4.4) ---

Provision for Secondary Axial Position Detector (2.8.2) (Req'd)

No. of Prints and/or Reproductions Req'd. for Approval ---

Time for Submittal --- (6.2.1.1)

Mfr. to Proceed without Purchaser's Review of Drawings (6.2.1.1) (No)