

Quotation

To

Company : Siemens AG
City / Country : Duisburg / Germany
Name : Stoverink Simon
Dept :
Tel :
Fax :
E-mail :

Name : N. HOST
Dept : Sales Dept.
Tel : +33 (0)3 69 20 51 50
Fax : +33 (0)3 88 67 60 75
E-mail : nhost@flender-graff.com
Page(s) : 19
Copy :
Date : 16.03.2016

Y/ref : Khursaniyah Al Fadhili - D43-K-1801 -
O/ref : D41104 quotation number 3

In response to your inquiry referenced above, we are pleased to confirm our quotation as follows :

ITEM A 1 : Flender Graffenstaden (FG) High Speed increaser, model **TX50/4C**

- *Rating conditions :* Rated power at **6800 kW**
Driven by a electric motor at **1800.0 rpm** (specified : 1800.0 rpm)
Driving a centrifugal compressor at **7309.1 rpm** (specified : 7285.0 rpm)
Service factor **1.45** according to **API613/03** (required : > 1.4)
- *Technical description :* Double helical
Manufacturing according to API standard
Flange on LS shaft end
Flange on HS shaft end
Estimated Weight : 4000 kg
- *Bearings description :* 2 cylindrical bearings on LS shaft
2 offset bearings on HS shaft
1 double acting tilting pad thrust bearing on low speed shaft non driven end
- *Mechanical running test :* Full speed, no load test during 4 hours according to the API 613 5th Edition standard.
- *Lubrication conditions :* 164 l/min of Oil ISO VG 46 at 60°C and 2.5 bar at inlet (calculated values only)
- *Miscellaneous:* Efficiency at full load : 99.03 %
Power losses at full load : 66 kW (calculated value only)
Anticipated Sound Pressure Level: 82.0 ± 2dB(A) at 1 meter

Base price : **117 900 EUR** each gear box
Delivery time : **36 weeks** after the FG acknowledgement of the order
Quantity : **8 gearboxes**

Comments :

- Coupling data taken into account on HS Shaft:
 - o Weight: 26.6 kg
 - o Center of gravity position from shaft end: 30.9 mm
 - o Inertia: 0.266 kgm²
- Coupling data taken into account on LS Shaft:
 - o Weight: 87.5 kg
 - o Center of gravity position from shaft end: 40.9 mm
 - o Inertia: 0.875 kgm²

Including :

- Customer witness of test
- After test disassembly and inspection
- Noise level test report
- Lateral analysis undamped
- Documentation : downloadable electronic file in english

Instrumentation (see the complete package on additional technical data sheet):

- *Temperature package*
12 RTD's PT100 Duplex 3 wires from Thermo Electric Company Inc.
(2 per bearing and thrust bearing side) not wired with terminal heads..... Price included
- *Bently Nevada vibration package*
8 radial (4 per shaft) & 2 axial (on LS shaft) vibration probes, 2 accelerometers (1 per shaft), 2
keyphasors (1 per shaft) not wired Price included

Spare parts (Prices are net valid only if spares are ordered together with the gearbox):

- *Commissioning Spares*
2 RTD's, 2 BN vibration probes, 2 BN accelerometers 7 900 EUR Lot Net
- *2 Years Normal Operation Spares*
2 set of bearings with RTD's, 1 set of oil seals 48 420 EUR Lot Net
- *Strategic Spare Parts*
One complete set of rotating elements consisting of one pinion and one gear.
Tested if ordered together with the main gearbox according to API613/03
Full Speed, No Load, with Test Report..... 51 500 EUR Lot Net
- *Container for horizontal spare rotors storage painted according FG standard..... 17 100 EUR Lot Net*

SPECIAL PURPOSE GEAR UNITS
API 613 FIFTH EDITION
DATA SHEET SI UNITS

Job No. 41104 Item No. A
P.O. No. _____ Date _____
Requisition No. _____
Inquiry No. _____
Revision 1 Date 06.03.2015 By HNI

1	Applicable To: ☒ Proposal ☐ Purchase ☐ As Built	☐ US Standards (1.7) ☒ ISO Standards (1.7)
2	For <u>Siemens AG Dulsburg</u>	Manufacturer <u>FLENDER-GRAFFENSTADEN</u>
3	Site <u>Khursanlyah Al Fadhill</u>	Model No. <u>TX50/4C</u>
4	Unit <u>STC-SV 08-4-A</u>	Serial No. _____
5	Service <u>EM/CC</u>	Driver type <u>electric motor</u>
6	No. required <u>9</u>	Driven equipment <u>centrifugal compressor</u>
7		
8	NOTE : Numbers within () refer to applicable API standard 613 paragraphs	
9	☐ Information to be completed by purchaser ☐ Information to be completed by manufacturer	
10	○ UNITS OF MEASUREMENT	■ BASIC GEAR DATA
11	☐ US Customary units	
12	☒ SI units	
13	○ RATING REQUIREMENTS	
14	Driven equip. (2.1.4): Norm. _____ Max _____ kW	☒ Single stage ☐ Single helical
15	Driver: Rated _____ Max _____ kW	☐ Double stage ☒ Double helical
16	Normal transmitted power (2.2.2) _____ kW	☐ Epicyclic ☐ horizontal offset
17	Gear unit rated power (2.2.1) <u>6800</u> kW	Mechanical rating (1.5.16) <u>9520</u> kW @ <u>1800 / 7309,1</u> rpm
18	Torque @ max cont speed _____ Nm	Gear service factor (2.2.3.1) <u>1,44</u> API 613/2003 5 TH (actual)
19	Max torque (2.2.1) _____ Nm @ _____ rpm	Full load gear unit power loss <u>66</u> kW
20	☐ Reducer ☒ Increaser	Gear Unit Mechanical efficiency <u>99,03</u> %
21	Rated speed (2.1.5):	Rating speed Pinion <u>7,309,1</u> Gear <u>1,800,0</u> rpm
22	Input <u>1800</u> rpm ☐ Specified ☒ Nominal	Hardness used for
23	Output <u>7285</u> rpm ☐ Specified ☒ Nominal	Rating, (HB or Rc) Pinion <u>58 HRC</u> Gear <u>58 HRC</u>
24	Allow var in gear ratio (2.1.6) (+) (-) _____ %	Tooth pitting index, "K" (2.2.4.1) (2.2.4.2)
25	Max continuous speed (1.5) <u>1800 / 7285</u> rpm	Allowable <u>2,17</u> Actual <u>2,10</u> MPa
26	Trip speed (1.5) (2.1.7) <u>1980 / 8013,5</u> rpm	Material index number (Fig 3, Table 4) <u>3,03</u> MPa
27	Gear service factor (2.2.3.1) <u>1,4</u> API 613/2003 5 TH (min)	Bending stress number, "S _t " (2.2.5.1) (2.2.5.2)
28	Hardness (2.2.3.2) Pinion _____ Gear _____	Pinion: Allowable <u>265,4</u> Actual <u>256,0</u> MPa
29	Shaft assembly designation (2.1.10) _____ L/R	Gear: Allowable <u>265,4</u> Actual <u>240,9</u> MPa
30	HS shaft rot fac'g cpl'g (2.1.20.2) ☒ CW ☐ CCW	Pitch line velocity <u>77,1</u> m/s
31	LS shaft rot fac'g cpl'g (2.1.20.2) ☒ CW ☐ CCW	Anticipated SPL (2.1.6) <u>82</u> dB(A) @ <u>1</u> m
32	External loads (2.1.16) _____	WR ² referred to LS shaft <u>126,12</u> kgm ²
33	Other operating conditions (2.2.2) (2.6.1.3) _____	Breakaway torque <u>412</u> Nm @ LS Shaft
34		Pinion teeth hardness range <u>58 - 63 HRC</u>
35	○ INSTALLATION DATA (2.1.14)	Pinion teeth hardening method <u>CARBURIZED</u>
36	☐ Indoor ☐ Heated ☐ Under roof	☐ HS shaft separate hardness range _____
37	☒ Outdoor ☐ Unheated ☐ Partial sides	Gear teeth (rim) hardness range <u>58 - 63 HRC</u>
38	☐ Grade ☐ Mezzanine ☒ ONSHORE	Gear teeth hardening method <u>CARBURIZED</u>
39	☐ Winterization required ☐ Tropicalization required	Gear hub:
40	Electrical area (2.1.10) Class _____ Grp _____ Div _____	☒ Forged cylinder ☐ Forged & Copped ☐ Fabricated
41	Electrical area (2.1.10) Zone <u>2</u> Grp <u>IIA</u> Temp <u>T1</u> °C	Gear to Shaft fit method (2.5.3.2)
42	Max allow SPL (2.1.6) _____ dB(A) @ _____ m	☐ Integral ☐ Keyed interference ☒ Keyless interference
43	Elevation _____ m Barometer _____ kPa abs	Rim attachment (2.5.3.2) <u>FORGED GEAR WHEEL</u>
44	Range of ambient temperatures:	LS shaft hardness range <u>HB 230 - 274</u>
45	Dry bulb _____ Wet bulb _____	Journal static weight loads (2.6.6.3)
46	Normal _____ °C _____ °C	Pinion <u>128 / 42</u> kg Gear <u>942 / 707</u> kg
47	Maximum <u>82</u> °C _____ °C	Total gear unit assembled weight <u>4000</u> kg
48	Minimum <u>0</u> °C _____ °C	NOTES: _____
49	Unusual conditions ☐ Dust ☐ Fumes	_____
50	☐ _____	_____

SPECIAL PURPOSE GEAR UNITS
API 613 FIFTH EDITION
DATA SHEET SI UNITS

■ GEAR DATA				○ COUPLINGS AND GUARDS		
	Pinion	Gear			Pinion	Gear
Number of teeth	33	134		Coupling furnished by (3.2.1)	Compr. Supplier	Compr. Supplier
Gear ratio	4,06			Mount coupling halves (3.2.2)	Compr. Supplier	Compr. Supplier
Tangential load, "Wt" (2.2.4.2)	88,155	N		Cplg. guard adapter by (3.2.3)	Gear Supplier	Gear Supplier
AGMA Geometry factor "J"	0,55	0,57		Cplg. guard furnished by (3.2.3)	Compr. Supplier	Compr. Supplier
Pitch diameter	201,56	818,44	mm	Coupling vendor (3.2.3)		
Outside diameter	214,10	827,60	mm	Vendor's model number (3.2.3)		
Root diameter	187,25	800,74	mm	Coupling weight on shaft, kg	26,6	87,5
Center groove diameter	177,00	790,00	mm	CG Inboard / outboard of shaft end	Outboard	Outboard
Normal pressure angle	20,00	deg		Hub drill template provided	☐	☐
Normal diametral pitch	4,62	in ⁻¹		■ SHAFT END DETAIL (2.5.4.2)		
Helix angle	25,00	deg		Shaft end detail specified by: ☒ Purchaser ☐ Gear vendor		
Center distance	510,00	mm		(Integral unless otherwise specified)		
Backlash min	0,34	mm		Shaft end detail if 'otherwise' specified:		
Net face width, "Fw"	260,00	mm		Tapered / Keyless	☐ ☐	☐ ☐
Pinion L/D	1,71			Tapered / 1-Key	☐ ☐	☐ ☐
Face overlap ratio	6,36			Tapered / 2-Keys	☐ ☐	☐ ☐
Transverse contact ratio	1,45			Cylindrical / 1-Key	☐ ☐	☐ ☐
AGMA 6011 service factor	2,64			Cylindrical / 2-Keys	☐ ☐	☐ ☐
Rating based on ANSI/AGMA 6011 with SF=1.0				Other <u>Flanged</u>	☒ ☐	☒ ☐
Durability Power	21442	kW		Shaft diameter	120,0	190,0 mm
Strength Power	17946	kW		(If integral flange use diameter immediately adjacent to flange)		
Tooth Surface Finish, Ra	0,4	0,4	µm	■ RADIAL BEARINGS		
Tooth Generation Process	Hobbing	Hobbing		Type	Pinion	Gear
Tooth Finishing Process	Grinding	Grinding			OFFSET / OFFSET	CYL. / CYL.
Lead modification (2.2.4.6)	☒ Not Req'd	☐ Req'd		Diameter	130 / 130	200 / 200 mm
Calculated Total Lead Mismatch		µm		Length	130 / 130	100 / 100 mm
■ SCUFFING DATA (2.2.6)				Journal velocity	49,8 / 49,8	18,8 / 18,8 m/s
Scuffing Data per ANSI/AGMA 925-A03				Loading	2,78 / 2,81	2,87 / 2,71 N/mm²
Scuffing Risk (2.2.6) <=5% (Low)	Calculation Method	AGMA925		Clearance (min-max)		mm
Composite surface roughness, αx	0,57	µm		Span	550	550 mm
Specific film thickness, EHL Amin	3,31	µm		Power loss each bearing	13,8 / 13,8	3,0 / 3,0 kW
Tooth temperature, θm	82	°C		Oil flow each bearing	42,0 / 42,0	10,0 / 10,0 l/min
Maximum contact temperature, θBmax	101	°C		■ THRUST BEARINGS		
■ MATERIALS				Location		OPP.CPLG.SIDE
Gear casing	Steel	Oil seals	aluminium	Manufacturer	FLENDER	FLENDER
Pinion(s)	18CrNiMo7-6			Type	NO	COMB.TAP.LANDS
Gear rim(s)	18CrNiMo7-6			Size		BPK LEG 6"
HS Shaft	Integral	LS Shaft	42CrMo4	Area		11615 mm²
Radial bearings	Babbitt	Backing	Steel	Loading		1,14 MPa
Thrust bearing(s)	Babbitt	Backing	Steel	Rating		1,50 MPa
○ SHAFT END DETAIL				Int. thrust load		N
☒ Gear shaft end for coupling integral flange (2.5.4.2)				Ext. thrust load	4,050	9,200 N
☒ Pinion shaft end for coupling integral flange (2.5.4.2)				Power loss each	0,0	6,0 kW
☐ Other:	WITHOUT BOLTS			Oil flow each bearing	0,0	20,0 l/min
				NOTES:		

SPECIAL PURPOSE GEAR UNITS
API 613 FIFTH EDITION
DATA SHEET SI UNITS

SPECIAL PURPOSE GEAR UNITS API 613 FIFTH EDITION DATA SHEET SI UNITS ☐ Oil system furnished by (2.8.3) _____ ☐ Other _____ ☐ Gear vendor _____ ☐ Oil visc. _____ cp @ 40°C _____ cp @ 100°C (2.8.6) _____ ☐ ISO Grade _____ Load stage (2.2.6) 5,0 ■ MESH Mesh and windage power loss 26,4 kW Oil flow, mesh 40,0 l/min ■ LUBRICATION REQUIREMENTS Min. startup oil temperature 20,0 °C Normal oil inlet temperature 60,0 °C Maximum oil inlet temperature 65,0 °C Unit oil flow (total) 164,0 l/min Unit oil pressure 2,5 bar ☐ Oil visc. _____ cp @ 40°C _____ cp @ 100°C (2.8.6) _____ ☐ ISO Grade 46 Load stage (2.2.6) 5,0 ■ PIPING CONNECTIONS <table border="1" style="width:100%; border-collapse: collapse;"> <thead> <tr> <th>Service</th> <th>No.</th> <th>Size</th> <th>Type</th> </tr> </thead> <tbody> <tr> <td>Lube oil inlet</td> <td>1</td> <td>2 in.</td> <td>ANSI 150 LBS</td> </tr> <tr> <td>Lube oil outlet</td> <td>1</td> <td>6 in.</td> <td>ANSI 150 LBS</td> </tr> <tr> <td>Casing drain *</td> <td></td> <td></td> <td></td> </tr> <tr> <td>Vent</td> <td>1</td> <td>1,5 in.</td> <td>ANSI 150 LBS</td> </tr> <tr> <td>Casing purge</td> <td></td> <td></td> <td></td> </tr> </tbody> </table> * Casing drain is 'dead bottom' housing drain, not lube oil outlet ○ MOUNTING PLATES ☐ Gear furnished with (3.3.1.1) _____ ☐ Baseplate ☐ Soleplate ☐ Subplate(s) (3.3.2.10) _____ ☐ Mounting plates(s) furnished by (3.3.1.1) _____ ☐ Baseplate leveling (3.3.2.3) _____ ☐ Baseplate with leveling pads (3.3.2.3) _____ ☐ Baseplate suitable for column mounting (3.3.2.4) _____ ☐ Vendor review of purchaser's foundation dwgs. (2.1.13) _____ ☐ Grout type (3.3.1.2.4) _____ ○ CONTRACT DATA ☐ Test data prior to shipment _____ ☒ Progress report (5.3.3) _____ ☐ Vendor signoff of Inspector checklist (4.1.1.3) _____ ☒ Information retained for 20 years (4.2.1.1) (4.2.2.6.1) _____ ☐ Technical manual (5.3.5.4) _____ ☒ PAINTING (4.4.3.1) ☒ Flender standard RAL5015 (blue) ☒ Painting housing interior not allowed (2.3.1.14) _____ ○ SHIPMENT ☐ Steel rotor storage container (4.4.5) ☐ Shaft covers (4.4.4) _____ Contract unit Spares Export boxing ☐ Domestic boxing ☐ Outdoor storage over 6 mos. ☐ 3 years Indoor ☐ ○ ADDITIONAL REQUIREMENTS ○ VIBRATION DETECTORS RADIAL (3.4.2.1) (2.7.4.5) (2.7.4.6) ☒ Manufacturer BENTLY NEVADA ☒ Total No. 8 ☒ X-Y probes pinion bearings ☒ Coupling end ☒ Blind end ☒ X-Y probes gear bearings ☒ Coupling end ☒ Blind end ☐ Other _____ AXIAL (3.4.2.1) (2.7.4.5) (2.7.4.6) ☒ Manufacturer BENTLY NEVADA ☒ Total No. 2 ☐ Dual probes at each thrust bearing ☐ Single probe any shaft without thrust bearing ☐ Other _____ ONE EVENT PER REVOLUTION PROBE (2.7.4.5) (2.7.4.6) ☒ Manufacturer BENTLY NEVADA Total No. 2 ☒ One on input shaft ☒ One on output shaft ☐ Other _____ ACCELEROMETER (3.4.2.1) (2.7.4.5) (2.7.4.6) ☒ Manufacturer BENTLY NEVADA ☒ No. required 2 ☒ Pinion coupling end ☒ Gear coupling end ☐ Other _____ ○ TEMPERATURE DETECTORS ☐ Dial type thermometers (3.4.2.7) _____ ☒ Type brg. temp. sensors (3.4.2.7) (2.7.1.3) PT100 ☐ RTD ☐ Thermocouple / ☐ Simplex ☒ Duplex Calibration Yes ☒ HS/LS bearings no. sensors each 2 / 2 ☒ Thrust number of sensing elements each face 2 ○ OTHER VIBRATION AND TEMPERATURE (3.4.2.5) (3.4.2.6) Oscillator demodulator supplied by ☐ Vibration monitor supplied by ☒ ☐ Vibration shutdown delay time _____ seconds Temperature monitor supplied by ☒ Oscillator demodulator J-box by ☒ Temp. sensor termination J-box by ☒ J-box type _____ Mount _____ Other ☐ Gear vendor ☒ ○ MISCELLANEOUS ☒ Undamped critical analysis report (2.6.2.1) _____ ☐ w/ dampd rotr respsn analys rpt (2.6.2.4.3) (2.6.2.6) Torsional analysis by (2.6.5.2) ☐ Gear vendor ☒ Other _____ ☐ Spare set of gear rotors (4.3.2.4) _____ ☐ Gear case furnished with inlet purge connection (2.4.3) _____ ☐ Orientation of oil inlet & drain conns. (2.4.6) _____ ☒ Filter breather location (2.3.1.12) Prov. on upper casing ☐ Torsional device provisions (2.5.4.5) _____ ☐ Rotor vertical storage provisions (2.5.4.8) _____ ☐ Rotor vertical storage fixture(s) (3.6.2) _____ ☐ Vendor service rep. on site (2.1.13) _____	Service	No.	Size	Type	Lube oil inlet	1	2 in.	ANSI 150 LBS	Lube oil outlet	1	6 in.	ANSI 150 LBS	Casing drain *				Vent	1	1,5 in.	ANSI 150 LBS	Casing purge				Job No. 41104 Item No. A P.O. No. _____ Date _____ Requisition No. _____ Inquiry No. _____ Revision 1 Date 06.03.2015 By HNI
Service	No.	Size	Type																						
Lube oil inlet	1	2 in.	ANSI 150 LBS																						
Lube oil outlet	1	6 in.	ANSI 150 LBS																						
Casing drain *																									
Vent	1	1,5 in.	ANSI 150 LBS																						
Casing purge																									

SPECIAL PURPOSE GEAR UNITS
API 613 FIFTH EDITION
DATA SHEET SI UNITS

Job No. 41104 Item No. A
P.O. No. _____ Date _____
Requisition No. _____
Inquiry No. _____
Revision 1 Date 06.03.2015 By HNI

O INSPECTIONS AND TESTS (4.1)				
	Req'd	Witness	Observe	Test Log
☐ Advance notice of witness testing required (4.1.3)				
Number calendar days _____				
Shop Inspection (4.1.1)	☐	☐	☐	
Cleanliness Inspection (4.2.3.1)	☐	☐	☐	
Hardness Verification (4.2.3.3)	☒	☐	☐	☒
Dismantle-reassembly (4.3.2.3.1)	☒	☐	☐	☐
Contact Check (2.5.2.2)	☒	☐	☐	☐
Contact Check Tape Lift (2.5.2.2)	☒	☐	☐	☒
Gear accuracy check (2.5.2.1)	☒	☐	☐	☐
Double helical axial stability (2.5.2.3)	☒	☐	☐	☒
Special testing Integral forged gears (2.5.3.3)				
(testing per mutual agreement)	☐	☐	☐	☐
Residual unbalance check (2.6.6.2)	☒	☐	☐	☒
Mechanical Run Test (Main) (4.3.2)	☒	☐	☐	☒
Mechanical Run Test (Spare) (4.3.2.4)	☐	☐	☐	☐
Addl. Mechanical Tests (4.3.2.2.16)	☐	☐	☐	☐
Part or Full Load And Full Speed				
Test (4.3.3.1)	☐	☐	☐	☐
Full torque, reduced speed (4.3.3.2)	☐	☐	☐	☐
Full Torque Static Test (4.3.3.3)	☐	☐	☐	☐
Back-To-Back Locked Torque				
Test (4.3.3.4)	☐	☐	☐	☐
Sound Level Test (4.3.3.5)	☒	☐	☐	☒
Additional gear tooth test (4.2.2.8)	☐	☐	☐	☐
Use shop Lube System	☒	☐	☐	
Use Job lube system	☐	☐	☐	
Use shop Vibration Probes, Etc.	☐	☐	☐	
Use Job Vibration Probes, Etc.	☒	☐	☐	
Final Assembly, Maintenance &				
Running Clearance (4.2.1.1.e)	☒	☐	☐	☒
Oil System Cleanliness (4.2.3.2)	☐	☐	☐	
Oil System-Casing Joint				
Tightness (4.3.2.1.4)	☐	☐	☐	
Warning And Protection				
Devices (4.3.2.1.5)	☐	☐	☐	
Seismic Vibration Data (4.3.2.2.3)	☐	☐	☐	☐
Vibration, Phase Plots (4.3.2.2.12)	☒	☐	☐	☒
Oil Inlet Range test (4.3.2.2.13)	☐	☐	☐	☐
Tape recorded Vibration Data	☒	☐	☐	☒
(4.3.2.2.14) (4.3.2.2.15)	☐			Purchaser copy
NON-DESTRUCTIVE TESTING (4.2.1.2) (4.2.2.1)				
	Surface	Sub surface		Log
☐ Casing	☐	☐		☐
☒ Rot. Elemts.	☒	☒		☒
☒ Bearings	☒	☒		☒
☐ Other :	☐	☐		☐
(Specify)				

NOTES : _____

During start-up, gears can exhibit a transient spike reading of vibration levels that will exceed shutdown settings. Therefore a trip multiplier is recommended in the control system.

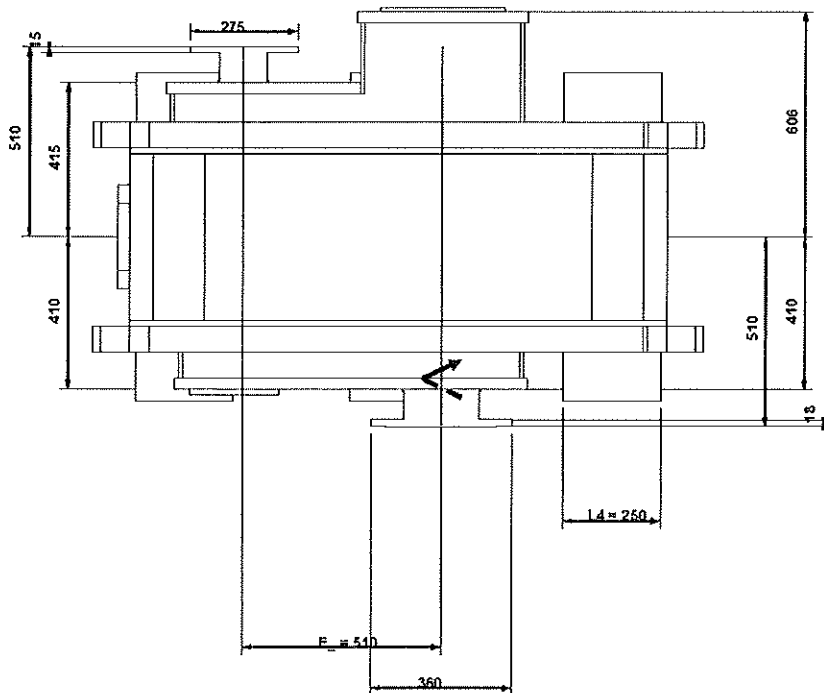
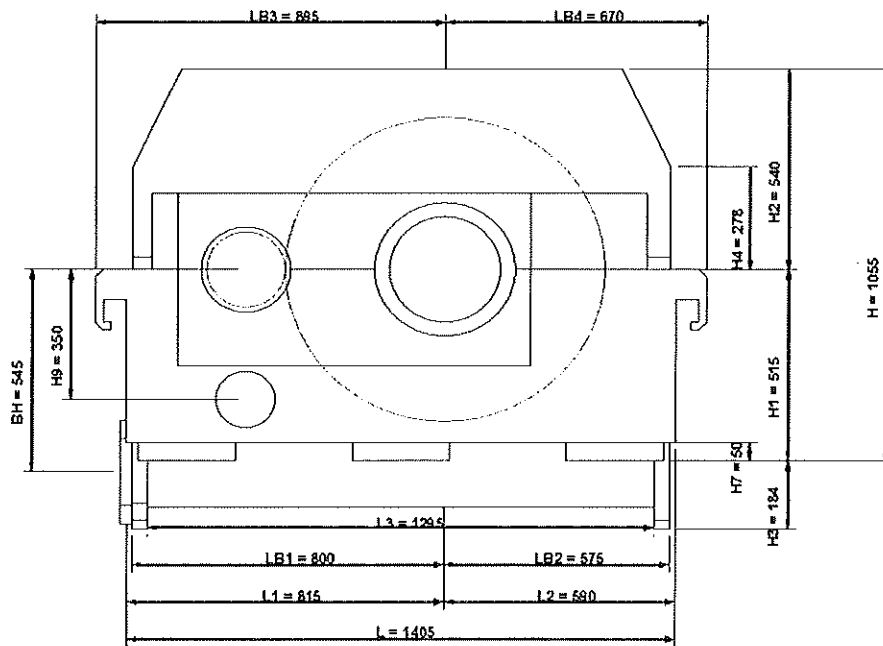
Mechanical running test duration 4 hours including

- Shaft vibration record using job vibration probes if ordered
- Bearings temperature records
- Casing vibration measurement
- Sound level pressure measurement
- Power losses measurement at oil outlet
- Performed with oil ISO VG 32

Oil flow requirement and power losses are calculated values only, add normal safety margins for sizing heat exchangers.



APPAREIL.xls _ Edition du :06.03.2015
1/1



ADDITIONAL TECHNICAL DATASHEET				Job No. 41104 Item No. A																																											
				P.O. No. _____ Date _____																																											
				Requisition No. _____																																											
				Inquiry No. _____																																											
				Revision 1 Date 06.03.2016 By HNI																																											
1	☒ ADDITIONAL GEAR DATA			☐ TURNING GEAR (Dimensioning is preliminary !)																																											
2	<i>Efficiency</i>			<i>Calculation results</i>																																											
3	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 50%;">Percent of rated power</th> <th style="width: 50%;">Efficiency</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">100%</td> <td style="text-align: center;">99,03</td> </tr> <tr> <td style="text-align: center;">75%</td> <td style="text-align: center;">98,92</td> </tr> <tr> <td style="text-align: center;">50%</td> <td style="text-align: center;">98,79</td> </tr> <tr> <td style="text-align: center;">25%</td> <td style="text-align: center;">98,08</td> </tr> <tr> <td style="text-align: center;">10%</td> <td style="text-align: center;">90,80</td> </tr> </tbody> </table>			Percent of rated power	Efficiency	100%	99,03	75%	98,92	50%	98,79	25%	98,08	10%	90,80	Required turning speed _____ rpm Actual turning speed _____ rpm Required breakaway torque _____ Nm Actual breakaway torque _____ Nm Actual maximum torque _____ Nm Actual acceleration time _____ s																															
Percent of rated power	Efficiency																																														
100%	99,03																																														
75%	98,92																																														
50%	98,79																																														
25%	98,08																																														
10%	90,80																																														
4																																															
5																																															
6																																															
7																																															
8																																															
9																																															
10	<i>Losses</i>			<i>Motor</i>																																											
11	Power loss at no load _____ kW			Supplier _____																																											
12	Heat rejection _____ kcal/h			Power _____ kW																																											
13				Voltage _____ V																																											
14				Frequency _____ Hz																																											
15	☐ PUMP DETAILS (Dimensioning is preliminary !)			Speed _____ rpm																																											
16				Electric standard _____																																											
17	Design : _____			<i>Turning gear</i>																																											
18	Speed : _____ rpm			Type _____																																											
19	Oil flow : _____ l/min			Ratio _____																																											
20	Oil pressure : _____ bar			<i>Clutch</i>																																											
21	NPSH : _____ m			Type _____																																											
22	Safety valve : _____			Max. allowable torque _____ Nm																																											
23	Driving method : _____			<i>Miscellaneous</i>																																											
24	Material : _____			Starting device _____																																											
25	Flanges : _____			Switch details _____																																											
26	Testing : _____																																														
27	Furniture of ATEX certificate : _____																																														
28																																															
29																																															
30	☒ INSTRUMENTATION PACKAGE																																														
31	<i>Thermometer</i>			<i>Thermoelements</i>																																											
32	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th></th> <th>Bearing</th> <th>Thrust bearing</th> <th>Oil inlet/outlet</th> </tr> </thead> <tbody> <tr> <td>Qty</td> <td></td> <td></td> <td></td> </tr> <tr> <td>Type</td> <td></td> <td></td> <td></td> </tr> </tbody> </table>				Bearing	Thrust bearing	Oil inlet/outlet	Qty				Type				<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th></th> <th>Bearing</th> <th>Thrust bearing</th> <th>Oil inlet/outlet</th> </tr> </thead> <tbody> <tr> <td>Type</td> <td>DUPLEX 2x3F</td> <td>DUPLEX 2x3F</td> <td></td> </tr> <tr> <td>Classification</td> <td>IEC60751</td> <td>IEC60751</td> <td></td> </tr> <tr> <td>Removable from the outside</td> <td>NO</td> <td>NO</td> <td></td> </tr> <tr> <td>ATEX</td> <td>ATEX Exia</td> <td>ATEX Exia</td> <td></td> </tr> </tbody> </table>			Bearing	Thrust bearing	Oil inlet/outlet	Type	DUPLEX 2x3F	DUPLEX 2x3F		Classification	IEC60751	IEC60751		Removable from the outside	NO	NO		ATEX	ATEX Exia	ATEX Exia											
	Bearing	Thrust bearing	Oil inlet/outlet																																												
Qty																																															
Type																																															
	Bearing	Thrust bearing	Oil inlet/outlet																																												
Type	DUPLEX 2x3F	DUPLEX 2x3F																																													
Classification	IEC60751	IEC60751																																													
Removable from the outside	NO	NO																																													
ATEX	ATEX Exia	ATEX Exia																																													
33																																															
34																																															
35																																															
36																																															
37																																															
38																																															
39																																															
40	<i>Shaft vibrations</i>																																														
41																																															
42	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th></th> <th>Radial</th> <th>HS</th> <th>Axial</th> <th>Keyphasor</th> <th>Accelerometer</th> </tr> </thead> <tbody> <tr> <td>Type</td> <td>B.N. 3300 XL 8mm Sys. 9M</td> <td>LS</td> <td>No</td> <td>B.N. 3300 XL 8mm Sys. 9M</td> <td>ACCELEROMETER BENTLY</td> </tr> <tr> <td>Probe</td> <td>Yes</td> <td>LS</td> <td>No</td> <td>Yes</td> <td></td> </tr> <tr> <td>Proximitior</td> <td>Yes</td> <td>HS</td> <td>No</td> <td>Yes</td> <td></td> </tr> <tr> <td>Probe holder</td> <td>Yes</td> <td>LS</td> <td>Yes</td> <td>Yes</td> <td></td> </tr> <tr> <td>Connection head</td> <td>Yes</td> <td>HS</td> <td>No</td> <td>Yes</td> <td></td> </tr> <tr> <td>mounting kit</td> <td></td> <td>LS</td> <td>Yes</td> <td>Yes</td> <td>Yes</td> </tr> </tbody> </table>						Radial	HS	Axial	Keyphasor	Accelerometer	Type	B.N. 3300 XL 8mm Sys. 9M	LS	No	B.N. 3300 XL 8mm Sys. 9M	ACCELEROMETER BENTLY	Probe	Yes	LS	No	Yes		Proximitior	Yes	HS	No	Yes		Probe holder	Yes	LS	Yes	Yes		Connection head	Yes	HS	No	Yes		mounting kit		LS	Yes	Yes	Yes
	Radial	HS	Axial	Keyphasor	Accelerometer																																										
Type	B.N. 3300 XL 8mm Sys. 9M	LS	No	B.N. 3300 XL 8mm Sys. 9M	ACCELEROMETER BENTLY																																										
Probe	Yes	LS	No	Yes																																											
Proximitior	Yes	HS	No	Yes																																											
Probe holder	Yes	LS	Yes	Yes																																											
Connection head	Yes	HS	No	Yes																																											
mounting kit		LS	Yes	Yes	Yes																																										
43																																															
44																																															
45																																															
46																																															
47																																															
48																																															
49																																															
50																																															
51																																															
52																																															
53																																															
54																																															
55	<i>Junction box(es)</i>			<i>Miscellaneous</i>																																											
56	Qty _____			Identification ☒ wire ☒ conduit ☐ junction box																																											
57	Manufacturer _____			Conduit type _____																																											
58	Material _____			Transmitter type _____ Qty _____																																											
59	ATEX _____			Terminal block type _____ Qty _____																																											
60																																															
61																																															

Y/ref : Khursaniyah Al Fadhili - D43-K-3801 -
O/ref : D41104 quotation number 3

ITEM B 1 : Flender Graffenstaden (FG) High Speed increaser, model **TX40/5C**

- *Rating conditions :* Rated power at **1620 kW**
Driven by a electric motor at **1800.0 rpm** (specified : 1800.0 rpm)
Driving a centrifugal compressor at **10737.9 rpm** (specified : 10736.0 rpm)
Service factor **1.47** according to **API613/03** (required : > 1.4)
- *Technical description :* Double helical
Manufacturing according to API standard
Flange on LS shaft end
Flange on HS shaft end
Estimated Weight : 1900 kg
- *Bearings description :* 2 cylindrical bearings on LS shaft
2 tilting pads bearings on HS shaft
1 double acting tilting pad thrust bearing on low speed shaft non driven end
- *Mechanical running test :* Full speed, no load test during 4 hours according to the API 613 5th Edition standard.
- *Lubrication conditions :* 64 l/min of Oil ISO VG 46 at 60°C and 2.5 bar at inlet (calculated values only)
- *Miscellaneous:* Efficiency at full load : 98.70 %
Power losses at full load : 21 kW (calculated value only)
Anticipated Sound Pressure Level: 82.0 ± 2dB(A) at 1 meter

Base price : **103 850 EUR** each gear box

Delivery time : **36 weeks** after the FG acknowledgement of the order

Quantity : **1 gearbox**

Comments :

- Coupling data taken into account on HS Shaft:
 - o Weight: 10.4 kg
 - o Center of gravity position from shaft end: 28.2 mm
 - o Inertia: 0.104 kgm²
- Coupling data taken into account on LS Shaft:
 - o Weight: 26.4 kg
 - o Center of gravity position from shaft end: 30.9 mm
 - o Inertia: 0.264 kgm²

Including :

- Customer witness of test
- After test disassembly and inspection
- Noise level test report
- Lateral analysis undamped
- Documentation : downloadable electronic file in English

Instrumentation (see the complete package on additional technical data sheet):

- *Temperature package*
12 RTD's PT100 Duplex 3 wires from Thermo Electric Company Inc.
(2 per bearing and thrust bearing side) not wired with terminal heads..... Price included
- *Bently Nevada vibration package*
8 radial (4 per shaft) & 2 axial (on LS shaft) vibration probes, 2 accelerometers (1 per shaft), 2 keyphasors (1 per shaft) not wired Price included

Spare parts (Prices are net valid only if spares are ordered together with the gearbox):

- *Commissioning Spares*
2 RTD's, 2 BN vibration probes, 2 BN accelerometers 7 900 EUR Lot Net
- *2 Years Normal Operation Spares*
1 set of bearings with RTD's, 1 set of oil seals 26 010 EUR Lot Net
- *Strategic Spare Parts*
One complete set of rotating elements consisting of one pinion and one gear.
Tested if ordered together with the main gearbox according to API613/03
Full Speed, No Load, with Test Report..... 37 100 EUR Lot Net
- *Container for horizontal spare rotors storage painted according FG standard*..... 15 850 EUR Lot Net

SPECIAL PURPOSE GEAR UNITS
API 613 FIFTH EDITION
DATA SHEET SI UNITS

1 Applicable To: ☒ Proposal ☐ Purchase ☐ As Built 2 For <u>Siemens AG Dulsburg</u> 3 Site <u>Khursaniyah Al Fadhlili</u> 4 Unit <u>STC-SV 06-3-A</u> 5 Service <u>EM/CC</u> 6 No. required <u>1</u>	Job No. <u>41104</u> Item No. <u>B</u> P.O. No. _____ Date _____ Requisition No. _____ Inquiry No. _____ Revision <u>1</u> Date <u>06.03.2015</u> By <u>HNI</u> ☐ US Standards (1.7) ☒ ISO Standards (1.7)
7 NOTE : Numbers within () refer to applicable API standard 613 paragraphs 8 ☐ Information To be completed by purchaser ☐ Information to be completed by manufacturer	
10 ○ UNITS OF MEASUREMENT 11 ☐ US Customary units 12 ☒ SI units 13 ○ RATING REQUIREMENTS 14 Driven equip. (2.1.4): Norm. _____ Max _____ kW 15 Driver: Rated _____ Max _____ kW 16 Normal transmitted power (2.2.2) _____ kW 17 Gear unit rated power (2.2.1) <u>1620</u> kW 18 Torque @ max cont speed _____ Nm 19 Max torque (2.2.1) _____ Nm @ _____ rpm 20 ☐ Reducer ☒ Increaser 21 Rated speed (2.1.5): 22 Input <u>1800</u> rpm ☐ Specified ☒ Nominal 23 Output <u>10736</u> rpm ☐ Specified ☒ Nominal 24 Allow var in gear ratio (2.1.5) (+) (-) _____ % 25 Max continuous speed (1.5) <u>1800 / 10736</u> rpm 26 Trip speed (1.5) (2.1.7) <u>1980 / 11809,6</u> rpm 27 Gear service factor (2.2.3.1) <u>1,4 API 613/2003 5 TH</u> (min) 28 Hardness (2.2.3.2) Pinion _____ Gear _____ 29 Shaft assembly designation (2.1.10) <u>L/R</u> 30 HS shaft rot fac'g cpl'g (2.1.20.2) ☒ CW ☐ CCW 31 LS shaft rot fac'g cpl'g (2.1.20.2) ☒ CW ☐ CCW 32 External loads (2.1.16) _____ 33 Other operating conditions (2.2.2) (2.6.1.3) _____	■ BASIC GEAR DATA ☒ Single stage ☐ Single helical ☐ Double stage ☒ Double helical ☐ Epicyclic ☐ <u>horizontal offset</u> Mechanical rating (1.5.16) <u>2268</u> kW @ <u>1800 / 10737,9</u> rpm Gear service factor (2.2.3.1) <u>1,46 API 613/2003 5 TH</u> (actual) Full load gear unit power loss <u>21</u> kW Gear Unit Mechanical efficiency <u>98,70</u> % Rating speed Pinion <u>10.737,9</u> Gear <u>1.800,0</u> rpm Hardness used for Rating, (HB or Rc) Pinion <u>58 HRC</u> Gear <u>58 HRC</u> Tooth pitting index, "K" (2.2.4.1) (2.2.4.2) Allowable <u>2,17</u> Actual <u>2,06</u> MPa Material index number (Fig 3, Table 4) <u>3,03</u> MPa Bending stress number, "S_t" (2.2.5.1) (2.2.5.2) Pinion: Allowable <u>265,4</u> Actual <u>251,0</u> MPa Gear: Allowable <u>265,4</u> Actual <u>238,8</u> MPa Pitch line velocity <u>63,0</u> m/s Anticipated SPL (2.1.6) <u>82</u> dB(A) @ <u>1</u> m WR² referred to LS shaft <u>29,88</u> kgm² Breakaway torque <u>90</u> Nm @ LS Shaft Pinion teeth hardness range <u>58 - 63 HRC</u> Pinion teeth hardening method <u>CARBURIZED</u> ☐ HS shaft separate hardness range _____ Gear teeth (rim) hardness range <u>58 - 63 HRC</u> Gear teeth hardening method <u>CARBURIZED</u> Gear hub: ☒ Forged cylinder ☐ Forged & Capped ☐ Fabricated Gear to Shaft fit method (2.5.3.2) ☐ Integral ☐ Keyed interference ☒ Keyless interference Rim attachment (2.5.3.2) <u>FORGED GEAR WHEEL</u> LS shaft hardness range <u>HB 230 - 274</u> Journal static weight loads (2.6.6.3) Pinion <u>37</u> / <u>4</u> kg Gear <u>347</u> / <u>253</u> kg Total gear unit assembled weight <u>1900</u> kg NOTES: _____ _____ _____
35 ○ INSTALLATION DATA (2.1.14) 36 ☐ Indoor ☐ Heated ☐ Under roof 37 ☒ Outdoor ☐ Unheated ☐ Partial sides 38 ☐ Grade ☐ Mezzanine ☒ ONSHORE 39 ☐ Winterization required ☐ Tropicalization required 40 Electrical area (2.1.10) Class _____ Grp _____ Div _____ 41 Electrical area (2.1.10) Zone <u>2</u> Grp <u>IIA</u> Temp <u>T1</u> °C 42 Max allow SPL (2.1.6) _____ dB(A) @ _____ m 43 Elevation _____ m Barometer _____ kPa abs 44 Range of ambient temperatures: 45 Dry bulb _____ Wet bulb _____ 46 Normal _____ °C _____ °C 47 Maximum <u>82</u> °C _____ °C 48 Minimum <u>0</u> °C _____ °C 49 Unusual conditions ☐ Dust ☐ Fumes 50 ☐ _____	

SPECIAL PURPOSE GEAR UNITS
API 613 FIFTH EDITION
DATA SHEET SI UNITS

Job No.	41104	Item No.	B
P.O. No.		Date	
Requisition No.			
Inquiry No.			
Revision	1	Date	06.03.2015 By HNI

■ GEAR DATA				○ COUPLINGS AND GUARDS			
	Pinion	Gear		Pinion	Gear		
Number of teeth	29	173		Coupling furnished by (3.2.1)	Compr. Supplier	Compr. Supplier	
Gear ratio	5,97			Mount coupling halves (3.2.2)	Compr. Supplier	Compr. Supplier	
Tangential load, "Wt" (2.2.4.2)	25.731	N		Cplg. guard adapter by (3.2.3)	Gear Supplier	Gear Supplier	
AGMA Geometry factor "J"	0,52	0,54		Cplg. guard furnished by (3.2.3)	Compr. Supplier	Compr. Supplier	
Pitch diameter	111,98	668,02	mm	Coupling vendor (3.2.3)			
Outside diameter	120,30	673,50	mm	Vendor's model number (3.2.3)			
Root diameter	103,05	656,32	mm	Coupling weight on shaft, kg	10,4	26,4	
Center groove diameter	93,00	640,00	mm	CG Inboard / outboard of shaft end	Outboard	Outboard	
Normal pressure angle	20,00	deg		Hub drill template provided	☐	☐	
Normal diametral pitch	7,26	in ⁻¹		■ SHAFT END DETAIL (2.5.4.2)			
Helix angle	24,25	deg		Shaft end detail specified by:	☒ Purchaser	☐ Gear vendor	
Center distance	390,00	mm		(Integral unless otherwise specified)			
Backlash min	0,28	mm		Shaft end detail if 'otherwise' specified:	Pinion	Gear	
Net face width, "Fw"	130,00	mm		Tapered / Keyless	☐ ☐	☐ ☐	
Pinion L/D	1,74			Tapered / 1-Key	☐ ☐	☐ ☐	
Face overlap ratio	4,86			Tapered / 2-Keys	☐ ☐	☐ ☐	
Transverse contact ratio	1,45			Cylindrical / 1-Key	☐ ☐	☐ ☐	
AGMA 6011 service factor	2,87			Cylindrical / 2-Keys	☐ ☐	☐ ☐	
Rating based on ANSI/AGMA 6011 with SF=1,0				Other	☒ Flanged	☐ ☐	
Durability Power	5404	kW		Shaft diameter	75,0	120,0	mm
Strength Power	4652	kW		(If integral flange use diameter immediately adjacent to flange)			
Tooth Surface Finish, Ra	0,4	0,4	µm	■ RADIAL BEARINGS			
Tooth Generation Process	Hobbing	Hobbing		Type	T.PADS / T.PADS	CYL. / CYL.	
Tooth Finishing Process	Grinding	Grinding		Diameter	80 / 80	120 / 120	mm
Lead modification (2.2.4.6)	☒ Not Req'd	☐ Req'd		Length	56 / 56	60 / 60	mm
Calculated Total Lead Mismatch		µm		Journal velocity	45,0 / 45,0	11,3 / 11,3	m/s
■ SCUFFING DATA (2.2.6)				Loading	3,08 / 3,10	2,52 / 2,26	N/mm ²
Scuffing Data per ANSI/AGMA 925-A03				Clearance (min-max)			mm
Scuffing Risk (2.2.6) <=5% (Low)	Calculation Method	AGMA925		Span	340	340	mm
Composite surface roughness, ox	0,57	µm		Power loss each bearing	6,3 / 6,3	0,7 / 0,7	kW
Specific film thickness, EHL Amin	2,54	µm		Oil flow each bearing	15,0 / 15,0	5,0 / 5,0	l/min
Tooth temperature, 0m	80	°C		■ THRUST BEARINGS			
Maximum contact temperature, 0Bmax	93	°C		Location		OPP.CPLG.SIDE	
■ MATERIALS				Manufacturer	FLENDER	FLENDER	
Gear casing	Steel	Oil seals	aluminum	Type	NO	COMB.TAP.LANDS	
Pinion(s)	18CrNiMo7-6			Size		BPK LEG 4"	
Gear rim(s)	18CrNiMo7-6			Area		5160	mm ²
HS Shaft	Integral	LS Shaft	42CrMo4	Loading		1,35	MPa
Radial bearings	Babbitt	Backing	Steel	Rating		1,50	MPa
Thrust bearing(s)	Babbitt	Backing	Steel	Int. thrust load			N
				Ext. thrust load	2.700	4.250	N
○ SHAFT END DETAIL				Power loss each	0,0	5,0	kW
☒ Gear shaft end for coupling integral flange (2.5.4.2)				Oil flow each bearing	0,0	15,0	l/min
☒ Pinion shaft end for coupling integral flange (2.5.4.2)				NOTES :			
☒ Other :	WITHOUT BOLTS						

SPECIAL PURPOSE GEAR UNITS
API 613 FIFTH EDITION
DATA SHEET SI UNITS

1 ○ LUBRICATION REQUIREMENTS 2 ☐ Oil system furnished by (2.8.3) _____ 3 ☐ Other _____ ☐ Gear vendor _____ 4 ☐ Oil visc. _____ cp @ 40°C _____ cp @ 100°C (2.8.6) 5 ☐ ISO Grade _____ Load stage (2.2.6) 7,0 6 7 ■ MESH 8 Mesh and windage power loss 2,0 kW 9 Oil flow, mesh 9,0 l/min 10 11 ■ LUBRICATION REQUIREMENTS 12 Min. startup oil temperature 20,0 °C 13 Normal oil inlet temperature 60,0 °C 14 Maximum oil inlet temperature 65,0 °C 15 Unit oil flow (total) 64,0 l/min 16 Unit oil pressure 2,5 bar 17 ☐ Oil visc. _____ cp @ 40°C _____ cp @ 100°C (2.8.6) 18 ☐ ISO Grade 46 Load stage (2.2.6) 7,0 19 20 ■ PIPING CONNECTIONS <table border="1" style="width:100%; border-collapse: collapse;"> <tr> <th>Service</th> <th>No.</th> <th>Size</th> <th>Type</th> </tr> <tr> <td>Lube oil inlet</td> <td>1</td> <td>1,5 in.</td> <td>ANSI 150 LBS</td> </tr> <tr> <td>Lube oil outlet</td> <td>1</td> <td>6 in.</td> <td>ANSI 150 LBS</td> </tr> <tr> <td>Casing drain *</td> <td></td> <td></td> <td></td> </tr> <tr> <td>Vent</td> <td>1</td> <td>1,5 in.</td> <td>ANSI 150 LBS</td> </tr> <tr> <td>Casing purge</td> <td></td> <td></td> <td></td> </tr> </table> 27 * Casing drain is 'dead bottom' housing drain, not lube oil outlet 28 ○ MOUNTING PLATES 29 ☐ Gear furnished with (3.3.1.1) 30 ☐ Baseplate ☐ Soleplate ☐ Subplate(s) (3.3.2.10) 31 ☐ Mounting plates(s) furnished by (3.3.1.1) _____ 32 ☐ Baseplate leveling (3.3.2.3) _____ 33 ☐ Baseplate with leveling pads (3.3.2.3) 34 ☐ Baseplate suitable for column mounting (3.3.2.4) 35 ☐ Vendor review of purchaser's foundation dwgs. (2.1.13) 36 ☐ Grout type (3.3.1.2.4) _____ 37 38 ○ CONTRACT DATA 39 ☐ Test data prior to shipment _____ 40 ☒ Progress report (5.3.3) _____ 41 ☐ Vendor signoff of inspector checklist (4.1.1.3) 42 ☒ Information retained for 20 years (4.2.1.1) (4.2.2.6.1) 43 ☐ Technical manual (5.3.6.4) 44 ☒ PAINTING (4.4.3.1) ☒ Flender standard RAL5015 (blue) 45 ☒ Painting housing interior not allowed (2.3.1.14) 46 ○ SHIPMENT 47 ☐ Steel rotor storage container (4.4.5) ☐ Shaft covers (4.4.4) 48 <table style="width:100%;"><tr><td></td><td>Contract unit</td><td>Spares</td></tr><tr><td>Export boxing</td><td>☐</td><td>☐</td></tr><tr><td>Domestic boxing</td><td>☐</td><td>☐</td></tr><tr><td>Outdoor storage over 6 mos.</td><td>☐</td><td>3 years indoor ☐ (4.4.3.9)</td></tr></table>	Service	No.	Size	Type	Lube oil inlet	1	1,5 in.	ANSI 150 LBS	Lube oil outlet	1	6 in.	ANSI 150 LBS	Casing drain *				Vent	1	1,5 in.	ANSI 150 LBS	Casing purge					Contract unit	Spares	Export boxing	☐	☐	Domestic boxing	☐	☐	Outdoor storage over 6 mos.	☐	3 years indoor ☐ (4.4.3.9)	Job No. 41104 Item No. B P.O. No. _____ Date _____ Requisition No. _____ Inquiry No. _____ Revision 1 Date 08.03.2015 By HNI ○ ADDITIONAL REQUIREMENTS ○ VIBRATION DETECTORS RADIAL (3.4.2.1) (2.7.4.5) (2.7.4.6) ☒ Manufacturer BENTLY NEVADA ☒ Total No. 8 ☒ X-Y probes pinion bearings ☒ Coupling end ☒ Blind end ☒ X-Y probes gear bearings ☒ Coupling end ☒ Blind end ☐ Other _____ AXIAL (3.4.2.1) (2.7.4.5) (2.7.4.6) ☒ Manufacturer BENTLY NEVADA ☒ Total No. 2 ☐ Dual probes at each thrust bearing ☐ Single probe any shaft without thrust bearing ☐ Other _____ ONE EVENT PER REVOLUTION PROBE (2.7.4.5) (2.7.4.6) ☒ Manufacturer BENTLY NEVADA Total No. 2 ☒ One on input shaft ☒ One on output shaft ☐ Other _____ ACCELEROMETER (3.4.2.1) (2.7.4.5) (2.7.4.6) ☒ Manufacturer BENTLY NEVADA ☒ No. required 2 ☒ Pinion coupling end ☒ Gear coupling end ☐ Other _____ ○ TEMPERATURE DETECTORS ☐ Dial type thermometers (3.4.2.7) _____ ☒ Type brg. temp. sensors (3.4.2.7) (2.7.1.3) PT100 ☐ RTD ☐ Thermocouple / ☐ Simplex ☒ Duplex Calibration Yes ☒ HSALS bearings no. sensors each 2 / 2 ☒ Thrust number of sensing elements each face 2 ○ OTHER VIBRATION AND TEMPERATURE (3.4.2.5) (3.4.2.6) Other Gear vendor Oscillator demodulator supplied by ☐ ☒ Vibration monitor supplied by ☒ ☐ ☐ Vibration shutdown delay time _____ seconds Temperature monitor supplied by ☒ ☐ Oscillator demodulator J-box by ☒ ☐ Temp. sensor termination J-box by ☒ ☐ J-box type _____ Mount _____ ○ MISCELLANEOUS ☒ Undamped critical analysis report (2.6.2.1) ☐ w/ dampd rotr resps analys rpt (2.6.2.4.3) (2.6.2.6) Torsional analysis by (2.6.5.2) ☐ Gear vendor ☒ Other ☒ Spare set of gear rotors (4.3.2.4) ☐ Gear case furnished with inlet purge connection (2.4.3) ☐ Orientation of oil inlet & drain conns. (2.4.6) ☒ Filter breather location (2.3.1.12) Prov. on upper casing ☐ Torsional device provisions (2.5.4.5) ☐ Rotor vertical storage provisions (2.5.4.8) ☐ Rotor vertical storage fixture(s) (3.6.2) ☐ Vendor service rep. on site (2.1.13)
Service	No.	Size	Type																																		
Lube oil inlet	1	1,5 in.	ANSI 150 LBS																																		
Lube oil outlet	1	6 in.	ANSI 150 LBS																																		
Casing drain *																																					
Vent	1	1,5 in.	ANSI 150 LBS																																		
Casing purge																																					
	Contract unit	Spares																																			
Export boxing	☐	☐																																			
Domestic boxing	☐	☐																																			
Outdoor storage over 6 mos.	☐	3 years indoor ☐ (4.4.3.9)																																			

SPECIAL PURPOSE GEAR UNITS
API 613 FIFTH EDITION
DATA SHEET SI UNITS

Job No. 41104 Item No. B
P.O. No. _____ Date _____
Requisition No. _____
Inquiry No. _____
Revision 1 Date 06.03.2015 By HNI

O INSPECTIONS AND TESTS (4.1)				
	Req'd	Witness	Observe	Test Log
☐ Advance notice of witness testing required (4.1.3)				
Number calendar days _____				
Shop Inspection (4.1.1)	☐	☐	☐	
Cleanliness Inspection (4.2.3.1)	☐	☐	☐	
Hardness Verification (4.2.3.3)	☒	☐	☐	☒
Dismantle-reassembly (4.3.2.3.1)	☒	☐	☐	☐
Contact Check (2.5.2.2)	☒	☐	☐	☐
Contact Check Tape Lift (2.5.2.2)	☒	☐	☐	☒
Gear accuracy check (2.5.2.1)	☒	☐	☐	☐
Double helical axial stability (2.5.2.3)	☒	☐	☐	☒
Special testing integral forged gears (2.5.3.3)				
(testing per mutual agreement)	☐	☐	☐	☐
Residual unbalance check (2.6.6.2)	☒	☐	☐	☒
Mechanical Run Test (Main) (4.3.2)	☒	☐	☐	☒
Mechanical Run Test (Spare) (4.3.2.4)	☐	☐	☐	☐
Adm. Mechanical Tests (4.3.2.2.16)	☐	☐	☐	☐
Part or Full Load And Full Speed				
Test (4.3.3.1)	☐	☐	☐	☐
Full torque, reduced speed (4.3.3.2)	☐	☐	☐	☐
Full Torque Static Test (4.3.3.3)	☐	☐	☐	☐
Back-To-Back Locked Torque				
Test (4.3.3.4)	☐	☐	☐	☐
Sound Level Test (4.3.3.5)	☒	☐	☐	☒
Additional gear tooth test (4.2.2.8)	☐	☐	☐	☐
Use shop Lube System	☒	☐	☐	
Use job lube system	☐	☐	☐	
Use shop Vibration Probes, Etc.	☐	☐	☐	
Use job Vibration Probes, Etc.	☒	☐	☐	
Final Assembly, Maintenance &				
Running Clearance (4.2.1.1.e)	☒	☐	☐	☒
Oil System Cleanliness (4.2.3.2)	☐	☐	☐	
Oil System-Casing Joint				
Tightness (4.3.2.1.4)	☐	☐	☐	
Warning And Protection				
Devices (4.3.2.1.5)	☐	☐	☐	
Seismic Vibration Data (4.3.2.2.3)	☐	☐	☐	☐
Vibration, Phase Plots (4.3.2.2.12)	☒	☐	☐	☒
Oil Inlet Range test (4.3.2.2.13)	☐	☐	☐	☐
Tape recorded Vibration Data	☒	☐	☐	☒
(4.3.2.2.14) (4.3.2.2.15)	☐			
Purchaser copy				
NON-DESTRUCTIVE TESTING (4.2.1.2) (4.2.2.1)				
	Surface	Sub surface		Log
☐ Casing	☐	☐		☐
☒ Rot. Elmts.	☒	☒		☒
☒ Bearings	☒	☒		☒
☐ Other :	☐	☐		☐
(Specify)				

NOTES : _____

During start-up, gears can exhibit a transient spike reading of vibration levels that will exceed shutdown settings. Therefore a trip multiplier is recommended in the control system.

Mechanical running test duration 4 hours including

- Shaft vibration record using job vibration probes if ordered
- Bearings temperature records
- Casing vibration measurement
- Sound level pressure measurement
- Power losses measurement at oil outlet
- Performed with oil ISO VG 32

Oil flow requirement and power losses are calculated values only, add normal safety margins for sizing heat exchangers.

PRELIMINARY MASS ELASTIC DATA

Customer : Siemens AG Duisburg
Destination : Khursaniyah Al Fadhl
Purchaser order :
F-G job number : D 4110481 OL:
Type and serial N° : TX40/5C

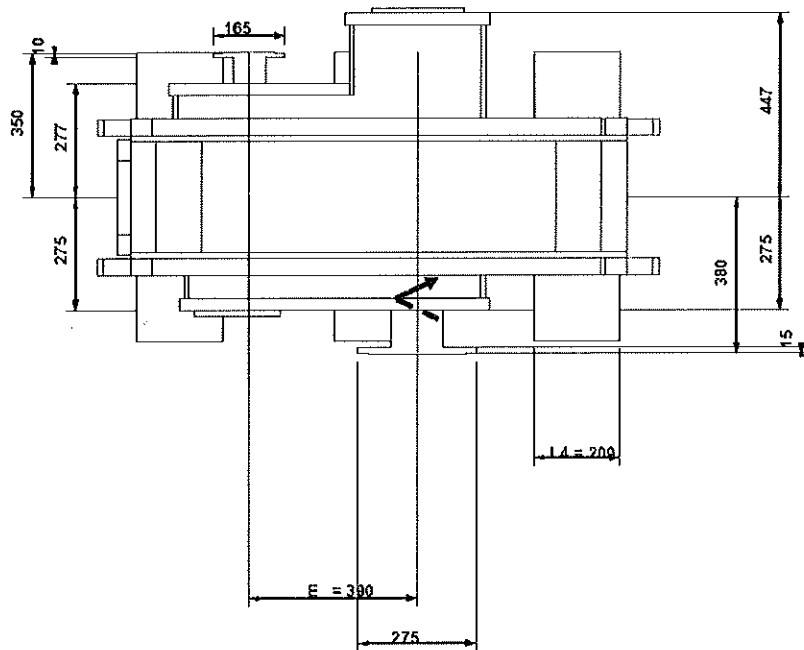
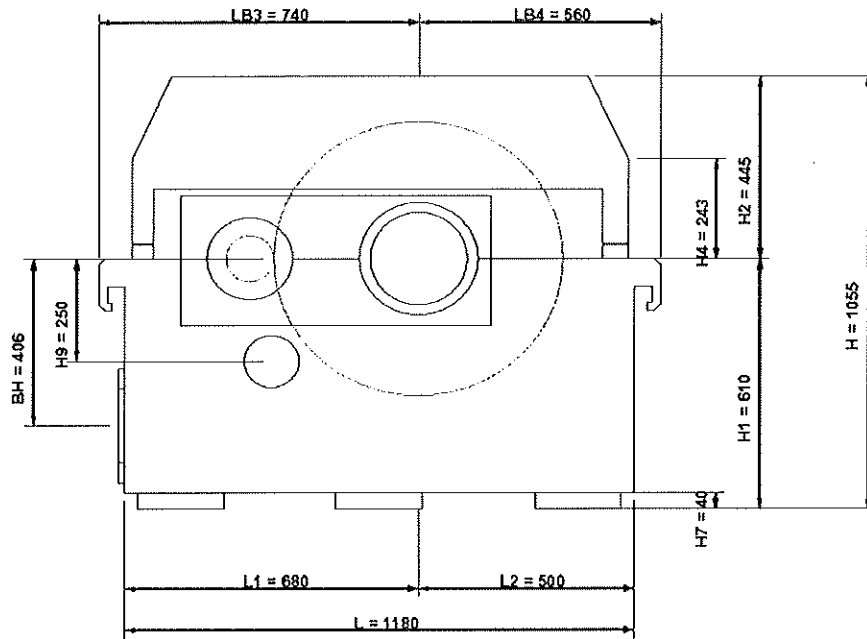
Power rating : 1620 kW
Service factor : $AP1613.03 \times \approx 1,4$
Input speed : 1800 rpm
Output speed : 10737,9 rpm
Speed ratio : 5,96

Weight HSS : 30,5 kg
Weight pos. from teeth middle HSS : 57,5 mm
Inertia HSS : 0,038 Kg.m²
Stiffness HSS : 1,11 MN/mrd
Bearing type 1 : Tilting pads 80 x 56
Bearing type 2 : Tilting pads 80 x 56
Add. weight on brg. side 1 : 10,4 kg

Weight LSS : 574,3 kg
Weight pos. from teeth middle LSS : 9 mm
Inertia LSS : 28,526 Kg.m²
Stiffness LSS : 6,5 MN/mrd
Bearing type 4 : Cylindrical 120 x 60
Bearing type 3 : Cylindrical 120 x 60
Add. weight on brg. side 4 : 26,4 kg

Positive direction of external

APPAREIL.xls _ Edition du :06.03.2015
1/1



ADDITIONAL TECHNICAL DATASHEET				Job No. 41104 Item No. B																																				
				P.O. No. _____ Date _____																																				
				Requisition No. _____																																				
				Inquiry No. _____																																				
				Revision 1 Date 06.03.2015 By HNI																																				
☒ ADDITIONAL GEAR DATA			☐ TURNING GEAR (Dimensioning is preliminary I)																																					
Efficiency			Calculation results																																					
<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 50%;">Percent of rated power</th> <th style="width: 50%;">Efficiency</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">100%</td> <td style="text-align: center;">98,70</td> </tr> <tr> <td style="text-align: center;">75%</td> <td style="text-align: center;">98,66</td> </tr> <tr> <td style="text-align: center;">50%</td> <td style="text-align: center;">98,38</td> </tr> <tr> <td style="text-align: center;">25%</td> <td style="text-align: center;">97,42</td> </tr> <tr> <td style="text-align: center;">10%</td> <td style="text-align: center;">87,68</td> </tr> </tbody> </table>			Percent of rated power	Efficiency	100%	98,70	75%	98,66	50%	98,38	25%	97,42	10%	87,68	Required turning speed _____ rpm Actual turning speed _____ rpm Required breakaway torque _____ Nm Actual breakaway torque _____ Nm Actual maximum torque _____ Nm Actual acceleration time _____ s																									
Percent of rated power	Efficiency																																							
100%	98,70																																							
75%	98,66																																							
50%	98,38																																							
25%	97,42																																							
10%	87,68																																							
Losses			Motor																																					
Power loss at no load _____ kW Heat rejection _____ kcal/h			Supplier _____ Power _____ kW Voltage _____ V Frequency _____ Hz Speed _____ rpm Electric standard _____																																					
☐ PUMP DETAILS (Dimensioning is preliminary I)			Turning gear																																					
Design : _____ Speed : _____ rpm Oil flow : _____ l/min Oil pressure : _____ bar NPSH : _____ m Safety valve : _____ Driving method : _____ Material : _____ Flanges : _____ Testing : _____ Furniture of ATEX certificate : _____			Type _____ Ratio _____																																					
			Clutch																																					
			Type _____ Max. allowable torque _____ Nm																																					
			Miscellaneous																																					
			Starting device _____ Switch details _____																																					
☒ INSTRUMENTATION PACKAGE																																								
Thermometer			Thermoelements																																					
<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th></th> <th style="width: 33%;">Bearing</th> <th style="width: 33%;">Thrust bearing</th> <th style="width: 33%;">Oil inlet/outlet</th> </tr> </thead> <tbody> <tr> <td>Qty</td> <td></td> <td></td> <td></td> </tr> <tr> <td>Type</td> <td></td> <td></td> <td></td> </tr> </tbody> </table>				Bearing	Thrust bearing	Oil inlet/outlet	Qty				Type				<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th></th> <th style="width: 33%;">Bearing</th> <th style="width: 33%;">Thrust bearing</th> <th style="width: 33%;">Oil inlet/outlet</th> </tr> </thead> <tbody> <tr> <td>Type</td> <td>DUPLEX 2x3F</td> <td>DUPLEX 2x3F</td> <td></td> </tr> <tr> <td>Classification</td> <td>IEC60751</td> <td>IEC60751</td> <td></td> </tr> <tr> <td>Removable from the outside</td> <td>NO</td> <td>NO</td> <td></td> </tr> <tr> <td>ATEX</td> <td>ATEX Eexia</td> <td>ATEX Eexia</td> <td></td> </tr> </tbody> </table>				Bearing	Thrust bearing	Oil inlet/outlet	Type	DUPLEX 2x3F	DUPLEX 2x3F		Classification	IEC60751	IEC60751		Removable from the outside	NO	NO		ATEX	ATEX Eexia	ATEX Eexia				
	Bearing	Thrust bearing	Oil inlet/outlet																																					
Qty																																								
Type																																								
	Bearing	Thrust bearing	Oil inlet/outlet																																					
Type	DUPLEX 2x3F	DUPLEX 2x3F																																						
Classification	IEC60751	IEC60751																																						
Removable from the outside	NO	NO																																						
ATEX	ATEX Eexia	ATEX Eexia																																						
Shaft vibrations																																								
<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th></th> <th style="width: 25%;">Radial</th> <th style="width: 25%;">Axial</th> <th style="width: 25%;">Keyphasor</th> <th style="width: 25%;">Accelerometer</th> </tr> </thead> <tbody> <tr> <td>Type</td> <td>B.N. 3300 XL 8mm Sys. 9M</td> <td>HS No LS BENTLY NEVADA 3300 XL 8mm Sys. 9M</td> <td>B.N. 3300 XL 8mm Sys. 9M</td> <td>ACCELEROMETER BENTLY</td> </tr> <tr> <td>Probe</td> <td>Yes</td> <td>HS No LS Yes</td> <td>Yes</td> <td></td> </tr> <tr> <td>Proximitior</td> <td>Yes</td> <td>HS No LS Yes</td> <td>Yes</td> <td></td> </tr> <tr> <td>Probe holder</td> <td>Yes</td> <td>HS No LS Yes</td> <td>Yes</td> <td></td> </tr> <tr> <td>Connection head</td> <td>Yes</td> <td>HS No LS Yes</td> <td>Yes</td> <td></td> </tr> <tr> <td>mounting kit</td> <td></td> <td></td> <td></td> <td>Yes</td> </tr> </tbody> </table>							Radial	Axial	Keyphasor	Accelerometer	Type	B.N. 3300 XL 8mm Sys. 9M	HS No LS BENTLY NEVADA 3300 XL 8mm Sys. 9M	B.N. 3300 XL 8mm Sys. 9M	ACCELEROMETER BENTLY	Probe	Yes	HS No LS Yes	Yes		Proximitior	Yes	HS No LS Yes	Yes		Probe holder	Yes	HS No LS Yes	Yes		Connection head	Yes	HS No LS Yes	Yes		mounting kit				Yes
	Radial	Axial	Keyphasor	Accelerometer																																				
Type	B.N. 3300 XL 8mm Sys. 9M	HS No LS BENTLY NEVADA 3300 XL 8mm Sys. 9M	B.N. 3300 XL 8mm Sys. 9M	ACCELEROMETER BENTLY																																				
Probe	Yes	HS No LS Yes	Yes																																					
Proximitior	Yes	HS No LS Yes	Yes																																					
Probe holder	Yes	HS No LS Yes	Yes																																					
Connection head	Yes	HS No LS Yes	Yes																																					
mounting kit				Yes																																				
Junction box(es)			Miscellaneous																																					
Qty 0 Manufacturer _____ Material _____ ATEX None			Identification ☒ wire ☒ conduit ☐ junction box Conduit type _____ Transmitter type _____ Qty _____ Terminal block type _____ Qty _____																																					

Commercial Conditions

- Prices are quoted FCA Illkirch-Graffenstaden following Incoterms 2010 including packing cat 1A of SEI, 1999 issue, ind. 2.
- Progress payments : 100% at delivery.
- This quotation is subjected to the Flender Graffenstaden Standard Terms and Conditions of Sales and valid for acceptance until the 15th of July 2015.
- Where approval of drawings is required, approval must be in line with the document schedule.
- Warranty period is 18 months of operation or 24 months after delivery whichever occurs first. We recommend the supervision of our engineer for the commissioning.
- Flender-Graffenstaden SAS shall not be obligated to fulfill this agreement if such fulfillment is prevented by any impediments arising out of national or international foreign trade or customs requirements or any embargoes or other sanctions.

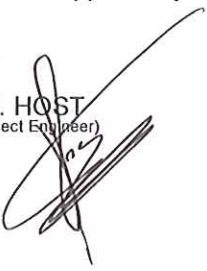
Applicable documents for the quotation (available on demands)

Documents schedule,
Quality plan
Painting standard,
Standard Terms and Conditions of Sales

We thank you for the opportunity of quoting and look forward to the pleasure of serving you.

Very truly yours,

N. HOST
(Project Engineer)



Y. FRIEDMANN
(Sales Manager)



Generated with CAMEC V 4.9.5 26 Feb 2014

**** "This quotation is subject to confidentiality. Information thereof may not be shared with or forwarded to any third parties!"**