

Quotation

To

Company : Siemens AG
City / Country : Duisburg / Germany
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Page(s) : 19
Copy :
Date : 16.03.2015

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*

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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 Duisburg</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		
18	Torque @ max cont speed _____ Nm	Mechanical rating (1.5.16) <u>9520</u> kW @ <u>1800 / 7309,1</u> rpm	
19	Max torque (2.2.1) _____ Nm @ _____ rpm	Gear service factor (2.2.3.1) <u>1,44</u> API 613/2003 5 TH (actual)	
20	☐ Reducer ☒ Increaser	Full load gear unit power loss <u>66</u> kW	
21	Rated speed (2.1.5):	Gear Unit Mechanical efficiency <u>99,03</u> %	
22	Input <u>1800</u> rpm ☐ Specified ☒ Nominal	Rating speed Pinion <u>7.309,1</u> Gear <u>1.800,0</u> rpm	
23	Output <u>7285</u> rpm ☐ Specified ☒ Nominal	Hardness used for	
24	Allow var in gear ratio (2.1.5) (+) (-) _____ %	Rating, (HB or Rc) Pinion <u>58 HRC</u> Gear <u>58 HRC</u>	
25	Max continuous speed (1.5) <u>1800 / 7285</u> rpm	Tooth pitting Index, "K" (2.2.4.1) (2.2.4.2)	
26	Trip speed (1.5) (2.1.7) <u>1980 / 8013,5</u> rpm	Allowable <u>2,17</u> Actual <u>2,10</u> MPa	
27	Gear service factor (2.2.3.1) <u>1,4</u> API 613/2003 5 TH (min)	Material index number (Fig 3, Table 4) <u>3,03</u> MPa	
28	Hardness (2.2.3.2) Pinion _____ Gear _____	Bending stress number, "S _t " (2.2.5.1) (2.2.5.2)	
29	Shaft assembly designation (2.1.19) <u>L/R</u>	Pinion: Allowable <u>265,4</u> Actual <u>256,0</u> MPa	
30	HS shaft rot fac'g cpl'g (2.1.20.2) ☒ CW ☐ CCW	Gear: Allowable <u>265,4</u> Actual <u>246,0</u> MPa	
31	LS shaft rot fac'g cpl'g (2.1.20.2) ☒ CW ☐ CCW	Pitch line velocity <u>77,1</u> m/s	
32	External loads (2.1.16) _____	Anticipated SPL (2.1.6) <u>82</u> dB(A) @ <u>1</u> m	
33	Other operating conditions (2.2.2) (2.6.1.3) _____	WR ² referred to LS shaft <u>126,12</u> kgm ²	
34		Breakaway torque <u>412</u> Nm @ LS Shaft	
35	○ INSTALLATION DATA (2.1.14)	Pinion teeth hardness range <u>58 - 63 HRC</u>	
36	☐ Indoor ☐ Heated ☐ Under roof	Pinion teeth hardening method <u>CARBURIZED</u>	
37	☒ Outdoor ☐ Unheated ☐ Partial slides	☐ HS shaft separate hardness range _____	
38	☐ Grade ☐ Mezzanine ☒ ONSHORE	Gear teeth (rim) hardness range <u>58 - 63 HRC</u>	
39	☐ Winterization required ☐ Tropicalization required	Gear teeth hardening method <u>CARBURIZED</u>	
40	Electrical area (2.1.10) Class _____ Grp _____ Div _____	Gear hub:	
41	Electrical area (2.1.10) Zone <u>2</u> Grp <u>IIA</u> Temp <u>T1</u> °C	☒ Forged cylinder ☐ Forged & Copied ☐ Fabricated	
42	Max allow SPL (2.1.6) _____ dB(A) @ _____ m	Gear to Shaft fit method (2.5.3.2)	
43	Elevation _____ m Barometer _____ kPa abs	☐ Integral ☐ Keyed interference ☒ Keyless interference	
44	Range of ambient temperatures:	Rim attachment (2.5.3.2) <u>FORGED GEAR WHEEL</u>	
45	Dry bulb _____ Wet bulb _____	LS shaft hardness range <u>HB 230 - 274</u>	
46	Normal _____ °C _____ °C	Journal static weight loads (2.6.6.3)	
47	Maximum <u>82</u> °C _____ °C	Pinion <u>128</u> / <u>42</u> kg Gear <u>842</u> / <u>707</u> kg	
48	Minimum <u>0</u> °C _____ °C	Total gear unit assembled weight <u>4000</u> kg	
49	Unusual conditions ☐ Dust ☐ Fumes	NOTES: _____	
50	☐	_____	

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■ 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	Coupling vendor (3.2.3)			
Outside diameter	214,10	827,60	Vendor's model number (3.2.3)			
Root diameter	187,25	800,74	Coupling weight on shaft, kg	26,6	87,5	
Center groove diameter	177,00	790,00	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	Pinion Gear			
Pinion L/D	1,71		Tapered / Keyless ☐ ☐ ☐ ☐			
Face overlap ratio	6,36		Tapered / 1-Key ☐ ☐ ☐ ☐			
Transverse contact ratio	1,45		Tapered / 2-Keys ☐ ☐ ☐ ☐			
AGMA 6011 service factor	2,64		Cylindrical / 1-Key ☐ ☐ ☐ ☐			
Rating based on ANSI/AGMA 6011 with SF=1.0			Cylindrical / 2-Keys ☐ ☐ ☐ ☐			
Durability Power	21442	kW	Other <u>Flanged</u> ☒ ☐ ☐ ☐			
Strength Power	17946	kW	Shaft diameter <u>120,0</u> <u>190,0</u> mm			
Tooth Surface Finish, Ra	0,4	µm	(If integral flange use diameter immediately adjacent to flange)			
Tooth Generation Process	Hobbling		■ RADIAL BEARINGS			
Tooth Finishing Process	Grinding		Pinion Gear			
Lead modification (2.2.4.6) ☒ Not Req'd ☐ Req'd			Type <u>OFFSET / OFFSET</u> <u>CYL. / CYL.</u>			
Calculated Total Lead Mismatch		µm	Diameter <u>130 / 130</u> <u>200 / 200</u> mm			
■ SCUFFING DATA (2.2.6)			Length <u>130 / 130</u> <u>100 / 100</u> mm			
Scuffing Data per ANSI/AGMA 926-A03			Journal velocity <u>49,8 / 49,8</u> <u>18,8 / 18,8</u> m/s			
Scuffing Risk (2.2.6) <u><=5% (Low)</u>	Calculation Method <u>AGMA925</u>		Loading <u>2,78 / 2,81</u> <u>2,87 / 2,71</u> N/mm²			
Composite surface roughness, σx	0,57	µm	Clearance (min-max)			
Specific film thickness, EHL λmin	3,31	µm	Span <u>550</u> <u>550</u> mm			
Tooth temperature, θm	82	°C	Power loss each bearing <u>13,8 / 13,8</u> <u>3,0 / 3,0</u> kW			
Maximum contact temperature, θBmax	101	°C	Oil flow each bearing <u>42,0 / 42,0</u> <u>10,0 / 10,0</u> l/min			
■ MATERIALS			■ THRUST BEARINGS			
Gear casing	Steel	Oil seals	aluminum	Location		
Pinion(s)	18CrNiMo7-6			Manufacturer		
Gear rim(s)	18CrNiMo7-6			Type		
HS Shaft	Integral	LS Shaft	42CrMo4	Size		
Radial bearings	Babbitt	Backing	Steel	Area		
Thrust bearing(s)	Babbitt	Backing	Steel	Loading		
○ SHAFT END DETAIL			Rating			
☒ Gear shaft end for coupling integral flange (2.5.4.2)			Int. thrust load			
☒ Pinion shaft end for coupling integral flange (2.5.4.2)			Ext. thrust load			
☒ Other : <u>WITHOUT BOLTS</u>			Power loss each			
			Oil flow each bearing			
			NOTES :			

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○ LUBRICATION REQUIREMENTS ☐ 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 <table border="1" style="width:100%; border-collapse: collapse;"> <thead> <tr> <th></th> <th>Contract unit</th> <th>Spares</th> </tr> </thead> <tbody> <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> </tbody> </table>	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					Contract unit	Spares	Export boxing	☐	☐	Domestic boxing	☐	☐	Outdoor storage over 6 mos.	☐	3 years indoor ☐ (4.4.3.9)	Job No. 41104 Item No. A P.O. No. _____ Date _____ Requisition No. _____ Inquiry No. _____ Revision 1 Date 06.03.2015 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 ☒ HSLS bearings no. sensors each 2 / 2 ☒ Thrust number of sensing elements each face 2 ○ OTHER VIBRATION AND TEMPERATURE <table border="1" style="width:100%; border-collapse: collapse;"> <thead> <tr> <th>(3.4.2.5) (3.4.2.6)</th> <th>Other</th> <th>Gear vendor</th> </tr> </thead> <tbody> <tr> <td>Oscillator demodulator supplied by</td> <td>☐</td> <td>☒</td> </tr> <tr> <td>Vibration monitor supplied by</td> <td>☒</td> <td>☐</td> </tr> <tr> <td>Vibration shutdown delay time _____ seconds</td> <td></td> <td></td> </tr> <tr> <td>Temperature monitor supplied by</td> <td>☒</td> <td>☐</td> </tr> <tr> <td>Oscillator demodulator J-box by</td> <td>☒</td> <td>☐</td> </tr> <tr> <td>Temp. sensor termination J-box by</td> <td>☒</td> <td>☐</td> </tr> <tr> <td>J-box type _____ Mount _____</td> <td></td> <td></td> </tr> </tbody> </table> ○ MISCELLANEOUS ☒ Undamped critical analysis report (2.6.2.1) ☐ w/ dampd rtr 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)	(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 _____		
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O INSPECTIONS AND TESTS (4.1)				
☐ Advance notice of witness testing required (4.1.3) Number calendar days _____				
	Req'd	Witness	Observe	Test Log
6	Shop Inspection (4.1.1)	☐	☐	☐
7	Cleanliness Inspection (4.2.3.1)	☐	☐	☐
8	Hardness Verification (4.2.3.3)	☒	☐	☒
9	Dismantle/reassembly (4.3.2.3.1)	☒	☐	☐
10	Contact Check (2.5.2.2)	☒	☐	☐
11	Contact Check Tape Lift (2.5.2.2)	☒	☐	☒
12	Gear accuracy check (2.5.2.1)	☒	☐	☐
13	Double helical axial stability (2.5.2.3)	☒	☐	☒
14	Special testing Integral forged gears (2.5.3.3)			
15	(testing per mutual agreement)	☐	☐	☐
16	Residual unbalance check (2.6.6.2)	☒	☐	☒
17	Mechanical Run Test (Main) (4.3.2)	☒	☐	☒
18	Mechanical Run Test (Spare) (4.3.2.4)	☐	☐	☐
19	Addtl. Mechanical Tests (4.3.2.2.16)	☐	☐	☐
20	Part or Full Load And Full Speed			
21	Test (4.3.3.1)	☐	☐	☐
22	Full torque, reduced speed (4.3.3.2)	☐	☐	☐
23	Full Torque Static Test (4.3.3.3)	☐	☐	☐
24	Back-To-Back Locked Torque			
25	Test (4.3.3.4)	☐	☐	☐
26	Sound Level Test (4.3.3.5)	☒	☐	☒
27	Additional gear tooth test (4.2.2.8)	☐	☐	☐
28	Use shop Lube System	☒	☐	☐
29	Use Job lube system	☐	☐	☐
30	Use shop Vibration Probes, Etc.	☐	☐	☐
31	Use Job Vibration Probes, Etc.	☒	☐	☐
32	Final Assembly, Maintenance &			
33	Running Clearance (4.2.1.1.e)	☒	☐	☒
34	Oil System Cleanliness (4.2.3.2)	☐	☐	☐
35	Oil System-Casing Joint			
36	Tightness (4.3.2.1.4)	☐	☐	☐
37	Warning And Protection			
38	Devices (4.3.2.1.5)	☐	☐	☐
39	Seismic Vibration Data (4.3.2.2.3)	☐	☐	☐
40	Vibration, Phase Plots (4.3.2.2.12)	☒	☐	☒
41	Oil inlet Range test (4.3.2.2.13)	☐	☐	☐
42	Tape recorded Vibration Data	☒	☐	☒
43	(4.3.2.2.14) (4.3.2.2.15)	☐	Purchaser copy	
44	NON-DESTRUCTIVE TESTING (4.2.1.2) (4.2.2.1)			
45		Surface	Sub surface	Log
46	☐ Casing	☐	☐	☐
47	☒ Rot. Elmts.	☒	☒	☒
48	☒ Bearings	☒	☒	☒
49	☐ Other :	☐	☐	☐
50	(Specify)			

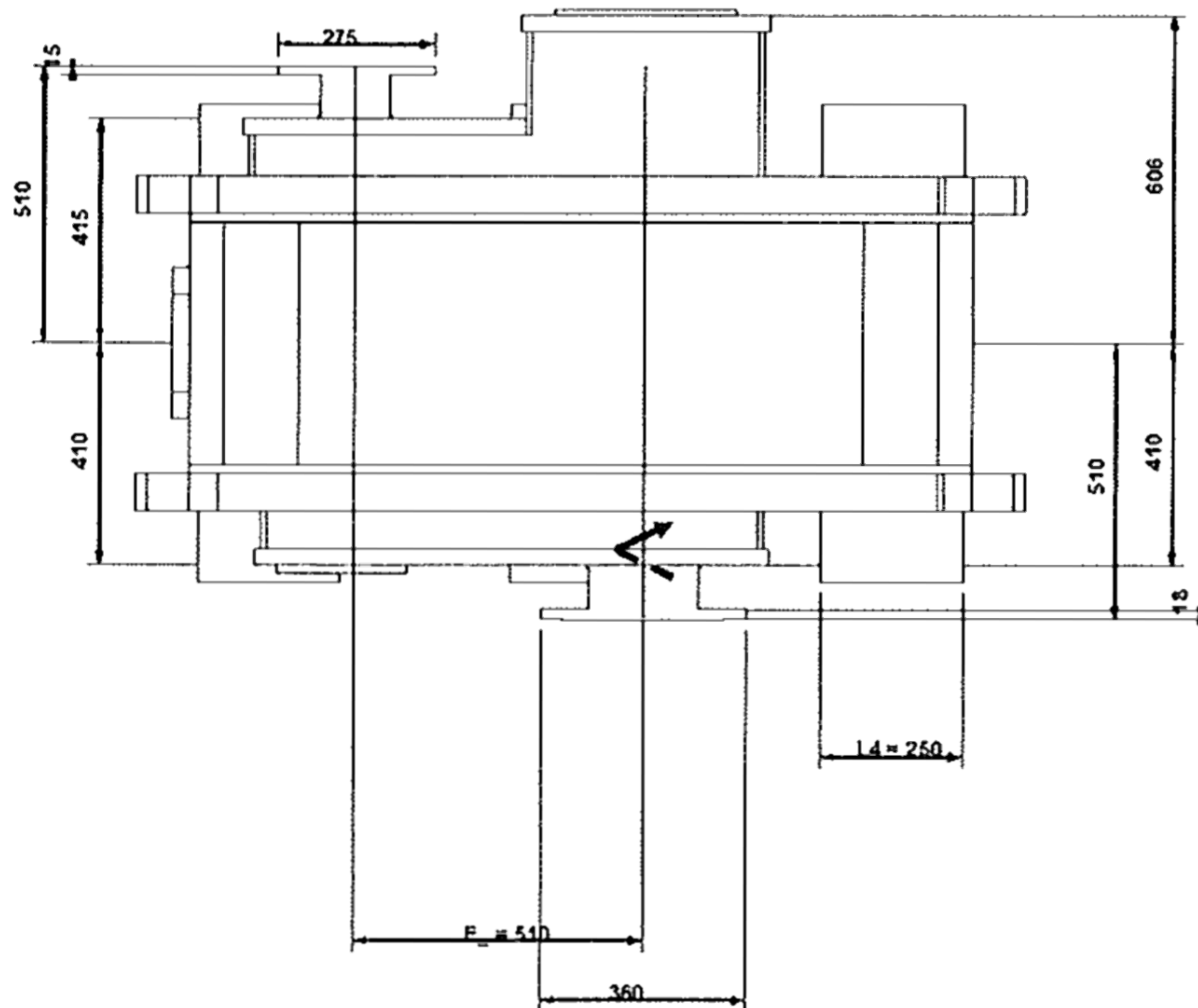
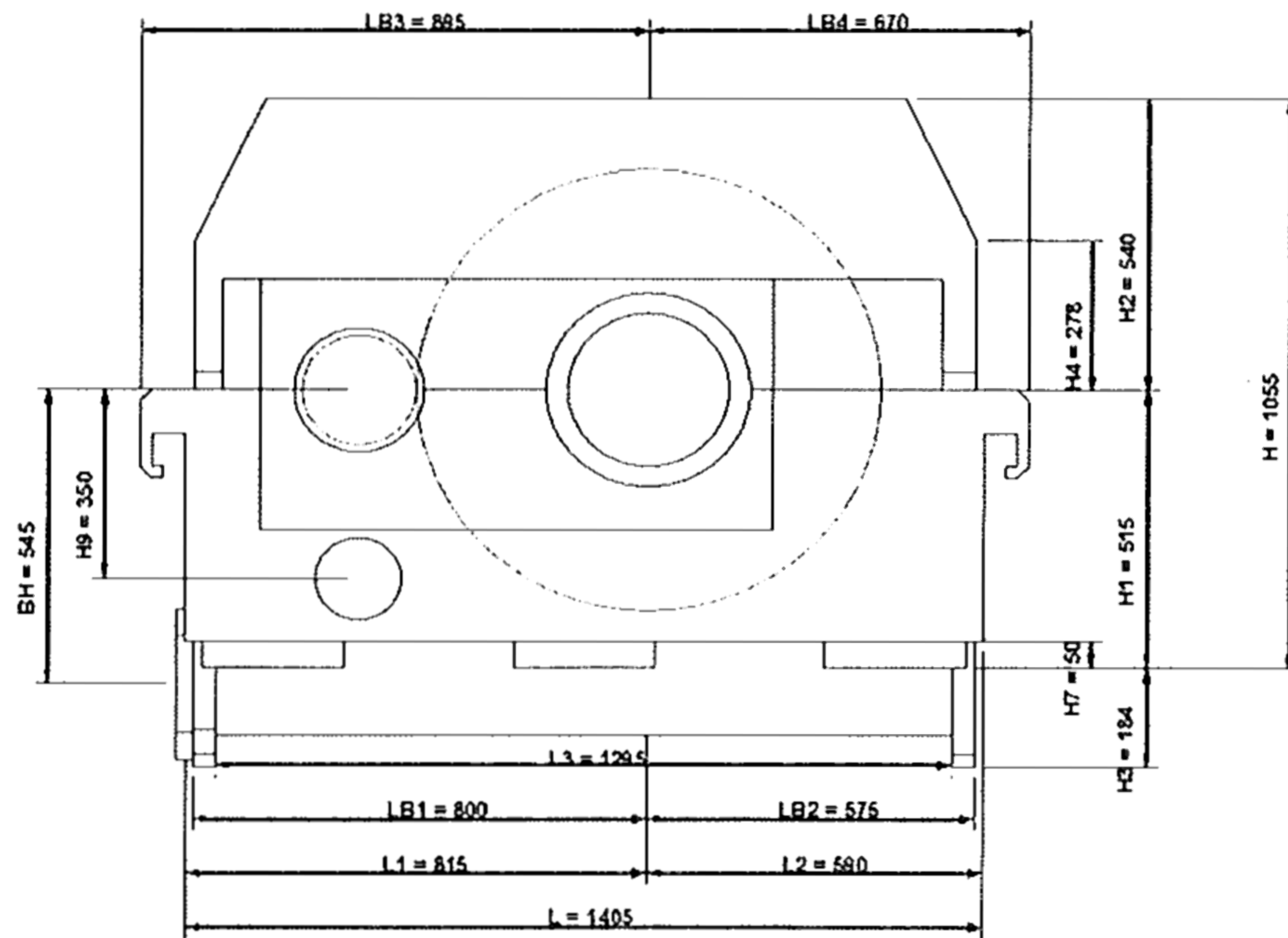
NOTES : _____

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.



ADDITIONAL TECHNICAL DATASHEET				Job No. <u>41104</u> Item No. <u>A</u> P.O. No. _____ Date _____ Requisition No. _____ Inquiry No. _____ Revision <u>1</u> Date <u>06.03.2016</u> By <u>HNI</u>			
☒ ADDITIONAL GEAR DATA				☐ TURNING GEAR (Dimensioning is preliminary !)			
Efficiency				Calculation results			
Percent of rated power		Efficiency		Required turning speed		rpm	
100%		99,03		Actual turning speed		rpm	
75%		98,92		Required breakaway torque		Nm	
50%		98,79		Actual breakaway torque		Nm	
25%		98,08		Actual maximum torque		Nm	
10%		90,80		Actual acceleration time		s	
Losses				Motor			
Power loss at no load		kW		Supplier		_____	
Heat rejection		kcal/h		Power		kW	
				Voltage		V	
				Frequency		Hz	
☐ PUMP DETAILS (Dimensioning is preliminary !)				Speed		rpm	
Design : _____				Electric standard		_____	
Speed : _____ rpm				Turning gear			
Oil flow : _____ l/min				Type		_____	
Oil pressure : _____ bar				Ratio		_____	
NPSH : _____ m				Clutch			
Safety valve : _____				Type		_____	
Driving method : _____				Max. allowable torque		Nm	
Material : _____				Miscellaneous			
Flanges : _____				Starting device		_____	
Testing : _____				Switch details		_____	
Furniture of ATEX certificate : _____							
☒ INSTRUMENTATION PACKAGE							
Thermometer				Thermoelements			
		Bearing		Thrust bearing		Oil inlet/outlet	
Qty				Type		DUPLX 2x3F	
Type				Classification		IEC60751	
				Removable from the outside		NO	
				ATEX		ATEX Exia	
						ATEX Exia	
Shaft vibrations							
		Radial		Axial		Keyphasor	
Type		B N. 3300 XL 8mm Sys 9M		HS		No	
				LS		BENTLY NEVADA 3300 XL 8mm Sys 9M	
Probe		Yes		HS		No	
				LS		Yes	
Proximitor		Yes		HS		No	
				LS		Yes	
Probe holder		Yes		HS		No	
				LS		Yes	
Connection head		Yes		HS		No	
				LS		Yes	
mounting kit						Yes	
Junction box(es)				Miscellaneous			
Qty		0		Identification		☒ wire ☒ conduit ☐ junction box	
Manufacturer		_____		Conduit type		_____	
Material		_____		Transmitter type		Qty _____	
ATEX		None		Terminal block type		Qty _____	

FLENDER GRAFFENSTADEN

FLENDER-GRAFFENSTADEN S.A., FRANCE
BP 84, F-67402 ILLKIRCH-CEDEX
1, rue du Vieux Moulin
F-67400 ILLKIRCH-GRAFFENSTADEN

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

Applicable To: ☒ Proposal ☐ Purchase ☐ As Built For <u>Siemens AG Duisburg</u> Site <u>Khursaniyah Al Fadhili</u> Unit <u>STC-SV 06-3-A</u> Service <u>EMCC</u> No. required <u>1</u>	☐ US Standards (1.7) ☒ ISO Standards (1.7) Manufacturer <u>FLENDER-GRAFFENSTADEN</u> Model No. <u>TX40/5C</u> Serial No. _____ Driver type <u>electric motor</u> Driven equipment <u>centrifugal compressor</u>
NOTE: Numbers within () refer to applicable API standard 613 paragraphs ☐ Information To be completed by purchaser ☐ Information to be completed by manufacturer	
○ UNITS OF MEASUREMENT ☐ US Customary units ☒ SI units ○ RATING REQUIREMENTS Driven equip. (2.1.4): Norm. _____ Max _____ kW Driver: Rated _____ Max _____ kW Normal transmitted power (2.2.2) _____ kW Gear unit rated power (2.2.1) <u>1620</u> kW Torque @ max cont speed _____ Nm Max torque (2.2.1) _____ Nm @ _____ rpm ☐ Reducer ☒ Increaser Rated speed (2.1.5): Input <u>1800</u> rpm ☐ Specified ☒ Nominal Output <u>10736</u> rpm ☐ Specified ☒ Nominal Allow var in gear ratio (2.1.5) (+) (-) _____ % Max continuous speed (1.5) <u>1800 / 10736</u> rpm Tripp speed (1.5) (2.1.7) <u>1980 / 11809,6</u> rpm Gear service factor (2.2.3.1) <u>1,4 API 613/2003 5 TH</u> (min) Hardness (2.2.3.2) Pinion _____ Gear _____ Shaft assembly designation (2.1.19) <u>L/R</u> HS shaft rot fac'g opt'g (2.1.20.2) ☒ CW ☐ CCW LS shaft rot fac'g opt'g (2.1.20.2) ☒ CW ☐ CCW External loads (2.1.16) _____ Other operating conditions (2.2.2) (2.6.1.3) _____ ○ INSTALLATION DATA (2.1.14) ☐ Indoor ☐ Heated ☐ Under roof ☒ Outdoor ☐ Unheated ☐ Partial sides ☐ Grade ☐ Mezzanine ☒ ONSHORE ☐ Winterization required ☐ Tropicalization required Electrical area (2.1.10) Class _____ Grp _____ Div _____ Electrical area (2.1.10) Zone <u>2</u> Grp <u>IIA</u> Temp <u>T1</u> °C Max allow SPL (2.1.6) _____ dB(A) @ _____ m Elevation _____ m Barometer _____ kPa abs Range of ambient temperatures: Dry bulb _____ °C Wet bulb _____ °C Normal _____ °C Maximum <u>82</u> °C Minimum <u>0</u> °C Unusual conditions ☐ Dust ☐ Fumes ☐	■ BASIC GEAR DATA ☒ Single stage ☐ Single helical ☐ Double stage ☒ Double helical ☐ Epicyclic ☐ horizontal offset 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: _____ _____ _____

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■ 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	Coupling vendor (3.2.3)			
Outside diameter	120,30	673,50	Vendor's model number (3.2.3)			
Root diameter	103,05	656,32	Coupling weight on shaft, kg	10,4	26,4	
Center groove diameter	93,00	640,00	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:			
Net face width, *Fw*	130,00	mm	Pinion Gear			
Pinion L/D	1,74		Tapered / Keyless ☐ ☐ ☐ ☐			
Face overlap ratio	4,86		Tapered / 1-Key ☐ ☐ ☐ ☐			
Transverse contact ratio	1,45		Tapered / 2-Keys ☐ ☐ ☐ ☐			
AGMA 6011 service factor	2,87		Cylindrical / 1-Key ☐ ☐ ☐ ☐			
Rating based on ANSI/AGMA 6011 with SF=1.0			Cylindrical / 2-Keys ☐ ☐ ☐ ☐			
Durability Power	5404	kW	Other ☒ Flanged ☐ ☐ ☐			
Strength Power	4652	kW	Shaft diameter 75,0 120,0 mm			
Tooth Surface Finish, Ra	0,4	µm	(If integral flange use diameter immediately adjacent to flange)			
Tooth Generation Process	Hobbing		■ RADIAL BEARINGS			
Tooth Finishing Process	Grinding		Pinion Gear			
Lead modification (2.2.4.6) ☒ Not Req'd ☐ Req'd			Type T.PADS / T.PADS CYL. / CYL.			
Calculated Total Lead Mismatch		µm	Diameter 80 / 80 120 / 120 mm			
■ SCUFFING DATA (2.2.6)			Length 56 / 56 60 / 60 mm			
Scuffing Data per ANSI/AGMA 925-A03			Journal velocity 45,0 / 45,0 11,3 / 11,3 m/s			
Scuffing Risk (2.2.6) <=5% (Low) Calculation Method AGMA925			Loading 3,08 / 3,10 2,52 / 2,26 N/mm²			
Composite surface roughness, ox	0,57	µm	Clearance (min-max)			
Specific film thickness, EHL Amin	2,54	µm	Span 340 340 mm			
Tooth temperature, θm	80	°C	Power loss each bearing 6,3 / 6,3 0,7 / 0,7 kW			
Maximum contact temperature, θBmax	93	°C	Oil flow each bearing 15,0 / 15,0 5,0 / 5,0 l/min			
■ MATERIALS			■ THRUST BEARINGS			
Gear casing Steel Oil seals aluminium			Location			
Pinion(s) 18CrNiMo7-6			Manufacturer FLENDER FLENDER			
Gear rim(s) 18CrNiMo7-6			Type NO COMB.TAP.LANDS			
HS Shaft Integral LS Shaft 42CrMo4			Size BPK LEG 4"			
Radial bearings Babbit Backing Steel			Area 5160 mm²			
Thrust bearing(s) Babbit Backing Steel			Loading 1,35 MPa			
○ SHAFT END DETAIL			Rating 1,50 MPa			
☒ Gear shaft end for coupling integral flange (2.5.4.2)			Int. thrust load N			
☒ Pinion shaft end for coupling integral flange (2.5.4.2)			Ext. thrust load 2.700 4.250 N			
☒ Other : WITHOUT BOLTS			Power loss each 0,0 5,0 kW			
			Oil flow each bearing 0,0 15,0 l/min			
			NOTES :			

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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) <u>7,0</u> 6 7 ■ MESH 8 Mesh and windage power loss <u>2,0</u> kW 9 Oil flow, mesh <u>9,0</u> l/min 10 11 ■ LUBRICATION REQUIREMENTS 12 Min. startup oil temperature <u>20,0</u> °C 13 Normal oil inlet temperature <u>60,0</u> °C 14 Maximum oil inlet temperature <u>65,0</u> °C 15 Unit oil flow (total) <u>64,0</u> l/min 16 Unit oil pressure <u>2,5</u> bar 17 ☐ Oil visc. _____ cp @ 40°C _____ cp @ 100°C (2.8.6) 18 ☐ ISO Grade <u>46</u> Load stage (2.2.6) <u>7,0</u> 19 20 ■ 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>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> </tbody> </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 (5.3.5.4) 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) <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th></th> <th>Contract unit</th> <th>Spares</th> </tr> </thead> <tbody> <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> </tbody> </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. <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> ○ ADDITIONAL REQUIREMENTS ○ VIBRATION DETECTORS RADIAL (3.4.2.1) (2.7.4.5) (2.7.4.6) ☒ Manufacturer <u>BENTLY NEVADA</u> ☒ Total No. <u>8</u> ☒ 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 <u>BENTLY NEVADA</u> ☒ Total No. <u>2</u> ☐ 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 <u>BENTLY NEVADA</u> Total No. <u>2</u> ☒ One on input shaft ☒ One on output shaft ☐ Other _____ ACCELEROMETER (3.4.2.1) (2.7.4.5) (2.7.4.6) ☒ Manufacturer <u>BENTLY NEVADA</u> ☒ No. required <u>2</u> ☒ 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) <u>PT100</u> ☐ RTD ☐ Thermocouple / ☐ Simplex ☒ Duplex Calibration <u>Yes</u> ☒ HSAS bearings no. sensors each <u>2</u> / <u>2</u> ☒ Thrust number of sensing elements each face <u>2</u> ○ OTHER VIBRATION AND TEMPERATURE <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th>(3.4.2.5) (3.4.2.6)</th> <th>Other</th> <th>Gear vendor</th> </tr> </thead> <tbody> <tr> <td>Oscillator demodulator supplied by</td> <td>☐</td> <td>☒</td> </tr> <tr> <td>Vibration monitor supplied by</td> <td>☒</td> <td>☐</td> </tr> <tr> <td>Vibration shutdown delay time _____ seconds</td> <td></td> <td></td> </tr> <tr> <td>Temperature monitor supplied by</td> <td>☒</td> <td>☐</td> </tr> <tr> <td>Oscillator demodulator J-box by</td> <td>☒</td> <td>☐</td> </tr> <tr> <td>Temp. sensor termination J-box by</td> <td>☒</td> <td>☐</td> </tr> <tr> <td>J-box type _____ Mount _____</td> <td></td> <td></td> </tr> </tbody> </table> ○ 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) <u>Prev. on upper casing</u> ☐ 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)	(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 _____		
Service	No.	Size	Type																																																										
Lube oil inlet	1	1,5 in.	ANSI 150 LBS																																																										
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Export boxing	☐	☐																																																											
Domestic boxing	☐	☐																																																											
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Oscillator demodulator supplied by	☐	☒																																																											
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J-box type _____ Mount _____																																																													

SPECIAL PURPOSE GEAR UNITS
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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 (4.2.3.3)	☐	☐	☐	
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. 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 Fadhlil
Purchaser order :
F-G job number : D 4110481 OL
Type and serial N° : TX40/SC

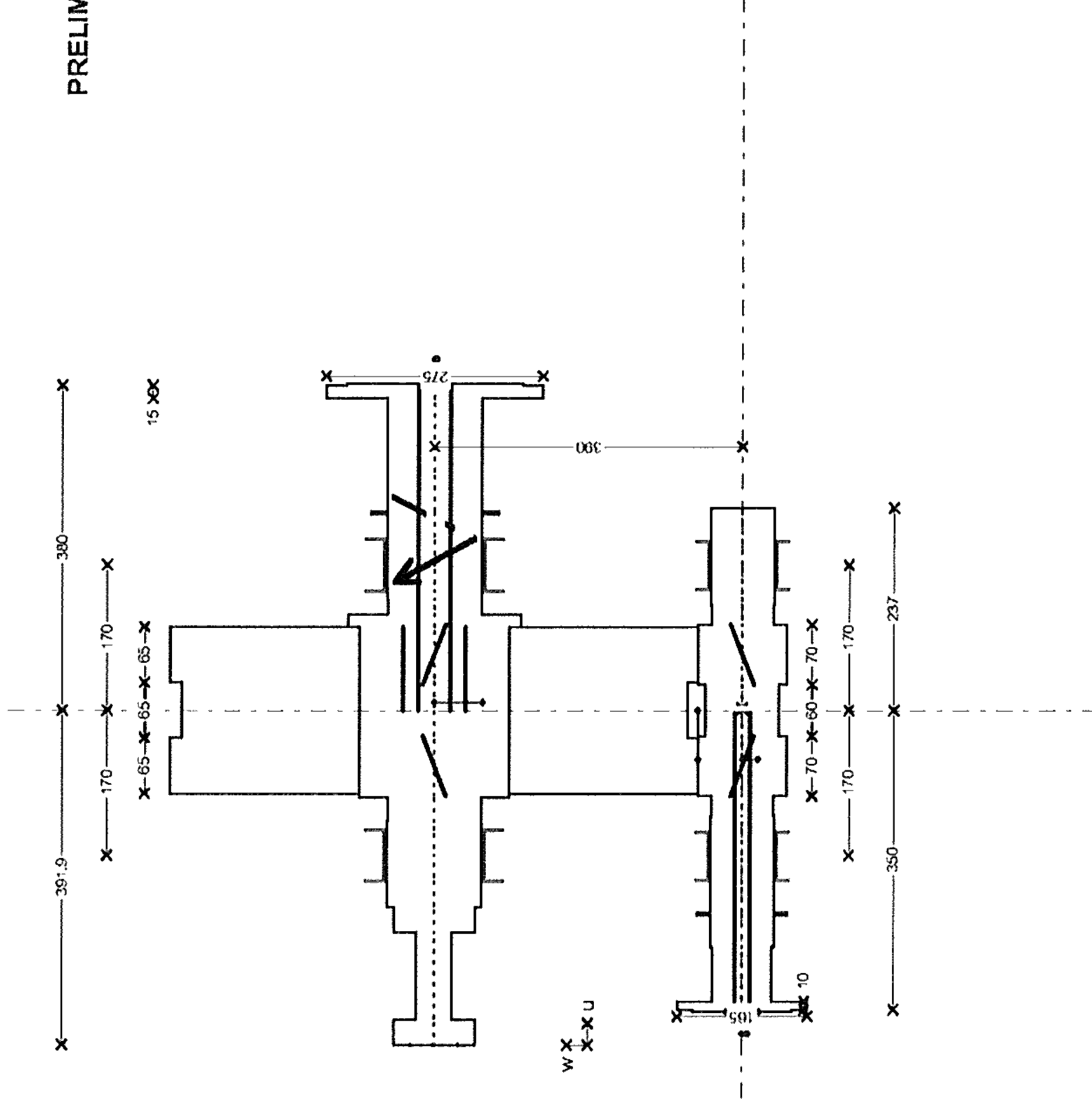
Power rating : 1620 kW
Service factor : $AP1613.03 \geq 1.4$
Input speed : 1800 rpm
Output speed : 10737.9 rpm
Speed ratio : 5.96

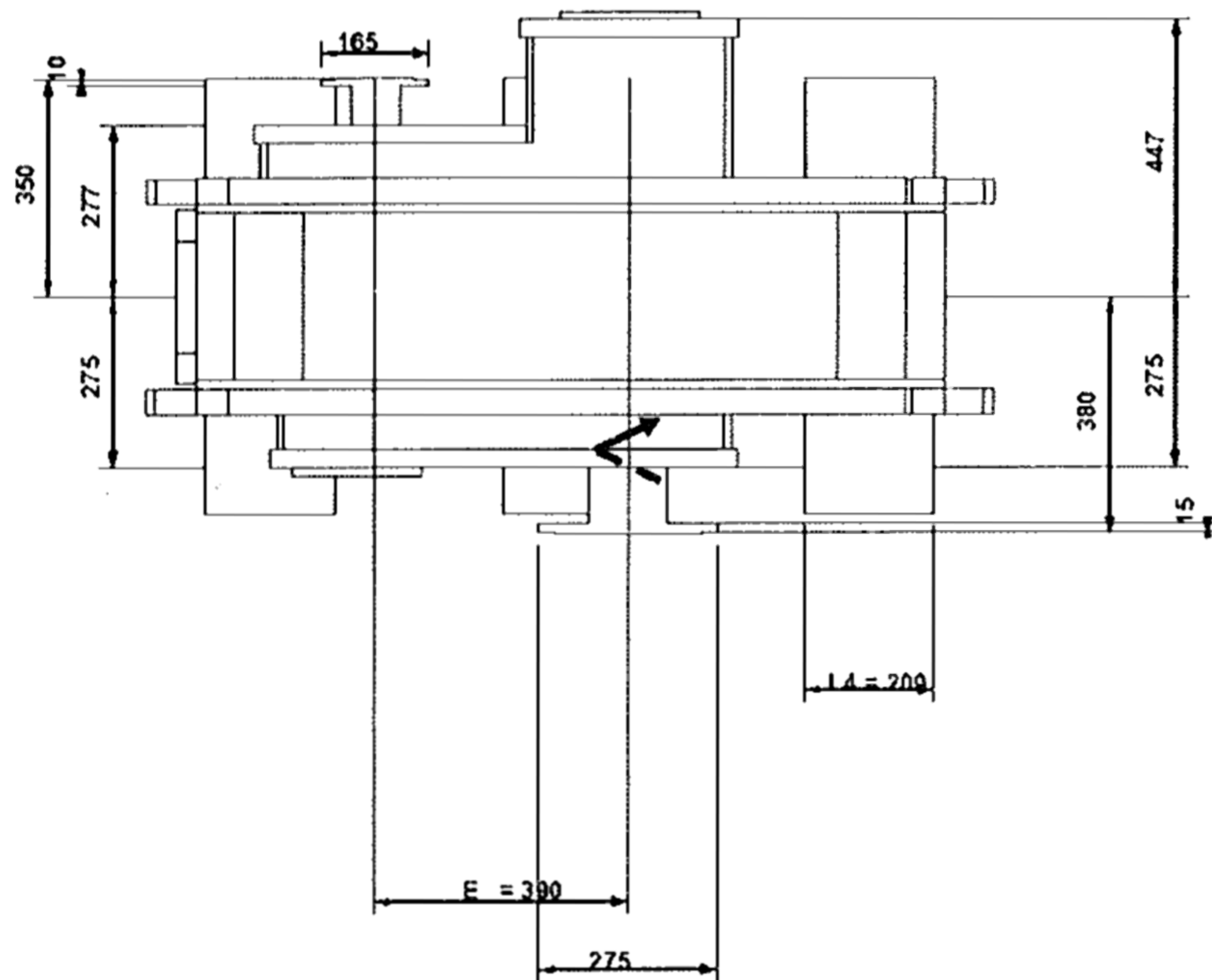
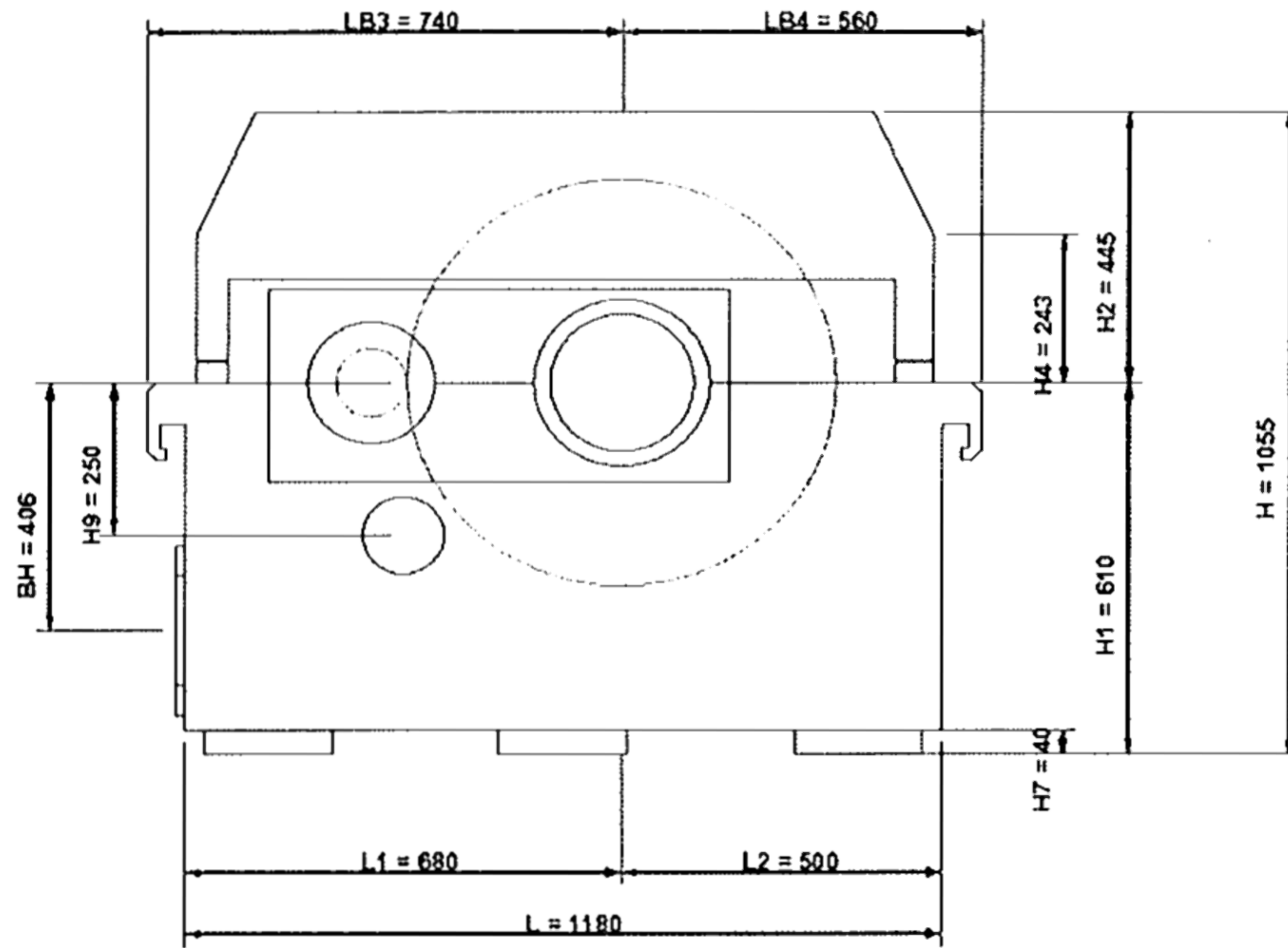
Weight HSS : 30.5 kg
Weight pos. from teeth middle HSS : 57.5 mm
Inertia HSS : 0.008 Kg.m²
Stiffness HSS : 1.11 MN/mrd
Bearing type 1 : Tilting pads 80 x 56
Bearing type 2 : Tilting pads 80 x 56
Add. weight on brg. side 1 : 10.4 kg

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

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ADDITIONAL TECHNICAL DATASHEET				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>																																																																											
☒ ADDITIONAL GEAR DATA				☐ TURNING GEAR (Dimensioning is preliminary !)																																																																											
Efficiency <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <th style="width: 50%;">Percent of rated power</th> <th style="width: 50%;">Efficiency</th> </tr> <tr> <td>100%</td> <td>98,70</td> </tr> <tr> <td>75%</td> <td>98,56</td> </tr> <tr> <td>50%</td> <td>98,38</td> </tr> <tr> <td>25%</td> <td>97,42</td> </tr> <tr> <td>10%</td> <td>87,68</td> </tr> </table>				Percent of rated power	Efficiency	100%	98,70	75%	98,56	50%	98,38	25%	97,42	10%	87,68	Calculation results Required turning speed _____ rpm Actual turning speed _____ rpm Required breakaway torque _____ Nm Actual breakaway torque _____ Nm Actual maximum torque _____ Nm Actual acceleration time _____ s																																																															
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Losses Power loss at no load _____ kW Heat rejection _____ kcal/h				Motor Supplier _____ Power _____ kW Voltage _____ V Frequency _____ Hz Speed _____ rpm Electric standard _____																																																																											
☐ PUMP DETAILS (Dimensioning is preliminary !)				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																																																																											
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Qty <u>0</u> Manufacturer _____ Material _____ ATEX <u>None</u>				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.

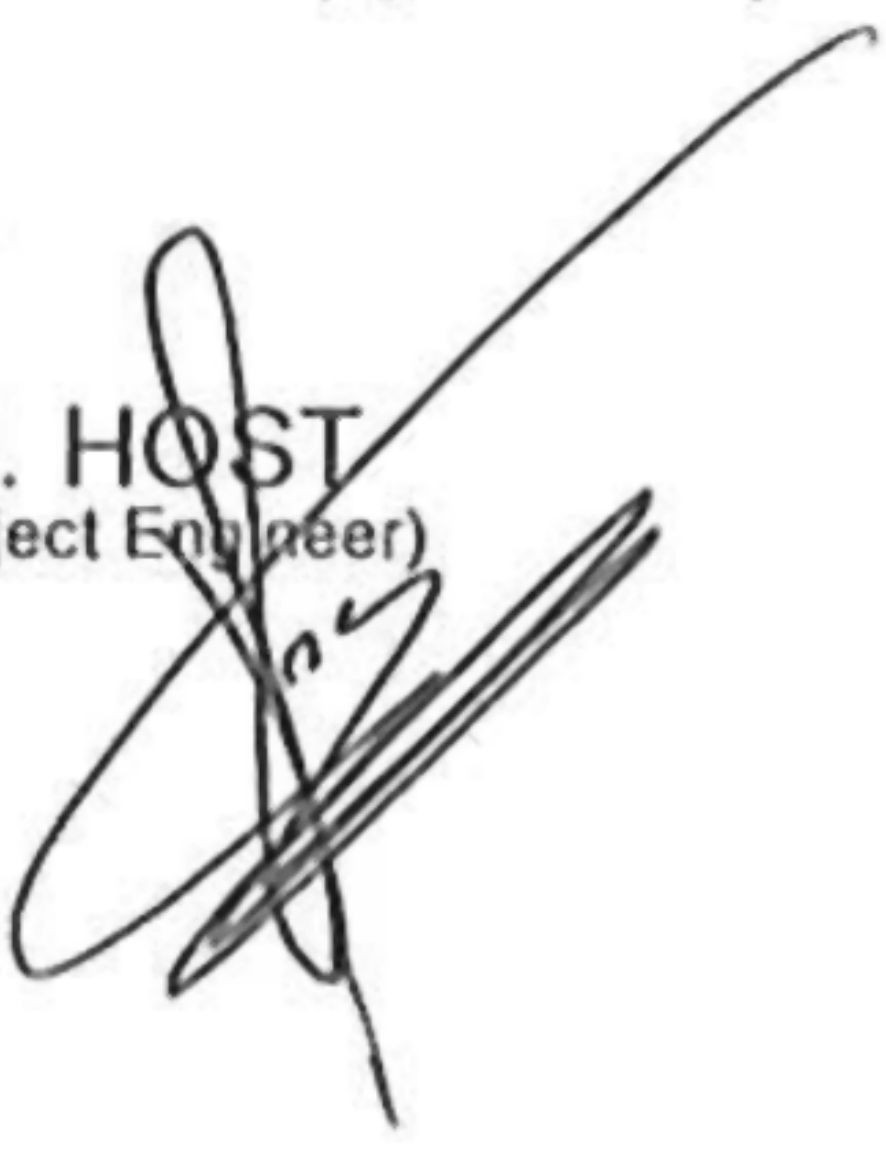
Applicable documents for the quotation (available on demands)

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)



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