3.1.4 GAS COOLER

Manufacturer: OELTECHNIK or equivalent

Construction type / Configuration:
- ☒ Tube bundle heat exchanger with pull-out nest
- ☐ Plain tubes
- ☒ Finned tubes with ☐ Plate fins ☐ Extruded fins

Design Regulations:
- ☒ Pressure Equipment Directive DGRL 97/23/EC
- ☒ AD 2000
- ☐ ASME, Div.1, Section 8
- ☐ TEMA R ☐ TEMA C

3.1.4.1 Design data

Cooler acc.to stage		1		2		3	
Type							
		shell side	tube side	shell side	tube side	shell side	tube side
Operating specifications							
Medium		Nitrogen	Water	Nitrogen	Water	Nitrogen	Water
Heat quantity	kW	559		405		293	
Working pressure	Bara	2,5	2,5	4,6	2,5	7,4	2,5
CW quantity	m^3/h		48,5		35		26
Intake temperature	°C	125	16	96	16	79	16
Output temperature	°C	21	26	21	26	25	26
Fouling factor	m^2K/W	0,00017	0,00017	0,00017	0,00017	0,00017	0,00017
Thermodynamic values							
Flow velocity	m/s	5,36	2,15	2,8	1,6	1,6	1,3
Pressure loss	mbar	47	611	38	341	38	197
Heat transfer	W/m^2K	72,6	9.253	71,8	7012	68,7	5.821
Heat transmission	W/m^2K						
Condensate quantity	kg/h						
Installed heat transfer area	m^2		344,7		344,7		293
Configuration data							
Design pressure	barg	7,5	8,0	7,5	8,0	12	8
Test pressure	barg						
Design temp.	°C	150	80	150	80	150	80
Cooler tube dim.	mm						
Flow count							
Finned tube length	mm						
Separator type							
Degree of separation	%						
Expansion compensation							

Exchangeability:
- ☐ Coolers of stages _____
- ☐ Cooler bundle of stages

Rev.	Date	Name	Appr.	Change	Rev.	Date	Name	Appr.	Change
4					5				
2					3				
0	01.06.04	Schürgers			1	11.10.04	Wilde		for order

3.1.4.2 Materials

	Material	*Surface treatment*
Shell	CS	External: Manufact. standard Internal: none
Chambers	CS	2 component epoxy resin, cold setting
Tube plates	Cu Zn 38	
Cooling tubes	Cu Ni 10 Fe	
Fins		
Deflectors / baffles		
Separator	SS	
Guide rails	SS	
Internal screws	SS	

3.1.4.3 General

The coolers are to be so designed that all their components are able to withstand sudden or periodic changes in through flow quantity, pressures or temperatures within the permitted limits specified by the approval data, without the occurrence of damage or operational malfunction.
In particular, all necessary measures are to be taken to exclude vibration fractures in the piping. The clamping length on pipes should not in general exceed 50 to 60 times their external diameter.
In the vicinity of gas inflow zones, tube bundle should be protected by baffle plates if necessary.

Cooler bundle, cooler elements, water separators and other components must be capable of quick and easy removal and reassembly. Cooler bundle etc. must be equipped with hoist loops.
External water chambers or covers must be capable of removal for manual cleaning without breaking a gas side seal.
The pipe connections are to be so located that the extraction of bundles or elements is not impeded. Appropriate, easily removable adapter fittings are to be fitted in the connection pipes.

All parts must be free of impurities, particularly of oil, grease or preservatives of any kind, on both the gas and water sides.
Exceptions exclusively after consultation.

In the case of floating head heat exchangers, the external pressures acting on the floating head and the effects of load reversal caused by startup and rundown of the plant should be taken into account by the application of correspondingly greater axial force and safety coefficients.

3.1.4.4 Accessories

☒ The coolers are to be equipped with boiler cradles or platforms and with transport loops

☒ Water side emptying and air bleed connections, DN 15 or greater with weld neck flanges.

☒ Emptying connections, DN 15 and blind flanges at the lowest point of the gas space and at the lowest points of the water chambers or spaces.

☒ Boiler nameplates of Niro material. Nameplate brackets sufficient for additional sign. Additional sign - No welding on this vessel -.

☐ Condensate removal (only MAC) ☐ automatic with auxiliary power 24 VDC ☐ automatic without auxiliary power

	ZK 1	ZK 2	ZK 3	
Manufacturer	Oeltechnik	Oeltechnik	Oeltechnik	
Type	EKE 77.280	EKE 77.280	EKE 66.230	
Design quantity	1	1	1	

☐ Shutoff valve before condensate drain and bypass pipe with shutoff valves, so that the drain can be removed and reinstalled during operation.

3.1.5 OIL SYSTEM

Manufacturer: Atlas Copco

Design specification:
☐ API Standard
☒ standard machine supplier, insofar as not otherwise specified below

Base frame:
☒ integrated in the compressor base frame
☐ separate

Dimensions: L x W x H =

Configuration:
☐ Oil drip pan
☐ Oil collector pan
☐ with bottom plate ☐ without bottom plate
☐ Emptying with shutoff valve

3.1.5.1 Oil tank

Capacity	l	1.400	Approx.
Oil filling	l	950	
Recirculation number	1/h		
Dwell time (min. 5 min)	min	≥ 5	
Material		CS	
Corrosion protection, internal		oil	
Accessories - Filler connection with blind flange - Emptying with secure single valve shutoff - Inspection aperture - Connection with shutoff valve for oil cleaning unit	 ☒ ☒ ☒ ☐		

3.1.5.2 Electrical heater

☒ with integrated power switch

Supplier		Czepek	
Number of heater elements	piece	2	
Nominal rating per element	kW	4,5 (each)	
Specific surface load	W/cm²	2,5	
Regulation range	°C	0 – 85	
Connection voltage	V	400V/50Hz	
Temperature limiter, set at	°C	80	

3.1.5.3 Oil pumps

	Main oil pump	*Auxiliary oil pump*	*HP oil pump*
Location	flanged on to gearbox	on oil tank	(N/A)
Drive unit	mechanical	electric motor	-----
Number	1	1	0
Manufacturer	IMO	Allweiler	-----
Construction type	Screw type	Screw type	-----
Type	C3E3CX-143	Trilas 80236	-----
Volume flow [ltr./min]	106	113	-----
Pump head [barg]	5	5	-----
Speed [min⁻¹]	2980	2950	-----
Power consumption[kW]	3	2,2	-----

Motor			-----
Nominal rating [kW]	----	2,2	-----
Connection voltage [V]	----	400 V / 50 Hz	-----
Protection type	----	> IP 54	-----
Insulating material class	----	F to B	-----

3.1.5.4 Oil cooler

☐ Double oil cooler incl. 10% performance reserve with switching valves

☒ Single cooler incl. 20 % performance reserve

Manufacturer: Gesellschaft für Öltechnik mbH

Construction type / Configuration:
- ☒ Tube bundle heat exchanger with pull-out nest
- ☐ Plain tubes
- ☐ Finned tubes

Design Regulations:
- ☒ Pressure Equipment Directive DGRL 97/23/EC
- ☒ AD 2000
- ☐ ASME, Div.1, Section 8
- ☐ TEMA R ☐ TEMA C

		shell side	tube side		
Operating specifications					
Medium		oil	water		
Heat quantity	kW	60			
Working pressure	bara	4			
CW quantity	m^3/h	6,4	5,1		
Intlet temperature	°C	68	20		
Output temperature	°C	48	30		
Fouling factor	m^2K/W		0,00017		

		shell side	tube side		
Thermodynamic values					
Flow velocity	m/s	0,62	0,92		
Pressure loss	mbar	259	110		
Heat transfer	W/m^2K	804	4672		
Heat transmission	W/m^2K				
Condensate quantity	kg/h	-	-		
Installed heat transfer area	m^2	3,6			
Design pressure	barg	10	10		
Test pressure	barg	15	15		
Configuration data					
Design temp.	°C	90	90		
Cooler tube dim.	mm	7			
Flow count					
Finned tube length	mm	1400			
Separator type		-			
Degree of separation	%	-			

Expansion compensation					

Materials

	Material	Surface treatment
Shell	CS	External: Manufact. standard Internal:
Chambers	CS	2 component epoxy resin, cold setting
Tube plates	Cu Zn 38	
Cooling tubes	Cu Ni 10 Fe	
Fins	Al	
Deflectors / Baffles	CS	
Guide rails	SS	
Internal screws	SS	

Accessories:

☐ Switching fittings before and after cooler

☒ AMOT regulator valve

☒ Air bleeding and emptying on water side

☒ Air bleeding and emptying on oil side.

☐ Pressure compensation line between the double oil coolers

3.1.5.5 Oil filter

☒ Double filter with switching fittings
☐ Single filter

Manufacturer: Internormen

Type: DU. 251. 10 VG

Design Regulations:
☒ Pressure Equipment Directive DGRL 97/23/EC
☒ AD 2000
☐ ASME, Div.1, Section 8
☐ API 614

Operating specifications			
Flow rate	ltr./min	106	
Operating temperature	°C	48	
Filter mesh	µm	10	
Filter area	cm^2		
Pressure loss, pure	mbar	300	
Design data			
Design pressure	barg	32	
Test pressure	barg	42	
Design temperature	°C	80	
Materials			
Filter housing		GGG 40	
Filter element		Interpor Vlies	
Switch			
Internal switch components			

Accessories

☒ Switching valves
☒ Air bleed and emptying on oil side with return line to oil tank
☒ Pressure compensation pipe between the filters
☒ Contamination indicator (local) with contact sensor

Valves

installed in	*Pressure hold valve*	*Throttle valve*	*Throttle orifice*	*Flow monitor with contact*	*Inspection glass*
Inlet line	☐	☐	☐	☐	☐
- Compressor bearing	☐	☐	☐	☐	☐
- Gearbox bearing	☐	☐	☐	☐	☐
- Gearbox housing	☐	☐	☐	☐	☐
- Drive aggregate bearing	☐	See attached PID, attachment 1			☐
Outlet line	☐				☐
- Compressor bearing	☐				☐
- Gearbox bearing	☐				☐
- Gearbox housing	☐	☐	☐	☐	☐
- Drive aggregate bearing	☐	☐	☐	☐	☐

Operation Safety, Compressor Rundown

In the case of failure of the compressor and the auxiliary oil pump, the oil supply is provided by the mechanically driven main oil pump.
An appropriate switching / arrangement of non-return valves between suction and pressure pipe also guarantees the oil supply when the compressor runs in reverse.

3.1.5.6 Oil pipes

Design Regulations: ☒ DIN / European Pressure Equipment Directives
☐ ANSI / ASME

Material: ☒ complete CS
☐ complete SS
☐ before oil filter CS / after oil filter SS

☒ Oil lines of C-steel are to be pickled before installation, then neutralized and flushed out with oil!

☒ For function testing of the auxiliary oil pump during operation, a simulation line or additional branch line is to be provided

3.1.5.7 Oil mist separator

Manufacturer	----	Atlas Copco	
Type	----	FF2-66	
Volume flow	Nm^3/h	66	
Permitted operating temperature	°C		
Negative pressure required in oil tank	mbar		
Intake loading	mg/m^3		
Outlet loading	mg/m^3		
Material of separator elements	----		
Number of separator elements	piece	7	
Replacement of separator elements possible in running operation	----	☐ yes ☐ no	

Oil suction fan

Manufacturer	----	Atlas Copco	
Type	----		
Speed	min^{-1}	2.980	
Nominal volume flow	Nm^3/h	66	
Total pressure increase	mbar		
Nominal output	kW	0,7	
Voltage / Frequency	V / Hz	400 / 50	

3.1.6 DRIVE AGGREGATE

☐ scope of delivery of contractor

☒ dilivery by customer *Option: delivery by vendor*

Construction type	----	☐ synchronous ☒ asynchronous	
Manufacturer	----		
Type	----		
Design	----		
Startup	----	☒ direct ☐ star/delta ☐ gentle ☐ FC	
Nominal rating	kW	1600	
Voltage	V	6000	
Frequency	Hz	50	
Speed	min^{-1}		
Efficiency	%		
Nominal torque	Nm		
Starting torque	Nm		
Tilting moment	Nm		
Short circuit moment	Nm		
Moment of inertia	Nm		
Insulation class	---		
Lubricant : Consumption	ltr./min		
Feed pressure	bar		
Pressure loss	mbar		
Temperature rise	°C		
Heat to be removed	kW		
Cooling water: Consumption	m^3/h		
Feed pressure	bar		
Pressure loss	mbar		
Temperature rise	°C		
Heat to be removed	kW		

3.1.7 COUPLING

☒ Location between gearbox and compressor

Design specification: ☒ API 671

☐ Manufacturer's standard

Coupling			
Manufacturer	----	Tschan	
Type	----		
Construction type	----	☐ dry running multi-disk coupling ☐ membrane coupling ☒ curved tooth coupling	
Design data			
Continuous output	kW	1700	
Max. transmittable power	kW		
Operating torque	Nm	5447	
Continuous torque	Nm	5447	
shock moment for 10^5 load reversal	Nm	> 3.5 x nominal moment	
Thrust factor	---		
Materials			
Coupling flange	----	CS	
Coupling sleeve	----	30 CRNIMo8	
Coupling bolt	----		
Elastic elements	----		
Lubrication by	----	☐ not required ☐ oil ☒ grease packing	
Coupling protection	----	☒ required	

The motor side half of the coupling must be provided in good time to the Motor Supplier by the Contractor.