Kelvion

Technisches Datenblatt SPECIFICATION SHEET	PSA Abscheider PA SWITCH CONDENSER	Order-No.: 1237382 Seite / PAGE: 1/7 Datum / DATE: 23.11.18

Deckblatt / COVER SHEET

Kenndaten:	BASIC DATA:	
Typ:	TYPE:	Jupiter 2 U6800/2548-4B2
KELVION Projekt-Nr.:	KELVION PROJECT-NO.:	271/07891
KELVION Auftrags-Nr.:	KELVION ORDER-NO.:	1237382
Kennwort:	CODE:	Koppers
Kunde:	CUSTOMER:	Koppers Inc.
Bestell-Nr:	ORDER-NO.:	
Endkunde:	FINAL CUSTOMER:	Koppers Inc.
Zeichnungs-Nr: (Übersicht)	DRAWING-NO.: (GENERAL)	UEB10000137577

TABLE OF CONTENTS

ONLY OIL SIDE:

U-STAMP

Revision REVISION	Datum DATE	erstellt durch PREPARED BY	Unterschrift SIGNATURE	Datum DATE	geprüft durch CHECKED BY	Unterschrift SIGNATURE
3	08.04.19	W. Friedl	Friedl	08.04.19	A. Mohr	Mohr
2	01.04.19	W. Friedl	Friedl	01.04.19	A. Mohr	Mohr
1	03.12.18	W. Friedl	Friedl	03.12.18	A. Mohr	Mohr
0	23.11.18	W. Friedl	Friedl	23.11.18	A. Mohr	Mohr

Kelvion

Technisches Datenblatt SPECIFICATION SHEET	PSA Abscheider PA SWITCH CONDENSER	Order-No.: 1237382 Seite / PAGE: 2/7 Datum / DATE: 23.11.18

PROCESS DATA I

1. SPECIFIC DATA OF PA-PLANT PER TRAIN

NUMBER OF REACTOR-TUBES (2 identical reactors, 9.948 tubes each)		19.896
DESIGN AIR QUANTITY	Nm^3/h	79.584
DESIGN O-XYLENE LOADING OF THE AIR	g oX/Nm^3	80
TOTAL GAS FLOW TO SWITCH CONDENSERS	kg/h	108.862
PA FLOW TO SWITCH CONDENSERS (ASSUMED YIELD 1,15)	kg/h	7.257
TOTAL NUMBER OF PA SWITCH CONDENSER PER TRAIN	-	6
APPROXIMATED HEAT DUTIES:		
- COOLING: NORMAL, FOR GAS COOLING AND SUBLIMATION	kW	4.400
ENERGY PEAK AT THE BEGINNING OF RECOOLING [1]	kW	7.250
- HEATING: PERMANENT HEATING OF HOODS	kW	800
ENERGY PEAK AT BEGINNING OF MELTING [1]	kW	3.600
HEAT TRANSFER MEDIUM		THERMINOL 59
PROPERTY VALUES OF THERMINOL 59 AT 60°C:		
- KINEMATIC VISCOSITY	cSt	2,65
- DENSITY	kg/m^3	945
- SPECIFIC HEAT CAPACITY	kJ/(kg K)	1,81

TOTAL OIL FLOWS		COLD OIL	HOT OIL
4 S/C IN LOADING, 1 IN MELTING, 1 IN RECOOLING [2]	m^3/h	approx. 625	approx. 170
5 S/C IN LOADING, 1 IN MELTING, 0 IN RECOOLING [2]	m^3/h	approx. 625	approx. 170

2. SPECIFIC DATA OF ONE SWITCH CONDENSER TYPE Jupiter 2 U-6800/2548-4B-2

2.1 ENERGY EFFICIENCY

APRROXIMATED ENERGY TO HEAT/RECOOL CYCLE WEIGHT	kWh	375
SPECIFIC MASS FACTOR (CYCLE WEIGHT PER PA LOAD PER CYCLE) [3]	kg/kg	5,25

2.2 GAS SIDE

MECHANICAL EFFICIENCY [5]	%		min 99,5
DESIGN AIR FLOW [4] (AT DESIGN OX-LOADING OF **80 g/Nm³**)	Nm^3/h		21.600
DESIGN PA LOAD PER CYCLE [4] (AT DESIGN LOADING of **80 g/Nm³**)	kg		5.600
INSTALLED SURFACE	m^2		4.442
AVERAGE SPECIFIC LOADING [3]	kg/m^2		1,26
GAS SIDE MAXIMUM PRESSURE DROP	mbar		approx. 30
GAS TEMPERATURES		INLET	OUTLET
CASE 1 (DESIGN CONDITION AND OIL INLET TEMPERATURE 60°C)	°C	170	70
CASE 2 (ACTUAL OPERATING CONDITION AND OIL INLET 56°C)	°C	190	75

2.3 OIL BYPASS CONTROL

OPTIMUM OUTLET TEMPERATUR OF FIN TUBES OF TOP BUNDLE	°C	80-105
MAXIMUM BYPASS FLOW	m^3/h	40
PRESSURE DROP OF TOP HD-SECTION (BYPASS OIL FLOW 40 m^3/h)	mbar	approx. 400
PRESSURE DROP: LOADING WITH BYPASS VALVE OPEN [5]	mbar	approx. 700

REMARKS:

[1] ASSUMED TEMPERATURE FOR SWITCHING BETWEEN HOT AND COLD OIL CIRCUIT: 120°C

[2] DESIGN CASE COLD OIL: 5 S/C IN LOADING AND BYPASS VALVE CLOSED

[3] VALUE VALID FOR DESIGN OX-LOADING OF AIR OF 80 g/Nm³

[4] VALUES FOR LOADING AT 100 g/Nm³ ARE 21.000 Nm³ OF AIR AND 6.000 kg PA PER CYCLE

[5] EFFICIENCY DOES NOT CONSIDER PA-LOSSES DUE TO PA-VAPOUR PRESSURE IN OFF-GAS.

Revision REVISION	Datum DATE	erstellt durch PREPARED BY	Unterschrift SIGNATURE	Datum DATE	geprüft durch CHECKED BY	Unterschrift SIGNATURE
3						
2	01.04.19	W. Friedl	Friedl	01.04.19	A. Mohr	Mohr
1	03.12.18	W. Friedl	Friedl	03.12.18	A. Mohr	Mohr
0	23.11.18	W. Friedl	Friedl	23.11.18	A. Mohr	Mohr

Kelvion

Technisches Datenblatt SPECIFICATION SHEET	PSA Abscheider PA SWITCH CONDENSER	Order-No.: 1237382 Seite / PAGE: 3/7 Datum / DATE: 23.11.18

PROCESS DATA II

2. SPECIFIC DATA OF ONE SWITCH CONDENSER TYPE Jupiter 2 U-6800/2548-4B-2

2.4 OIL SYSTEM

MAXIMUM PRESSURE DROP (DESIGN CONDITIONS [1]):	COLD OIL	bar		1,2
	HOT OIL	bar		1,1
OIL FLOW:	COLD OIL, LOADING (DESIGN CASE)	m^3/h		125
	COLD OIL, RECOOLING [4]	m^3/h		100 - 125
	HOT OIL, MELTING	m^3/h		125
	HOT OIL, PERMANENT HEATING	m^3/h		7
			INLET	OUTLET
HOT OIL TEMPERATURE [2,3,6]		°C	185	120 - 180
COLD OIL TEMPERATURE [2,6]:	CASE 1 (DESIGN CONDITION)	°C	60	70 - 120
	CASE 2 (ACTUAL OPERATION CONDITION)	°C	56	65 - 120

2.5 CYCLE DATA

DEFINITION OF MELTING TIME:	hot oil supply valve is open (steps 1 - 5 in Kopper's timing chart)
DEFINITION OF PRE-COOL TIME:	cold oil supply valve is open and hot gas valve is closed (steps 6 and 7 in Kopper's timing chart)
DEFINITION OF LOADING TIME:	hot gas valve is open (steps 8 - 10 in Kopper's timing chart)

RECOMMENDED CYCLE TIMES		MELTING	PRE-COOL	LOADING	TOTAL
CASE A: OERATION OF 6 SWCS:					
ACTUAL DATA KOPPERS	min	44	20	200	264
RECOMMENDATION KELVION	min				
CASE B: OPERATION OF 5 SWCS:					
ACTUAL DATA KOPPERS	min	44	20	156	220
RECOMMENDATION KELVION	min				
CASE C: OPERATION OF 4 SWCS:					
ACTUAL DATA KOPPERS	min	44	20	112	176
RECOMMENDATION KELVION	min				

2.6 OPERATING DATA

Design air flow: 21.600 Nm³/h
Design PA load: 5.600 kg

	Air flow in SCW train [Nm³]	PA flow in SWC train [kg/h]	SWCs in loading [-]	PA-load per cycle [kg]	Average air flow per SWC [nm³/h] min.	max.
CASE A: OERATION OF 6 SWCS:						
ACTUAL DATA KOPPERS	79.548	7.257	4,4545	5.322	15.910	19.887
RECOMMENDATION KELVION						
CASE B: OPERATION OF 5 SWCS:						
ACTUAL DATA KOPPERS	79.548	7.257	3,4545	5.322	19.887	26.516
RECOMMENDATION KELVION						
CASE C: OPERATION OF 4 SWCS:						
ACTUAL DATA KOPPERS	65.657	5.987	2,4545	4.392	26.516	39.774
RECOMMENDATION KELVION						

REMARKS:

[1] INCLUDING A SAFETY FACTOR FOR OPERATING WITH AGED OIL AND / OR FOULING
[2] ASSUMED TEMPERATURE FOR SWITCHING OVER BETWEEN HOT AND COLD OIL CIRCUIT: 120°C
[3] HOT OIL TEMPERATURE SHOULD BE INCREASED UP TO 200°C ONCE PER WEEK FOR TWO CYCLES
[4] RECOOLING OIL FLOW IS DEPENDING ON OPENING OF BYPASS VALVE DURING LOADING
[5] PRESSURE DROP IS DEPENDING ON OPENING OF THE BYPASS VALVE
[6] TEMPERATURE AT S/C INLET SHOULD NOT BE INCREASED/DECREASED FASTER THAN 50°C/MINUTE.

Revision REVISION	Datum DATE	erstellt durch PREPARED BY	Unterschrift SIGNATURE	Datum DATE	geprüft durch CHECKED BY	Unterschrift SIGNATURE
3						
2						
1	01.04.19	W. Friedl	Friedl	01.04.19	A. Mohr	Mohr
0	23.11.18	W. Friedl		23.11.18	A. Mohr	

Kelvion

Technisches Datenblatt SPECIFICATION SHEET	PSA Abscheider PA SWITCH CONDENSER	Order-No.: 1237382 Seite / PAGE: 4/7 Datum / DATE: 23.11.18

Mechanische Auslegungsdaten / MECHANICAL DESIGN DATA

1. Betriebsdaten / 1. OPERATING DATA

			Ölseite / OILSIDE		Gasseite	Dampfseite
			TUBE BUNDLE	COMPLETE OIL SYSTEM	GASSIDE	STEAMSIDE
zulässiger Druck (PS):	ALLOWABLE PRESSURE (PS):					
minimal	MINIMUM	bar(g)				
		psi(g)				
1 maximal	MAXIMUM	bar(g)	6,0		0,7	12,5
MAXIMUM ALLOWABLE WORKING TEMPERATURE (MAWP)		psi(g)	87		10	181,3
Probedruck bei 20°C	TEST PRESSURE AT 20°C	bar(g)	7,8	6,6	0,77	26,2
		psi(g)	113	95,7	11	380
Prüfmedium	TEST MEDIUM		WATER	AIR	AIR	WATER
zulässige Temperatur (TS):	ALLOWABLE TEMPERATURE (TS):					
3 minimal	MINIMUM	°C	-29		-29	-29
2 MINIMUM DESIGN METAL TEMPERATURE (MDMT)		°F	-20		-20	-20
maximal	MAXIMUM	°C	220		220	205
		°F	428		428	401
ca. Inhalte (gesamt)	APPR. CONTENTS (TOTAL)	L	3.100		58.000	3x5
- Rohrbündel	TUBE BUNDLE	L	1.700		-	-
- Ölumführungen	OIL CONNECTION	L	600		-	-
- Gehäuse	CASING	L	800		58.000	3x5
- Waschen[1)]	WASHING[1)]	L	-		45.000	-
Auslegung nach	DESIGN ACCORDING TO	-	ASME CODE Section VIII DIV. I,Ed.17		AD-Merkblätter STATIC RULES	ASME CODE Section VIII DIV. I,Ed.17
Abnahme	INSPECTION	-	TÜV-Nord			
Zeichnungsprüfung	DRAWING EXAMINATION	-	TÜV-Nord, CUSTOMER			
Korrosionszuschlag (nur Gehäuse, ohne Kernrohr / Rippe)	CORROSION ALLOWANCE (CASING ONLY, WITHOUT CORE TUBE / FIN)	mm	1		1	1
Gesamtgewicht	TOTAL WEIGHT	kg	approx. 35.000			
Zyklusgewicht[2)]	CYCLE WEIGHT[2)]	kg	approx. 29.400			

Bemerkungen / REMARKS:

1) Volumen bis Oberkante Rohrpaket SIZE UP TO UPPER EDGE OF PIPE PACKAGE

2) Gewicht außer Haube, Stahlkonstruktion WEIGHT WITHOUT HOOD, SUPPORT FRAME

Revision REVISION	Datum DATE	erstellt durch PREPARED BY	Unterschrift SIGNATURE	DATUM DATE	geprüft durch CHECKED BY	Unterschrift SIGNATURE
3	09.04.19	W. Friedl		09.04.19	A. Mohr	
2	01.04.19	W. Friedl	Friedl	01.04.19	A. Mohr	Mohr
1	03.12.18	W. Friedl	Friedl	03.12.18	A. Mohr	Mohr
0	23.11.18	W. Friedl	Friedl	23.11.18	A. Mohr	Mohr

Kelvion

Technisches Datenblatt SPECIFICATION SHEET	PSA Abscheider PA SWITCH CONDENSER	Order-No.: 1237382 Seite / PAGE: 5/7 Datum / DATE: 23.11.18

Mechanische Auslegungsdaten / MECHANICAL DESIGN DATA

2. Werkstoffe / 2. MATERIALS

		THICKNESS	DIN	EN	ASME
Gehäuse	CASING	8 - 10 mm	WSTE 355 / H II	P 355 NH / P265 GH	SA-516 Gr. 70 / SA 515 Gr. 60
Ölkammern	OIL HEADERS	6 - 12 mm	WSTE 355	P 355 NH	SA-516 Gr 70
Kernrohre	CORE TUBES	2,05 mm	St 35.8 I	-	SA 179
Heizrohre	HEATING COILS	4,0 - 8,0 mm	St 35.8 I	P235 GH	SA 106 Gr.B
Flansche	FLANGES		C22.8 / C21	P250 GH	SA 105
Stützrahmen	SUPPORT FRAME		St 37	S 235 JR	SA 283 Gr. B
Dichtungen	GASKETS	Edelstahl mit Graphitauflagen / STAINLESS STEEL WITH GRAPHITE LAYERS			
			Abnahmezeugnis nach DIN 50049	Abnahmezeugnis nach EN 10204	MATERIAL TEST CERTIFICATION

3. Toleranzen / 3. TOLERANCES

lower limit [mm]	2	30	120	400	1000	2000	4000	8000	12000	16000	20000
upper limit [mm]	30	120	400	1000	2000	4000	8000	12000	16000	20000	-
degree of accuracy [mm]	± 1	± 4	± 7	± 9	± 12	± 16	± 21	± 27	± 32	± 36	± 40

Bemerkungen / REMARKS: ACCORDING TO EN ISO 13920 TABLE 1 "CLASS D"

Stutzengröße / NOZZLE SIZE	up to DN 250 (10")	from DN 300 (12") to DN 800 (32")	from DN 900 (36")
accuracy of angle deflection	± 1° 30'	± 1° 15'	± 1°

Bemerkungen / REMARKS: ACCORDING TO EN ISO 13920 TABLE 2 "CLASS D"

4. Kräfte & Kraftkombinationen / 4. LOADS & LOAD COMBINATIONS

	DEAD WEIGHT	FILLING	INSULATION SNOW LOAD	TRANSP. ACCES. [HORZ.]	EARTH QUAKE [HORZ.][1)]	WIND [m/s]	TEMP. CHANGE [°C/min]		GASSIDE PRESS. [bar g]
TESTING		-	-	-	-	-	-		0,77
TRANSPORT		-	-	0,2 g	-	-	-		-
1 OPERATION		OIL, PA	X	-	0,23 g	51,4	50		0,15
WASHING		OIL, CAUSTIC	X	-	-	-	-		-
DEFLAGRATION			X	-	-	-	-		0,5

Bemerkungen / REMARKS:

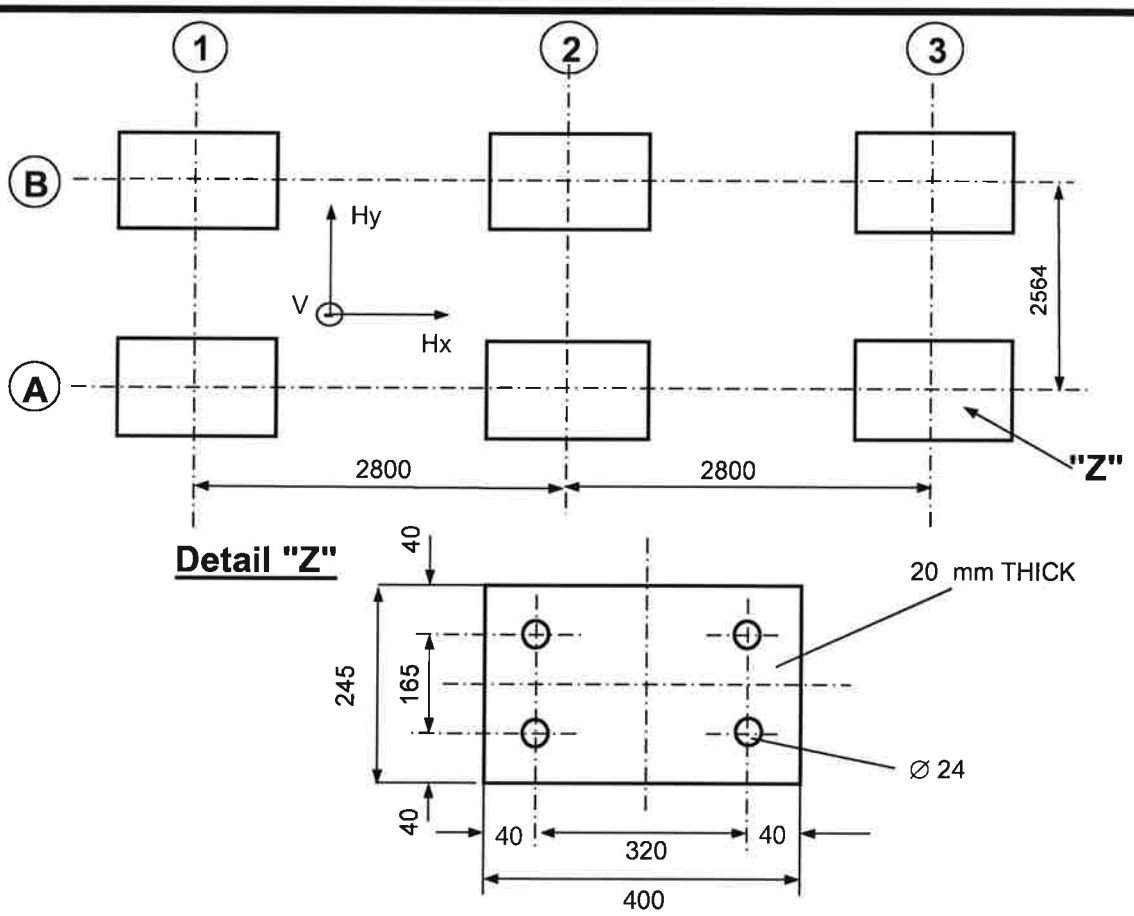
1) NOT FOR FATIGUE CALCULATION

Revision REVISION	Datum DATE	erstellt durch PREPARED BY	Unterschrift SIGNATURE	Datum DATE	geprüft durch CHECKED BY	Unterschrift SIGNATURE
3						
2						
1	01.04.19	W. Friedl	Friedl	01.04.19	A. Mohr	Mohr
0	23.11.18	W. Friedl		23.11.18	A. Mohr	

Kelvion

Technisches Datenblatt SPECIFICATION SHEET	PSA-Abscheider PA SWITCH CONDENSER	Project-No.: 1237382 Seite / PAGE: 6/7 Datum / DATE: 23.11.18

Belastungsplan / LOADING PLAN



Aktionslasten in kN LOADS OF ACTION IN KN			A1			A2			A3			B1			B2			B3		
			V	Hx	Hy	V	Hx	Hy	V	Hx	Hy	V	Hx	Hy	V	Hx	Hy	V	Hx	Hy
1	Leergewicht DEAD WEIGHT		-52	-	-	-72	-	-	-52	-	-	-52	-	-	-72	-	-	-52	-	-
2	Füllung mit ÖL FILLING WITH OIL		-4,5	-	-	-6	-	-	-4,5	-	-	-4,5	-	-	-6	-	-	-4,5	-	-
3	Füllung mit PSA FILLING WITH PSA		-9	-	-	-12	-	-	-9	-	-	-9	-	-	-12	-	-	-9	-	-
4	Füllung mit Flüssig-PSA FILLING WITH LIQUID-PA		-80	-	-	-111	-	-	-80	-	-	-80	-	-	-111	-	-	-80	-	-
5	Wind WIND	Hx	±5	±3	-	-	±3	-	±5	±3	-	±5	±3	-	-	±3	-	±5	±3	-
	± 1,5 x 0,8 kN/m²	Hy	±12	-	±6,5	±17	-	±9	±12	-	±6,5	±12	-	±6,5	±17	-	±9	±12	-	±6,5
1 6	Erdbeben (±) c=0,23g	Hx	±20	±15			±21		±20	±15		±20	±15			±21		±20	±15	
1	EARTHQUAKE	Hy	±26		±15	±36		±21	±26		±15	±26		±15	±36		±21	±26		±15
7	Nutzlast LIVE LOAD		-21	-	+3,1	-23	-	+3,5	-21	-	+3,1	-21	-	-3,1	-23	-	-3,5	-21	-	-3,1

Betriebszustand OPERATING CONDITION	1, 2, 3, 5, 7	Reinigungszustand CLEANING CONDITION	1, 2, 4, 5	Erdbeben EARTHQUAKE	1, 2, 3, 6

Revision REVISION	Datum DATE	erstellt durch PREPARED BY	Unterschrift SIGNATURE	Datum DATE	geprüft durch CHECKED BY	Unterschrift SIGNATURE
3						
2						
1	01.04.2019	A.Mohr	Mohr	01.04.19	W.Friedl	Friedl
0	23.11.18	A.Mohr		23.11.18	W.Friedl	

Kelvion

Technisches Datenblatt SPECIFICATION SHEET	PSA Abscheider PA SWITCH CONDENSER	Order-No.: 1237382 Seite / PAGE: 7/7 Datum / DATE: 23.11.18

SCOPE OF SUPPLY

1.) Subject of Supply

- casings completely assembled, welded and pressure tested
- internal pipings mounted, welded and pressure tested
- positions of nozzles will be identical with former delivery (assumption fabrication tolerances)
- switch condenser with yellow marked transport devices and lifting beams;
  all yellow marked parts have to be removed before operation

2.) Transport Protection

- painting of casing outside (twice), suitable for sea transport and operation conditions
- casing inside (gasside) protected by corrosion protection fluid
- all connections are closed with steel covers:
  - drains with gaskets and blind flanges (ready for operation)
  - all other nozzles with rubber gaskets (to be removed before operation) and transport covers
- oil- and steamside pipes filled with N_2 including manometers and refill valves

3.) Accessories

- two gaskets for manhole per switch condenser

4.) Others

- material and personal costs for TÜV approval, inspection and certificate
- seaworthy packing of accessories, switch condenser prepared for ocean shipment
- marking

5.) Documentation

- dispatch documentation
- spare part list
- general drawing
- insulation specification
- pressure vessel certification
- manufacturer´s certificate
- transport specification with transport sketch

3						
2						
1						
0	23.11.18	W. Friedl		23.11.18	A. Mohr	
Revision REVISION	Datum DATE	erstellt durch PREPARED BY	Unterschrift SIGNATURE	Datum DATE	geprüft durch CHECKED BY	Unterschrift SIGNATURE