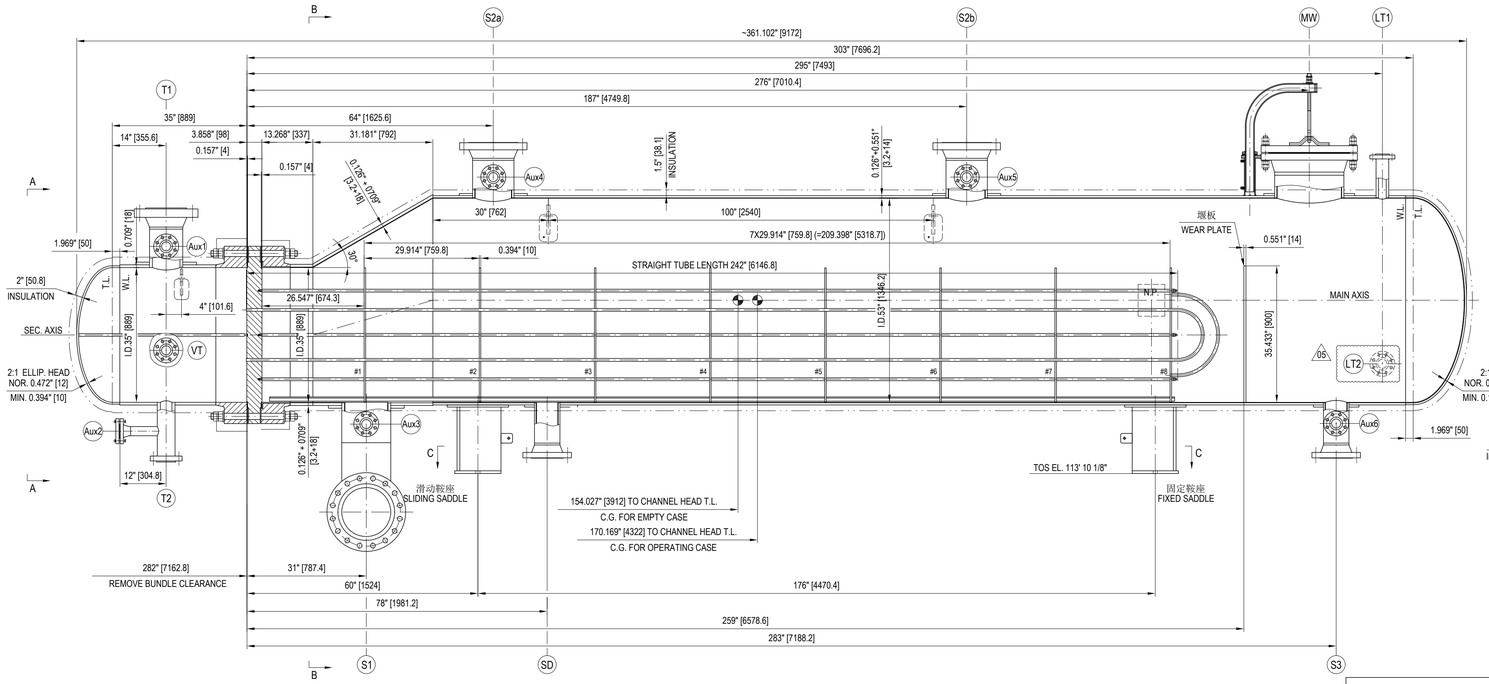
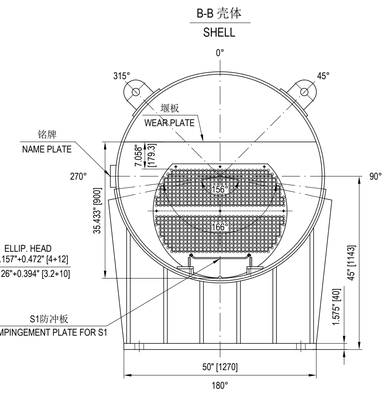
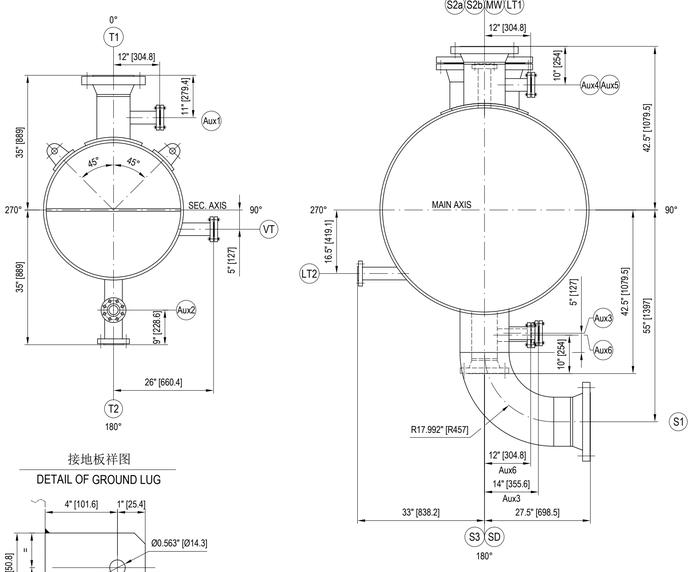
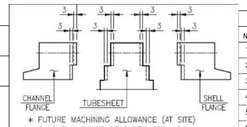








扭矩表 TORQUE TABLE		
部 件 PART	螺 栓 规 格 BOLT SIZE	扭 矩 (lbf-ft) TORQUE
CHANNEL FLANGE AND SHELL FLANGE TO TUBESHEET	1 1/2"	1967
NOZZLE MW	1 1/8"	567
NOZZLE VT,Aux(1-6)	5/8"	90

管口详图 NOZZLE DETAIL DRAWING	WXCE6703-03	1/1			
管束详图 BUNDLE DETAIL DRAWING	WXCE6703-02	1/1	运输及吊装图 SHIPPING AND LIFTING DETAIL DRAWING	WXCE6703-07	1/1
壳体图 SHELL DETAIL DRAWING	WXCE6703-01	1/1	铭牌图 NAMEPLATE DETAIL DRAWING	WXCE6703-06	1/1
装配图 II GENERAL ASSEMBLY DRAWING II	WXCE6703-00	2/2	鞍座及吊耳详图 SADDLE AND LIFTING LUG DETAIL DRAWING	WXCE6703-05	1/1
装配图 I GENERAL ASSEMBLY DRAWING I	WXCE6703-00	1/2	人孔图 MANWAY DRAWING	WXCE6703-04	1/1
名 称 TITLE	图 号 DWG. NO.	张 数 SHEET NO.	名 称 TITLE	图 号 DWG. NO.	张 数 SHEET NO.

图纸汇总表 DRAWING SUMMARY

PROJECT SPECIFICATION

NO.	DOC. NO.	DESCRIPTIONS	Rev
1	ABKM-PP-000-200001-A	Plant Site Data Sheet	0B
2	ABKM-PP-000-400002-A	Structural Data for Mechanical Equipment General	0
3	ABKM-PP-000-500005-A	Design of Lifting Component for Mechanical Equipment	0
4	ABKM-PP-000-500510-A	Hot Insulation	0C
5	ABKM-PP-000-500520-A	Painting	0D
6	ABKM-PP-000-500512-A	Positive Material Identification - PMI	0
7	ABKM-PP-000-500530-A	Materials and Fabrication Requirements for Duplex Stainless Steel	0
8	ABKM-PP-000-500550-A	Welding-NDE Requirements for Equipment	0B
9	ABKM-PP-000-50720-A	Shell and Tube Heat Exchangers	0
10	ABKM-PP-000-500532-A	Materials and Fabrication Requirements for Carbon Steel Equipment and Piping in Wet H2S Environments	0B
11	SPEC-MED-DOC001	Design Basis for Mechanical Equipment	0
12	4WPI-670210	Bolt-Up Procedure for Flanged Connections	5
13	Form 8232	Flanged Joint Assembly Record and Tightening Sequence	
14	SPEC-ENG-DOC001	Supplier-Designed, Shop-Fabricated Pressure Equipment	0
15	SPEC-ENG-DOC002	Shell & Tube Heat Exchanger	0
16	SPEC-ENG-MQ057	Mechanical Equipment Gaskets	1
17	4WGN-10001	Shipment and Packing Specification for Equipment and Materials being Exported Directly by Vendors	6
18	4WEQ-1051	Welding of HyCO Plant Equipment	0
19	SPEC-ENG-MQ042	Material Certification and Retesting Requirements	0

MATERIAL

CHANNEL		SKID BARS/RAILS	SA-240 316L
CHANNEL HEAD	SA-516 Gr.70N	IMPINGEMENT PLATE	SA-240 316L
CHANNEL FLANGE	SA-266 Gr.2N	SPACERS	SA-213 TP316L
CHANNEL SHELL	SA-516 Gr.70N	EXTERNAL ATTACHMENTS	SA-516 Gr.70N
NOZZLE NECK	SA-266 Gr.2N	EXTERNAL BOLTING/ NUT (CHANNEL)	SA-193 Gr.B7 / SA-194 Gr.2H
NOZZLE FLANGE	SA-105N	EXTERNAL BOLTING/ NUT (SHELL)	SA-193 Gr.B7M / SA-194 Gr.2HM
PASS PARTITION	SA-516 Gr.70N	INTERNAL BOLTING/ NUT	NA
SHELL		SUPPORT SADDLES	SA-516 Gr.70N
SHELL AND SHELL HEAD	SA-516 Gr.70N + SS316L CLADDING	SLIDING PLATE	NA
SHELL FLANGE	SA-266 Gr.2N + SS316L OVERLAY	ANCHOR BOLTS	ASTM F3125, Grade A325,Type 1 (by others
NOZZLE NECK	SA-516 Gr.70N + SS316L OVERLAY SA-266 Gr.2N + SS316L OVERLAY	SHELLSIDE GASKET	SS316L with graphite soft facing
NOZZLE FLANGE	SA-105N + SS316L OVERLAY	TUBESIDE GASKET	SS316L with graphite soft facing
TUBE BUNDLE		GROUND LUG	SS304
TUBES	SA-789 S32205(SEALMESS)	NAMEPLATE	SS304
TUBESHEETS	SA-182 F60	NAMEPLATE BRACKET	SA-516 Gr.70N
BAFFLES	SA-240 316L	COLLAR BOLTS (INTEGRAL):	SA-193 Gr.B7M
TIE / SEAL RODS:	SS316L	JACK SCREW / DOWEL PIN	SS304
NOZZLE FLANGE GASKET	SS316L spiral wound with graphite filler , and inner and outer rings		

	SADDLE		TOTAL
	SLIDING	FIXED	
EMPTY WEIGHT (lb)	18490	9330	27820
OPERATING WEIGHT (lb)	29281	21829	51110
TEST WEIGHT(FIELD) (lb)	29821	21959	51780
TEST WEIGHT(SHOP) (lb)	29654	21836	51490

MAXIMUM FOUNDATION LOADING DATA (AS PER ASD)

		SLIDING SADDLE		FIXED SADDLE	
		EMPTY	OPERATING	EMPTY	OPERATING
WIND LOAD	TRANSVERSE SHEAR (lbf)	570.5	570.5	570.5	570.5
	TRANSVERSE BENDING (lbf.ft)	2139.4	2139.4	2139.4	2139.4
	LONGITUDINAL SHEAR (lbf)	554.1	554.1	554.1	554.1
	LONGITUDINAL BENDING (lbf.ft)	2077.9	2077.9	2077.9	2077.9
EARTHQUAKE	TRANSVERSE SHEAR (lbf)	9967	15834	5029	11805
	TRANSVERSE BENDING (lbf.ft)	37376	59378	18859	44269
	LONGITUDINAL SHEAR (lbf)	14996	27639	14996	27639
	LONGITUDINAL BENDING (lbf.ft)	56235	103646	56235	103646
Bundle pull out: @150% bundle weight (lbf)		14040			

管口表 NOZZLE SCHEDULE

符号 MARK	数量 QTY.	公称尺寸 NPS	壁厚等级 SCH /THK	补强圈外径x厚度 REIN. PAD O.D.X THK.	公称压力 RATING	连接标准, 法兰型式/密封面 CONNECTING STD./ TYPE	法兰密封面到设备中心线长度 PROJECTION FROM VESSEL C.L. TO FLANGE FACE	用途或名称 SERVICE	备 注 REMARKS
S1	1	12"	0.709" [18]	Ø19.69"X0.709" [Ø500X18]	CL300	ASME B16.5-2017 WN/RF	见图/SEE DWG	SHELL SIDE INLET	
S2a	1	10"	0.594" [15.09]	Ø17.72"X0.55" [Ø450X14]	CL300	ASME B16.5-2017 WN/RF	42.5" [1079.5]	SHELL SIDE OUTLET (VAPOR)	
S2b	1	10"	0.594" [15.09]	Ø17.72"X0.55" [Ø450X14]	CL300	ASME B16.5-2017 WN/RF	42.5" [1079.5]	SHELL SIDE OUTLET (VAPOR)	
S3	1	6"	0.432" [10.97]	Ø11.81"X0.55" [Ø300X14]	CL300	ASME B16.5-2017 WN/RF	42.5" [1079.5]	SHELL SIDE OUTLET (LIQUID)	
SD	1	6"	0.432" [10.97]	Ø11.81"X0.55" [Ø300X14]	CL300	ASME B16.5-2017 WN/RF	42.5" [1079.5]	SHELL SIDE DRAIN	
LT1	1	2"	0.654" [16.6]	--	CL600	ASME B16.5-2017 LWN/RF	38" [965.2]	LEVEL	
LT2	1	2"	0.654" [16.6]	--	CL600	ASME B16.5-2017 LWN/RF	见图/SEE DWG	LEVEL	
T1	1	8"	0.594" [15.09]	Ø15.75"X0.71" [Ø400X18]	CL600	ASME B16.5-2017 WN/RF	35" [889]	TUBE SIDE INLET	
T2	1	3"	0.803" [20.4]	--	CL600	ASME B16.5-2017 LWN/RF	35" [889]	TUBE SIDE OUTLET	
Vt	1	2"	0.654" [16.6]	--	CL300	ASME B16.5-2017 LWN/RF	见图/SEE DWG	TUBE SIDE VENT	With BF & Gasket & Bolt & Nut
MW	1	18"	0.551" [14]	Ø23.62"X0.55" [Ø600X14]	CL150	ASME B16.5-2017 WN/RF	38" [965.2]	MANWAY	With BF & Hinges & Gasket & Bolt & Nut
Aux(1,3~6)	5	2"	0.654" [16.6]	--	CL300	ASME B16.5-2017 LWN/RF	见图/SEE DWG	AUXILIARY	With BF & Gasket & Bolt & Nut
Aux 2	1	2"	0.218" [5.54]	--	CL300	ASME B16.5-2017 WN/RF	见图/SEE DWG	AUXILIARY	With BF & Gasket & Bolt & Nut

无 损 检 验 NONDESTRUCTIVE EXAMINATION

焊接接头型式或焊缝编号 JOINT TYPE OR WELD SEAM NO		焊接接头系数 JOINT EFFICIENCY	射线探伤 R.T 检测比例 EXAM. RATE	射线探伤 R.T 合格级别 CLASS OF ACC.	超声波探伤 U.T	磁粉探伤 M.T	着色探伤 P.T	备 注 REMARKS
A,B类 CATEGORY A,B	壳程 SHELL SIDE	1.0	FULL	UW-51	Appendix 12	100%	Appendix 8	
	管程 TUBE SIDE	1.0	FULL	UW-51	/	100%	/	
C类/CAT. C 壳程 SHELL SIDE	设备法兰与壳体 GIRTH FLANGE TO SHELL	1.0	FULL	UW-51	/	100%	/	
	接管与法兰(≥10") NOZZLE TO FLANGE	1.0	FULL	UW-51	/	/	/	
	接管与法兰(<10") NOZZLE TO FLANGE	/	/	/	/	100%	/	
C类/CAT. C 管程 TUBE SIDE	设备法兰与壳体 GIRTH FLANGE TO SHELL	1.0	FULL	UW-51	/	100%	/	
	接管与法兰 NOZZLE TO FLANGE	/	/	/	/	100%	/	
D类 TYPE D		/	/	/	/	100%	/	
吊耳焊缝 LIFTING LUG WELDS		/	/	/	100%	100%	/	
鞍座焊缝 SADDLES. WELDS		/	/	/	/	100%	/	
换热管与管板的连接接头 TUBE TO TUBESHEET JOINT		/	/	/	/	/	100%	

注/NOTE:
1.应在焊后热处理前对吊耳进行超声波检查，焊后热处理后应进行磁粉检测。
Lifting lugs shall be ultrasonically checked before post-weld heat treatment and magnetic particle inspection after post-weld heat treatment.
2.无损检测要求见"其他要求和说明第6条"
For requirements of NDT, see clause 6 of "Other Requirements and Notes"

设 计.制 造 .检 验 与 验 收 数 据 表
DATA SHEET OF DESIGN,FABRICATION,INSPECTION & ACCEPTANCE

设 计,制 造,检 验 与 验 收 标 准
STANDARDS OF DESIGN,FABRICATION ,INSPECTION & ACCEPTANCE

1. ASME SECTION VIII DIV.1 2021 ED.
2. TEMA Tenth Edition CLASS R
3. API660-2020.

设计数据 DESIGN DATA

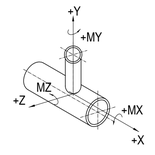
	壳 程 SHELL SIDE	管 程 TUBE SIDE
名称 DESIGNATION		
换热器型式 EXCHANGER TYPE(TEMA)	BKU	
传热面积 ft²[m²] HEAT TRANSFER SURFACE AREA	2521.7 [234.3]	
DESIGN DUTY MM Btu/hr	26.4	
设计压力(内压/外压) psig[barg] DESIGN PRESSURE (INT/EXT)	180 [12.41] / 15 [1.034]	232 [16.0] / 15 [1.034]
工作压力(NORMAL) psig[barg] OPERATING PRESSURE	20.89 [1.44]	78.3 [5.40]
最大允许工作压力 MAWP(INTERNAL) psig[barg]	222.1 [15.313] (Limited by nozzle flange)	306.5 [21.13] (Limited by head)
最大允许工作压力 MAWP(EXTERNAL) psig[barg]	15 [1.034]	15 [1.034]
最大允许压力 MAP psig[barg]	285 [19.65] (Limited by nozzle flange)	449.3 [30.978] (Limited by head)
设计温度 DESIGN TEMPERATURE °F[°C]	320 [160] / 300 [148.9] (SEE NOTE 1)	430 [221.1] / 300 [148.9] (SEE NOTE 1)
工作温度 OPERATING TEMPERATURE °F[°C]	264.2 [129] / 266.5 [130.3]	339.6 [170.9] / 321.6 [160.9]
最低设计金属温度 MDMT °F[°C]	32[0] @222.1 PSIG	32[0] @306.5 PSIG
工作介质 OPERATING FLUID	Lean Amine	Medium Pressure Steam
介质特性 VESSEL SERVICE	NA	NA
湿H2S工况 WET H2S SERVICE	YES	NA
氢工况 HYDROGEN SERVICE	NA	NA
介质致死工况 FLUID LETHAL SERVICE	非致死/Nonlethal	非致死/Nonlethal
介质密度 lb/ft³[kg/m³] DENSITY OF FLUID	60.63 [971.3] / 60.71 [972.6]	0.26 [4.2] / 56.71 [907.3]
腐蚀裕量 In.[mm] CORROSION ALLOWANCE	CORROSION ALLOWANCE: 0 1/8" [3.175] (min) Clad	1/8" [3.175] (SEE NOTE 2)
焊接接头系数(筒体/封头) JOINT EFFICIENCY (SHELL/HEAD)	1.0 / 1.0	1.0 / 1.0
容 积 ft³[m³] CAPACITY	377 [10.69]	50 [1.41]
冲击试验 IMPACT TEST	不需要 / NO (As per ASME Code UG-20(f) UCS-66(a) & (c) & (g))	不需要 / NO (As per ASME Code UG-20(f) UCS-66(a) & (c) & (g))
程数 NUMBER OF PASSES	1	2
换热管与管板的连接 TUBE-TO-TUBESHEET JOINT	强度焊 + 贴胀 Strength welded + light expanded	
换热管间距/排列方式/数量 PITCH/PATTERN/NO.	1" [25.4] / 90° / 312U	
换热管外径/壁厚/直段管长 TUBE O.D./WALL THK./LENGTH	0.75"/ 0.065 (AVG) / 242 (直段) [19.05] / [1.651] (AVG) / 6146.8 (Straight)	
焊后热处理 POST-WELD HEAT TREATMENT	不需要 / NO	不需要 / NO
成型后热处理 POST FORMING HEAT TREATMENT	需要 / YES (Elliptical head)	需要 / YES (Elliptical head & Tube)
保温类型/厚度 In.[mm] INSULATION TYPE/THK	IH / 1.5" [38.1]	IH / 2" [50.8]
防火类型/厚度 In.[mm] FIREPROOF MATERIAL/THK	NA	NA
油漆系统号 PAINT SYSTEM CODE	6	6

NB REGISTRATION	YES
ASME CERTIFICATE	YES (With U Designator)

	壳 程 SHELL SIDE	管 程 TUBE SIDE
工厂水压试验 psig[barg] SHOP HYDROSTATIC TEST	370.0 [25.51]	580.6 [40.03]
现场水压试验 psig[barg] FIELD HYDROSTATIC TEST	288.8 [19.91]	398.5 [27.48]
气密试验 psig[barg] PNEUMATIC TEST	/	/
制造重量 Lb[Kg] FABRICATED WEIGHT	27300 [12383]	
空重 Lb[Kg] EMPTY WEIGHT	27820 [12619]	
安装重量 Lb[Kg] ERECTED WEIGHT	27820 [12619]	
操作重量 Lb[Kg] OPERATING WEIGHT	51110 [23183]	
水压试验(现场) Lb[Kg] TEST WEIGHT(FIELD)	51780 [23487]	
水压试验(工厂) Lb[Kg] TEST WEIGHT(SHOP)	51490 [23356]	
管束重量 Lb[Kg] TUBE BUNDLE WEIGHT	9360 [4246]	
管箱重量 CHANNEL WEIGHT	1900 [862]	
管箱盖重量 CHANNEL COVER WEIGHT	-	
地震设计规范 SEISMIC DESIGN CODE	ASCE 7-2016, SI=0.579g, Ss=1.616g SDs=1.077g, SD1=0.996g, Site Class=D IMP. FACTOR=1.5, DESIGN CATEGORY=D	
风载设计规范 WIND DESIGN CODE	ASCE 7-2016	
基本风速 mph.[m/s] BASIC WIND VELOCITY	101 [45.2] EXPOSURE CATEGORY=C	
管口方位 NOZZLE ORIENTATION	按本图 AS PER THIS DWG	

Note : 1. 300°F is for F.V case
2. Tubesheet : 1/16" total, Tube : 0

管口载荷表 NOZZLES LOADS LIST



NOZZLE	NPS	FORCES (UNIT: Lbf) FY	FX	FZ	MOMENTS (UNIT: Lbf-ft) MX	MZ	MY
S1	12" (2X150#)	3060	3840	3840	11280	14320	18220
S2a,S2b	10" (2X150#)	2580	3240	3240	8020	10180	12960
S3	6" (2X150#)	1600	2000	2000	3060	3880	4920
SD	6" (1X150#)	800	1000	1000	1530	1940	2460
LT1,LT2	2" (1X300#)	360	450	450	250	320	400
T1	8" (2X300#)	3640	4560	4560	9020	11460	14600
T2	3" (2X300#)	1060	1340	1340	1080	1360	1720

WET H2S SERVICE
(SHELL SIDE)

AIR PRODUCTS FLUOR

Air Products Project Number	EN207122	Fluor Project Number	A8KM
Project Name	World Energy Renewables Project	RFQ No.	A8KM-4-403-RQ
Purchase Order Number	4505600570	PO/Contract No	A8KM-4-403-PO-4
Air Products Open Text document number	EN207122-WUXI-9V3-00063	Project Area	SWS/H2S
Client	WORLD ENERGY PARAMOUNT	Client Doc No:	

05	供批准/ ISSUED FOR APPROVAL	Xiaosheng Huang	Shengfang Zhao	Kevin Yang	20-FEB-23
04	供批准/ ISSUED FOR APPROVAL	Xiaosheng Huang	Shengfang Zhao	Kevin Yang	10-JAN-23
03	供批准/ ISSUED FOR APPROVAL	Xiaosheng Huang	Shengfang Zhao	Kevin Yang	18-OCT-22
02	供批准/ ISSUED FOR APPROVAL	Xiaosheng Huang	Shengfang Zhao	Kevin Yang	11-Aug-22
01	供批准/ ISSUED FOR APPROVAL	Xiaosheng Huang	Shengfang Zhao	Kevin Yang	31-May-22
00	供批准/ ISSUED FOR APPROVAL	Xiaosheng Huang	Shengfang Zhao	Kevin Yang	28-Feb-22
版次 REV.	版次说明/DESCRIPTION	设计/PREPARED	审核/REVIEWED	批准/APPROVED	日期/DATE

WCE 无锡化工装备股份有限公司 WUXI CHEMICAL EQUIPMENT CO., LTD.

设 计 PREPARED			AGR1 Amine Regen Reboiler GENERAL ASSEMBLY DRAWING I	设计项目 DESIGN ITEM	World Energy Renewables Project
审 核 REVIEWED				设计阶段 DESIGN PHASE	详细设计 Detail Design
批 准 APPROVED				设备位号 ITEM NO.	18-X-270
			比 例: SCALE 1:1	图 号 DWG. NO.	WXCE6703-00
			版 次: REV. 05	第 1 页 共 2 页 PAGE 1 OF 2	

其他要求和说明：
Other Requirements and Notes:
1.一般要求/General requirements
1.1 除注明外，所有尺寸均以英制为准，括号外为英制尺寸，括号内为米制尺寸。
All dimensions shall be in US customary unit as primary unit and metric unit shown in bracket, unless otherwise specified.
1.2 法兰的螺栓孔应跨换热器自然中心线。
Flange bolt holes shall straddle the natural centerlines of exchanger.
1.3 公差应符合ASME第八卷第1部分、API-660和TEMA-R的要求，除非图纸另有规定，否则应采用最严格的公差。
Tolerance shall be accordance with ASME SEC VIII Div-1, API-660 & TEMA-R and most stringent shall be applied unless otherwise specified on the drawing.

2.材料/Materials
2.1受压元件和非受压元件材料应符合ASME Section II, Part A,项目文件SPEC-ENG-MQ042 和批准的MPS文件，文件编号：EN207122-MPS。
Material of pressure and non pressure retaining parts shall be in accordance with ASME Section II, Part A and Project specification SPEC-ENG-MQ042，and approved Material Purchasing Specification，Document No：EN207122-MPS
2.2 所有材料应提供EN10204中3.1类证书，且需按照项目规范SPEC-ENG-MQ042的附录A进行复验
All materials shall be delivered with Certificates 3.1 acc. to EN 10204 and it shall be subjected to retesting per Appendix A of SPEC-ENG-MQ042
2.3 材料按照项目文件A8KM-PP-000-500512-A及WCE的程序EN207122-WCE-0010进行PMI。
PMI shall be performed in accordance with specification A8KM-PP-000-500512-A and WCE's PMI PROCEDURE EN207122-WCE-0010.
2.4所有换热管不得拼接，所有换热管不得有纵焊缝
All tubes shall be one piece without circumferential weld seams ，All tubes shall be also without longitudinal weld seams.
2.5 垫片硬度应低于法兰接触面硬度
HARDNESS OF GASKET SHALL BE LOWER THAN THAT OF FLANGE CONTACT SURFACE
2.6 垫片应满足项目规范SPEC - ENG - MQ057的要求
GASKETS SHALL COMPLY WITH THE REQUIREMENTS OF SPEC - ENG - MQ057
2.7.U型管弯制后其弯管部分加150mm长直管段应进行固溶退火热处理。热处理应使用电夹方法，程序应提交买方批准。不允许进行炉内热处理
Tube u-bends shall receive post bend solution annealing heat treatment. Heat treatment shall use electric clamp methods, and the procedure shall be submitted to Buyer for approval. Furnace heat treatments are not allowed
2.8 所有承压部件的厚度应通过超声波检测进行测量，并记录在最终档案中并可追溯到部件。包括（但不限于）所有壳体板材、封头、锻件、接管和管件。
(1)相同厚度的板材、管子仅在一个位置进行测量；
(2)对于不同厚度的锻件，应针对每个直径测量一次（比如自增强式锻管将有两次测量-一次在锻管大端厚度测量，一次在颈部测量）；
(3)标准管件应在焊接端测厚；
(4)标准法兰应在焊接端口及法兰盘处测厚.
(5)对于换热器管，制造商应测量每批的5%（每根管一个位置）
Thickness of all pressure-containing components shall be measured by UT and logged in the final dossier and traceable to the component. This includes (but is not limited to) all shell plates, dished ends, forgings, pipes & fittings.
(1)Items of consistent thickness (i.e. plates, pipe) shall be measured in one location only.
(2)Forgings with varying thicknesses shall be measured once for each diameter (i.e. SRN nozzle forging would have two measurements - one at barrel and one at neck).
(3) Standard fittings (e.g. ASME B16.9) shall be checked at the weld prep end.
(4)Standard flanges (e.g. ASME B16.5/47) shall be checked at the weld prep end and flange.
（5） For heat exchanger tubes, 5% of each lot shall be measured by the fabricator (one location per tube).
2.9 复合后，但在制造之前，应根据压力设计规范，从复层侧对整体复合材料进行超声波检查。复合板应进行100%超声波测试，以验证基材和覆层之间的结合。试验应符合ASTM A-578的要求。程序和验收标准应符合A-264第13.3.1段所述的1级质量等级。
After cladding, but prior to fabrication, integrally-clad material shall be subjected to an ultrasonic examination from the clad side in accordance with the pressure design code. Clad plate shall be 100 percent tested ultrasonically to verify the bond between the base material and the cladding. The test shall be in accordance with ASTM A-578. procedure and acceptance criteria shall be in accordance with Quality Level Class 1 as described in Paragraph 13.3.1 of ASTM A-264;

3.制造与检验/Fabrication and inspection
3.1 法兰密封面粗糙度 Ra3.2~6.3μm;
The finish of the gasket contact surface of flange facing shall be Ra125~250in;
3.2 除非已表明，接管应与容器内表面轮廓齐平，其接管端部应打磨呈最小5mm的圆角。
Unless specified otherwise, nozzles shall finish flush with the internal contour of the vessel. All inside edges of nozzle shall be radiused to 5 mm minimum.
3.3 加工完后的法兰面应有充分的保护防止受损伤和污染,并涂上防锈油,需要热处理时应涂上易去除的涂层保护。
Finished flange facings shall be adequately protected to prevent any deterioration, daub suitable rust inhibitor, for heat treatment conditions, protection shall be achieved by applying easily removable coatings.
3.4补强圈应至少有一个NPT 1/8英寸的试验孔，位于距离换热器纵轴至少45度的位置。本要求适用于每个补强圈或补强圈的每一部分。在对换热器进行压力测试之前，应对每个补强圈或补强圈的每一部分的焊缝应通入15psi的压缩空气进行空气和肥皂泡试验。试验孔应保持打开状态，以便在压力试验期间用作信号孔。压力试验后和装运前，应在试验孔中填充润滑脂
Reinforcing pads shall have at least 1 test hole, tapped 1/8 inch minimum pipe thread, located at least 45 degrees off the longitudinal axis of the exchanger. This requirement applies to each pad or segment thereof. The welds of each pad or segment shall be tested pneumatically to 15psi air-and-soap solution test before pressure testing the exchanger. Test holes shall be left open for use as tell tale holes during the pressure test. Test holes shall be filled with grease after pressure test and prior to shipment.
3.5 管程椭圆封头应冷成形，成形后进行消应力处理；壳程椭圆封头应热成形，成形后进行正火处理；封头按炉批号准备试板,试板应进行与封头相同的热处理,然后取样进行机械性能试验;管程及壳程的椭圆封头形状偏差还应满足UG-81（b）的要求；壳程椭圆封头在机械性能试验合格后还应按照ASTM A262 的E法做晶间腐蚀试验，管程封头最大的成型偏差e为3.79mm；壳程封头最大的成型偏差e为4.83mm；
The ellip.head for tube side shall be of Cold-formed , and to be Stress relief after Cold-forming. The ellip.head for shell side shall be of Hot-formed , and normalizing treatment shall be carried out after hot forming. Test specimens shall be extracted from the same heat as the head, and subjected to the same heat treatments done on the head, and then a mechanical test shall be carried out on it：The forming shape tolerance of ellipsoidal head for tubeside and shell side shall meet the requirement of UG-81（b）：After mechanical test， the shell side elliptical head shall also be subject to intergranular corrosion test according to ASTM A262 practice E；the maximum permissible deviation e of tubeside ellip.head is 3.79mm.the maximum permissible deviation e of shellside ellip.head is 4.83mm.
3.6 卧式容器的焊缝不得鞍座相碰。相邻纵焊缝之间的距离应大于钢板厚度的5倍或150 mm（6 in）
Weld joints in horizontal vessels shall not be located coincident with or across saddle supports. Longitudinal seam offset shall be the greater of five times the plate thickness or 150 mm (6 in).
3.7开孔和附件（包括补强板和垫板）到焊缝的间隙应至少2英寸。经买方批准，如果无法满足以上要求，则在将接管或附件焊接至换热器之前，应将焊缝打磨平整，并对开孔两侧4英寸的距离或附件覆盖的全长加上两侧4英寸的距离进行RT检测
Openings and attachments (including reinforcing and support pads) shall clear weld seams by at least 2 inches. Subject to approval of the purchaser, if this construction is not possible, the seam weld shall be ground flush and radiographed for a distance of 4 inches on either side of the opening or for the full length covered by an attachment plus 4 inches on both sides prior to welding the nozzle or attachment to the exchanger.
3.8 通过气刨或热切割移除的制造辅助工具、临时支撑等，与表面的距离不得小于1/8英寸（3.2 mm）。剩余材料应与母材磨平；附件区域不得导致减薄至规定壁厚以下,焊接处应打磨光滑,并采用100%MT进行表面裂纹检测。Fabrication aids, temporary supporting lugs, etc., that are removed by gouging or thermal cutting shall not be reduced less than 1/8 inch (3.2 mm) from the surface. The remaining material shall be ground flush with the base metal; the ground area shall not result in thinning below the specified wall thickness ，the surfaces shall be ground and subjected to a surface crack examination by 100%MT after their removal.
3.9 1.5"及以上的螺栓使用液压拉伸器上紧，螺栓应具有足够的间隙和长度，以便使用液压螺栓张紧器
At and above 1.5" diameter, bolting shall be suitable for hydraulic tensioning. bolting shall have adequate clearance and length for use of hydraulic bolt tensioner
3.10 所有螺栓螺母垫圈按照项目文件4WPI-670210指定的PTFE干膜润滑剂进行润滑。
All stud bolts and nuts and waster shall be lubricated with PTFE dry film lubricant as per 4WPI-670210.
3.11不应在不锈钢（SS）或镍合金上使用润滑剂、螺纹化合物、油漆、蜡笔标记、酸洗溶液、墨水标记、胶带和含有氯化物的粘合剂。SS不得与锌、铝或其他低熔点金属接触
Lubricants, thread compounds, paints, crayon markers, pickling solutions, ink markers, tapes and adhesives containing chlorides shall not be used on stainless steel (SS) or nickel alloys. SS shall not come in contact with zinc, aluminum or other low melting point metals
3.12 禁止使用加热来纠正SS或Cr-Mo钢的焊接变形和尺寸偏差。对于所有其他材料，需要买方预先批准
The application of heat to correct weld distortion and dimensional deviation in SS or Cr-Mo steels is prohibited. For all other materials, pre-approval by Buyer is required.
3.13 非管法兰的垫片接触面的平面度按照API 660-2020 表5的要求。
The flatness tolerances on peripheral gasket contact surfaces other than nozzle flange facings shall be measured in accordance with table 5 of API 660-2020.
3.14 螺柱每端应提供两（2）个螺母和硬化垫圈（即4个螺母和2个垫圈）
Two (2) nuts and hardened washer shall be provided for each end of the stud (i.e. 4 nuts and 2 washers)
3.15 小于等于12"的接管应该是无缝的，大于12"的接管可以用板卷，板卷接管焊缝应100% RT检测；
Nozzle necks up to 12 NPS made from pipe material shall be seamless for Nozzle greater than 12 NPS made from plate & Longitudinal weld seams will be full radiographed.

4.焊接/Welding
4.1 设备的焊接规程和焊工资质应符合ASME IX以及项目文件A8KM-PP-000-500550-A 及4WEQ-1051及A8KM-PP-000-500530-A的要求。
Welding procedure qualification and welders' performance qualifications shall confirm to the requirements of Section IX of the ASME Code and Project specification A8KM-PP-000-500550-A and 4WEQ-1051 and A8KM-PP-000-500530-A.
4.2 承压对接焊接接头,应采用全截面焊透接头形式；接管连接焊缝、吊耳焊缝应为全熔透焊缝，非承压件与承压件之间的焊缝将是全焊透
Holding pressure butt welded joints shall be full penetration weld. Nozzle attachment welds, Lifting lug welds shall be full penetration weld. non-pressure-attachment welds to pressure parts shall use full penetration welds；
4.3 对接焊缝应在背面清根，并对清根区域进行PT检测，合格证明没有裂纹或其他缺陷后再进行焊接，不能清根时应采用氩弧焊打底。
All butt welded joints shall be back chipped ,and the back-gouged area shall be subject to PT to demonstrate freedom from cracks or other flaws before rewelding on that side. Wherever back chipping is not possible root run shall be welded by GTAW.
4.4未注角焊缝焊脚高度为较薄板厚度。
The fillet weld height not dimensioned shall be equal to the thickness of thinner plate.
4.5 除特别说明外,所有焊缝均为连续焊。
Unless specified,all welds shall be continuous.
4.6禁止使用不可拆卸的焊接背部垫板
Non-removable welding backing strips or rings are prohibited.
4.7换热器上的所有焊接应由合格焊工根据适用的国家和地区规范进行
All welding performed on the exchanger shall be performed by qualified welders in accordance with the applicable national and regional code(s).
4.8焊接前，应目视检查接头；清洁度、正确的坡口配置、对齐和根部间隙状况、定位焊缝（如有）、预热（如有规定）和待使用的填充金属。它们应符合WPS的要求。
Prior to welding, joints shall be visually inspected for: cleanliness, correct groove configuration, alignment and root gap conditions, condition of tack welds if present, preheat if specified, and filler metal to be used. They shall be in accordance with the WPS.
4.9 待焊接表面应在外径和内径的焊缝两侧清洁1 1/2英寸（38 mm）。表面应无油漆、油、污垢、氧化皮、氧化物和其他对焊缝有害的异物。
Surfaces to be welded shall be cleaned 1 1/2 inch (38 mm) on either side of the weld on the OD and ID. Surfaces shall be free from paint, oil, dirt, scale, oxides, and other foreign material detrimental to the weld

5.预热和层间温度/Preheat and Interpass temperature
5.1 预热要求应满足项目文件A8KM-PP-000-500550-A的要求第9条及4WEQ-1051及WCE的热处理程序EN207122-WCE-0002的要求
Preheating and heat treatment requirements shall meet the article 9 of Project specification A8KM-PP-000-500550-A and 4WEQ-1051 and WCE's Heat Treatment Procedure EN207122-WCE-0002
5.2 壳程焊缝金属及热影响区的硬度不得超过200 BHN，硬度检测要求应满足项目文件A8KM-PP-000-500550-A的第11条及WCE的硬度试验程序EN207122-WCE-0005要求
The hardness of weld metal and heat-affected zones of shell side shall not exceed 200 BHN , and the hardness test requirements shall meet the article 11.2 of Project specification A8KM-PP-000-500550-A and WCE's Hardness Procedures EN207122-WCE-0005
5.3 应在壳程每个纵向、环向和接管焊缝上进行硬度测试
Hardness testing shall be conducted on each longitudinal, circumferential, and nozzle weld for shell side
5.4 复层焊缝硬度小于22HRC
The hardness of clad weld is less than 22HRC

6.无损检测/Nondestructive examination
6.1见无损检测表/See Nondestructive examination table
6.2 所有NDE应满足项目文件A8KM-PP-000-500550-A第10条的要求及WCE的NDE程序EN207122-WCE-0004的要求
NDE requirements shall meet the article 10 of Project specification A8KM-PP-000-500550-A and WCE's NDE Procedures EN207122-WCE-0004
6.3 所有NDE应由按照ASNT推荐规程SNT-TC-1A或经买方批准的类方自己的认证计划认证的人员进行
All NDE shall be performed by personnel certified in accordance with ASNT Recommended Practice SNT-TC-1A or Seller's own certification program that has been approved by Buyer.
6.4无损检测结果的解释应由获得二级或三级认证的人员执行
Interpretation of NDE results shall be performed by personnel certified Level II or III
6.5 所有无损检测（NDE）应满足以下要求：a) 焊接后至少48小时内不得进行,且；b） 焊后热处理（PWHT）后进行。
All nondestructive examination (NDE) shall; a) Not be performed until at least 48 hours after welding and b) Be performed after postweld heat treatment (PWHT).
6.6 所有内部和外部附件上的焊缝应圈焊。应采用液体渗透法或磁粉探伤法检查焊缝。
The welds on all internal and external attachments shall be welded all around. The welds shall be checked by means of liquid-penetrant or magnetic particle methods.
6.7 应在焊后热处理前对高应力附件（如吊耳）进行射线照相或超声波检查，焊后热处理后应进行磁粉检测。不允许有裂纹，吊耳或耳轴附件焊缝的单独试验证书应随船装运
Highly-stressed attachments, such as lifting lugs, shall be radiographed or ultrasonically checked before post-weld heat treatment and magnetic particle inspection after post-weld heat treatment. No crack indication is allowed. A separate test certificate for the lifting lug or trunnion attachments welds shall be shipped with the equipment.
6.8 焊缝的磁粉检测应包括焊缝两侧至少一（1）英寸（25 mm）宽的母材带（对不锈钢，将执行100% PT检测）
MT or PT examination of welds shall include a band of base metal at least one (1) inch (25 mm) wide on each side of the weld.
6.9 焊接坡口边缘超过2英寸范围将执行100% MT检测（对不锈钢，将执行100% PT检测）
Weld bevel edges over 2 inch (50 mm) shall be examined by MT (or PT for austenitic SS materials).
6.10 如果在磁粉探伤过程中发生电弧烧伤，应清除电弧烧伤，并用磁轭法重新检查该区域。
If arc burns occur during magnetic particle examination, the arc burns shall be removed and the area reexamined by the magnetic yoke method
6.11对于焊后热处理设备，应使用磁轭法
For PWHT'd equipment, the magnetic yoke method shall be used
6.12渗透材料应符合ASME第五卷第6条第T-641段中硫和卤素含量的要求，无论待检验材料的类型如何。
Penetrant materials shall meet the requirements of Paragraph T-641 of Article 6, ASME Section V, for sulfur and halogen content regardless of the type of material to be examined.
6.13如果设备焊缝按照UW-52进行局部射线检测，选择检测的焊缝应能代表每种设备上使用的每种WPS的焊缝
If the equipment welds are spot radiographed in accordance with uw-52, spots shall be selected so that examination is made of welds representing each WPS utilized on each type of equipment

7.试验/Testing
7.1 水压试验期间的金属温度应为保持至少高于最低设计金属温度30°F（17°C），但不需要超过120°F（48°C），以将脆性断裂风险降至最低。。
The metal temperature during hydrostatic test be maintained at least 30°F (17°C) above the minimum design metal temperature, but need not exceed 120°F (48°C), to minimize the risk of brittle fracture.7.2 在压力试验期间，垫片应该与正式垫片的类型及材料相同。当设备因任何原因拆卸时，应使用相同类型和材料的新垫圈重新组装，并重新进行水压试验。
The gaskets used during pressure testing shall be the same type and material as the service gaskets. When equipment is dismantled for any cause, it shall be reassembled with the new gaskets of the same type & material and re-hydrotested..
7.3 水压试验时间应保持至少一小时。
Hydraulic test shall be maintained at least 1 hour.
7.4 用于水压试验的水应为冷凝水、软化水或可溶氯化物含量小于50ppm（按体积计）的饮用水。
Water used for hydrostatically testing shall be condensate, demineralized, or potable with a soluble chloride content of less than 50ppm by volume.
7.5当且仅当水压试验水的氯化物含量小于1ppm时，可使用热空气进行干燥。
Hot air may be used for drying if and only if the hydrostatic test water has chloride content of less than 1ppm.
7.6如果压力试验期间使用的螺栓超过设计屈服应力或螺栓1%的验证应力，则应更换螺栓，并随成品容器交付新螺栓
If the bolts used during the pressure test exceed the design yield stress or 1% proof stress of the bolts, the bolts shall be replaced and new bolts shall be delivered with the finished vessel.
7.7 删除
Delete

8.表面处理/Surface treatment
8.1 设备的油漆按照项目文件A8KM-PP-000-50520-A及WCE的油漆工艺EN207122-WCE-0017。
Surface preparation and painting shall be carried out per Air Products specification A8KM-PP-000-50520-A and WCE's Surface Preparation and Painting Procedure EN207122-WCE-0017.
8.2装运前，热交换器应无异物。每个换热器的内部和外部均应彻底清洁，且应无油脂、焊接飞溅物、氧化皮、熔渣、铁锈和其他异物。试验后，应彻底干燥交换器。不允许通过蒸发进行热空气烘干；压力测试后，不得出现任何水迹。
Heat exchangers shall be free of foreign matter prior to shipment. Each exchanger shall be thoroughly cleaned inside and outside, and shall be free of grease, weld spatter, scale, slag, rust, and other foreign matter. Exchangers shall be thoroughly dried after testing. Hot air drying by evaporation is not permitted. no trace of water shall be present after pressure testing
8.3 不锈钢表面应进行酸洗和钝化
PICKLING AND PASSIVATION SHALL BE CARRIED OUT FOR SS SURFACES.

9.包装、标记和运输/Packing, Marking & Shipping
9.1 设备、备件和松散件的运输准备应符合项目文件4WGN-10001 的相关要求及WCE的包装运输程序EN207122-WCE-0008。
Preparation for shipping of equipment, spares, and any loose items shall be in accordance with Air Products specifications 4WGN-10001 WCE's Packing/shipping preservation procedure EN207122-WCE-0008
9.2 每个容器应用100 mm（4 in）高的字母喷涂 Air Products project及位号，对于卧式容器，该识别标志应位于90和270角位置，并位于切线之间的大约中间位置（位于任何重心标记的右侧）
Each vessel shall be identified with the Air Products project and vessel tag numbers painted on using 100 mm (4 in) high letters. For horizontal vessels this identification marking shall be at the 90 and the 270 angle positions and located approximately midway between tangent lines (to the right of any centre of gravity marks).
9.4 换热器应使用0.34 bar g（5 psig）干燥无油空气或氮气,露点为-10C或更低，总油含量（气溶胶、液体、蒸汽<5mg/m3。
开口应正式垫片及全螺栓连接进行密封，以保持运输压力; 法兰连接禁止使用临时运输垫片
Vessels shall be pressurized with 0.34 bar g (5 psig) of dry, oil-free air or nitrogen. with a dew point of -10C or lower and a total oil content (aerosol, liquid, vapor) < 5mg/m3. Openings shall be fully bolted in conjunction with service gaskets. to hold the shipping pressure. temporary shipping gaskets are prohibited for flanged connections
9.4充氮的设备应在每个盲板连接处贴上警告通知，清楚地表明该装置是用空气或氮气加压的
Equipment that has been pressurized for shipping shall carry a warning notice at each blinded connection clearly indicating that the unit is pressurized with either air or nitrogen.
9.5 所有临时盲板应符合容器内表面要求的清洁检查和验收要求
All temporary shipping cover plates/blinds shall meet the same cleaning inspection and acceptance requirements as that required for the internal surfaces of the vessels
9.6 所有临时盲板和螺栓应涂上"发光黄色"RAL 1026或类似涂料。
All temporary shipping plugs, metal or plywood cover plates and bolting shall be painted 'luminous yellow' RAL 1026 or similar.
9.7 在包装系统运行前必须拆除的所有临时装运支架应涂上黄色，以明确标识。此外，必须在操作前用书面说明对其进行标记或标记，以便于在工厂现场拆除。
All temporary shipping supports that must be removed before operation of the packaged system shall be clearly identified by painting them YELLOW. In addition,they must be tagged or labeled with written instructions for their removal at the plant site prior to operation.
9.8 备件应与容器分开包装。备件包装应清楚地标明内容物和换热器编号。
Spare parts shall be packed separately from the exchanger. Spare part packages shall be clearly marked with contents and exchanger number
9.9 在所有开口上贴上标签或有线金属标签，注明"设备处于氮气压力下，必须在打开前减压"
Apply a label or wired metal tag on all opening that states，"contents are under Nitrogen pressure and must be depressurized before opening"
10.备品备件/Spares
建造，调试和开车
-垫片：200%
-容器法兰、人孔、及带法兰盖的管口用螺栓/螺母/垫圈：10%（至少2个）
For construction, commissioning, and start-up
-Gaskets for girth flanges, manholes, hand holes and blinded nozzles： 200%
-Stud bolt/nuts for girth ranges, manholes and blinded nozzles： 10% (min 2 pieces)

11.堆焊及复合要求/WELD OVERLAY AND CLAD RESTORATION
11.1堆焊和复层堆焊应按照项目规范A8KM-PP-000-500550-A Rev.0B第13条进行
weld overlay and clad restoration shall be performed in accordance with the article 13 of Project specification A8KM-PP-000-500550-A Rev.0B
11.2表面准备/Surface Preparation
11.2.1待焊接表面应无搭接、凹坑或其他表面不规则和异物，如氧化皮、飞溅物、油脂等
Surfaces to be welded shall be free from laps, pits or other surface irregularities and foreign matter such as scale, spatter, grease, etc
11.2.2应在母材焊接前，将覆层从母材上剥离，每侧至少1/4英寸（6.4毫米）。剥离的背面区域应使用硝酸或硫酸铜溶液进行蚀刻，以确保完全去除覆层。
Cladding shall be stripped back from the base metal for a minimum distance of 1/4 inch (6.4 mm) on each side prior to base metal welding. The stripped-back area shall be etched with a nitric acid or copper sulfate solution to ensure complete removal of the cladding.
11.2.3复合焊缝的基材应在覆层焊接前完全焊接。覆层焊接前，覆层界面处的基底金属表面应磨平
The base metal for clad restored seams shall be completely welded before the clad restoration is applied. The base metal surface at the cladding interface shall be ground flush before cladding restoration
11.3制造焊接要求/Fabrication Welding Requirements
11.3.1除非买方设计图纸或数据表中另有规定，否则打磨和表面处理后的堆焊层最小厚度应为1/8英寸（3.2 mm）
Minimum thickness of weld overlay after grinding and surface preparation shall be 1/8 inch (3.2 mm) unless otherwise specified in Buyer design drawings or data sheets.
11.3.2除非买方另有批准，否则堆焊层应分两层进行。
Weld overlays shall be deposited in two layers unless otherwise approved by Buyer.
11.3.3多层堆焊的最小层数应与焊接工艺评定中合格的层数相同
Multiple-layer overlay welds shall have the same minimum number of layers as those qualified on the welding procedure qualification.
11.3.4堆焊层的沉积方式应确保焊道沿容器内部的圆周方向。对于内径小于12英寸（300 mm）的小直径接管，焊道可沿纵向沉积
The weld overlay shall be deposited such that weld passes are oriented circumferentially around the inside of the vessel. In the case of small diameter nozzles less than 12 inches (300 mm) inside diameter, the weld passes may be deposited in the longitudinal direction.
11.4产品化学试验/Production Chemical Testing
11.4.1堆焊层应通过主要元素的检查分析进行验证。化学分析应从等于堆焊层厚度一半的深度进行。然而，规定堆焊层厚度上的1/8英寸（3.2毫米）是从堆焊层表面取样的最小距离。
The production weld overlay deposits shall be verified by check analysis of the principal elements. Chemical analysis shall be taken from a depth equal to one-half the overlay thickness. However, 1/8 inch (3.2 mm) on the specified overlay thickness is the minimum distance from the overlay surface that a sample shall be taken.
11.4.2对于主要部件，应从每200平方英尺（18平方米）的堆焊表面上取一个试样，并从通过相同程序焊接的每组子组件（如接管）上取一个代表性试样。
One test sample shall be taken from each 200 sq. ft. (18 sq. m.) of overlay surface for major components and one representative sample from each group of subassemblies, such as nozzles, welded by the same procedure.
11.4.3对于复合部件的堆焊，堆焊的每个环缝应具有一个样本，每个纵缝应具有一个样本
For production clad restoration, overlay deposits shall have one sample for each circumferential seam and one sample for each longitudinal seam.
11.4.4化学分析试验可在实验室进行湿化学分析，或根据规范A8KM-PP-000-500512-A 通过PMI测试（在要求的深度）进行测试
Testing can be by wet chemical analysis in a laboratory or by PMI testing (at the required depth) in accordance with Specification A8KM-PP-000-500512-A, Positive Materials Identification
11.4.5对于奥氏体不锈钢焊缝熔敷，应报告以下元素：C、Ni、Mn、Cr和Mo。对于稳定不锈钢，还应报告Cb和Ti。如果可通过批准的试验方法获得氮气，则应报告采用气体保护焊接工艺制成的堆焊层。完成的覆盖层应符合API RP 582附件B.3.2和表B.2的化学成分要求。
For austenitic SS weld deposits, the following elements shall be reported: C, Ni, Mn, Cr and Mo. For stabilized stainless steels, Cb and Ti shall also be reported. Nitrogen shall be reported for overlay made with gas shielded welding processes, when available from the approved test method. The completed overlay shall meet the chemical composition requirements of API RP 582, Annex B.3.2 and Table B.2.
11.5无损检测/Nondestructive Examination
11.5.1所有焊缝均应按照项目规范13.7.1条进行目视检查，且应在进行任何其他无损检测之前进行
All welds shall be examined visually in accordance with the article 13.7.1 of Project specification A8KM-PP-000-500550-A Rev.0B
and this shall be done before any other nondestructive examinations are performed.
11.5.2所有堆焊层和复合层堆焊焊缝表面应按照项目规范A8KM-PP-000-500550-A Rev.0B第13.7.2条及ASME VIII-2第7.5.7条进行100% PT检查，当堆焊程涉及两道（层）且该程序使用中间热处理，并在堆焊第二层之前冷却至室温时，应对每一层进行PT检测。如果需要加工堆焊层，例如接管和法兰密封面，应检测加工表面。检测应在焊后热处理后进行
All weld overlay and clad restored weld surfaces, shall be 100% PT examined in accordance with the article 13.7.2 of Project specification A8KM-PP-000-500550-A Rev.0B & ASME code , section VIII, Division 2, part 7.5.7， When the overlay involves two passes (layers) and the procedure uses an intermediate heat treatment with cooling to room temperature prior to applying the second layer, each layer shall be examined. Where overlay is to be machined, such as in nozzles and flange facing, machined surfaces shall be examined. Examination shall be performed after PWHT
11.5.3堆焊容器的RT检测应符合ASME VIII-1 UCL-35或第一节PW-51的要求（如适用）
Radiography of weld overlayed vessels shall be in accordance with ASME Section VIII, Division I, UCL-35 or Section I, PW-51, as applicable
11.6维焊或复合层堆焊的焊接修复应符合项目规范A8KM-PP-000-500550-A修订版第13.8条的规定
Weld Repairs in Overlays or Clad Restorations shall be in accordance with the article 13.8 of Project specification A8KM-PP-000-500550-A Rev.0B

12 换热管与管板连接接头
Joints between tubes and tubesheets
12.1换热管与管板的焊接应满足项目规范A8KM-PP-000-500530-A第5.2条要求及WCE的换热管与管板连接程序EN207123-WCE-0007
the article 5.2 of Project specification A8KM-PP-000-500530-A shall apply to tube-to-tubesheet welding,and WCE's Tube to tubesheet Joint Procedure EN207123-WCE-0007
12.2换热管与管板之间的焊接应采用GTAW工艺，并添加填充金属。焊喉（最小泄漏路径）不得小于换热管壁厚。
Tube-to-tubesheet welds shall be made using the GTAW process with the addition of filler metal. The weld throats (minimum leak paths) shall not be less than the thickness of the tube wall.
12.3填充金属应符合满足项目规范A8KM-PP-000-500530-A第5.2.3条要求
The filler metal shall be in accordance with the article 5.2.3 of Project specification A8KM-PP-000-500530-A
12.4除非买方批准替代保护气体，否则保护气体应为含2%至3%氮气的氩气
The shielding gas shall be argon with 2 to 3% nitrogen unless an alternate shielding gas is approved by Buyer.
12.5对于强度焊焊接接头，可在焊接前使用贴胀（<3%）以保持装配，焊接后，还需要一个贴胀（<3%），以消除换热管和管板之间的缝隙。
For strength welded joints, a light roll (<3%) may be used before welding to maintain fitup. A light roll (<3%) may also be required on shell and tube exchangers after welding (with no harder rolling) to remove the crevice between the tube and tubesheet.
12.6应根据ASME Section IX QW-193和项目规范A8KM-PP-000-500530-A 的第7.3条中的要求，使用mokeup鉴定试验对换热管与管板焊接程序进行鉴定。
The tube-to-tubesheet welding procedures shall be qualified using a mockup qualification test in accordance with ASME Section IX, QW-193, and the article 7.3 of Project specification A8KM-PP-000-500530-A Rev.0
12.7应根据项目规范A8KM-PP-000-500530-A 的第7.3条中的要求，使用mokeup鉴定试验对换热管与管板胀接程序进行鉴定。
The tube-to-tubesheet rolled procedures shall be qualified using a mockup qualification test in accordance with the article 7.3 of Project specification A8KM-PP-000-500530-A Rev.0
12.8 换热管与管板分两道焊接,两道焊缝的起点应错开180°,在最终膨胀之前，应使用肥皂水溶液在50 kPa（7.5 psi）和100 kPa（15 psi）之间的表压下从壳侧进行气密试验，以验证管道焊接完整性，以确定泄漏
Tube-to-tubesheet joints shall be welded in two welding layers, the start arc welding point for layer shall be stagger 180 degree, Tube weld integrity shall be verified before final expansion of the tubes by a pneumatic test from the shell side at a gauge pressure of between 50 kPa (7.5 psi) and 100 kPa (15 psi), using a soap-water solution to identify leaks
12.9气密试验合格后再进行100%PT检测。PT合格后再进行贴胀, 贴胀完成后再进行空气泡沫气密性试验和100%PT检测。
and the final layer shall be examined by air leakage test with 15psi & 100%PT. After that, tube expansion should be performed, and air leakage test with 50 kPa(ga) & 100%PT. shall be performed again after expansion.
12.10 应对至少5%的最终换热管焊缝进行铁素体试验，基本金属：35~65%，热影响区：30~45%，焊缝金属：30%~65%：
FERRITE TEST FOR MINIMUM 5% OF FINAL TUBE WELDS SHALL BE PERFORMED，Ferrite content at these locations shall be 35-65% in base metal, 30-45% in the HAZ, and 30-65% in weld metal

AIR PRODUCTS　FLUOR

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