



### 技术要求

### 1.材料要求:

- 1) 换热管S31603采用GB/T 13296—2023中的1级(高级精度)冷拔管,并满足NB/T 47019.1—2021及NB/T 47019.5—2021的规定,换热管不允许拼焊;换热管外径允许偏差为 $\pm 0.08\text{mm}$ ,最小壁厚偏差为 $+15\%S, 0$ ;换热管应在涡流检测合格后,再按GB/T 13296标准中的规定逐根进行液压试验。钢管应加除无损检测盲区(包括水压试验盲区)、切口端面应光滑、无毛刺、裂纹缺陷;
- 2) 设备所用的Q345R板材应符合GB/T 713.2—2023《承压设备用钢板和钢带 第2部分:规定温度性能的非合金钢和合金钢》的规定,轧制状态供货;膨胀节材料Q345R板材应符合GB/T 713.2—2023《承压设备用钢板和钢带 第2部分:规定温度性能的非合金钢和合金钢》的规定,正火状态供货,膨胀节还应按GB/T 16749—2018的规定进行制造、检验及验收,且膨胀节应采用整体方法成形,成形后进行恢复性热处理;设备所用的S31603板材应符合GB/T 713.7—2023《承压设备用钢板和钢带 第7部分:不锈钢和耐热钢》的规定,固溶状态供货,表面加工类型1D;
- 3) 设备所用Q345D管材应符合GB/T 6479—2013《高压化肥设备用无缝钢管》的规定,外径不小于76mm,且壁厚不小于6.5mm的钢管(管口U01的 $\phi 168.3 \times 10.97$ 和U02的 $\phi 88.9 \times 7.62$ 的钢管),应进行 $-20^\circ\text{C}$ 的纵向冲击试验,3个标准试样的冲击吸收能量平均值不小于4J,1个试样的最低值以及小尺寸试样的冲击吸收能量指标按GB/T 150.2—2024 第4.11b)和第4.11c)的规定,冲击试样应优先选用较大尺寸的试样。设备所用S31603/S30403管材应符合GB/T 14976—2012《流体输送用不锈钢无缝钢管》的规定。采用无缝钢管的接管厚度允许偏差 $\leq 10\%S$ ( $S$ 为接管壁厚)。
- 4) 设备所用16Mn锻件应符合NB/T 47008—2017《承压设备用碳素钢和合金钢锻件》Ⅲ级的规定,锻件不允许拼接焊制,正火状态供货;设备所用S31603/S30403锻件应符合NB/T 47010—2017《承压设备用不锈钢和耐热钢锻件》Ⅲ级的规定,锻件不允许拼接焊制,固溶状态供货;
- 5) 本设备所用封头除应符合GB/T 25198—2023中的相关规定外,还应在成形后检测铁素体含量,不大于25%方为合格。
- 6) 螺栓材料用钢应符合GB/T 150.2—2024中第8.1.3条和第8.1.5条的相关要求;螺栓的螺纹宜采用滚制方法加工。所有螺栓螺纹加工后,应逐根按NB/T 47013.4的规定进行磁粉检测,不应有任何裂纹显示和任何指向缺陷显示;
- 7) 受压元件用S31603材料及其焊接接头(包括焊接工艺评定、产品焊接试件)按GB/T 4334—2020方法B进行晶间腐蚀试验,平均腐蚀速率应不大于 $1.6\text{g}/\text{m}^2 \cdot \text{h}$ ,腐蚀试验取样和组批应按GB/T 21433—2008第8条规定进行。

## 2.加工制造:

- 1) 管板密封面与壳体轴线垂直,其公差为1mm;管板堆焊层表面应平整,平面度公差为1mm;
- 2) 受压元件的对接及角接头须保证全焊透,焊接接头表面不得有裂纹,气孔,咬边。所有接管与筒体的角接头应头打磨光滑,接管不得凸出筒体内壁,并凹形圆滑过渡,接管端部打磨光滑(无尖角),圆角半径为R3。
- 3) 管、壳程组焊完毕后,应按照GB/T 150.4—2024中第6.5.11条检查壳体的圆度。
- 4) 管板堆焊技术要求严格按照HG/T20584—2020中第9.4条规定,管板堆焊过渡层后需进行消除应力热处理。
- 5) 与工艺介质接触的S31603材料焊缝应采用氩弧焊盖面且保持焊态。

3.无损检测:本设备的无损检测应符合《设计数表表》中的规定外,还应满足下列要求:

- 1) 换热管与管板连接方式采用强度焊(填丝氩弧焊),贴胀(液压胀),施焊前应NB/T 47014—2023附录E进行焊接工艺评定,至少分二次完成,焊完第一层后,以壳程0.1MPa空气作气源作漏试验检查焊接接头,经皂液检测无泄漏后焊第二层,每层焊后均应进行100%PT检测,符合NB/T 47013.5-2015中Ⅰ级合格。管子与管板应采用合格的填丝氩弧焊,管子与管板焊后应保持完整的管端,管端伸出管板应平整,其焊接接头不得有未融合、未焊透、焊穿、焊瘤等缺陷,管端应完整。
- 2) 吊耳垫板与封头、吊耳与法兰之间的焊接接头按NB/T 47013.5-2015进行100%渗透检测,符合PT—Ⅰ级为合格;
- 3) 壳程筒体与管板之间的焊接接头应氩弧焊打底全焊透,焊缝表面应按NB/T 47013.4-2015进行100%磁粉检测,符合MT—Ⅰ级为合格;
- 4) 耳座及轴耳垫板、吊耳与筒体之间的焊接接头按NB/T 47013.4-2015进行100%磁粉检测,符合MT—Ⅰ级为合格;
- 5) DN≥250mm的插入式接管与筒体、封头之间的焊接接头应按NB/T 47013.3-2023进行100%超声检测,技术等级不低于B级,质量等级为Ⅰ级;

#### 4. 耐压试验:

2) 耐压试验合格后, 不锈钢材料的内外表面应进行酸洗钝化处理, 与介质接触的不锈钢表面所形成的钝化膜还应按 GB/T 25150—2010 规定的方法检测, 合格后必须将酸洗介质清洗干净, 不得有残留。

5.其他:

1) 接管、地脚螺栓、吊耳、锦带、接地板等方位见管道专业管口方位图。U01、U02与布置的相对方位技术图。所有法兰螺栓孔与壳体主轴线或铅垂线跨中均布。

2) 吊耳仅可吊装筒体垂直，且起吊时须两只同时起吊，不得用于吊装整套设备。

3) 设备制造完毕后，设备(碳钢)外表面(法兰密封面除外)进行喷砂处理，除锈等级应达到Sa2.5级。表面处理及涂装要求按项目统一规定。

注: (1) 介质组成(wt%): 新戊二醇: 97.75, 羟基特戊酸新戊二醇酯: 1.08, 异丁酸酯: 1.18。

(2) 伴热介质(0.4 MPaG蒸汽), 操作温度151℃, 操作压力4.08kg/cm<sup>2</sup>G, 设计温度230℃, 设计压力: 6.2kg/cm<sup>2</sup>G/FV, 以下管口需带伴热, 其规格如下:

N01管口伴热入口为17,伴热出口为01,伴热管口规格为DN25,接管规格为 $\phi 33.4 \times 4.55$ ;

N02管口伴热入口为I2,伴热出口为O2,伴热管口规格为DN50,接管规格为 $\phi 60.3 \times 5.54$ ;

(3) 管程出口管线为两相流, 容易引发震动, 建议管道专业采取相应措施。

(4).本设备安全泄放装置由工艺在系统中统一设置;

## TECHNICAL REQUIREMENTS

## 1.MATERIAL REQUIREMENTS

1. THE HEAT EXCHANGE TUBES MADE OF S31603 SHALL BE GRADE II (HIGH PRECISION) COLD-DRAWN TUBES IN ACCORDANCE WITH GB/T 13296-2023 AND SHALL COMPLY WITH NB/T 47019.1-2021 AND NB/T 47019.5-2017. THE HEAT EXCHANGE TUBES SHALL NOT BE SPLICED. THE ALLOWABLE DEVIATION OF THE OUTSIDE DIAMETER OF THE TUBES SHALL BE  $\leq 0.08\text{mm}$ , AND THE MINIMUM WALL THICKNESS DEVIATION SHALL BE  $\pm 0.5\%$ , 0. AFTER PASSING THE EDDY CURRENT TESTING, EACH HEAT EXCHANGE TUBE SHALL UNDERGO HYDRAULIC TESTING ACCORDING TO THE PROVISIONS OF GB/T 13296. THE NON-DESTRUCTIVE TESTING BLIND ZONES (INCLUDING HYDRAULIC TESTING BLIND ZONES) SHALL BE DEDUCTED FROM THE STEEL TUBES. THE CUT ENDS SHALL BE SMOOTH, FREE OF BURRS, AND CRACK DEFECTS.

2. THE Q345R PLATES USED IN THE EQUIPMENT SHALL COMPLY WITH GB/T 7132-2023 "STEEL PLATES AND STRIPS FOR PRESSURE EQUIPMENT - PART 2: NON-ALLOY AND ALLOY STEELS WITH SPECIFIED TEMPERATURE PROPERTIES" AND SHALL BE SUPPLIED IN THE HOT-ROLLED CONDITION. THE EXPANSION JOINT MATERIAL Q345R PLATES SHALL COMPLY WITH GB/T 7132-2023 AND SHALL BE SUPPLIED IN THE NORMALIZED CONDITION. THE EXPANSION JOINTS SHALL ALSO BE MANUFACTURED, INSPECTED, AND ACCEPTED IN ACCORDANCE WITH GB/T 16749-2018. THE EXPANSION JOINTS SHALL BE FORMED USING AN INTEGRAL METHOD AND SHALL UNDERGO PERFORMANCE RESTORATION HEAT TREATMENT AFTER FORMING. THE S31603 PLATES USED IN THE EQUIPMENT SHALL COMPLY WITH GB/T 7132-2023 "STEEL PLATES AND STRIPS FOR PRESSURE EQUIPMENT - PART 3: STAINLESS AND HEAT-RESISTING STEELS" AND SHALL BE SUPPLIED IN THE SOLUTION-ANNEALED CONDITION, WITH SURFACE FINISH TYPE 1D.

3. THE Q345D PIPES USED IN THE EQUIPMENT SHALL COMPLY WITH GB/T 6479-2013 "SEAMLESS STEEL PIPES FOR HIGH-PRESSURE FERTILIZER EQUIPMENT." FOR PIPES WITH AN OUTER DIAMETER NOT LESS THAN 76mm AND A WALL THICKNESS NOT LESS THAN 6.5mm INCLUDING THE PIPES FOR NOZZLES U01:  $\phi 68.3 \times 3.0197$  AND U02:  $\phi 88.9 \times 1.621$ , LONGITUDINAL IMPACT TESTING SHALL BE CONDUCTED AT  $-20^{\circ}\text{C}$ . THE AVERAGE IMPACT ENERGY OF THREE STANDARD SAMPLES SHALL NOT BE LESS THAN 41J. THE MINIMUM IMPACT ENERGY OF ONE SAMPLE AND THE IMPACT ENERGY OF SMALL-SIZED SAMPLES SHALL COMPLY WITH CLAUSES 4.1(b) AND 4.1(c) OF GB/T 150.2-2024. LARGER-SIZED SAMPLES SHALL BE PREFERRED FOR IMPACT TESTING. THE S31603/S30403 PIPES USED IN THE EQUIPMENT SHALL COMPLY WITH GB/T 14976-2012 "STAINLESS STEEL SEAMLESS PIPES FOR FLUID TRANSPORTATION." THE NEGATIVE WALL THICKNESS DEVIATION OF SEAMLESS STEEL PIPES USED FOR NOZZLES SHALL NOT EXCEED 10% (WHERE S IS THE NOZZLE WALL THICKNESS).

4. THE 16Mn FORGINGS USED IN THE EQUIPMENT SHALL COMPLY WITH GRADE III OF NB/T 47008-2017 "CARBON AND ALLOY STEEL FORGINGS FOR PRESSURE EQUIPMENT." THE FORGINGS SHALL NOT BE SPLICED BY WELDING AND SHALL BE SUPPLIED IN THE NORMALIZED CONDITION. THE S31603/S30403 FORGINGS USED IN THE EQUIPMENT SHALL COMPLY WITH GRADE III OF NB/T 47010-2017 "STAINLESS AND HEAT-RESISTING STEEL FORGINGS FOR PRESSURE EQUIPMENT." THE FORGINGS SHALL NOT BE SPLICED BY WELDING AND SHALL BE SUPPLIED IN THE SOLUTION-ANNEALED CONDITION.

5. THE HEADS USED IN THIS EQUIPMENT SHALL NOT ONLY COMPLY WITH THE RELEVANT PROVISIONS OF GB/T 25198-2023 BUT ALSO SHALL UNDERGO FERRITE CONTENT TESTING AFTER FORMING. THE FERRITE CONTENT SHALL NOT EXCEED 25% TO BE CONSIDERED ACCEPTABLE.

6. THE MATERIAL FOR THE STUDS SHALL COMPLY WITH THE RELEVANT REQUIREMENTS OF CLAUSES 8.1.3 AND 8.1.5 OF GB/T 150.2-2024. THE THREADS OF THE STUDS SHALL PREFERABLY BE PROCESSED BY ROLLING. AFTER THREAD PROCESSING, ALL STUDS SHALL UNDERGO MAGNETIC PARTICLE TESTING ACCORDING TO NB/T 47013.4, AND NO CRACKS OR TRANSVERSE DEFECTS SHALL BE DISPLAYED.

7. THE S31603 MATERIAL AND ITS WELDED JOINTS (INCLUDING WELDING PROCEDURE QUALIFICATION AND PRODUCT WELD TEST PIECES) USED FOR PRESSURE PARTS SHALL UNDERGO INTERGRANULAR CORROSION TESTING ACCORDING TO METHOD B OF GB/T 4334-2020. THE AVERAGE CORROSION RATE SHALL NOT EXCEED  $1.6\text{mg}\cdot\text{m}^{-2}\cdot\text{h}$ . THE SAMPLING AND BATCHING OF CORROSION TEST SPECIMENS SHALL COMPLY WITH THE PROVISIONS OF CLAUSE 8 OF GB/T 21433-2008.

## 2.MANUFACTURING AND PROCESSING:

1. THE SEALING SURFACE OF THE TUBE SHEET SHALL BE PERPENDICULAR TO THE AXIS OF THE SHELL, WITH A TOLERANCE OF 1mm. THE SURFACE OF THE TUBE SHEET OVERLAY WELDING SHALL BE FLAT, WITH A FLATNESS TOLERANCE OF 1mm.

2. THE BUTT AND FILLET JOINTS OF PRESSURE PARTS SHALL BE FULLY PENETRATED. THE WELDED JOINTS SHALL BE FREE OF CRACKS, POROSITY, AND UNDERCUTS. ALL FILLET JOINTS BETWEEN NOZZLES AND THE SHELL SHALL BE GROUND SMOOTH. THE NOZZLES SHALL NOT PROTRUDE FROM THE INNER WALL OF THE SHELL AND SHALL HAVE A CONCAVE AND SMOOTH TRANSITION. THE NOZZLE ENDS SHALL BE GROUND SMOOTH (WITHOUT SHARP CORNERS), WITH A FILLET RADIUS OF R3.

3. AFTER THE TUBE-SIDE AND SHELL-SIDE ASSEMBLY WELDING IS COMPLETED, THE ROUNDNESS OF THE SHELL SHALL BE CHECKED ACCORDING TO CLAUSE 6.5.11 OF GB/T 150.4-2024.

4. THE OVERLAY WELDING REQUIREMENTS FOR THE TUBE SHEET SHALL STRICTLY COMPLY WITH CLAUSE 9.4 OF HG/T 20584-2020. AFTER OVERLAY WELDING THE TRANSITION LAYER, STRESS RELIEF HEAT TREATMENT SHALL BE PERFORMED.

5. THE WELDS OF S31603 MATERIAL IN CONTACT WITH THE PROCESS MEDIUM SHALL BE COVERED WITH TIG WELDING AND SHALL REMAIN IN THE AS-WELDED CONDITION.

3. NON-DESTRUCTIVE TESTING: THE NON-DESTRUCTIVE TESTING OF THIS EQUIPMENT SHALL NOT ONLY COMPLY WITH THE PROVISIONS OF THE "DESIGN DATA SHEET" BUT ALSO SHALL MEET THE FOLLOWING REQUIREMENTS:

1. THE CONNECTION BETWEEN THE HEAT EXCHANGE TUBES AND THE TUBE SHEET SHALL BE MADE BY STRENGTH WELDING (FILLER WIRE TIG WELDING) + TIGHT EXPANSION (HYDRAULIC EXPANSION). BEFORE WELDING, WELDING PROCEDURE QUALIFICATION SHALL BE PERFORMED ACCORDING TO APPENDIX E OF NB/T 47014-2023. THE WELDING SHALL BE COMPLETED IN AT LEAST TWO STEPS. AFTER COMPLETING THE FIRST LAYER, A LEAK TEST SHALL BE CONDUCTED ON THE WELDED JOINT USING 0.1MPa COMPRESSED AIR ON THE SHELL SIDE. AFTER CONFIRMING NO LEAKS USING SOAP SOLUTION, THE SECOND LAYER SHALL BE WELDED. EACH LAYER SHALL UNDERGO 100% PT TESTING AFTER WELDING, COMPLYING WITH GRADE I OF NB/T 47013-2015. THE TUBE-TO-TUBE SHEET WELDING SHALL USE QUALIFIED FILLER WIRE TIG WELDING. AFTER WELDING, THE TUBE ENDS SHALL REMAIN INTACT. THE TUBE ENDS EXTENDING FROM THE TUBE SHEET SHALL BE FLAT, AND THE WELDED JOINTS SHALL BE FREE OF LACK OF FUSION, INCOMPLETE PENETRATION, BURN-THROUGH, AND COLLAPSE DEFECTS. THE TUBE ENDS SHALL BE COMPLETE.

2. THE WELDED JOINTS BETWEEN THE LIFTING LUG PAD AND THE HEAD, AND BETWEEN THE LIFTING LUG AND THE FLANGE, SHALL UNDERGO 100% PENETRANT TESTING ACCORDING TO NB/T 47013-2015, WITH PT-I ACCEPTANCE.

3. THE WELDED JOINT BETWEEN THE SHELL-SIDE CYLINDER AND THE TUBE SHEET SHALL BE ROOTED WITH TIG WELDING AND FULLY PENETRATED. THE WELD SURFACE SHALL UNDERGO 100% MAGNETIC PARTICLE TESTING ACCORDING TO NB/T 47013.4-2015, WITH MT-I ACCEPTANCE.

4. THE WELDED JOINTS BETWEEN THE SADDLE PAD AND THE CYLINDER, AND BETWEEN THE TAIL LIFTING AND THE CYLINDER, SHALL UNDERGO 100% MAGNETIC PARTICLE TESTING ACCORDING TO NB/T 47013.4-2015, WITH MT-I ACCEPTANCE.

5. THE WELDED JOINTS BETWEEN INSERTED NOZZLES AND THE CYLINDER OR HEAD WITH DN ≥ 250mm SHALL UNDERGO 100% ULTRASONIC TESTING ACCORDING TO NB/T 47013-2023, WITH A TECHNICAL LEVEL NOT LOWER THAN GRADE B AND A QUALITY LEVEL OF GRADE I.

4. PRESSURE TESTING:

#### 4.1. PRESSURE TESTING:

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2) AFTER THE PRESSURE TEST IS COMPLETED, THE INTERNAL AND EXTERNAL SURFACES OF THE STAINLESS STEEL MATERIAL SHALL UNDERGO ACID PICKLING AND PASSIVATION. THE PASSIVATION FILM ON THE STAINLESS STEEL SURFACES IN CONTACT WITH THE MEDIUM SHALL BE TESTED ACCORDING TO THE METHOD SPECIFIED IN GB/T 2550-2010. AFTER PASSING THE TEST, THE ACID PICKLING MEDIUM SHALL BE THOROUGHLY CLEANED, AND NO RESIDUE SHALL BE ALLOWED.

5. OTHERS:

1. THE ORIENTATION OF NOZZLES, ANCHOR BOLTS, LIFTING LUGS, NAME PLATES, AND GROUNDING PLATES SHALL FOLLOW THE NOZZLE ORIENTATION DRAWING OF THE PIPING DISCIPLINE. THE RELATIVE ORIENTATION OF U01 AND U02 TO THE TUBE LAYOUT SHALL FOLLOW THIS DRAWING. ALL FLANGE BOLT HOLES SHALL BE EVENLY DISTRIBUTED ACROSS THE MAIN AXIS OR VERTICAL LINE OF THE SHELL.
2. THE LIFTING LUGS SHALL ONLY BE USED TO LIFT THE EMPTY WEIGHT OF THE TUBE CHEST, AND TWO LUGS MUST BE USED SIMULTANEOUSLY DURING LIFTING. THEY SHALL NOT BE USED TO LIFT THE ENTIRE EQUIPMENT.
3. AFTER THE EQUIPMENT IS FABRICATED, THE EXTERNAL SURFACE OF THE EQUIPMENT (CARBON STEEL, EXCLUDING FLANGE SEALING SURFACES) SHALL UNDERGO SAND BLASTING TO ACHIEVE A RUST REMOVAL GRADE OF SA2.5. THE SURFACE TREATMENT AND PAINTING REQUIREMENTS SHALL FOLLOW THE PROJECT'S UNIFIED SPECIFICATIONS.


NOTE:

(1). MEDIUM COMPOSITION (WT%): NEOPENTYL GLYCOL: 97.75, NEOPENTYL GLYCOL HYDROXY PIVALATE: 1.08, ISOBUTYRATE: 1.18.

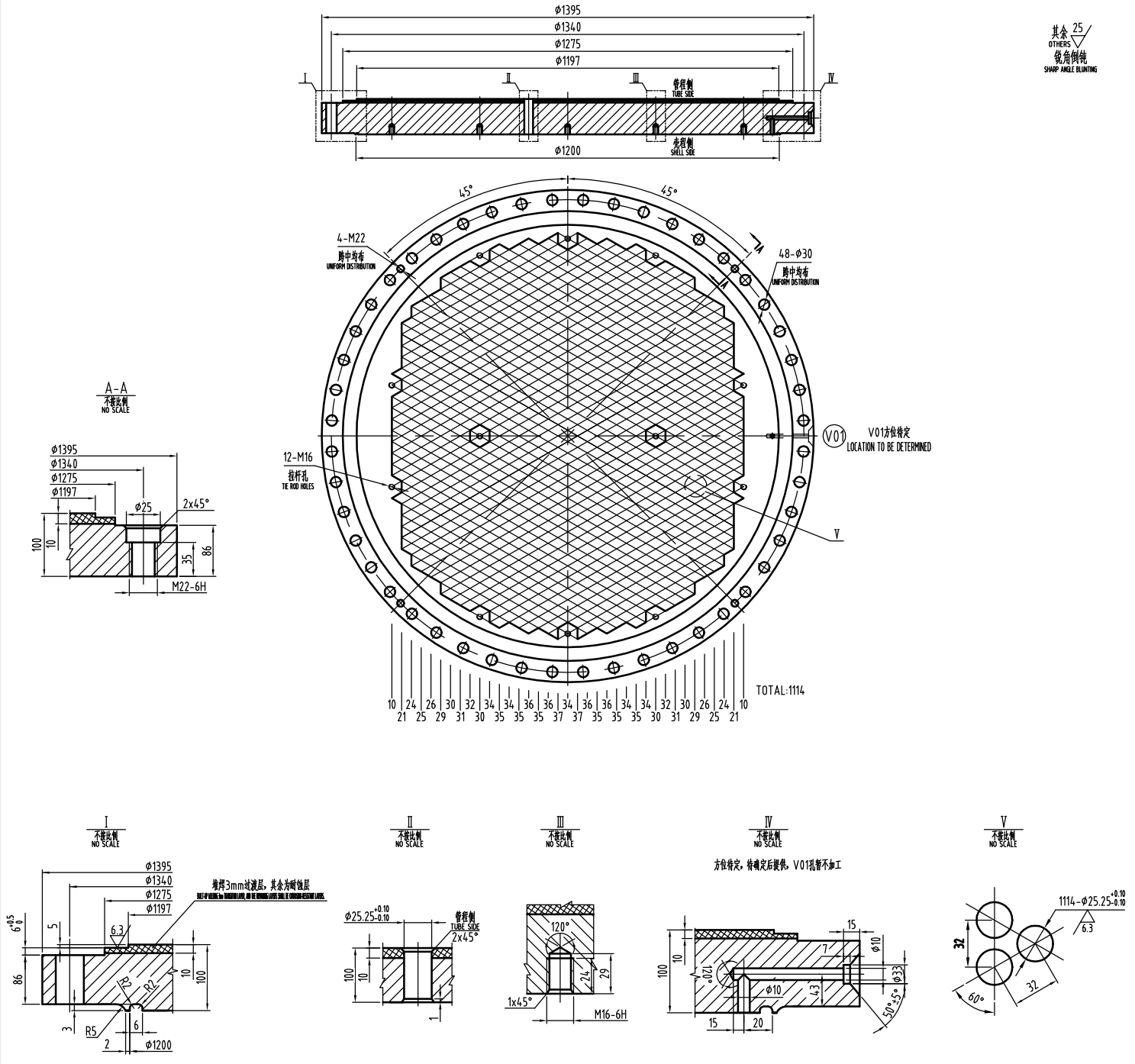
(3) THE TUBE-SIDE OUTLET PIPELINE IS A TWO-PHASE FLOW, WHICH MAY CAUSE VIBRATION. IT IS RECOMMENDED THAT THE PIPING DISCIPLINE TAKE APPROPRIATE MEASURES.

(4). THE SAFETY RELIEF DEVICE FOR THIS EQUIPMENT SHALL BE PROVIDED BY THE PROCESS DISCIPLINE IN THE SYSTEM.

31		A	TAIL LIFTING	尾吊 APA-2-15	1	组合件 ASSEMBLY		8.3	HG/T 21574-2018
30	HRQ01-00129-01	A	TIE RODS	拉杆Ⅱ $\phi 16$ L=2500	10	S30408	4	4.0	
29		A	NUTS	螺母 M16	24	A2-70	0.03	0.7	GB/T 6170-2015
28	HRQ01-00129-01	A	TIE RODS	拉杆Ⅰ $\phi 16$ L=2000	2	S30408	3.2	6.4	
27		A	SPACER	定距管Ⅳ $\phi 25 \times 2$ L=986	6	S30408	1.1	6.6	
26		A	SHELL SIDE	壳程筒体Ⅱ DN1200 $\delta=14$ L=1601(HOLD)	1	Q345R		671.1	GB/T 713.2-2023
25		A	SPACER	定距管Ⅲ $\phi 25 \times 2$ L=926	2	S30408	1.06	2.12	
24		A	SPACER	定距管Ⅱ $\phi 25 \times 2$ L=486	32	S30408	0.56	18	
23		A	LIFTING TRUNNIONS	吊耳 AXA-1-10-14(L=180)	2	组合件 ASSEMBLY	20.6	41.2	HG/T 21574-2018
22		A	SPACER	定距管Ⅰ $\phi 25 \times 2$ L=426	10	S30408	0.5	5	
21		A	PLATE LIFTING LUG	吊耳 TPB-2-3.5-14	2	Q345R/S31603	4.4/4.6	8.8/9.2	HG/T 21574-2018
20		A	INSULATION SUPPORT RING	保温圈Ⅲ $\delta=6, Q=0$	2	S31603	15	30	060-STD-E012
19		A	TOP CHANNEL SHELL	上管箱筒体 DN1200 $\delta=20$ L=1165	1	S31603		714.4	GB/T 713.7-2023
18	HRQ01-00129-02	A	TOP TUBESHEET	上管板 $\delta=100$	1	16MnIII堆焊S31603		651/51	
17	HRQ01-00129-01	A	JACKSCREW	顶丝 M22x135	8	A2-70	0.5	4	
16	HRQ01-00129-03	A	NAMEPLATE AND NAMEPLATE BRACKET	铭牌及铭牌座	1	组合件 ASSEMBLY		4.5	
15		A	EARTH PLATE	接地板 50x110x10	2	S30408	0.4	0.8	见图 SEE DRAW
14		A	LUG SUPPORT	耳式支座 C4, $\delta 3=14$	4	Q345R/Q345R	35.4	141.6	NB/T 47065.3-2018
13	HRQ01-00129-01	A	TRANSVERSE BAFFLE	折流板 $\delta=14$	5	S30408	46.5	232.5	
12		A	EXPANSION JOINT	膨胀节 ZDL(Ⅲ)U 1200-2.5-1x16(13.7)x1 Lt=34	1	Q345R(N)		259.5	GB/T 16749-2018
11		A	TUBES	换热管 $\phi 25 \times 2$ L=3000	1114	S31603	3.47	3865.6	GB/T 13296-2023
10		A	SHELL SIDE	壳程筒体Ⅰ DN1200 $\delta=14$ L=909(HOLD)	1	Q345R		381	GB/T 713.2-2023
9		A	NUTS	螺母 M27	192	30CrMoA	0.25	48	NB/T 47027-2012
8		A	STUDS	螺栓 M27x290-B	96	35CrMoA	1.3	124.8	NB/T 47027-2012
7	HRQ01-00129-02	A	BTM TUBESHEET	下管板 $\delta=100$	1	16MnIII堆焊S31603		651/51	
6		A	GRAPHITE GASKETS	垫片 B42-1200-2.5	2	S31603+RSB	/	/	NB/T 47025-2012
5		A	CHANNEL FLANGE	管箱法兰 FM 1200-2.5/109-210 $\delta_0=20$	2	S31603Ⅲ	396	792	NB/T 47023-2012
4	HRQ01-00129-01	A	BTM CHANNEL LIFTING LUG	下管箱吊耳 $\delta=16$	2	S31603	1.5	3	
3		A	BTM CHANNEL SHELL	下管箱筒体 DN1200 $\delta=20$ L=265	1	S31603		162.5	GB/T 713.7-2023
2		A	CHANNEL HEAD	管箱封头 EHA1200x18(15.6)	2	S31603	239.2	479.4	GB/T 25198-2023
1		A	NOZZLE ASSEMBLY	管口组件	1	组合件 ASSEMBLY		516.3	

序号 ITEM NO.	图号 DWG NO.	版本 Issu	英文名称 ENGLISH NAME	中文名称和标准号 CHINESE NAME & STANDARD NO	数量 QTY	材料 MATERIAL	单件 EACH	总计 TOT	备注 REMARK	
							质量 WEIGHT (kg)			
2				 荆门宏图特种飞行器制造有限公司 JINGMEN HONGTU SPECIAL AIRCRAFT MANUFACTURING CO., LTD.						
2										
0	标记 MARK	外委 NUM	更改单号 ALT NO.		签名 SIG.	日期 DATE				
	人员 STAFF	签名 SIG.	日期 DATE		人员 STAFF	签名 SIG.	日期 DATE	重量 WEIGHT(g)	~9850	设备名称 EQUIPMENT NAME
	制图 DRAWING			工艺 CRAFT WORKING		材料 MATERIAL	组创件 ASSEMBLY		轻组分塔再沸器E-2401	
2	设计 DESIGN	江帆	2025.4.22	焊接 WELDING	版次 REV	C			LIGHT COMPONENT TOWER REBOILER	
	校核 CHECK	刘锦	2025.4.22	标准化 STANDARD	比例 SCALE	/		图号 DWG.NO.	HRQ01-00129(2/2)	
	审核 REVIEW	郭	2025.4.22	批准 APPROVAL			第 2 张 SHEET NO.	共 2 张 OF		
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1. THE TUBE SHEET MATERIAL 16Mn SHALL BE MANUFACTURED, INSPECTED, AND ACCEPTED IN ACCORDANCE WITH NB/T 47008-2017 "CARBON STEEL AND ALLOY STEEL FORGINGS FOR PRESSURE EQUIPMENT," WITH GRADE B BEING ACCEPTABLE. THE MATERIAL SHALL BE SUPPLIED IN THE NORMALIZED CONDITION.

2. THE TUBE SHEET SHALL BE MADE BY FORGING AND OVERLAY WELDING. THE OVERLAY WELDING METHOD SHALL USE STRIP OVERLAY WELDING (OR A SUPERIOR WELDING METHOD; MANUAL WELDING MAY BE USED FOR SPECIAL STRUCTURES). THE OVERLAY WELDING SHALL CONSIST OF AT LEAST TWO LAYERS, WITH THE FIRST LAYER BEING A TRANSITION LAYER AND THE REMAINING LAYERS BEING CORROSION-RESISTANT LAYERS. THE TOTAL THICKNESS OF THE OVERLAY WELDING SHALL BE 10mm. AFTER OVERLAY WELDING, THE CHEMICAL COMPOSITION WITHIN 2mm DEPTH BELOW THE SURFACE OF THE CORROSION-RESISTANT LAYER SHALL BE INSPECTED TO MEET THE REQUIREMENTS OF S31603. THE SURFACE OF THE ENTIRE OVERLAY WELDING LAYER SHALL BE FLAT, WITH A FLATNESS TOLERANCE OF 1mm. THE THICKNESS OF THE OVERLAY WELDING LAYER SHALL BE UNIFORM, WITH THE DIFFERENCE BETWEEN THE THICKEST AND THINNEST PARTS BEING <1mm. THE THICKNESS OF THE TRANSITION LAYER SHALL BE 3mm.

3. BEFORE OVERLAY WELDING, THE SURFACE TO BE WELDED SHALL BE CLEANED OF OIL, RUST, AND OTHER IMPURITIES. THE SURFACE SHALL THEN UNDERGO 100% MT (MAGNETIC PARTICLE TESTING) INSPECTION, AND NO DEFECTS SUCH AS CRACKS SHALL BE ALLOWED. THE RESULTS SHALL COMPLY WITH GRADE I OF NB/T 47013.4-2015. THE INTERPASS TEMPERATURE DURING OVERLAY WELDING SHALL BE STRICTLY CONTROLLED, AS DETERMINED BY THE WELDING PROCEDURE QUALIFICATION.

4. AFTER COMPLETING THE OVERLAY WELDING OF THE TRANSITION LAYER, STRESS RELIEF TREATMENT SHALL BE PERFORMED, FOLLOWED BY 100% PT (PENETRANT TESTING) INSPECTION, COMPLYING WITH GRADE I OF NB/T 47013.5-2015. SUBSEQUENTLY, THE CORROSION-RESISTANT LAYER SHALL BE OVERLAY WELDED. AFTER COMPLETING THE OVERLAY WELDING OF THE CORROSION-RESISTANT LAYER AND MACHINING (BEFORE DRILLING), 100% PT INSPECTION SHALL BE PERFORMED, COMPLYING WITH GRADE I OF NB/T 47013.5-2015. AFTER MACHINING (BEFORE DRILLING), THE OVERLAY WELDED SURFACE SHALL ALSO UNDERGO 100% UT (ULTRASONIC TESTING) INSPECTION, WITH THE ACCEPTANCE CRITERIA COMPLYING WITH GRADE I OF NB/T 47013.3-2023.

5. OTHER REQUIREMENTS FOR OVERLAY WELDING SHALL ALSO COMPLY WITH THE PROVISIONS OF CLAUSE 9.4 OF HG/T 20584-2020. AFTER COMPLETING THE OVERLAY WELDING AND PASSING THE INSPECTION, THE SEALING SURFACE, JACKING SCREW HOLES, BOLT HOLES, AND TUBE HOLES OF THE TUBE SHEET SHALL BE MACHINED.

6. THE SEALING SURFACE OF THE TUBE SHEET SHALL BE PERPENDICULAR TO THE AXIS, WITH A PERPENDICULARITY TOLERANCE OF 0.04mm.

7. THE DIAMETER OF THE TUBE HOLES ON THE TUBE SHEET SHALL ALLOW NO MORE THAN 4% OF THE TUBE HOLES TO EXCEED THE UPPER DEVIATION OF  $\phi 25.25^{+0.10}_{-0.10}$ , BUT NOT EXCEEDING 50% OF THE CORRESPONDING UPPER DEVIATION.

8. THE TUBE HOLES SHALL BE STRICTLY PERPENDICULAR TO THE SEALING SURFACE OF THE TUBE SHEET, WITH A PERPENDICULARITY TOLERANCE OF 0.10mm. THE SURFACE OF THE TUBE HOLES SHALL BE CLEAN, FREE OF BURRS, IRON CHIPS, RUST SPOTS, OIL STAINS, AND OTHER IMPURITIES THAT MAY AFFECT THE QUALITY OF EXPANSION OR WELDING CONNECTIONS. THE HOLE SURFACE SHALL NOT HAVE LONGITUDINAL OR SPIRAL SCRATCHES THAT MAY AFFECT THE QUALITY OF EXPANSION.

9. AFTER DRILLING, 90% OF THE TUBE HOLES ON THE TUBE SHEET SHALL HAVE A BRIDGE WIDTH OF  $\geq 5.66$ mm, WITH A MINIMUM BRIDGE WIDTH OF 4.05mm ALLOWED FOR NO MORE THAN 4% OF THE TUBE HOLES.

10. THE DIAMETER OF THE BOLT HOLE CENTER CIRCLE ON THE TUBE SHEET AND THE CHORD LENGTH BETWEEN ADJACENT BOLT HOLES SHALL HAVE A LIMIT DEVIATION OF  $\pm 0.6$ mm. THE CHORD LENGTH BETWEEN ANY TWO BOLT HOLES SHALL HAVE A LIMIT DEVIATION OF  $\pm 2.0$ mm.

11. THE BASIC DIMENSIONS OF THE THREADS SHALL COMPLY WITH GB/T 196-2003 "GENERAL PURPOSE METRIC SCREW THREADS - BASIC DIMENSIONS," AND THE THREAD TOLERANCES SHALL COMPLY WITH GB/T 197-2018 "GENERAL PURPOSE METRIC SCREW THREADS - TOLERANCES."

12. UNLESS OTHERWISE SPECIFIED, THE LIMIT DEVIATIONS FOR LINEAR DIMENSIONS OF MACHINED AND NON-MACHINED SURFACES SHALL COMPLY WITH GRADE H AND GRADE C OF GB/T 1804-2000, RESPECTIVELY.

13. AFTER COMPLETING THE MACHINING OF THE TUBE SHEET, THE SEALING SURFACE SHALL BE PROTECTED FROM DAMAGE.

14. THE S31603 MATERIAL AND ITS WELDED JOINTS (INCLUDING WELDING PROCEDURE QUALIFICATION) SHALL UNDERGO INTERGRANULAR CORROSION TESTING ACCORDING TO METHOD B OF GB/T 4334-2020. THE AVERAGE CORROSION RATE SHALL NOT EXCEED  $1.6\text{mg}/\text{m}^2\cdot\text{h}$ . THE SAMPLING AND BATCHING OF CORROSION TEST SPECIMENS SHALL COMPLY WITH THE PROVISIONS OF CLAUSE 8 OF GB/T 21433-2008.

技术要求:

1. 管板材料16Mn应按NB/T 47008-2017《承压设备用碳素钢和合金钢锻件》进行制造、检验和验收，Ⅲ级为合格，锻件不允许拼焊锻制，正火状态供货。

2. 管板采用锻件锻制，堆焊方法采用带极堆焊(或性能更优的堆焊方式，结构特殊时可手工焊)，堆焊至少由两层组成，第一层为过渡层，其余为耐蚀层，堆焊层厚度10mm，堆焊后应修磨耐蚀层表面以下2mm深度以内的化学成分，满足S31603的要求。整个堆焊层表面平整，平面度公差为1mm，堆焊层厚度均匀，壁厚与壁厚之差<1mm，过渡层厚度为3mm。

3. 在堆焊前，应清除堆焊表面的油、锈和污物等杂质，而后堆焊表面应进行100%MT检测，不得有任何裂纹等缺陷存在，结果符合NB/T 47013.4-2015中的I级合格。堆焊过程中应严格控制层间温度，具体由焊接工艺评定确定。

4. 管板堆焊过渡层完成后应进行消除应力处理，而后进行100%PT检测，按NB/T 47013.5-2015中的I级合格；然后再堆焊耐蚀层，耐蚀层堆焊完毕且加工后(钻孔前)进行100%PT检测，按NB/T 47013.5-2015中的I级合格。加工后(钻孔前)的堆焊表面应进行100%UT检测，合格标准按NB/T 47013.3-2023中I级合格。

5. 堆焊其它要求还应符合HG/T20584-2020中9.4条要求规定。堆焊完毕并检验合格后应加工管板密封面、顶丝孔、螺栓孔和管口孔。

6. 管板密封面应与轴线垂直，其垂直度公差为0.40mm。

7. 管板管孔直径，允许有不大干4%的管孔上偏差超出 $\phi 25.25^{+0.10}_{-0.10}$ ，但不超出轴向上偏差的50%。

8. 管孔应严整垂直管板密封面，其垂直度公差为0.10mm。管板管孔表面应清理干净，不应有影响连接或焊接连接质量的毛刺、铁屑、锈迹、油污等；孔表面不应有影响连接质量的纵向或螺旋状划痕等缺陷。

9. 管板钻孔后>96%的孔桥宽度应 $\geq 5.66$ mm，允许(<4%的孔桥宽)的最小孔桥宽度为4.05mm。

10. 管板上螺栓孔中心圆直径和相邻两螺栓孔孔长桥宽度偏差为 $\pm 0.6$ mm;任意两螺栓孔孔长桥宽度偏差为 $\pm 2.0$ mm。

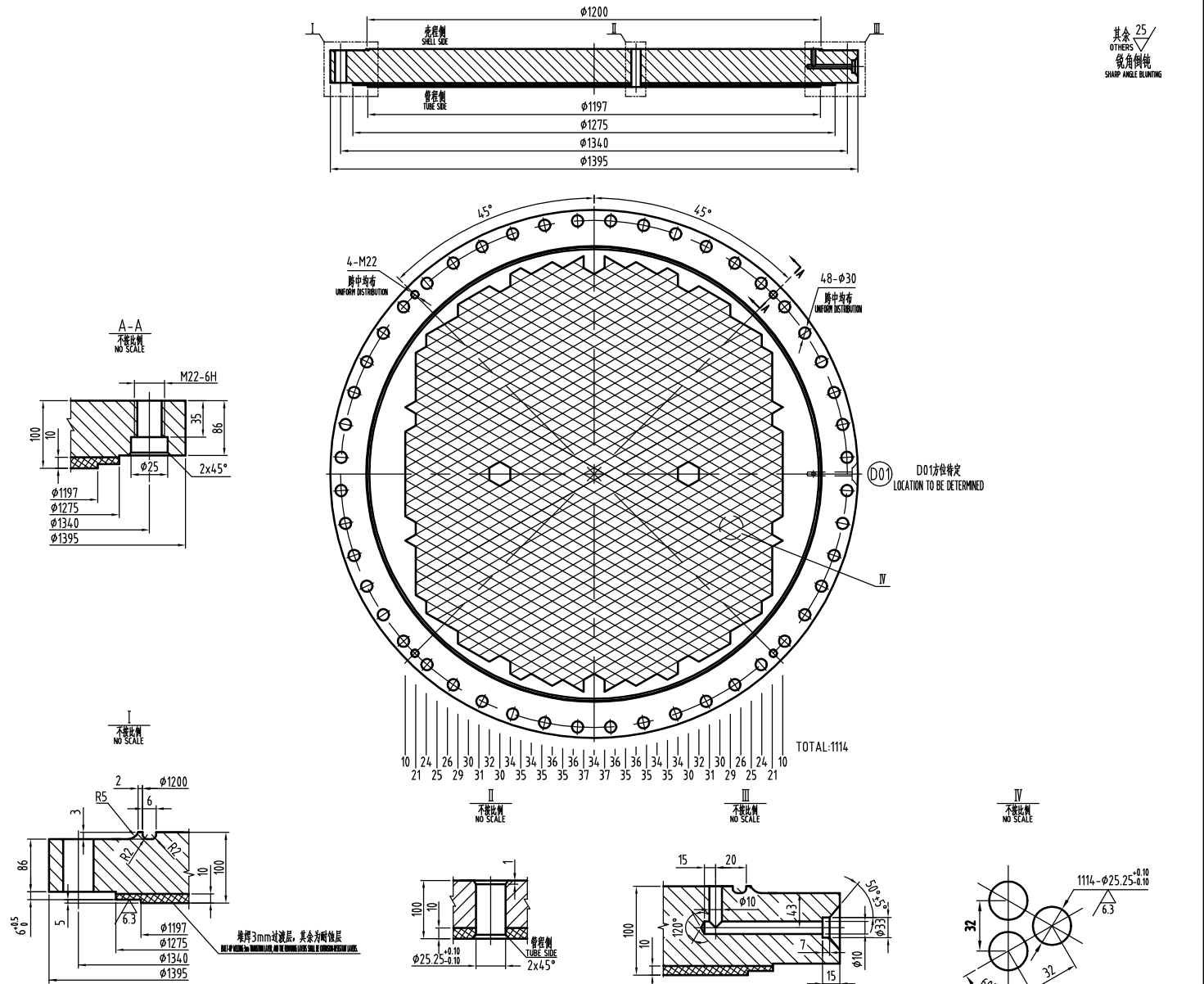
11. 螺栓的基本尺寸按GB/T 196-2003《普通螺纹 基本尺寸》的规定，螺栓公差按GB/T 197-2018《普通螺纹 公差》的规定。

12. 除注明外，机加工面和非机加工面线性尺寸的数值偏差，分别按 GB/T 1804-2000的m级和c级规定。

13. 管板加工完成后应防止划伤表面缺陷。

14. S31603材料及其焊接接头(包括焊接工艺评定)按GB/T4334-2020方法B进行晶间腐蚀试验，平均腐蚀速率应不大于1.6g/m<sup>2</sup>·h，腐蚀试验取样和组批应按GB/T21433-2008第8条规定执行。

18	上管板 8=100 BTH TUBESHEET	16Mn凹堆焊S31603 NON BUILT-UP WELDING S31603	651/51	1:8	HRQ01-00129-02	HRQ01-00129(2/2)
代号 PARTS NO.	名称 PARTS NAME	材料 MATERIAL	质量(kg) WEIGHT	比例 SCALE	所在图号 DWG NO.	装配图号 ASSEMBLY DWG. NO.



TECHNICAL REQUIREMENTS:

1. THE TUBE SHEET MATERIAL 16Mn SHALL BE MANUFACTURED, INSPECTED, AND ACCEPTED IN ACCORDANCE WITH NB/T 47008-2017 "CARBON STEEL AND ALLOY STEEL FORGINGS FOR PRESSURE EQUIPMENT," WITH GRADE B BEING ACCEPTABLE. THE MATERIAL SHALL BE SUPPLIED IN THE NORMALIZED CONDITION.

2. THE TUBE SHEET SHALL BE MADE BY FORGING AND OVERLAY WELDING. THE OVERLAY WELDING METHOD SHALL USE STRIP OVERLAY WELDING (OR A SUPERIOR WELDING METHOD; MANUAL WELDING MAY BE USED FOR SPECIAL STRUCTURES). THE OVERLAY WELDING SHALL CONSIST OF AT LEAST TWO LAYERS, WITH THE FIRST LAYER BEING A TRANSITION LAYER AND THE REMAINING LAYERS BEING CORROSION-RESISTANT LAYERS. THE TOTAL THICKNESS OF THE OVERLAY WELDING SHALL BE 10mm. AFTER OVERLAY WELDING, THE CHEMICAL COMPOSITION WITHIN 2mm DEPTH BELOW THE SURFACE OF THE CORROSION-RESISTANT LAYER SHALL BE INSPECTED TO MEET THE REQUIREMENTS OF S31603. THE SURFACE OF THE ENTIRE OVERLAY WELDING LAYER SHALL BE FLAT, WITH A FLATNESS TOLERANCE OF 1mm. THE THICKNESS OF THE OVERLAY WELDING LAYER SHALL BE UNIFORM, WITH THE DIFFERENCE BETWEEN THE THICKEST AND THINNEST PARTS BEING <1mm. THE THICKNESS OF THE TRANSITION LAYER SHALL BE 3mm.

3. BEFORE OVERLAY WELDING, THE SURFACE TO BE WELDED SHALL BE CLEANED OF OIL, RUST, AND OTHER IMPURITIES. THE SURFACE SHALL THEN UNDERGO 100% MT (MAGNETIC PARTICLE TESTING) INSPECTION, AND NO DEFECTS SUCH AS CRACKS SHALL BE ALLOWED. THE RESULTS SHALL COMPLY WITH GRADE I OF NB/T 47013.4-2015. THE INTERPASS TEMPERATURE DURING OVERLAY WELDING SHALL BE STRICTLY CONTROLLED, AS DETERMINED BY THE WELDING PROCEDURE QUALIFICATION.

4. AFTER COMPLETING THE OVERLAY WELDING OF THE TRANSITION LAYER, STRESS RELIEF TREATMENT SHALL BE PERFORMED, FOLLOWED BY 100% PT (PENETRANT TESTING) INSPECTION, COMPLYING WITH GRADE I OF NB/T 47013.5-2015. SUBSEQUENTLY, THE CORROSION-RESISTANT LAYER SHALL BE OVERLAY WELDED. AFTER COMPLETING THE OVERLAY WELDING OF THE CORROSION-RESISTANT LAYER AND MACHINING (BEFORE DRILLING), 100% PT INSPECTION SHALL BE PERFORMED, COMPLYING WITH GRADE I OF NB/T 47013.5-2015. AFTER MACHINING (BEFORE DRILLING), THE OVERLAY WELDED SURFACE SHALL ALSO UNDERGO 100% UT (ULTRASONIC TESTING) INSPECTION, WITH THE ACCEPTANCE CRITERIA COMPLYING WITH GRADE I OF NB/T 47013.3-2023.

5. OTHER REQUIREMENTS FOR OVERLAY WELDING SHALL ALSO COMPLY WITH THE PROVISIONS OF CLAUSE 9.4 OF HG/T 20584-2020. AFTER COMPLETING THE OVERLAY WELDING AND PASSING THE INSPECTION, THE SEALING SURFACE, JACKING SCREW HOLES, BOLT HOLES, AND TUBE HOLES OF THE TUBE SHEET SHALL BE MACHINED.

6. THE SEALING SURFACE OF THE TUBE SHEET SHALL BE PERPENDICULAR TO THE AXIS, WITH A PERPENDICULARITY TOLERANCE OF 0.04mm.

7. THE DIAMETER OF THE TUBE HOLES ON THE TUBE SHEET SHALL ALLOW NO MORE THAN 4% OF THE TUBE HOLES TO EXCEED THE UPPER DEVIATION OF  $\phi 25.25^{+0.10}_{-0.10}$ , BUT NOT EXCEEDING 50% OF THE CORRESPONDING UPPER DEVIATION.

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9. AFTER DRILLING, 90% OF THE TUBE HOLES ON THE TUBE SHEET SHALL HAVE A BRIDGE WIDTH OF  $\geq 5.66$ mm, WITH A MINIMUM BRIDGE WIDTH OF 4.05mm ALLOWED FOR NO MORE THAN 4% OF THE TUBE HOLES.

10. THE DIAMETER OF THE BOLT HOLE CENTER CIRCLE ON THE TUBE SHEET AND THE CHORD LENGTH BETWEEN ADJACENT BOLT HOLES SHALL HAVE A LIMIT DEVIATION OF  $\pm 0.6$ mm. THE CHORD LENGTH BETWEEN ANY TWO BOLT HOLES SHALL HAVE A LIMIT DEVIATION OF  $\pm 2.0$ mm.

11. THE BASIC DIMENSIONS OF THE THREADS SHALL COMPLY WITH GB/T 196-2003 "GENERAL PURPOSE METRIC SCREW THREADS - BASIC DIMENSIONS," AND THE THREAD TOLERANCES SHALL COMPLY WITH GB/T 197-2018 "GENERAL PURPOSE METRIC SCREW THREADS - TOLERANCES."

12. UNLESS OTHERWISE SPECIFIED, THE LIMIT DEVIATIONS FOR LINEAR DIMENSIONS OF MACHINED AND NON-MACHINED SURFACES SHALL COMPLY WITH GRADE H AND GRADE C OF GB/T 1804-2000, RESPECTIVELY.

13. AFTER COMPLETING THE MACHINING OF THE TUBE SHEET, THE SEALING SURFACE SHALL BE PROTECTED FROM DAMAGE.

14. THE S31603 MATERIAL AND ITS WELDED JOINTS (INCLUDING WELDING PROCEDURE QUALIFICATION) SHALL UNDERGO INTERGRANULAR CORROSION TESTING ACCORDING TO METHOD B OF GB/T 4334-2020. THE AVERAGE CORROSION RATE SHALL NOT EXCEED  $1.6\text{mg}/\text{m}^2\cdot\text{h}$ . THE SAMPLING AND BATCHING OF CORROSION TEST SPECIMENS SHALL COMPLY WITH THE PROVISIONS OF CLAUSE 8 OF GB/T 21433-2008.

技术要求:

1. 管板材料16Mn应按NB/T 47008-2017《承压设备用碳素钢和合金钢锻件》进行制造、检验和验收，Ⅲ级为合格，锻件不允许拼焊锻制，正火状态供货。

2. 管板采用锻件锻制，堆焊方法采用带极堆焊(或性能更优的堆焊方式，结构特殊时可手工焊)，堆焊至少由两层组成，第一层为过渡层，其余为耐蚀层，堆焊层厚度10mm，堆焊后应修磨耐蚀层表面以下2mm深度以内的化学成分，满足S31603的要求。整个堆焊层表面平整，平面度公差为1mm，堆焊层厚度均匀，壁厚与壁厚之差<1mm，过渡层厚度为3mm。

3. 在堆焊前，应清除堆焊表面的油、锈和污物等杂质，而后堆焊表面应进行100%MT检测，不得有任何裂纹等缺陷存在，结果符合NB/T 47013.4-2015中的I级合格。堆焊过程中应严格控制层间温度，具体由焊接工艺评定确定。

4. 管板堆焊过渡层完成后应进行消除应力处理，而后进行100%PT检测，按NB/T 47013.5-2015中的I级合格；然后再堆焊耐蚀层，耐蚀层堆焊完毕且加工后(钻孔前)进行100%PT检测，按NB/T 47013.5-2015中的I级合格。加工后(钻孔前)的堆焊表面应进行100%UT检测，合格标准按NB/T 47013.3-2023中I级合格。

5. 堆焊其它要求还应符合HG/T20584-2020中9.4条要求规定。堆焊完毕并检验合格后应加工管板密封面、顶丝孔、螺栓孔和管口孔。

6. 管板密封面应与轴线垂直，其垂直度公差为0.40mm。

7. 管板管孔直径，允许有不大干4%的管孔上偏差超出 $\phi 25.25^{+0.10}_{-0.10}$ ，但不超出轴向上偏差的50%。

8. 管孔应严整垂直管板密封面，其垂直度公差为0.10mm。管板管孔表面应清理干净，不应有影响连接或焊接连接质量的毛刺、铁屑、锈迹、油污等；孔表面不应有影响连接质量的纵向或螺旋状划痕等缺陷。

9. 管板钻孔后>96%的孔桥宽度应 $\geq 5.66$ mm，允许(<4%的孔桥宽)的最小孔桥宽度为4.05mm。

10. 管板上螺栓孔中心圆直径和相邻两螺栓孔孔长桥宽度偏差为 $\pm 0.6$ mm;任意两螺栓孔孔长桥宽度偏差为 $\pm 2.0$ mm。

11. 螺栓的基本尺寸按GB/T 196-2003《普通螺纹 基本尺寸》的规定，螺栓公差按GB/T 197-2018《普通螺纹 公差》的规定。

12. 除注明外，机加工面和非机加工面线性尺寸的数值偏差，分别按 GB/T 1804-2000的m级和c级规定。

13. 管板加工完成后应防止划伤表面缺陷。

14. S31603材料及其焊接接头(包括焊接工艺评定)按GB/T4334-2020方法B进行晶间腐蚀试验，平均腐蚀速率应不大于1.6g/m<sup>2</sup>·h，腐蚀试验取样和组批应按GB/T21433-2008第8条规定执行。

7	下管板 8=100 BTH TUBESHEET	16Mn凹堆焊S31603 NON BUILT-UP WELDING S31603	651/51	1:8	HRQ01-00129-02	HRQ01-00129(2/2)
代号 PARTS NO.	名称 PARTS NAME	材料 MATERIAL	质量(kg) WEIGHT	比例 SCALE	所在图号 DWG NO.	装配图号 ASSEMBLY DWG. NO.
标注 MARK	名称 NAME	日期 DATE	日期 DATE	日期 DATE	日期 DATE	日期 DATE
制图 DRAWING	设计 DESIGN	审核 CHECK	审核 CHECK	审核 CHECK	审核 CHECK	审核 CHECK
日期 DATE	日期 DATE	日期 DATE	日期 DATE	日期 DATE	日期 DATE	日期 DATE
18	上管板 8=100 BTH TUBESHEET	16Mn凹堆焊S31603 NON BUILT-UP WELDING S31603	651/51	1:8	HRQ01-00129-02	HRQ01-00129(2/2)
代号 PARTS NO.	名称 PARTS NAME	材料 MATERIAL	质量(kg) WEIGHT	比例 SCALE	所在图号 DWG NO.	装配图号 ASSEMBLY DWG. NO.

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