铝真空钎焊缺陷分析和解决方案

铝合金换热器的生产是在真空状态下，对换热器结构件进行加热和保温，使钎料在适宜的温度和时间范围内熔化，在毛细力作用下与固态金属充分浸润、溶解、扩散、焊合，从而达到焊接目的的一种先进焊接方法。换热器**真空钎焊**的突出优点是可连接不同的金属、实现复杂结构的同时焊接，换热器钎焊后的产品焊接头光洁致密、变形小且具有优良的力学性能和抗腐蚀性能。然而真空钎焊下对换热器的结构设计、装配质量，铝合金复合板(以下简称复合板)的化学成分、钎料层厚度，换热器**真空钎焊工艺**制度、换热器装配环境的温度、相对湿度等的要求甚为严格，否则极易出现换热器翅片弯曲倒伏、钎缝不连续、虚焊、熔蚀、直至泄漏等其他质量缺陷。其中：换热器泄漏属重大**真空钎焊**质量缺陷。

换热器产品生产工艺的流程

(1)产品领料：按生产计划填写领料单到零件库领零件，并仔细核对换热器零件名称数量。搬运过程中不准磕碰以免损伤零件。对复合板、翅片、封条等进行定型、按照尺寸加工。

翅片成形工序内容
1.准备
根据图纸或油冷器用《铝翅片成型参数附表》选择正确
宽度和厚度的铝带，装夹在翅片成形机料架上,检查电源确保正常。
2．调整
1）根据图纸或附表调整所需高度，打开电源，轧制 3 段翅片，检查高
度是否在附表规定的尺寸公差范围 $5^{0}_{-0.05}$，且开窗清晰，表面平整,无
毛刺。否则要调整设备直至达到要求。
3．加工
首件合格后开启自动电源按钮，批量轧制 。
注：要不间断滴翅片专用油于铝带上以保证其润滑，防止翅片沾在刀具上。
4 检验
1）高度尺寸每小时自检 3 件，作《高度尺寸折线图》
2）翅片长度尺寸必须完全自检，对于自动切断尺寸大于长度公差上限
的，用剪刀修剪至长度要求，并连同长度合格的翅片一同整齐排放翅片

机右侧的合格零部件的料筐里。对于长度尺寸小于公差下限的翅片则放入
翅片机左侧的红色料筐里（标识清楚，以备长度尺寸较小规格产品修剪
后使用）。
3）要求所有翅片的开窗对称度、毛刺全部自检，出现毛刺过高，开窗
不对称的翅片时，需调整或修理刀具。
复合板落料工 序 内 容
1．备料
从仓库中领取 0.8mm 厚气氛焊用双面复合板要求：表面
平整、光亮、无气泡、无分层、无折痕、无划伤，尺寸：
2000mm×1000mm(2500mm×1000mm)。
2．下料
要求：1、在复合面用蓝色墨水做标记。调整剪板机上的定位，根据《铝板下料附表》尺寸剪成
1000mm×L 的块料。
首件检验合格后批量加工。
每 2 小时自检一次，每次三件。

调整模具，试落料，要求：尺寸 L1、L2、B 按《铝板下料附
表》,并且无缺口,无咯伤;毛刺高度≤0.06。
首件合格后，批量生产。注：每落 100 片要用毛刷沾 20#机
油刷模具刃口部分一次。
要求：1、每 1 小时自检一次，每次三件
2 、每 50 片用压缩气体吹模具型腔一次。

(2)产品表面清洗处理工艺流程:焊前预清理：对工件待焊接的部位，用打磨机清除氧化物，及其它杂质，清理后应可见金属光泽。首次配置碱液：在清洗池中按每吨水放 40Kg烧碱。温度 60±5°，比重值为 9±1。零件摆放：将零部件均匀铺在清洗篮中，凹面向下，一般以每个篮框中放 12 个；同样将零部件均匀铺在清洗篮中，将封条、翅片、侧板分别放入清洗筐，在碱洗池清洗 120 秒、80 秒、100 秒（可根据产品反应速度、PH值、温度、产品数量进行调整），在换热器产品零件浸没后清洗筐要上下晃动不少于三下。换热器翅片摆放时宽度方向竖立摆放，摆放时可多层摆放，但换热器每层翅片与翅片间可以拔动，既有可活动间隙。换热器长封条竖直或倾斜摆放，侧板交错摆放。将换热器隔板宽度方向竖立摆放入清洗筐，换热器隔板间要有间隙，换热器隔板也可多层摆放，在碱洗池清洗 30S，在零件浸没后清洗筐上下晃动不少于三下。换热器零件在碱洗池清洗后进入清水池清水循环漂洗 120S，在换热器零件浸没后清洗筐上下晃动不少于三下。转中和清洗。首次配中和液：将硝酸加入清水中配成 30%的中和液，PH近似为 5±1。中和清洗:将换热器清洗零件进行中和，90S后将换热器零件取出再入清水池清水循环漂洗 120S。此时换热器产品零部件工件清洗洁净无油污，自然烘干或转烘干炉烘干（许多单位节约成本放在太阳下晒，一点都不考虑产品的二次污染）。换热器产品零部件的烘干机温度 120±5℃、烘干转速 120±50r/min。干燥炉烘干温度烘干温度是比较重要的参数，钎焊时，常通过工艺试验确定不同产品的烘干温度，在保证烘干水分的前提下．烘干温度越低越好。装入小清洗烘干筐的零件可直接进烘干机烘干，如大清

洗筐，需将换热器零部件取出放入清洗烘干筐，摆放如清洗时摆放或散开摆放在烘干网带上进行烘干。将清洗烘干后的换热器零部件填写生产转序卡转下道工序。

1 真空钎焊焊前处理工艺准备
1）将需要清洗的零部件分别均匀的排列在专用料筐内，每个空格只能放一件。
2）焊料圈要单片挂于料筐的定位柱上，不得有重叠。
3）调整清洗线运行时间，将频率设定为 9~16 之间，超声波清洗机电流 3~4A。
2．除油、清洗
1) 将摆好零部件的料筐放在清洗线链条上（料筐或零部件不得伸出网带外部），依次进行除油、
喷淋、浸清水、喷淋，除油液浓度（2.8±0.2）%，温度 60℃。注：首次配置时加清洗液 50kg。
2）用离水检验法检验工件清洗是否干净，附着在工件上的水膜均匀为清洗干净，否则须调整除
油液浓度、调整链条速度、更换喷淋槽中的水，检验频率 1 次/半小时。
注：
1）含油多、难清洗的零部件需先在预处理槽中处理后再放在清洗线链条上。
2) 每清洗 800 台（约 12000 片）后需添加清洗液 25kg，清洗 1600 台（约 24000 片）后彻底更换
除油液一次
3）喷淋及浸泡处清水每半小时自检一次，发现表面油污较多时及时更换，每班至少换清水一次。
4) 每次配制清洗液填写《除油液配制记录》。

(3)组装:按侧板和封条尺寸调整装芯夹具。戴好防护手套开始装芯在同一夹具上并排摆放两个芯子，芯子相对夹具摆放均布，先放侧板再放隔板，依次放短封条和内翅片，重复放隔板、长封条和内翅片，隔板、短封条和内翅片，当内翅片数达到图纸要求数量时放隔板、侧板。最后放上夹具。用不少于 6 根的 M12 拉杆对称拉紧的同时整形（数显扭矩扳手 32N.m）。芯宽压紧尺寸为大于图纸要求尺寸的 1.25%或图纸要求的焊接前尺寸±1mm。将装好后的换热器芯子并排摆放在芯子暂存架上严禁将不合格及未清洗干净的换热器零部件装芯，装配过程中要戴好手套，以防汗渍等粘在换热器零件上，影响钎焊。装配换热器芯子对角线≤2MM。外观：换热器翅片无倒伏、封条整齐。换热器芯宽≥芯宽尺 1.25%。零部件与图纸要求数相符。

成品质量检验记录表

编号 ：

序号	检验项目	技术要求/依据	检测手段	判定方法	检测记录	备注
1	参与装配的连接尺寸	图纸	卡尺/角尺或卷尺等	各项合格接收		
2	外观 1.翅形 2.漆层均匀性 3.表面粗糙度 4.焊缝	1.翅形整齐 2.喷漆工艺守则 3.设计图/GB1804e级粗糙度 4.总装及氩弧焊工艺守则	1.2.3.目测 4.按数量抽样	1.翅形整齐 2.漆层均匀 3.符合设计图及GB1804规定 4.无缺陷，成形美观。各项合格接收		
3	包装	产品包装技术条件	目测	符合FSJT101-03规定合格		

4	其他 1.标牌	设计图	目测或其他 2.应按数量抽样	符合设计图。 各项合格接收		
检验结果						
检验员				检验日期		

作 业 顺 序

1、首先进行日常的设备点检。

2、领取换热器的封条、散热带、内翅片、隔板等，对领取的部件和辅件进行检查，并将不合格品剔除。

3、根据《换热器芯部参数表》选用相应的装芯工装、卡具。将钎焊卡具底板放到组装台上，将侧板对准组装台的限位槽平放在夹具面上，放上一片隔板，

4、在两端组装限位槽内各放一根短封条（带锥面向里）。

5、在隔板上布好散热带，放上一片隔板，再在隔板上装上两根长的封条（带锥面向里）。

6、在两长封条之间放入内翅片，放入数量根据封条长度而定重复叠加直到达到图纸要求数量，最后放一片隔板和侧板放上钎焊夹具固定好，用整平板将芯面、带面整平拧紧螺母取下芯体。

7、对芯体进行整体整平，调整散热带与两端封条的距离（带头保持平齐，两大面平整,结合部位平齐无明显落差），装上夹具的螺杆拧紧螺母将芯体固定好。

8、用卷尺测量芯宽和对角线保证芯宽和对角线与图纸要求尺寸是否超差，如有超差进行修整。

9、按下面管理项目所规定的控制项目和检查频率检查。

10、将换热器芯子分总成放在周转车上。

附：清洗工序操作规程

1 总则

1.1 本守则规定了产品钎焊零件（翅片、散热带、封条、隔片、护板）装配前的清洗、烘干及操作要求，以确保产品质量及人身、设备的安全。

1.2 零件的清洗质量对钎焊质量有着密切的关系，必须严格认真的执行。

2 准备

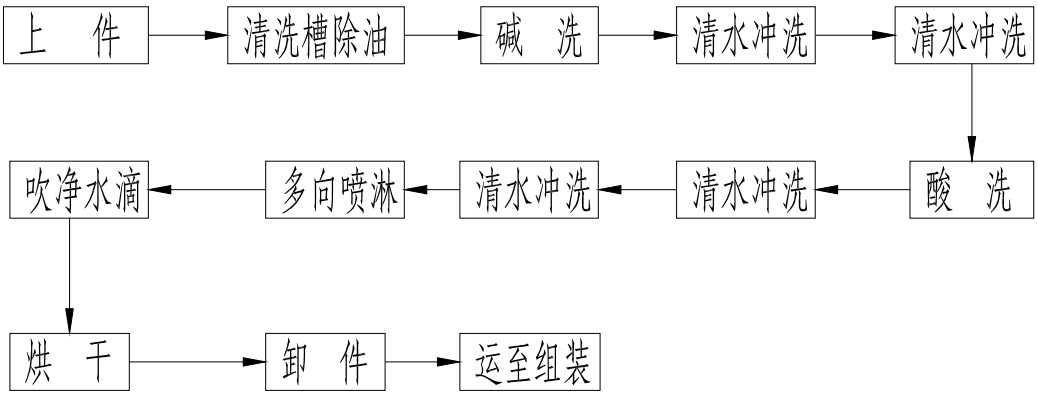
2.1 做好溶液的浓度配比

2.1.1 清洗液温度 60℃之间（温度计控制），浓度按 2%~3%配比。

2.1.2 碱液温度控制在 60℃之间（温度计控制），浓度控制在 10~12 之间（比重计控制）；

2.1.3 硝酸溶液温度为常温，浓度控制在 9~10 之间（比重计控制）。
2.2 准备好工位器具、上件
2.2.1 将翅片、散热带、封条、隔片、护板分别插入专用料筐内，插入过程中板面不擦伤、插后不彼此贴靠；翅片、散热带、封条立式摆放，不穿叉、不叠层。
2.3 戴好防护用品
3 清洗按下列程序进行
3.1 在清洗液槽中除油，时间 3~4 分钟，其中上下游动 5~6 次，并及时将浮油及脏污撇去；
3.2 在碱槽中浸泡（其中翅片约 1 分钟，封条、复合板约 1.5 分钟），其中上下游动 5~6 次，浸泡后零件必须颜色一致，不得有亮点，否则则延长时间。
3.3 清水冲洗（2 次），***碱中浸泡结束后要尽快将工件浸入清水中***；
3.4 在硝酸溶液中浸泡 1~2 分钟；浸泡后零件应发白，颜色一致；
3.5 清水冲洗（2 次）；
4 个别未洗净之处可重新清洗或用丙酮擦拭。
5 工件从清水槽提出后进行 2 分钟的多向喷淋；
6 清洗后的零件用干燥空气吹净水滴。
7 吹净水滴的零件放在烘箱中烘干，温度 60℃，直到烘干无水迹为止。
8 烘干后的零件必须戴干净白手套放入周转箱内，既送装配，一般在 12 小时内，最长不超过 24 小时装完。
9 检验：清洗烘干后的零件必须光泽一致，表面无亮点，不得有任何局部氧化及暗斑，零件与清洗前尺寸、强度基本一致，不得有明显变薄情况。

清洗工序过程流程图



1 操作工必须将零件合理的摆放，保证隔片、护板插入过程中板面不擦伤、插后不彼此贴靠；翅片、散热带、封条立式摆放，不穿叉、不叠层。
2 操作工必须保证清洗液浓度 2%~3%，温度 55~60℃；碱液比重 9~10，温度 55~60℃；硝酸比重 9~10。
3 操作工必须对清洗液浓度、碱液比重、酸液比重定时监测，每天 3 次（加工前、加工中、加工后各一次），发现比重低时及时添加，并将检测数值、添加清洗液、碱、酸情况做好记录每天报工艺部。
4 操作工必须保证除油时间 3~4 分钟；碱洗时间翅片约 1 分钟，封条、复合板 1.5 分钟；酸液 8~10 分钟。其间分别上下游动 5~6 次。
5 各清洗槽中浮油每清洗一筐必须立即清除。

6 工作必须吹净水滴后再入烤箱烘干，温度 60℃。
7 烘干后的零件必须戴干净的白手套放入周转箱送到组装工序。
8 清洗现场必须保证清洁，料筐摆放整齐。

(4)换热器的**真空钎焊**:换热器产品炉内摆放：用叉车将换热器芯子暂存架上的换热器芯子六个为一炉次，放入**真空钎焊炉**内，放置时前后左右居中放置，严禁放置时工件和夹具与钎焊炉的内壁接触，且放置要平稳轻放，以免损坏钎焊炉内壁钼屏和加热器。钎焊：设定该换热器产品的钎焊工艺参数，无特别要求的执行换热器**真空钎焊工艺**，按《**铝真空钎焊炉**操作规程》操作设备。

真空钎焊温度:

真空钎焊温度是根据所选用的钎料的熔化温度来确定的.**真空钎焊**温度只与所选定的钎料成分有美，而与产品的结构和形状无关 常由原材料厂家提供．在工艺试验时根据钎焊质量再适当调整。对真空钎焊炉抽真空后进行七个阶段的加温、保温，其工艺曲线如下图所示。

换热器钎焊工艺

即:第一阶段产品预热升温;第二阶段蓄能保温和第三阶段钎焊升温、第四阶段钎焊保温、第五阶段钎焊升温、第六阶段钎焊保温;第七阶段钎焊停电、降温。待钎焊炉温降至规定温度出炉：当产品按钎焊工艺结束后，温度降低到 350 度时，打开进气阀，平衡炉内外压差。打开炉门，将已经焊接好的换热器芯子及夹具用叉车平稳的移出放在芯子暂存架上。打开炉门时，操作者在炉门的前面打开炉门，不要在侧面，以免刚打开时热气伤人。产品温度高，不要直接触摸，以防烫伤。待冷却后进行拆除夹具操作。

4.1 查看每炉换热器产品的钎焊记录和换热器产品在炉内位置摆放记录，检查钎焊工艺是否正常，重点检查 520℃和 560℃两保温段的保温时间是否超长，真空度是否达到设定的真空度。因换热器钎焊温度在 59O℃～600℃， 熔点相当接近母材的熔点，因此应当严格地控制加热温度， 在保证钎透的情况下， 钎焊保温时间为 30～50 分钟为宜 当钎焊温度在 520℃以下时， 可采用较快的加热速率(4-5℃／min)和较长的保温时间， 也可设两个保温段， 而在 520℃以上，则需采用较慢的加热速率(4~5~C／min)和较短的保温时间，以达到钎焊质量和效率的完美结合。换热器钎焊温度因为换热器中心部位．没有辐射源，温度偏低，在钎焊温度偏高时，换热器中心温度低于表面温度、由于铝舍金线胀系散约为不锈钢夹具材料的 1．5 倍，且中心翅片在较高温度时，换热器中心强度明显降低，在夹具、配重材料的压力作用下产生部分塑性变形。在换热器钎焊降温后，产品的收缩量比夹具的收缩量大，使产品

与夹具之间产生了部分间隙，翅片在重力和配重材料的共同作用下产生错位。在钎焊保温结束后，适当地加快冷却速率，有利于细化纤缝组织，减小枝晶偏析， 从而提高钎焊强度，但如果冷却速度过高，可能使焊件形成过大的热应力而产生裂纹， 一般可选用 15～20℃ / m 的冷却速率。

产品摆放密度

产品摆放密度就成为影响钎焊质量的关键因素 对于尺寸较大，质量较小的产品(夹具) ，可以凭以往类似产品的工艺经验，直接进行工艺试验，确定产品摆故密度。但对于尺寸较小，质量较大的产品，建议先按以下方法计算，再工艺试验后确定，否则，损失严重。设：产品烘干温度为 T0 / ℃ ，钎焊温度为 T1 / ~C，保温时间为 I / s，摆放密度为 n / (件·m-1)，产品比热为 c1 / 【kJ，(kg，℃) 】、质量为 m1 / (kg ·件-1)，夹具比热为 C2 / 【kJ·(kg，℃) -1。】、质量为 m2 / (kg，件-1) ．真空钎焊炉额定功率为 P / kW，真空炉加热区长度为 L / m，宽度 W / m、度为 H / m。真空钎焊炉内换热器带走的热能功率和通过炉体表面散发的热能功率为 p1 / kW，产品和夹具嗳收的热能功率为 p2 / kW，钎焊炉加热区长\宽\高为 L W H / m。钎焊过程中 P-与环境温度有关，环境温度一定时，认为

P 一是常散，通过测试方法获得。例如：今天的温度在 15℃。在保持换热器正常钎焊的条件下，真空钎焊炉内不放产品，通过控制柜仪表显示的实时电流和电压值计算得出．P1。

又．$P_2=(c_1\cdot m_2+c_2\cdot m_2)(T_1-T_0)v\cdot n$ 所以总的耗热功率为 P 耗 = P1+ P2 ，而钎焊炉最大的发热功率为 P 发热 =P1，保温区段的功率为 $P_1\cdot v\cdot t\cdot L^{-1}$。当 $P_{耗}=P_{发热}-P_1\cdot v\cdot t\cdot L^{-1}$ 时，为最佳的摆放密度，

$$n=(P-P_1-P_1\cdot v\cdot t\cdot L^{-1})/[(c_1\cdot m_2+c_2\cdot m_2)(T-T_0)\cdot v],$$

此时钎料已完全熔化并有合理保温时间， 各处的钎缝饱满，无钎焊缺陷。这时．n 为该环境温度下最大的产品摆放密度。

换热器钎焊预热保温时间、抽真空时间

对于大型工件(有效直径≥1m)换热器的预热保温时间为：即 T1=3D(2) T2＝6D(3) T3=9D(4)

式中：T1 为第一次预热时间/h；T2 为第二次预热时间/h；T3 为最终保温时间/h；D 为工件有效厚度/m。

对于换热器在 800～1000mm 的，一般加热时应该有一次或二次预热保温，并且阶梯加热时，最大温差出现在 400～560℃和，在这个温度范围内的保温时间基本可以提高真空炉的真空度。通过实际生产证明，对于真空炉加热的中小零件(有效尺寸≤500mm)，预热和加热时的保温时间也可按以下方式计算。

G=301—600kg：T 真 1=T 真 2=T 真 3=30+D(13)

G=601—900kg：T 真 1=T 真 2＝T 真 3=60+D(14)

G≥901kg： T 真 1=T 真 2=T 真 3＝90+D(15)

抽真空时间是根据**真空钎焊炉**的旋片泵扩散泵

换热器钎缝装配间隙

复合板和封条接触面较小，钎料可以从钎缝两面进行钎悍，所以不需预留钎焊间隙。依靠外面的钎料流入钎缝钎接．并且对钎缝的强度和可靠性要求高，所以，除选用复合层较厚的单面或双面复台材外，应预留 0 .05—0 .10mm 的单面钎缝间隙

二、换热器加热保温时间的计算

传统的换热器钎焊加热保温时问的计算公式如下所示

T1=30+(1.5～2)D(5)　T2=30+(1.0～1.5)D(6)　T3=20+(0.25～0.5)D(7)式中：D 为工件有效厚度/m；T1 为第一次预热间/min；T2 为第二次预热时间/min；T3 为换热器最终保温时间/min。

换热器**真空钎焊保温时间**还与换热器产品装炉量的大小有关，**真空炉**的加热保温时间与装炉量、工件有效厚度等因素之关系的经验公式如下：

T 真 1=T 真 2=T 真 3=O.4×G(kg)+D(mm)(8)

式中：G 为换热器装炉工件净重量/kg，其它符号意义与以前各式相同。该式是基于换热器产品装炉量在 100～200kg 左右，工件有效尺寸在 100mm 左右。工件尺寸基本相同，摆放整齐，并留有一定空隙(摆放空隙< FONT>

G≤300kg：T 真 1=T 真 2=T 真 3=30+D(9)

G=301—600kg：T 真 1=T 真 2＝T 真 3=(30—60)+D(10)

G=601—900kg：T 真 l＝T 真 2：T 真 3=(60—90)+D(11)

G≥901kg：T 真 1=T 真 2=T 真 3=90+D(12)

式中：G为换热器装炉总重量，包括工件、料筐、料架及料盘的所有重量(kg)；D为工件有效直径/mm)。

对于变形要求严格的换热器，因为**真空炉**在低温时传热速度较慢，第一次预热保温时，若时间太短则工件表面和心部的温差太大，可能会造成工件热应力变形。因此，第一次预热时间应取上限值，第二次预热取中限值，最终热处理取下限值。对于普通铝合金换热器工件或变形要求不太严格的工件，第一次预热的时间可以取下限值，而在最终加热时取上限值。对于一炉仅装一件的大型工件，因为其受热均匀，传热较快，透烧较好，第一次和第二次预热时可以取下限，最终加热时，则根据实际要求取中限或上限。这样不但保证了换热器钎焊后的质量要求，也大大节约了换热器钎焊加热时间，降低了换热器**真空钎焊**生产成本。

4.2 换热器钎焊芯体的检验标准

4.2.1 封条、内翅片、隔板与散热带的钎焊缝的钎透率达到 80%以上，每根散热带与隔板无2cm以上的连续虚焊。

4.2.2 换热器散热带无熔蚀、倒伏；主板无焊料的堆积、流持，隔板通孔无钎料堵塞，换热器芯体外观无磕碰变形。

4.2.3 换热器芯体整形后主板、扁管、护板无大于 1cm的弯曲变形，换热器芯体的对角线偏差小于 2cm，芯体大面的平面度误差小于 2cm。

4.2.4 对于在护板外侧焊挂件的换热器芯体，两护板间的距离尺寸符合图纸要求。

4.2.5 检查操作工自检中对于钎焊虚焊的长缝是否用记号笔进行标识，对不合格品换热器产品是否隔离放置。

4.3 换热器钎焊质量的抽样和检查方法

4.3.1 换热器钎焊产品每炉抽检不能少于四台，对于钎焊工艺异常的炉产品要加倍抽检或全检,以确保大面积虚焊换热器产品的及时发现和处理。

4.3.2 对于 5.2.1 项中的扁管与散热带虚焊情况的检查，首先目测散热带的每个波峰与扁管间是否有饱满的焊点，对于无明显焊点的焊缝用细不锈钢针拔是否有松动，如果有连续的松动力则做好标识记号和炉号记录以便以后的统计分析。5.2.2、5.2.5 为目测检查项，5.2.3、5.2.4 采用 1m的钢直尺测量检查。

4.3.3 换热器芯体对角线长度的测量方法

取最外侧的扁管与主板焊接处的同一参照点进行测量对比。

2.1　换热器的装配

(1)换热器结构件的表面预处理

换热器的所有结构件在组装前均须经过表面处理即酸碱洗,以除去表层污垢、油渍、氧化膜等。污垢会阻碍构件间的有效接触;油渍在真空高温时将会分解气化，降低真空钎焊炉内

真空度；由于铝合金换热器
表层氧化膜致密,其熔化温度远比基体材料的要高, 特别是复合板钎料层的氧化膜在钎焊时钎料层熔化不充分，造成不能与被焊金属完全熔合,从而影响钎焊质量。为此必须严格控制原材料的表面预处理， 包括必要的机械清理，同时缩短钎焊前的装配时间。
(2)**换热器**产品结构件尺寸公差
复合板、大翅片、小翅片、大封条、小封条在进行定型、定尺加工后的尺寸偏差配合必须得到有效保证。换热器翅片应控制在正偏差范围，封条则应控制在负偏差范围。否则无法保证装配后复合板在与封条紧 密配合后，再与翅片间有适宜的接触面积即钎缝间隙,易造成虚焊、钎缝不连续或未焊合现象。
(3)结构件表面粗糙度及其形状
结构件表面粗糙度影响毛细力。一般说来，表面过于光滑，钎料难以在整个接触面积上分布均匀，由此产生的空穴会使钎焊强度降低，特别是封条的表面粗糙度。为了保证钎料均匀分布于接触焊缝上，结构件的钎焊面应有适宜的粗化。通常，表面粗糙度参考值可Ra0·7mm~2·0μm的平方根为宜。另外,，封条的内侧应制成 30°的倒角，有利于在真空钎焊时降低焊料的表面张力,增加润湿性,减少钎焊缺陷。
(4) 换热器**真空钎焊夹具**设计要点、夹持力
由于换热器装配后采用不锈钢真空夹具进行夹持，焊后翅片弯曲倒伏，夹紧力太小，翅片易松脱。故应根据具体换热器的结构设计设定适宜的夹紧力例如：利用柔性钎焊夹具。联系人：蔡东俊 联系电话： 13013744698 或 13905275903
钎焊材料的选择
因真空钎焊炉的特殊性．使用材料要有良好的热稳定性和耐腐蚀性及较好的传热性和耐磨性。因为夹具经常在高温状态下使
用，时冷时热．容易氧化和变形；钎剂残渣影响装配精度，需经常清除，它与产品紧密结合，传热性不好时会影响产品的升
温；一般采用 1Crl8NigTi。
钎焊结构设计
真空钎焊夹具除了要满足常规夹具的要求外．还应该满足如下要求。
材料形状
由于钎料的焊接温度范围小．夹具的热传导和热损耗对钎焊温度影响大，夹具与产品接触的部位热容量小，局部热容量过大时，会产生局部虚焊．经常采用的方法是使用空心材料和将接触面挖空，以减少夹其与产品的接触面积和降低夹具的热容量。
换热器结构设计
由于铝合金的线胀系数与夹具的线胀系数相差较大，因此加热时会有较太的内部应力。当夹其稳定性戈佳时，热胀引起
的应力迫使夹具产生内部相对移动而使产品变形，因此夹其应有较好的稳定性，最好将夹具设计成整体结构，尽量避免使用单十夹1蜃杆；为了释放因加热产生的热张，夹具还应有一定的弹性，因为翅片在较高的温度下，强度降低鞍严重，刚性太大时，在夹力的作用下，翅片会弯曲变形．影响外观质量。具体请参考：
换热器**铝钎焊工装夹具**设计
引 言
换热器是在真空下进行钎焊的，他能够获得精密光亮的接头，而且接头具备优良的机械性能和抗腐蚀性能，**真空钎焊**与其它钎焊方法相比，在零件氧化和零件变形的控制方面具有明显的优势，这些特点对于换热器、风冷散热器，水冷冷板和有特殊要求的箱体、盒体都非常适合，直接可以获得高精度的零件，质量也易于控制，现在**真空铝钎焊**在电子产品冷却系统

中的应用已十分广泛。换热器钎**真空钎焊**的主要工序包括：零件加加工、钎焊前处理、零件装配和固定、钎焊、钎焊后处理及质量检验等，每道工序均会影响最终的真空钎焊质量，下面主要讨论真空铝钎焊夹具设计和选择时必须考虑的因素。

1、 换热器钎焊夹具及其一般设计原则

换热器**钎焊**时钎焊零件应装配定位，以确保零件之间的相互位置和钎焊要求的接头间隙。钎焊夹具要涉及到钎焊零件的固定、装配、进炉、钎焊、出炉整个过程．夹具是否合理和实用直接影响到钎焊质量。普通夹具设计的原则和要求同样适用于钎焊夹具的设计，如夹具系统要具有一定的精度；夹具系统要具有一定的刚度以克服加工过程中的变形；夹具系统要具有结构紧凑、形状简单、装卸方便的特点 除了要考虑以上的原则，钎焊夹具还有它自身的特点，一般来说钎焊夹具设计还要考虑如下因素：

(1)夹具材料要可以经受钎焊温度，而不丧失强度，不变形和放出气体，不易与组焊件产生合金反应；

(2)重视夹具和零件的温度膨胀和收缩，在钎焊温度下，要保证钎焊零件具有合适的接头间隙；

(3)夹具要保证钎焊区的热传导，引起的热量转移对零件的稳定加热降温产生干扰最小，并且不妨碍钎料的流动。

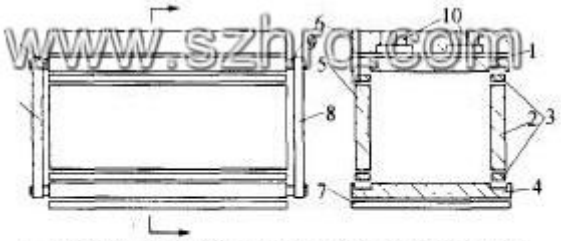
2 换热器**铝钎焊**夹具设计

2．1 **夹具**材料的选择夹具材料选用，最根本就是要保证：在钎焊温度下，夹具材料的刚性要大于钎焊零件材料，这样在钎焊过程中，焊件的变形始终受夹具的限制，焊件及其配合尺寸可以依靠夹具装配得到保证。**真空铝钎焊**工作温度在 600 ℃左右，钎焊时间 3～6 小时，一般情况选择 1Crl8Ni9Ti 可以满足使用要求 1Crl8Ni9Ti 属奥氏体不锈钢，抗氧化性达到 700 ℃以上，重要的是在钎焊温度时还有足够的热强性，刚性远大于铝合金，组织稳定，长期旋用不会脆化，故而，钎焊夹具基本框架及主要工作部件采用 1Crl8Ni9Ti 是非常合适的；对于一些配合尺寸及精度要求高的零件，夹具设计必须要涉及螺纹副以及定位孔轴配合，材料选择不合适，组织接近，热稳定性差，钎焊温度下夹具零件之间会有“咬死”现象，而选用铸铁与 lCrl8Ni9 Fi 配合交替使用就可以较好地解决这个问题。

2．2 要考虑热变形的影响

钎焊夹具及零件在钎焊温度下产生热变形对钎焊过程的影响应该着重予以考虑。由于夹具和钎焊零件的材料不同，热膨胀系数不同，在加热的情况下，会产生膨胀量差，钎焊零件会产生变形，夹具的目的就是让钎焊件随夹具的变形而变形，一般来说，主要对钎焊件平面度、垂直度、焊缝间隙有要求．其它要求不十分严格的零件，采用强制变形夹具可以满足使用要求；但是对于某些外形尺寸、配合尺寸精度要求比较高的零件，采用强制变形夹具就不能满足使用要求了，必须考虑在强制变形夹具的基础上，设计部分弹性元件组成柔性夹具系统，弹性元件一般采用高温弹簧或弹性夹头，经过膨胀量差的计算，控制弹性元件的变形范围，这样既可以对钎焊件保持必要的压力，又解决了膨胀量差的问题。

如图 1 所示，



1. 上导轨板; 2. 右侧板; 3. 钎料; 4. 下导轨板; 5. 左侧板;
配重平板; 7. 垫板; 8. 定位板; 9. 垫柱; 10. 散热孔及散热型腔

3 钎焊夹具示意图

零件为换热器焊件，上下导轨板与前后支撑框组成一个可拔插插件的箱体，上下盖板与上下导轨板之间放置波纹板起到散热作用。总体而言此零件有一个显著地要求，尺寸精度及装配精度要求高，成型后不经过加工，上下导轨板之间插槽定位精度不超过 0．15mm，上下间距尺寸精度不超过 0．2 mm，插件需拔插自如。在实际生产中经过对夹具及焊件材料热膨胀量精确地分析计算，设计弹性不锈钢垫和钢性C形夹配合使用，消除了热膨胀差对钎焊的影响。如图 1 夹具系统所示，箱体周边上下依靠小的刚性C形夹(图件 6)及垫板夹紧，箱体上下四个角在整个高度上用C形夹及弹性元件整体夹紧(图件 9、10)。按照两种材料热膨胀系数计算产生的膨胀量差。

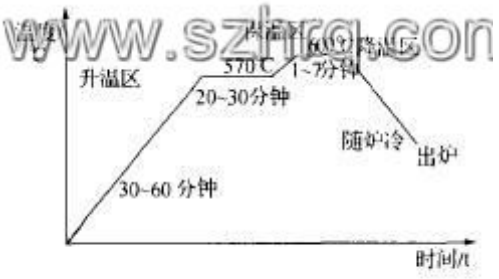
计算公式为：

$\triangle L=L\times \triangle T\times \triangle =L\times \triangle T\times(a2-a1)$

其中：△ 是热膨胀产生变化的膨胀量差；L 是夹持距离；△T 是钎焊温度减去室温，这里取 570℃～580℃；a2 是夹持件平均热膨胀系数，℃； a1 是被夹持件平均热膨胀系数，℃。箱体总高为 410 mm，四周小夹头夹持距离为 35～ 40 mm。经过计算，箱体总高度方向夹持后受热产生间隙量为一 2.38 mm，四周小夹头夹持后受热产生间隙量为一 0.19 mm(间隙量为负值说明加热膨胀后被夹持物长度大于夹头夹持间距)。在小 C 形夹头夹持位置受热后间隙为 0．19 mm，分析认为：此处包括两个钎焊面，由于钎焊料填充接头间隙。每一个钎焊面存在 0．10 mm 的塌陷，两项相抵，采用刚性夹头是可行的；而箱体整体高度上受热后间隙为 2．38 mm，减去四个钎焊面塌陷，还存在的间隙为 2 mm 左右，如果间隙调整太大，受热后夹持物不能有效夹紧，钎焊需要间隙无法保证，易于产生焊接不充分或焊缝明显不均匀的现象；如果间隙调整太小，受热后夹头形变量不能满足焊件的形变要求，箱体会因夹持物限制而变形，即四角支撑柱由于热膨胀空间不足而产生弯曲或扭曲变形，造成零件报废。通过自制不锈钢弹簧垫(图中件 10)(弹簧垫的变形量控制在 2 mm)的配合使用较好地解决了这个问题，钎焊件焊接充分，包括上下四角部分焊缝均匀一致，符合设计要求。

2．3 夹具要充分考虑到钎焊件加散热均匀性的要求钎焊时零件的加热和冷却速度也是重要的工艺参数，铝的真空钎焊，**真空度**控制在 3×10^{-3}Pa 左右，采用辐射加热，就是为了保证在真空钎焊过程中加热散热是一个均匀的过程，这样焊件的变形可以减少到最低，易于保证焊件的尺寸精度。

如图 2 所示



2 钎焊温度曲线

为铝钎焊热循环温度曲线 如果加热过快，会使焊件内温度不均匀而产生内应力，加热过慢又会造成例如母材晶粒长大，钎料低沸点组元蒸发以及金属氧化钎剂分解等有害过程的急剧发展,焊件的冷却速度对于接头质量也有直接的影响，过慢的冷却可能引起母材晶粒长大，加快冷却速度有利于细化钎缝组织提高接头强度，但冷却过快可能使焊件因形成过大的热应力而产生裂纹，或钎缝过速凝固使气体不及逸出而产生气孔。在焊件的温度控制方面以上述曲线为基准，在钎焊中都可以取得很好的效果，曲线中加热速率主要由焊件的材料形状及结构尺寸来决定，也与使用钎料的形式及钎料的结晶温度范围有直接关系。但是如果钎焊夹具忽略了散热性要求，限制了零件的热交换，钎焊件焊缝质量就难以保证。

钎焊零件是一个由上下导轨板及左右侧板通过钎焊连接而成的盒体，此零件不仅要求成型后插件拔插方便，而且对于盒体有气密性要求，这样在对钎焊精度有很高要求的同时，也提高了两侧焊缝的焊接标准，在实际钎焊过程中，经检验发现焊件存在气密检验不合格现象，这就是说焊缝的质量不达标准。经过分析，确认是真空钎焊夹具设计不合理，夹具限制了钎焊区的热传导进而影响了焊缝质量，在真空夹具设计时没有考虑散热性的因素，焊件处于前后定位板及配重平板的包围之中，影响到盒体内外的热交换，钎焊件的加热及散热过程受到夹具影响，在此过程中，盒体内外的温差可能引起热膨胀、冷收缩时变形不一致，而真空钎焊的作用过程是一个快速的过程，当钎焊件达到钎焊温度时，钎料的润湿和接头的形成大约只需要几秒钟的时间，钎焊件内外温度不一致，极易造成焊缝有气孔、夹渣，甚至是焊缝开裂，焊件报废。为了解决这一问题，在真空钎焊夹具(见图 3)的前后定位板和盒体之间设计增加了垫柱(图示 9)，定位板增加了散热孔，配重平板上设计了散热型腔及散热孔(图示 10)，此措施解决了钎焊件加热及散热的均匀性问题，提高了焊缝质量，达到了零件气密性的要求。

3 小 结

真空炉中**真空钎焊夹具**设计要考虑的因素比较复杂，在保证以上要求的条件下，还要考虑到重力影响，焊件加热后，接头因膨胀松弛，钎料会自然出现向下流动的趋势，所以必须注意夹具及焊件的夹持及放置形式；夹具结构要尽可能简单，真空钎焊是一个封闭进行的过程，具体过程不可见，夹具越简单，不可预见的问题越少，这样真空夹具可靠性高，可操作性强。总之，钎焊夹具设计应重点保证以下几个方面：保证钎焊件接头间隙，对于铝及铝合金的组装件，接头内有 0．05～0．10 mm 的间隙，此时钎料流动性最好；重视夹具与组焊件在钎焊温度时的膨胀和收缩，考虑膨胀系数的区别，保证零件相互协调；夹具对零件钎焊过程的影响最小，保证不影响钎焊区的热传导，不妨碍钎料的流动。

真空夹具的夹持力一般用数显扭力扳手控制。夹持力一般控制在 13905275903 或 13013744698

(5)换热器外观的整形:对换热器真空钎焊后的变形,一般采用机械法进行矫正。
操作方法：
1、 将换热器芯体放在**整形夹具**上，调节螺杆通过整形板对芯体进行整形，使两对角线长度差值达图样要求。
2、 目测换热器芯体大平面平面度误差，如误差超过 2mm，应固定一侧，用手轻扳另一侧进行较正，直到符合规定要求。
3、 用压缩空气吹除水管内杂物。
检查整形所使用的工装夹具的尺寸是否符合产品图样的要求。
操作现场工艺文件及生产图纸是否齐全，操作工是否按工艺文件的要求进行操作，对于需要敲击整形的尺寸是否存在野蛮操作，是否认真填写质量记录。
整形产品的检验标准
各装配孔的中心距尺寸、外形尺寸，气室孔的中心距尺寸符合产品图样的要求，装配孔的对角线中心距误差小于 2mm，各装配孔在与芯体大面平行的平面上的平面度误差小于 2mm。装配孔无变形和锉修现象，换热器产品无因整形不当而造成的变形和破裂缺陷，芯体无磕碰。
(6)导流板焊接:采用氩弧焊方式焊接换热器的导流板,即换热器两端大封条位置。
设备，仪器,工装夹具:
氩弧焊机
辅助用料:
铝镁焊丝 ER5356
动作要领：
首先进行日常的设备点检
1.根据《设备操作规程》调节氩弧机的相关参数。
2.对支撑板与主片结合处进行焊接，四个结合处都要求焊接，焊接点均匀美观，不可漏焊。取上一工序半成品，将固定板与护板进行焊接，上下两边各三处。不同产品要求焊接点的数量不同,根据技术要求进行焊接,每个焊点的长度为 6-8CM。
3、领取水室对领取的部件和辅件进行检查，并将不合格品剔除。焊前须清除焊件表面的油脂，涂层，润滑剂及氧化膜等。将水室半成品（冲压件）放工作台面上，按图纸要求进行并接（定位）。调整好相位置后进行点焊。将气室按图纸要求装入主片槽内用木槌敲击到位，然后在两端进行点焊每端点焊两点。取下完成点焊的总成转至下道工序进行整体焊接：
a.固定板整体焊接上下两面和两端都要求进行焊接，焊缝长度为 5-6CM。
b.用木棰敲击主片槽边使其与气室接焊面紧密配合，然后进行整体焊接。焊缝要求密封，可靠，美观，均匀。总成焊接完成后，用记号笔在自检 OK 的总成上写上工号。按管理项目所规定的控制项目和检查频率检查。
将芯体总成放在周转车上。

4.自检所做工序是否全部到位，OK 品整齐堆放转至下一工序。
注意事项：
1．取放产品时要轻拿轻放，水室焊接和搬运过程中注意轻拿轻放。不得磕碰、划伤。。
2．氩弧焊操作者，必须戴好头面罩、手套、穿好工作服、工作鞋，以避免电弧光中的紫外线和红外线灼伤在操作设备时注意视如安全，严格按《设备操作规范》要求进行作业。
气流量 参照《参数对照表》
焊接电流 参照《参数对照表》
焊缝质量标准
1 产品焊缝均匀、统一，主焊缝宽度为 8mm 以内，除主焊缝外配件焊缝不允许超过 6mm，使用直径 2mm 焊条。
2 焊缝要求有明显鱼鳞纹，纹路光滑平整，纹路与纹路间隙为 3mm。
3 主板与水室焊缝高度不超过主板高度，拼焊水室焊缝高度为 1.5mm。
4 整条焊缝直线偏差不超过 1.5mm。
5 产品焊缝长度＜600mm 的中间无接头，焊缝长度＞600mm 的中途只允许一个接头并且过渡要自然、光滑。
换热器总成质量标准
1 所有产品要保证外形尺寸与样品一致，有样品要按样品检测其总成，另外贸新品应有质检部、外贸部、技术部三方共同到场方可验收。
2 如产品外形尺寸与样品有误，则取其外形尺寸的负值为准。
3 严格执行自检制度，保证本工序产品外观质量合格。
5 工作台面和放置架必须垫胶皮，保持工作台面和放置架洁净，无金属碎屑、沙砾等容易划伤产品的杂物，放置架不许用脚踩。
6 产品在加工和运输过程中要注意防护，轻拿轻放，每个零部件之间要加垫布，防止划伤或磕碰。
换热器产品在加工中按下述制作和防护要求进行。
总成后产品在氩弧焊、试压、包装工序的转运过程中要做到三点，一是在转运小车上的堆放高度不能超过小车扶手，二是在产品与产品之间应放置保护用垫片，三是盖上防尘盖。
在水室上焊接用的各种零部件应表面光滑、无毛刺，且要进行化学抛光处理，样品少量的可手动抛光处理。
换热器水箱加水口座和水箱盖要求配合使用灵活，零件入库和总成出厂均要验收其灵活性。
钣金车间换热器零部件剪板、折弯、划线、打孔等制作过程中要保持光洁面的光洁，划线等操作在另一面进行。注意产品防护，工作台面和放置架要及时清除铝屑，光洁面不许有划痕、裂纹以及压痕现象。
钣金车间折弯时要使用垫布，不允许有折痕和压痕。
换热器抛光后的水室用清洗液（34-40℃）浸泡 2-3 分钟，然后及时放入漂洗糟中进行漂洗，漂洗后用干布擦干，背靠背，面靠面整齐站放在周转箱内，最后转运放在水室放置架上，每层水室之间必须要放置垫布。换热器水室放在放置架上要背靠背，面靠面整齐摆放，必须用垫布隔离防止划伤。
水室采取里外两道拼焊方法，里面焊缝要饱满无漏点，外面焊缝要美观，质量按焊接相关要求，水室外表面不允许有划伤及打火痕迹。
换热器水室抛光时内用木块支撑，防止水室变形。
(7)散热器总成的密封性检测:干式检漏（**真空氦气检漏**）。整体系统主要由真空箱系统、充氦回收系统、抽真空系统、清氦系统、补氦系统、气动传动系统、流水线传输系统、电器控制系统、**氦质谱检漏仪**等组成。水压检漏：水检采用压缩空气方式检验换热器承压能力,即泄

漏检验。
作 业 顺 序
首先进行日常的设备点检。
根据型号选用相应的堵塞工装。
启动设备设定参数（检测压力为：0.180Mpa，充气时间:15
秒,平衡时间:30 秒,保压时间:25 秒,报警极限:0.01 Mpa）。
将铆接好的产品放在平台上，用堵塞工装将所有的通口堵塞
好。
按下小键盘运行键“Enter”开始检测；按下控制盒上的运行键；测试结果判定：合格产品亮“绿灯”，NG 产品 亮“红灯”。
合格品整齐堆放到周转车上，不合格品放置不良品区待水检判定。
按下面管理项目所规定的控制项目和检查频率检查。
检查总成焊接夹具的尺寸是否符合产品图样的要求。
操作现场工艺文件及生产图纸是否齐全，操作工是否按工艺文件的要求进行操作，接收的产品零部件是否符合质量标准的要求，是否认真填写质量记录。
外观质量 与焊缝标准样件进行对比，焊缝应均匀牢固，美观。每台产品的扁管、散热带在焊接过程不得有碰伤和烧伤现象。总成后产品的型腔内无焊渣及其他杂质
密封性 总成焊缝经 0.3Mpa 的压缩空气试压，保压 1min 无泄漏。具体要求为对于钢模气室每台焊缝漏点不多于 4 点，对于砂模气室每台焊缝漏点不多于 2 点。
检验方法
为目测检查 通过“总成试压工序的漏点统计记录”定期的进行焊缝漏点的统计，并将统计结果及时反馈有关部门，对于焊缝泄漏严重的产品查明原因并采取措施。
(8)喷涂、抛光:对散热器表面进行清洗、烘干、喷涂、抛光、烘干, 改善产品外观质量。
作 业 顺 序
首先进行日常的设备点检。
领取油漆按产品图样要求和油漆说明书要求调和油漆。
根据《设备操作规范》开启调节相关设备参数。
取试压合格的产品放置于工作台面，用打磨机将护板上的划伤部位打磨消除。然后放置整形台上，使用整形工具将左右护板进行整平。U 型号槽护板的产品要求对护板进行打磨、整形，其它中冷器产品不作要求。并将总成左右护板用擦布进行清洁，然后悬挂到流动带的挂钩上流进烘干道。调整喷枪，使喷出的漆成雾状，当总成流到喷漆房时，对总成表面进行喷漆。（喷枪移动速度均匀，枪口离芯体 20-30CM）
喷漆完成后自检有无漏喷，如有立刻补喷。将喷好漆凉干后的产品从挂钩上取下，查看有无喷漆不良（流柱、漆瘤、色差），OK 产品在进出水口套上防尘罩整齐摆放在合格品区，NG 产品摆放不良品区。
按管理项目所规定的控制项目和检查频率检查。检查操作工是否按要求进行操作,是否认真填写质量记录.
外观质量 漆膜完整、均匀，色泽无明显差异，涂层无皱皮、流挂，无外来杂质异物。产品无磕碰。
对于产品外观有表面不平整等铸造缺陷的气室，在喷漆前必须进行刮腻子处理,并参照标准样件对刮腻子的质量进行检验。
附：喷漆工操作规程
1 喷漆前先将桶内漆上下翻转晃动，然后用木棍将漆搅拌均匀，确保底部无沉淀。
2 银粉漆和漆料按 3：1 比例配比并搅拌均匀。

3 将气源压力调整至 0.35~0.4Mpa。
4 开启喷枪开关后距离产品 30~40cm 开始喷漆，喷漆过程中开关严禁重复开启。
注意：如漆喷过程中出现线状物为漆配比浓度过高所至，应适当加漆料调整。
(9)包装交货。
作 业 顺 序
1、首先进行日常的设备点检。
2、根据《产品参数表》选用相应的组件包装箱。
3、根据产品图纸要求领取相应标签、标识牌，并使用打码机将标识牌打上生产日期。
4、使用电钻在固定板指定位置上打孔插上铆钉，插上铆钉用抽芯钳将标识牌铆接在固定板上。包装所使用的设备是否完好,所使用的包装箱外观尺寸、标识是否符合产品要求，合格证标识与产品是否相符，操作工是否认真填写质量记录。
5、检查包装质量 产品气室口盖防尘盖，产品装箱前套塑料袋，箱内有防振泡沫，包装牢固，封扎可靠。
6、将产品标签帖在固定板批定位置上。
7、在纸箱内放入泡沫垫，先在水室进出水口两角套上。相应的泡沫防护垫，将散热器总成放进箱内再套两个泡沫角垫。
8、封好纸箱两端留 20-25CM 的距离捆上打包带，套打包扣留好
余量切断、收紧打包带，用铆压钳将打包扣铆紧。
9、打包完成帖上外箱标签。
10、按下面管理项目所规定的控制项目和检查频率检查。
11、将打包好的产吕总成整齐堆放在周转车上，办理入库手续。
2 换热器产品泄漏原因分析
复合板的质量指标
(1)钎料层化学成分中主要元素的影响
Si 含量:复合板的钎焊性能体现在钎料层的流动性、润湿性、间隙填充能力和焊接强度。在 Al-S 合金二元相图中,温度达 577℃、w(Si)=11·7%时, 发生共晶反应。当 w(Si)≤11·7%时,二元合金熔化 温度随 Si 含量的升高而降低。所以,钎料层中 Si 含 量高时,其熔点则低。Si 含量过高时,虽然可使包覆 层合金熔点降低、流动性好,间隙填充能力强,但当其扩散到被焊金属界面,且使固相成分达到一定程度时,导致被焊金属固相熔化,产生熔蚀。Si 含量越高,浓度梯度越大,对基体合金的熔蚀倾向也越严重;Si 含量过低时,则产生相反的效果。真空钎焊用复合板的钎料层为 4004 铝合金,其 w(Si)的标准范 围为 9·0%~10·5%。Mg 含量:包覆层合金中的 Mg 是真空钎焊必不可少的金属活化剂、吸气剂,同时在增强复合板耐蚀 性方面可产生积极的影响。Mg 在 550℃以上时开始大量蒸发,在真空钎焊炉中形成含 Mg 的气氛。镁蒸气既可与钎焊气氛中剩余的氧或水蒸气中的氧结合,保护加热零件表面不致重新氧化,又能渗入到零件表面未清除干净的氧化膜中，将其去除。所以相对于真空钎焊炉的真空度而言，真空度高时，标准含量的 Mg 可以起到足够的作用；而真空度低时，则需要将 Mg 含量控制在上限或者更高。4004 铝合金的 w(Mg)=1·0%~2·0%。如果真空炉真空度不好可在真空炉里面放适当的镁。放置量：18913555906 或 13013744698 蔡东俊 QQ:87041989
(2)钎料层厚度
复合板厚度及钎料层厚度的设定应与换热器的承压要求相匹配,必须结合理论计算和生产实践来制定。这里特别指出当钎料层厚度过薄时，易造成焊接强度低、焊接不牢、承压不达标等焊接缺陷；过厚时,则会造成芯层合金厚度过薄、承压不达标、甚至出现熔蚀现象导致泄漏。因此，钎料层厚度及其均匀性是衡量其质量的重要指标，也是影响换热器钎焊质量的重要因素之一。实际应用中钎料层厚度一般控制在复合板厚度的(10±3)%为宜。

(3)复合板其它质量要求

复合板在换热器中的另一个作用是作通道隔板,也有承压要求。因此,不应有影响其承压的内在、外在缺陷。内在缺陷如芯层合金的气孔、夹渣、与钎料层的焊合不良等；外在缺陷除上述表面处理不洁净外，还有在加工过程中的磕碰伤、划伤，当其深度超过钎料层厚度时，也会直接破坏金属的连续性，导致承压能力下降。

2.3　换热器**真空钎焊工艺**制度

换热器生产的主要设备是：**真空钎焊炉**中，**真空钎焊**主要靠热辐射进行加热。而辐射传热有其特有的规律,即斯蒂芬玻尔兹曼定律:

$$Q_{辐} = \alpha\left[\frac{T_1^4}{100} - \frac{T_2^4}{100}\right]$$

式中:

$Q_{辐}$ —辐射传递的热量;

α —辐射传热系数;

T_1 —辐射元件表面温度;

T_2 —受辐射物体表面温度。

上式说明，高温时即使是很小的温度差也需要很高的热能传导，即真空加热温度越高，需要传递的热量越大。说明在相同情况下真空炉内升温速度要较其他加热方式慢很多。真空加热所需时间大约是空气炉的 3 倍、盐浴炉的 6 倍。因此，制定换热器钎焊加热工艺制度时，不能照搬空气炉、盐浴炉和气氛炉的加热工艺制度。上式同时说明:换热器钎焊过程中，应尽可能缓慢加热，以使换热器内外温度保持一致，否则直接影响钎焊质量。对工业化生产中的预热定温、保温，蓄能定温、保温，钎焊定温、保温以及停电降温,是既能实现上述目的又能提高生产效率的行之有效的工艺流程，其中换热器钎焊过程中钎焊温度、保温时间、真空度是影响换热器钎焊质量的关键。

(1)换热器钎焊温度:温度低时，钎料尚未达到必需的温度，钎料的流动性、浸润性均较差，易产生钎缝内部气孔、钎缝不连续、虚焊等缺陷，使换热器钎焊接头强度降低，承压能力不达标而产生泄漏，严重时甚至会造成撕裂；换热器钎焊温度高时，钎料完全熔化且流动性过大，易产生钎料氧化形成气孔和对焊缝的毛细力作用变差，造成钎料流失、熔蚀、翅片弯曲等缺陷。适宜的定温应注重焊料的流点，通常焊料的熔点应比被焊金属熔点低 60℃左右。此时，液态焊料对被焊金属具有良好的浸润性和流散性，能在毛细力作用下较好地填充钎焊间隙，并能与被焊金属产生良好的合金化作用,形成高强度接头。

(2)换热器钎焊保温时间:换热器钎焊时钎料的润湿和接头形成约需要 1s~2s,因此保温时间主要由换热器心部温度达到钎焊温度所需的时间及氧化膜层消散所需时间决定。如果保温时间过短，换热器中心部温度没有达到钎焊温度；时间过长，液态钎料容易使被焊金属熔蚀、产品塌陷。

2.4　换热器钎焊时的真空度

高温状态下的真空度较低时，炉内残留的 O2 H2O 等氧化性气体易与 Al 起化学反应生成质硬的 氧化膜即 Al2O3。Al2O3 组织致密、稳定、熔点高，在普通真空钎焊温度下不易分解，钎料氧化后使其流动性浸润性变坏；被焊金属氧化后变得难以浸润，从而导致焊料与基体间的焊接性能恶化。故需要尽可能提高换热器钎焊时的真空度,减少 O2、H2O 等氧化性气体的含量,控制 Al2O3 的生成量。一般要求，换热器钎焊炉采用多温区控温,炉温均匀性为±3℃,工作真空度应保证不小于 6.7×10-3Pa,预抽真空的极限真空度必须在 10-4 数量级。

2.5　换热器钎焊时环境状况

环境中的湿度会对散热器钎焊质量造成影响 在高湿度下进行散热器组装时，会有更多的水分留在翅片、隔板及封条上。将高湿度下组装的换热器放入真空炉中钎焊，水分会蒸发、释放出更多的气体，且散换热器产品内部的水分蒸发、气体释放是个缓慢的过程。水分需要大量蒸发热，影响换热器内部的温度；水分还会影响真空度；水分将加剧铝的氧化，从而影响换热器的钎焊质量。所以在进行换热器构件表面处理、组装及产品钎焊前都应该保持一定的环境湿度，或采取烘箱进行烘干燥加工（可以利用钎焊好的产品发出来的热进行烘干，烘干房温度控制在：13013744698 或 13905275903），控制由于环境湿度造成的换热器构件表面水分含量。

工步	名称	工　　步　　内　　容	设　备
01	准备	1）按(微电脑控制真空钎焊炉操作规程),做好设备运行系统	
		(水、电、气、仪表)等的检查工作。	
		2）填写生产记录表。	
		3）停炉超过 48 小时重新钎焊前需空炉加热至 700℃-900℃	
		保温烘烤 1 小时。	
02	装炉	1）将已装夹好的板束组件用铲车送入炉中央恒温区整齐码放。	
		2）工件码放应稳妥，可靠，整齐。	真空钎焊炉
		3）不允许工件与加热元件相接触，如发现应立即排除。	
		4）用酒精揩试干净炉门密封圈及接触面，关紧炉门并旋紧	
		搭扣。	
		5)　镁粉加入量按 10g/m^{3}计算，均匀布放。	
03	钎焊	1）按左图编制各时段保温温度及升、降温速度控制程序。	同上
		2）真空度达到 5×10－3Pa 时才能打开加热钎焊程序。	
		3）在整个钎焊过程中，要经常观察各仪表，防止异常发生。	
		4）钎焊温度 625-630℃和出炉温度 400℃要严格遵守，其	
		他温度区域及时段允许根据装炉量的多少作小幅度变动。	
04	出炉	1）当炉温降至 400℃以下时可以开启放气阀准备出炉。	
		2）打开炉门后,及时取出工件。避免因炉门打开时间过长而	
		使炉膛结露，影响下一炉生产。	
		3）出炉工件应放在安全区域内,自然冷却至室温。	
		4）拆卸钎焊夹具，并清理工件上的焊料飞溅物。	
		5）填写生产流转卡，自检后转检验。	
配套数据	1）打开水冷系统的各截止阀，使水压维持在 0.2～0.3MPa，保持排水畅　通，在炉子工作期间进口水温不低于 25℃，出水温度不高于 30℃。		同上
	2）启动滑阀泵使炉体真空度低于 133Pa 时，启动罗茨泵，。		

	3）真空炉平时停用时,炉内需抽真空，且应保持在不低于 5×10^{4}Pa的真空状态。	

换热器**真空钎焊缺陷**的主要现象有：

1 漫流

漫流是真空钎焊时钎料流过钎焊接头处在母材上所形成的薄的钎料覆盖层。

(1)漫流原因

换热器工装夹具在真空钎焊温度时应有一定的弹性和钢度，使焊缝联接处有合适的间隙，形成毛细现象吸附住熔化钎料。工装装夹不紧，钎焊组件缝隙太大就保持不住钎料，产生漫流缺陷。工装钢度低，加热后热变形和重力作用引起钎焊组件联结缝隙增大，不能形成钎料的毛细现象也导致钎料漫流。真空钎焊是辐射传热，工装夹具的热容量大，换热器钎焊零件的升温速率小，在钎料的固一液相温度区间停留时间长，钎料低熔点组分挥发较多，同时钎剂的作用时间也长，两者进一步破坏了液态钎料的表面张力，过度改善了钎料对母材的润湿性。装炉量大，升降温速率小，保温时间长等和工装夹具热容量大一样，钎料在液态停留时间长，降温速率慢相当于延长了钎料液态的保温时间，也会产生漫流。钎剂的作用是还原表面的氧化膜、降低液态钎料的表面张力，改善钎料对母材的润湿性。铝真空钎焊镁粉的使用量一般不大于控制在按 10g/m3 比例来配量。13013744698 或 13905275903。使用量还因零件的形状、表面积、装炉量的不同而异。镁粉使用量大，钎料对母材的润湿性太好而导致钎料漫流。保温温度高，液态钎料的表面张力小，钎剂降低表面张力的作用增强等这些因素综合作用的结果引起钎料漫流。工件在钎料的固一液相温度区间停留时间长而导致漫流。

(2)消除措施

可以增大换热器工装装夹力，缩小钎焊组件连接缝隙。提高工装夹具钢度，保证热状态时连接缝隙不变大。镂空减轻工装重量或者用石墨代替部分钢材，以减少工装的热容量。减少钎剂用量，在连续钎焊时应逐炉减少钎剂用量。采用分阶段升降温，在钎料固一液相温度区间快速升降温，缩短钎焊保温时间，降低钎焊保温温度，减少装炉量。

2 溶蚀

溶蚀是母材表面被熔化的钎料熔解而形成的凹陷 。

(1)溶蚀原因

钎料与钎焊母材不匹配，钎料与母材中的某个组元形成低熔点相，降低了母材部分区域的固相线温度。工装热容量大或装炉量大而导致零件升温速率慢，在钎料固一液相温度区间停留时间太长，在某个温度点钎料与母相中的某个组元络合成低熔点的相而导致母相合金部分

区域熔点降低而熔化。炉温不均匀，钎焊件局部温度太高，钎焊温度太高导致经钎料扩散区域母材的低熔点组分熔化。在钎料固一液相线区间升降温慢。钎焊保温时间太长。

(2)消除措施

解决措施一般是更换钎料牌号。或在接近钎料熔点时快速升温，减少装炉量，减轻工装重量，降低钎焊温度，缩短换热器钎焊的保温时间。

3 换热器产品钎焊强度低

(1)原因

换热器**真空钎焊**保温时间短，某个组元向母材扩散时间短。在钎料固一液相区问升温时间太长，钎料部分组元挥发多。真空压强太高或真空炉泄漏率大，加热时钎料或母材又部分氧化。氧化膜清除不彻底。钎料或母材在碱洗时过腐蚀而改变了钎料的组分。钎剂用量少，钎料的润湿性不好。

(2)消除措施

延长换热器钎焊保温时间，使扩散充分完成。采用分区间升温，在钎料固一液相区间快速升温，减少钎料低熔点组元的挥发。降低真空压强，防止加热时钎料或母材再度氧化。检查真空炉的压升率。控制在 0.3/S 以下;增加碱液浓度或温度，或延长碱蚀时间，彻底清除氧化膜。降低碱液浓度或温度（一般控制在 60°C），或缩短碱蚀时间，把钎料或母材分开碱洗，防止碱洗时改变钎料的组分。增加钎剂用量，改善钎料的润湿性。

4 漏焊

漏焊是钎焊件对接处钎缝处无钎料或钎料熔化流失而形成的未焊合的缝隙。

(1)原因

钎料用量不够或连接缝隙大。换热器钎焊升温速率太大导致零件变形大使联结缝隙增大，形不成毛细现象。钎剂使用量大，钎料的润湿性太好导致钎料流失或钎焊缝过宽。在钎料固一液相线区间升温速率慢，钎料低熔点组元的挥发多改变了钎料组分，提高了余下部分钎料的熔点，降低了钎料和母材间的相互扩散作用。装炉量大或工装设计不合理。工装太重吸热量太大，而导致升温速率慢。保温时间长或冷却速率慢等，钎料低熔点组元的挥发多。钎料过腐蚀，改变了其成分进而改变了熔点。

(2)消除措施

增加钎料用量，增大换热器工装的夹紧力缩小连接处缝隙。换热器钎焊前增加钎焊组件的去应力退火工序，或者分阶段升温并设置等温阶段，在 500℃ 以上快速升温。减少钎剂的使用量，连续钎焊时应逐炉减少钎剂的使用量。减少装炉量，减轻工装重量，用石墨取代部分不锈钢。缩短钎料碱腐蚀时间，或调整腐蚀工艺参数，钎料和母材的腐蚀应分开进行。

5 针孔(气孔)

钎焊过程中熔化钎料中的气泡在凝固时形成于表面的孔穴，小的称针孔，大的称气孔。

(1)原因

换热器钎焊时真空度达不到要求，正常换热器钎焊真空度要求在 2·0×10-3Pa。钎焊炉内压力大，钎料中的气泡逸出阻力大。钎料成分不对，低熔点高蒸气压元素含量过高。

(2)消除措施

在接近钎料熔点处设定保温平台以降低钎焊炉内压力。减少钎料中大蒸气压元素含量。

6 钎料不全熔

钎料不全熔是一部分钎料组分熔化而剩下高熔点的组分未熔，表观看就是钎料的表层熔化而中间没有熔化的缺陷。

(1)原因

换热器产品装炉量大，或者工装太重热容量大，在钎料固一液相线区间升温速率慢，在熔化过程中，在真空环境中，钎料的低熔点组分汽化过多，改变了钎料的成分，使余下的钎料

熔点升高而不熔。
(2)消除措施
分阶段升温，提高最后阶段的升温速率，在 500℃设置等温段，消除工件温度的滞后以提高钎料固一液相线区间升温速率，减少装炉量，减轻工装重量或更换部分不锈钢为石墨，减少工装的热容量以提高工件的升温速率。
7 换热器钎焊件变形
(1)原因
换热器钎焊升温速率大，释放应力过快或热应力过大，冷却过快也使热应力过大。工装钢度不足或装夹强度不足。
(2)消除措施
钎焊前增加钎焊组件的去应力退火；采用分阶段升温，设置等温平台，在接近钎焊保温温度时快速升温；分阶段控制降温，在钎料固相线温度以下慢冷。提高工装钢度和装夹精度。
8、填隙不良部分间隙未被填满。
产生原因为:
(1) 换热器接头设计不合理，换热器产品零部件装配间隙过大或过小，装配时零件歪斜。
(2)钎剂不合适，如活性差，钎剂与针料熔化温度相差过大，钎剂填隙能力差等，或者是气体保护钎焊时气体纯度低和真空钎焊时真空度低。
(3)钎料选用不当，如钎料的润湿作用差，钎料量不足。
(4)钎料安置不当。
(5)钎焊前准备工作不佳，如清理不净等。
(6)钎焊温度 过低或分布不均匀。
9 换热器芯体钎焊气孔产生原因为:
(1)接头间隙选择不当。
(2)钎焊前零件清理不净。
(3)钎剂去膜作用或保护气体去氧化物作用弱。
(4)钎料在钎焊时析出气体或钎料 过热。
10、钎缝夹渣产生原因为:
(l)钎剂使用量过多或过少。
(2)接头间隙选择不当。
(3)钎料从接头两面填缝。
(4)钎料与钎剂的熔化温度不匹配。
(5)钎剂密度过大。
(6)加热不均匀。
11、钎缝开裂产生原因为:
(1)由于异种母材的热膨 胀系数不同，冷却过程中形成的内应力过大。
(2)同种材料钎焊加热不均匀，造成冷却过程中收缩不一致。
(3)钎料凝固时，零件相互错动。
(4)钎料结晶温度间隔过大。
(5)钎缝脆性过大。
12、母材开裂产生原因为:
(1)母材过烧或过热。
(2) 钎料向母材晶间渗入，形成脆性相。
(3)加热不均匀或 由于刚性夹持而引起过大的内应力。
(4)工件本身有内 应力而引起的应力腐蚀。

(5)两种热膨胀系数相差过大而塑性偏低的异种母材。

13 母材被溶蚀产生原因为:

(l)钎焊温度过高，保温时间过长。

(2)母材与钎料之间的作用太剧烈。

(3)钎料量过多。

钎料流失产生原因为:

(1)钎焊温度过高或保温时间过长。

(2)钎料位置不当以致未起毛细作用。

(3)局部间隙过大。

结　论

通过以上的分析，为了提高换热器的真空钎焊一次合格率,应做好以下工作:

(1)所用换热器原材料应确保产品质量,要从正规、专业厂家购进；换热器由翅片、隔板、封条和封头组成，其材料都为铝合金。对材料进行复检合格后才可以使用。翅片、隔板、封条在组装板式体前都需要经过酸洗，除去污垢油污及表层氧化膜。油污在真空高温时会分解，降低了钎接炉炉内真空度，并使翅片隔板等氧化等。铝合金表层氧化膜很致密，而且氧化膜熔化温度比其基体材料高，在钎接时不易熔化，从而影响钎接质量。

(2)严格按照换热器钎焊工艺程序进行备料，控制好换热器产品零部件表面清洗处理、组装、产品烘干、换热器真空钎焊曲线；

(3)要在实践中对换热器的钎焊温度、保温时间、真空度等钎焊工艺制度进行优化并严格控制；

(4)控制好产品装配环境湿度保持环境: 冬季比较干燥湿度<60%RH、温度为 40±5℃,：换热器产品装配前必须烘干，烘干按换热器烘干工艺对产品进行烘干，烘干炉转速 200±50r/min，烘干温度 200±10℃。

(5)提高换热器真空炉钎焊合格率的关键因素有：

1 、要报据不同的换热器产品确定台理钎焊参数

2、 夹具的设计既要考虑其强度．要要兼顾其刚性，要有一定的弹性，要使用和调节方便，操作简单，减少人为因素（例如老板舍不得发奖金、工人责任心不强）的影响。

3、钎接时天气状况

在钎接时，大气中的环境温度及湿度都会对板翅式换热器钎体是否下凹及下凹程度造成很大影响。在大湿度下进行换热器安装时，会有更多的水分留在翅片、隔板及封条上。将高湿度下组装的板式体放人真空炉中钎接，会释放更多的气体。板翅式换热器在钎接炉中钎接时需保持一定的真空度，故钎接时慢慢释放的气体会影响到真空度。由于水蒸汽的蒸发需要大量热量，这会影响到板翅式换热器芯体内的温度。由于铝合金薄板在酸洗后容易被氧化，而其氧化物熔点和原材料不同，会影响钎接的质量，而环境温度的高低直接影响铝合金薄板表面的氧化程度。所以在板翅式换热器零部件的酸洗、部装及钎接前都应该保持一定的环境温度和湿度。

4、换热器钎接时达到的最高钎焊温度。换热器翅片及薄板上都有钎料，钎料熔化需要一定的温度。钎接温度不仅影响钎料的润湿性，而且影响换热器钎焊接头的连接强度。如果钎焊温度太低，则钎料的流动性差，容易造成虚焊，换热器钎缝内部存在气孔和夹渣，使强度降低，易产生泄漏，严重时甚至会鼓包撕裂；温度太高，换热器钎料完全熔化，易产生气孔而且钎料氧化严重。

5、 换热器钎焊保温时间。如果能够做到真空钎接时换热器芯体外部和中间的温度始终保持一致，即温度非常缓慢地上升到最高温度，保温后又缓慢下降，则换热器钎接质量可以得到很好的保证。但考虑到经济效益，在能够保证质量的前提下，应该尽量缩短钎接时间。

6、换热器产品温度传感器数量及摆放位置。为了掌握板翅式换热器芯体钎接时各部分的温度，需要有很多温度传感器及时测出各部分的温度，这样就可以及时直接调节真空钎焊钎接温控表。

7、在整个钎焊过程中，真空度不得低于 5×10-3Pa。

换热器技术需求参数表格

允许最大外形 mm

系统（液压或润滑）

环境温度 ℃

工作压力 Mpa

流量 L/min

冷却功率 KW

压降 bar

	热侧	冷侧
进口温度 ℃		
出口温度 ℃		
密度 kg/m^3		
动力黏度 pa/s		
比热容 kj/（kg·k）		
传热系数 W/（m·k）		

注：冷侧为风冷，就无需提供参数，如用户自配风机，请提供风机的参数。

换热器检验操作规程

1 本规程为板块式油冷器总成**真空钎焊**后、包装前的检验指导性文件。

2 包装前必须检验如下项目：

序号	检验项目	检验工具	判定标准	不合格品处置方法
1	接头中心距	卡尺或盒尺	按图纸	返修
2	接头平面度	卡尺	不平度小于1mm	返修
3	接头螺纹是否有铝屑	目测	无铝屑	用布擦掉
4	支架孔中心距	盒尺	按图纸	用锉修整
5	支架孔对角线	盒尺	按图纸	用锉修整
6	总成、芯体平整度	平台	用手按无明显翘曲、不平	返修
7	焊缝是否平齐、无焊瘤、无毛刺 ***(重点是支架安装孔附近)***	目测	焊缝平齐、美观、无焊瘤、无毛刺	用锉修平无焊瘤、去除毛刺
8	散热带是否整齐、节距是否均匀	目测	散热带无倒伏、无磕伤、节距均匀	用镊子调整
9	工厂厂标、氩弧焊工、打压员代号是否齐全	目测	齐全不得有遗漏	返工标识齐全
10	外观是否整洁	目测	无油、无黑斑、	油及黑斑用布

			无明显磕伤、划伤	擦，磕伤用锉修、划伤用砂纸打磨

备注：
我公司承接换热器的生产、铝制板翅换热器的设计制作、真空炉维修、真空钎焊工艺指导。
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Aluminum vacuum brazing defect analysis and solutions

The production of the heat exchanger of aluminium alloy is under the vacuum state, heat and keep structure one of heat exchanger warm, make borer material melt within the range of suitable temperature and time, fully soak with the metal of solid state under maos of detailed strength function, dissolve, spread, the seam, thus an advanced person achieving the goal of welding welds the method. The outstanding advantage that the vacuum of heat exchanger brazes can join different metal, realize the simultaneous welding of the complicated structure, the products after the heat exchanger is brazed weld the head bright and clean and dense, out of shape and small and having fine mechanics performance and anticorrosive performance. But the vacuum brazes structural design, assembly quality of downing to the heat exchanger, aluminium alloy compound board (hereafter referred to as the compound board) Chemical composition, borer material layers of thickness,it braze there aren't craft the system, heat exchangers heat exchanger, otherwise extremely apt to present a scene of crooked lodging of heat exchanger wing, borer to sew discontinously and welding, melting losing, other quality defects until letting out,etc. emptily. Among them: It belongs to the great quality defect that the heat exchanger is let out.

Procedure of the heat exchanger products production technology

(1)The products get the material: Fill in the materials requisition to the part storehouse to get the part according to the production schedule, and check the name quantity of the part of the heat exchanger carefully. Carry and is forbidden to knock against in the course so as not to damage the part. Finalize the design to compound board, wing slice, paper strip seal,etc., process according to the size.

(2)The surface of products washes and handles the technological process: Clear up in advance before welding: To the position to be welded of the work piece, remove oxides, and other impurity with the polishing machine, can see the metallic luster after clearing up. Dispose the lye for the first time: Put 40Kg caustic soda in the washing pool according to per ton of water. Temperature 60¡À 5 degrees, proportion value is 9¡À 1. The part is put: Will have the body of case to spread in washing the basket evenly, face concavely, generally 12 are put with each hoop; Have case body

spread, among washing basket, put and wash the basket paper strip seal, wing block, side board respectively evenly too, wash pool wash for 120 seconds, 80 seconds, 100 seconds in alkali ' Can adjust according to the reaction speed of the products, pH, temperature, quantity of products) ,Under rocking no less than three to wash the basket up and down after the products part of the heat exchanger submerges. The width direction is erected and put, can put multi-layerly while putting when wing slice of heat exchanger is put, but each layer wing slice of heat exchanger can be pulled out and moved with wing slice, there is very movable interval. Heat exchanger long paper strip seal vertical to slope, put, side board interlock putting. Erect the heat exchanger baffle width direction to put into and wash the basket, there should be interval among the heat exchangers baffle, heat exchanger baffle can also multi-layer to put, until alkali wash pool wash 30S, wash basket rock no less than 3 up and down until part submerge. Wash the pool to wash, in alkali enter clear water circulation of clear pond and rinse 120S with part of the heat exchanger, under washing the basket and rocking no less than three up and down after the part of the heat exchanger submerges. Rotate and neutralize washing. Worthy of neutralizing the liquid for the first time: Add nitric acid into fresh water to mix into 30% of the neutralization liquid, it is 5¡À 1 that PH is approximate. Neutralize and wash: Wash heat exchanger part go on, neutralize, take out, enter heat exchanger part clear pond clear water circulation rinse 120S behind the 90S. Heat exchanger products spare part work piece wash clean to have greasy dirt at this moment, dry or transfer to drying kiln dry (a lot of save cost set free under the sun shining naturally, do not consider the secondary pollution of the products at all) . Drying-machine temperature 120¡À 5 ¡æ, drying rotational speed 120¡À 50r/min of the heat exchanger products spare part. It is a more important parameter to dry temperature and dry temperature with dry stove, while brazing, often confirm the stoving temperature of different products through the craft test, on the premise of guaranteeing to dry the moisture. It is the better to dry temperature low. Pack into light to wash part to dry basket can enter drying-machine dry, if loud to wash the basket directly, need, take out, put, wash, dry basket by spare part heat exchanger, put, put or scatter, put, dry network pull to and dry if washing. Wash heat exchanger spare part dry, fill in, produce, transfer to preface Carlos turn down a process.

(3)Assemble: Adjust and put the core jig according to the side board and size of paper strip seal. Put on, protect glove begin, load with core put two fuse side by side on the same jig, fuse relative jig put, deploy, show baffle show the board first and then, show short paper strip seal and interior wing block sequentially, show baffle, long paper strip seal and interior wing slice repeatedly, baffle, short paper strip seal and interior wing slice, the baffle, side board are put as a quantity of counting and meeting requirements for drawinging of interior wing. Put on the jig finally. With M12 pull rod symmetrical simultaneous facelift that strains of no less than 6 ' Count and show the torsion spanner 32N.m) . Core wide to compress tightly size to greater than drawing 1.25% or size ¡À 1mm before the welding that drawing require to require size. Heat exchanger fuse put well, put in fuse keeping in shelf forbid not up to standard and heat exchanger spare part not washed install the core side by side, put on the glove in the assembling process, glue on the part of the heat exchanger in order to avoid sweat stain,etc., influence and braze. Assemble fuse diagonal ¡Ü 2MM of heat exchanger. Appearance: Wing slice of heat exchanger has not lodged, the paper strip seal is neat. The wide ruler of wide ¡Ý core of core of the heat exchanger is 1.25%. Spare part and drawing demand to count and conform.

Homework order

1,Hand over item by item the daily apparatus at first.
2,Get paper strip seal of the heat exchanger, distributing tropical, interior wing slice, baffle,etc., and complement one to check to the part that is got, and reject the unaccepted product.
3,Select corresponding putting core frock, fixture for use according to " parameter form of core department of the heat exchanger ". Braze fixture baseplate put, get assemble platform, incline board aim at limit location trough to assemble platform keep flat on jig surface, put a slice of baffle,
4,Respectively set a short paper strip seal free in the equipment limit location trough of both ends ' While taking awls to face) .
5,Cloth scattered tropical zone well, put one baffle, load two long paper strip seal (take awl face,) onto at baffle and then at baffle .
6,In two long wing slice put, under paper strip seal, put quantity depend on length of the paper strip seal, superpose until quantity of meeting requirements for drawinging repeatedly, it is put it brazes that jig is fixed and good not to put the baffle and side boards finally for one slice,by plateforms whole core, it brings that surface is whole to tighten there aren't nut flat.
7,Body carry on whole to be whole and flat to core, adjust scattered tropical zone with both ends distance of paper strip seal(take the lead to keep flat and neat, two big one is levelled, it is too flat to have obvious drop to combine the position together) ,Spiral shell pole to install jig tighten nut make core body fixed and kind.
8,Measure the core wide and diagonal and guarantee core wide and diagonal and drawing require whether the size is the ultra difference with the tape measure, if ultra difference is repaired.
9,And check the frequency inspection according to the control project that the following management project stipulates.
10,Dividing the heat exchanger fuse always becomes and puts it on the turnover car.
(4)The vacuum of the heat exchanger is brazed: Put in the heat exchanger products stove: What kept heat exchanger fuse in the shelf was changed hot device six pieces of fuse into a stove time by the forklift truck, put into the vacuum and braze it in the stove, put between two parties all around while putting, forbid work piece and jig while putting and braze the inboard wall contact of the stove, and put and put down gently steadily, in case that damage brazes stove molybdenum rejecting and heater of inboard wall. Braze: Establish brazing the craft parameter of this heat exchanger product, there is not execution heat exchanger that is especially required that braze the craft, operate the apparatus according to " the vacuum of aluminium brazes the operational procedure of the stove ".
Braze temperature:
Braze temperature to melt according to borer material selected for use temperature come, confirm. Braze temperature only until selected borer material composition have beauty, and structure and form in products have nothing to do, offer by the raw materials producer often. Adjust in the craft test appropriately according to the quality of brazing. Heating, warm-keeping of brazing the stove and smoking the vacuum, carrying on seven stages to the vacuum, its craft contours, the following picture, show.

I.e.: The first stage product is preheated and intensified; Hold, can protect gentle to braze, intensify, braze, keep warm, braze, intensify, braze and keep warm 6 stage five stage the fourth stage the third stage two stage; The seventh stage brazes and loses electrical power, lowers the temperature. Wait to braze furnace temperature to drop to fixed temperature and make: When after

the products are according to brazing the craft, temperature is reduced to 350 degrees, turn on the air inlet valve, equilibrate and press difference inside and outside the stove. Open furnace gate, weld good heat exchanger fuse and jig with forklift truck shifting out, putting in fuse keeping in shelfing steady already. When open the furnace gate, the operator opens the furnace gate in front of furnace gate, don't be on the side, the steam hurts one's feeling when so as not to just open. Products temperature are high, don't touch directly, so as not to scald. Wait to cool, remove the jig.
4.1 Look over the brazing and recording and is the record is put with the heat exchanger products seat in the stove of the heat exchanger products of every stove, check, braze craft normal, check 520 ¡æ especially and 560 ¡æ two temperature retention time to keep warm period overlengthy, whether the vacuum degree reaches the vacuum degree established. Because the heat exchanger brazes temperature at 59O ¡æ- 600 ¡æ, the melting point is quite close to the melting point of mother material, so should control heating temperature strictly, on condition that guarantee the borer completely, leave 30- 50 minute on temperature retention time as temperature of brazing when being 520 ¡æ following, can adopt faster heating speed (4-5 ¡æ/ min) With longer temperature retention time, can also have two to keep section warm, but at above ¡æ520, need to adopt slower heating speed (4 C/ mins) With shorter temperature retention time, so as to braze the perfect combination of quality and efficiency. The heat exchanger brazes temperature because of the position of heat exchanger centre. There is no radiant, temperature on the low side, while brazing temperature on the high side, heat exchanger centre temperature less than surface temperature, because aluminium give up gold line bloated to it comes loose to be stainless steel jig 1 of material about. 5, and centre wing slice in at being relatively high temperature, heat exchanger in the center intensity obviously reduce, produce some plasticity out of shape under the pressure function of the jig, counterweight material. After the heat exchanger is brazed and cools, the shrink amount of the products is larger than the shrink amount of the jig, enable and produce some interval between products and jig, produce and misplace under a scene of acting on commonly in gravity and counterweight material of wing. In braze, keep warm, finish, accelerate the rate of cooling, favorable to the detailed chemical fibre sew organization appropriate, reduce twigs to simply analyse brilliantly, thus improve the intensity of brazing, but if cooling is too high in pace, may make the weldment form the too big hot stress and produce the crackle, can generally select 15- 20 ¡æ/ rate of cooling of m for use.
Density that the products are put
Products put density become, influence key factor to braze quality relatively loud for size, products (jig) with smaller quality ,Can carry on the craft test directly according to the craft experience of the past similar products, confirm the products and put the reason density. But relatively small to measurement, the products with bigger quality, propose calculating according to the following methods first, confirm again, otherwise, it is serious to lose after the craft test. Have: Products dry temperature T0/ ¡æ, braze temperature T1/ products C, temperature retention time I/ s, put density as n/ (pieces of m-1) ,Products specific heat are c1 / [kJ, (kg, ¡æ)], quality is m1 /(One -1 of kg),The specific heat of the jig is C2/ [kJ (kg, ¡æ) -1.], quality is m2/ (kg, one - 1) . Vacuum braze stove rated power P/ kW, vacuum stove person who heat length L/ m, width W / m, degree H/ m. The vacuum is brazed in the stove the power of heat energy that the heat exchanger takes away is and p1/ kW through the power of heat energy that is sent out the stove body surface, products, and jig Oh, heat energy that charge power p2 / kW, braze stove heat head of district \ L W H/ m in wide \. It braze at course by P - not relate to ambient temperature,ambient

temperature will certainly hour,think

P one often breaks up, passes the method of testing to get. For example: The temperature of today is at 15 ¡æ. Under the terms of keeping the heat exchanger brazing normally, the vacuum is brazed and the products are put in the stove, can calculate through real-time electric current and voltage value that the switch board instrument reveal. P1. And. So the total one consumes the thermal power and dawdles for P = P1 + P2, and braze the largest generating heat of stove, the power generates heat for P =P1, the power of keeping the sector warm is. At that time, for the best density of putting,

The material of borer has already totally melted and had rational temperature retention time at this moment, the borer in every place is sewn energetically, there is no defect of brazing. At this moment. N loud product the density is put most for ambient temperature this.

Braze and preheat temperature retention time, smoke the time of vacuum with heat exchanger

As to the large-scale work piece (effective diameter ¡Ý 1m) The pre-warmed temperature retention time of the heat exchanger is: I.e. T1 =3D(2) T2 =6D(3) T3 =9D(4)

In the type: T1, in order to preheat time / h for the first time; It ask /h; T3 is final temperature retention time / h; D is the effective thickness / m of the work piece.

As to the heat exchanger in 800- 1000mm, once or preheat and keep warm twice while generally heating, and ladder, heat, most great difference in temperature appear and temperature retention time within the range of this temperature basically can improve vacuum vacuum degree of stove at 400- 560 ¡æ. Prove through producing actually, the medium and small part (effective size ¡Ü 500mm) heated as to the vacuum stove ,The temperature retention time when being preheated and heated can also be calculated according to the following ways.

G=301-600kg: T is really 1 =T is really 2 =T is really 3 =30+D(13)

G=601-900kg: T is really 1 =T is really 2 =T is really 3 =60+D(14)

G¡Ý 901kg: T is really 1 =T is really 2 =T is really 3 =90+D(15)

Smoke vacuum time to braze according to vacuum vortex sheet pump of stove spread the pump

The heat exchanger borer sews and assembles the interval

Compound board and paper strip seal exposed to surface to be relatively light, borer expect, can sew from borer two sides go on borer to be fierce, so does not need to reserve and braze the interval. Rely on the borer material outside to flow into the borer and sew the borer to connect. And expect much in intensity and dependability sewn to the borer, so, or replies a set of material two-sidedly one floor of thicker forms except selecting for use compounding, should reserve 0 . 05-0 . 10The borer sews the interval the form of mm

Heat the calculation of temperature retention time with second, heat exchanger

The traditional heat exchanger brazes and heats the calculation formula that asks while keeping warm to show as follows

T1 =30+(1.5- 2) D(5) T2 =30+(1.0- 1.5) D(6) T3 =20+(0.25- 0.5) D(7) In the type: D is the effective thickness / m of the work piece; T1, in order to preheat one / min for the first time; T2, in order to preheat time / min for the second time; T3 is the final temperature retention time / min of heat exchanger.

The heat exchanger brazes temperature retention time and still relates to size containing stove quantity of the heat exchanger products, the empirical formula of the relation in factors such as the heating temperature retention time and amount of stove put, effective thickness of work piece of the vacuum stove,etc. is as follows:

T is really 1 =T is really 2 =T is really 3 =O.4* G(kg) +D(mm) (8)

In the type: Last stove G for heat exchanger the work pieces have weight / kg, symbol meanings other netter and with before the various types of and the same. This type is based on the heat exchanger products amount of stove put about 100- 200kg, the effective size of the work piece is about 100mm. The work piece is basically the same in size, it is neat to put, leave certain space (put the space <FONT >

G¡Ü 300kg: T is really 1 =T is really 2 =T is really 3 =30+D(9)

G=301-600kg: T is really 1 =T is really 2 =T is really 3 =(30-60)+D(10)

G=601-900kg: T real l =T is really 2: T is really 3 =(60-90)+D(11)

G¡Ý 901kg: T is really 1 =T is really 2 =T is really 3 =90+D(12)

In the type: G puts the total weight of the stove, including work piece, material basket, material shelf and material weight (kg) of one for the heat exchanger ; D is the effective diameter / mm of the work piece) .

Require strict heat exchanger as to deformation, because vacuum stove conduct heat pace to be relatively slow at low temperature, preheat, keep Shi warm for the first time, if time too short work piece surface and heart difference in temperature of department too heavy, may cause the hot stress of the work piece to be out of shape. So preheat at time should be fetched limit for the first time, preheat the limit while fetching for the second time, the final heat treatment takes down limit. Require the work piece not very strict as to the ordinary aluminium alloy heat exchanger work piece or deformation, the first pre-warmed time can take down limit, and fetch the limit of having while heating finally. As to the thing that a stove only holds the large-scale work piece of one, because it is heated evenly, it is very fast to conduct heat, cook better completely, the first time and can fetch lower limit preheat for the second time, while heating finally, the limit or upper limit in then the foundation demands to fetch actually. Not only guaranteed the quality requirement after the heat exchanger is brazed like this but also saved the heat exchanger and brazed and heated time greatly, braze the production cost after reducing the heat exchanger.

4.2 The heat exchanger brazes the test stone of the body of core

4.2.1 paper strip seal, interior wing slice, with come loose borer borer of welding seam of tropical zone rate more than 80% completely baffle, each one does not have 2cm above welding to distribute tropical zone and baffle continuously and emptily.

The heat exchanger distributes tropical zone and has not melted losing, lodged on 4.2.2; Main board have to pile up, flow, hold solder, baffle coherent hole have borer material stop up, heat exchanger core body appearance have, knock against out of shape.

Main board, flat tube, side plate have greater than 1cm crooked and out of shape after heat exchanger core body have a facelift 4.2.3, heat exchanger core diagonal deviation of body smaller than 2cm, core body loud one degree of errors of level of below 2cm.

The 4.2.4, to welding the body of heat exchanger core of the pendant outside the side plate, the distance size between two side plates accords with the drawing requirement.

Check operation worker in not examining for braze timid long seam that weld go on identifications with the mark pen 4.2.5, whether isolate and put to the unaccepted product heat exchanger products.

4.3 The heat exchanger brazes the sample of quality and inspection method

The heat exchanger brazes products every stove and is inspected by random samples and can be less than four, should inspect for brazing the stove products with unusual craft by random samples

or all examine on 4.3.1, so as to ensure the large area and weld the prompt discovery of the heat exchanger products and deal with emptily.

4.3.2 One that is as to 5.2.1 item flat to in charge of, with scattered tropical zone timid inspection to weld situation, estimate scattered each crest of tropical zone with flat to in charge of one are there full solder joints at first, for have obvious welding seam of solder joint pull out and become flexible with detailed stainless steel stitch, if continuous strength of becoming flexible finishes the identification mark and stove symbol to record for the statistical analysis for the future. 5.2.2,Check one in order to estimate on 5.2.5, adopt the steel straightedge measurement of 1m to check on 5.2.3, 5.2.4.

4.3.3 Heat exchanger core body diagonal length measurement method

Fetch the in charge of measuring the contrast with the same reference point of welding the place of the main board flatlying of outside.

2.1¡¡Assembly of the heat exchanger

(1)Surface preconditioning of structure one of heat exchanger

All structure one of the heat exchanger must be dealt with through the surface before assembling i.e. acid alkali is washed, in order to remove dirt of top layer, grease spot, oxide film,etc.. The dirt will hinder the effective contact among the components; Grease spot divide, vent one's spleen, take, reduce vacuum braze stove vacuum degree at vacuum high temperature; Because of the heat exchanger of aluminium alloy

The oxide film of top layer is dense, it is higher than that of matrices material that it melts temperature far, especially compound board borer material oxide film of layer borer material layer melt insufficiently while braze, cause and can't totally alloy with welding the metal, thus influence the quality of brazing. For this reason must control the surface preconditioning of the raw materials strictly, including essential machinery is cleared up, shorten the assembly time before brazing at the same time.

(2)Heat exchanger product structure is a dimensional tolerance

Compound board, big wing slice, low wing slice, big paper strip seal, in go on, finalize the design, make chies of size deviation behind the processing cooperate and must get the valid assurance little paper strip seal. Wing one of heat exchanger should be controlled in the straight deviation range, the paper strip seal should control the range in minus deviation. Otherwise unable to guarantee the compound board is after cooperating with the paper strip seal closely after assembling, have suitable contact area i.e. borer sew interval is easy to cause timid to weld, the borer sew the discontinous or not seam phenomenon among the slice with wing and then.

(3)A surface roughness of structure and form

A surface roughness of structure influences detailed strength of the hair. Generally speaking, the surface is too smooth, it is difficult for the material of borer to be distributed on the whole contact area evenly, the consenquential hole will be enabled to braze the intensity to reduce, especially the surface roughness of the paper strip seal. In order to guarantee the material uniform distribution of borer is in contacting the welding seam, there should be suitable melting thickly in the brazing the surface of structure one. Usually, surface roughness person who consult but Ra0 7mm usually square root of 2 0¦Ì m. In addition ,, Inboard of paper strip seal should make to pour angle 30, help, reduce surface tension of solder when the vacuum is brazed, increase the wetting, reduce the defect of brazing.

(4) The heat exchanger brazes the jig and designs the main point, grasps strength

Because adopt the stainless steel jig to grasp after the heat exchanger is assembled, a scene of crooked lodging of wing after welding, clamp strength to be too little, wing block easy to loose and take off. So should concrete structural design of heat exchanger establish suitable clamping strength for example: Utilize the flexible jig. Contact: Cai DongJun Telephone number: 18913555906, 13013744698 or13905275903 QQ:87041989 SKYPE:jsyzcdj MSN:jsyzcdj@126.com www.yzpst.com Dong Jun Cai

Braze the choice of the material

Braze the particularity of the stove because of the vacuum. Use material have good hot stability and able to bear corrosivity and better biography hot and wearability. Because the jig is enabled under the high-temperature state frequently

Use, sometimes cold and sometimes hot. Easy to oxidize and out of shape; The pharmaceutical residue of borer influences the precision of assembling, need to remove frequently, it combines closely with products, will influence to rise products spread hot and kind,

Warm; Generally adopt 1Crl8NigTi.

Braze the structural design

Braze the jig besides responding to the request that the routine is begged to have. Should also meet the following requirement.

Material form

Because the welding temperature range of the borer material is small. Heat-conduction and heat had to beg loss to braze temperature to be of great impact, jig with position that products exposed to hot capacity little, when some hot capacity is too big, will produce and weld somely and emptily. The method to often adopt is to use the hollow material and contact the surface to dig freely, in order to reduce and insert the contact area of it and product and reduce the hot capacity of the jig.

Structural design of the heat exchanger

Because line bloated coefficient of aluminium alloy and line of jig bloated coefficient difference relatively loud, so there is internal stress very more while heating. As inserting its dagger-axe of stability when being good, it is caused that it is hot and bloated

Stress it lasts jig to be the relative to move and deform products without being lasted inside, so inserting their there should be better stability, had better design the jig into the whole structure, try hard to avoid using and inserting l clam's pole ten times singly; In order to release heat hot one that producing, there should also be certain elasticity in the jig, because wing slice is at higher temperature, the intensity reduces the saddle seriously, when rigidity is too great, under inserting the function of strength, the wing slice will be crooked and out of shape. Influence appearance quality. Ask to consult specifically:

Heat exchanger aluminium brazes the frock jig to design

Foreword

The heat exchanger is brazed under the vacuum, he can get the accurate and bright piecing, and connect and possess fine mechanical performance and anticorrosive performance, the vacuum brazes and compares with other methods of brazing, oxidizing the control with the part out of shape in the part has obvious advantages, characteristic these to heat exchanger, air-cooled radiator, cool cold board with water and have special case body, very much suitable body of the box of requirement, can get the high-accuracy part directly, quality is easy to control, the application that vacuum aluminium brazed in the cooling system of electronic product of now has been already

very extensive. The main process that the heat exchanger brazes includes: The part was added and processed, dealt with before brazing, the part assembled and fixed, brazed, brazed aftertreatment and quality inspection,etc., each dish of processes will influence the final quality of brazing, mainly discuss the aluminium of vacuum brazes the factor that the jig must be considered while designing and choosing below.

1,The heat exchanger brazes the jig and general design principle

Heat exchanger braze part should assemble, make a reservation, mutual position and splice required to braze that ask to so as to ensure part ask the crack braze. Brazing the jig should involve brazing the fixing, assembly of part, entering the stove, brazing, making the whole course. Whether the jig is rational and influencing the quality of brazing practically directly. Principle and requirement that the ordinary jig is designed are suitable for brazing the design of the jig too, if the jig system should have certain precision; The jig system should have certain rigidity in order to overcome the deformation in the processing course; Jig system want, have structural compactness, simple loading and unloading except convenient characteristic consider the above-mentioned principles form, brazing the jig has its own characteristic, generally speaking brazing the jig will consider the following factor when being designed:

(1)Jig material want, can stand temperature of brazing, lose intensity is out of shape and letting the gas, it is difficult to produce the alloy to react with the weldment of group;

(2)The temperature of paying attention to jig and part swells and shrinks, under brazing temperature, guarantee to braze the part and have piecing interval suitable;

(3)The jig should guarantee the heat-conduction of the brazing area, the heat that causes shifts to lower the temperature and interfere to the steady heating of the part minimumly, and does not hinder the flow of the material of borer.

2 heat exchanger aluminium brazes the jig to design

2.The choice jig materials of a jig of materials are selected for use, just guarantee at most all: Under brazing temperature, the rigidity of the jig material should be greater than brazing the part material, in the course of brazing like this, the deformation of the weldment is restricted by jig all the time, weldment and cooperating with the size to rely on the jig to assemble the assurance of getting. The aluminium of vacuum brazes about working temperature at 600 ¡æ, braze time for 3-6 hours, it belongs to the stainless steel of body of that the general situation chooses 1Crl8Ni9Ti to meet the instructions for use 1Crl8Ni9Ti, reach it above 700 ¡æ, the more important thing is anti-oxidantly that there is hot and strong enough one while brazing temperature, rigidity is far greater than the aluminium alloy, organize steadily, will not embrittle to use while fastening for a long time, so, it is very suitable to braze the basic frame of the jig and groundwork part and adopt 1Crl8Ni9Ti; Match size and part that precision expect much as to some, jig design, must involve whorl to be vice orienting hole axle cooperate, the material is chosen improperly, the organization is close, hot stability is bad, there is " kill " between the parts of the jig under brazing temperature Phenomenon, select for use casting iron cooperate with lCrl8Ni9 Fi alternative to use, may solve these problem well.

2.2 influence that will consider hot deformation

Should be considered to produce heat influence on brazing course out of shape emphatically under brazing temperature while brazing jig and part. Because the jig and material which brazes the part are different, hot coefficients of expansion are different, on condition that heat, will produce the difference of swelling amount, brazing the part will be deformed, the purpose of the

jig is to let the borer weldment be out of shape with deformation of the jig, generally speaking, mainly have requirements to borer weldment level degree, vertical degree, welding seam interval. Require strict part very while being other, adopt and force the jig out of shape to satisfied with the instructions for use; But to some external dimension, cooperate with the part that expected much of size precision, adopting be unable to meet the instructions for use once forcing the jig out of shape, must consider on the basis of forcing the jig out of shape, design some elastic components to make up the flexible jig system, the elastic component generally adopts the high-temperature spring or elastic chuck, measure bad calculation through swelling, control the deformation range of the elastic component, so can already keep the essential pressure to the borer weldment, have solved the bad problem of the swelling amount.

As shown in Fig. 1,

It is in part for heat exchanger weldment, guide boards upper and lower with in front and at the back of support there aren't frame, put the ripple board and play the function of heat dissipation between upper and lower aprons and upper and lower guides boards. There is one to require prominently this part, expect much in size precision and precision of assembling in general, is not processed after shaping, the slot orient the precision not to exceed 0 between upper and lower guides boards. 15mm, the size precision of upper and lower intervals does not exceed 0. 2 mm, the plug-in package needs to pull out inserting freely. Through analyzing accurately that calculates about the jig and thermal expansion amount of weldment material in actual production, design elastic stainless steel cushion and rigidity C to insert, cooperate, use, dispel thermal expansion difference influence on brazing. As a jig of systems of Fig. shows, rely on small rigidity to insert Cly from head to foot in the case body perimeter (map 6) And the backing board is clamped, upper and lower four angles of body of case are by inserting Cly on the whole height and the elastic component is clamped wholly (map 9, 10) . Calculate the inflation amount difference produced according to the hot coefficient of expansion of two kinds of materials.

Calculate the formula is:

L =L* T* =L* T * (a2 a a1)

Among them: It was the thermal expansion that produced the inflation amount difference changed; L grasps the distance; T brazes temperature and deducts the room temperature, fetches 570 ¡æ- 580 ¡æ here; A2 grasps an average hot coefficient of expansion, ¡æ; A1 is an average hot coefficient of expansion, ¡æ grasped. The total height of the body of case is 410 mm, the small chuck grasps the distance is 35- 40 mm all around. Through calculating, it is a 2.38 mm that total high direction of the body of case is heated the amount of interval produced after being grasped, small chuck heat amount of interval produced one 0.19 mm (interval amount explain, heat, grasp for negative value thing length greater than chuck grasp the interval swell,) grasp, all around . The interval is 0 to grasp the position in the small C chuck after heating. 19 mm, analyzes and thinks: Braze the surface here including two, because the borer solder packs and connects the interval. Every one braze surface store 0 in. The subside of 10 mm, two items are balanced, it is feasible to adopt the rigidity chuck; And the interval is 2 after heating on whole height of the body of case. 38 mm, deduct four braze surface collapse, exist interval about for 2 mm, if interval adjust too heavy, grasp thing can clamp effectively, braze, need interval to be unable to guarantee heat, it is apt to produce and weld the obviously not even phenomenon of insufficient or welding seam; If the interval is adjusted too small, the shape variable of the chuck can't meet the deformation requirement for the weldment after heating, it is out of shape that the case is realized because of

grasping the thing and limiting, i.e. the four corners support column is produced because the space of thermal expansion is insufficient crookedly or twisted out of shape, cause the part to scrap. Through making the stainless steel spring pad (piece 10 in picture) by oneself (the deformation amount of the spring pad is controlled in 2 mm) Cooperation use solve well this pieces of problem,borer it is abundant for weldment to weld, including some welding seams of upper and lower four corners are even and identical, accord with the designing requirement.

2.3 jig want, consider borer weldment add heat dissipation homogeneity demand heating of part braze, and cooling pace important craft parameter too fully, the vacuum of the aluminium is brazed, the control of vacuum degree is in 3* 10¡¥ about 3Pa, adopt radiation to be heated, in order to guarantee to heat dispelling the heat in the course of brazing it is a course about the same size, deformation of weldment can reduce to most low in this way, apt size precision to guarantee weldment.

As shown in Fig. 2

Braze for aluminium if thermal cycle temperature curve heat too fast, will make weldment temperature even, heat slow to can cause for example mother material crystalline grain grow up, borer material low boiling point group yuan evaporate and metal oxidize borer pharmaceutical person who decompose harmful rapid development of course, the cooling pace of the weldment has direct influence too in connecting quality, slow cooling may cause mother the material crystalline grain grow up, it helps the thinning borer to sew to organize to improve the intensity of connecting to accelerate the cooling pace, cool, may make weldment the crackle produces because form too big hot stress while being too fast, or the borer has sewn to solidify to make the gas not appear and produce in the air vent as the ease rapidly. Can make very good result in brazing on a basis of curve described above in temperature control of the weldment, curve heat speed decide by material form and physical dimension of weldment mainly, with using the form of the material of borer and crystallization temperature range of the borer material to have direct relations too. But if braze the jig and neglect and require scatteredly and hotly, limit the hot exchange of the part, the weldment welding seam quality of the borer is difficult to guarantee.

Braze part one by upper and lower guide board and about side body of the box that board succeed through brazing and joining, part this require plug-in package pull out, insert convenient behind the shaping, have airtight nature require to body of the box, like this in to braze precision have very high requirement, improve both sides welding standard of welding seam too, found in the course of brazing actually the weldment has phenomenon not up to standard of test of airtight by test, in other words the quality of the welding seam does not reach the standard. Through analyze it confirms to be to braze jig to be design unreasonable, jig exercise restraint in heat-conduction then influence welding seam quality of person who braze, not considering the scattered and hot factor in the jig design, the weldment is dull and stereotyped while surrounding in front and back positioning plate and counterweight, influence the hot exchange inside and outside the body of the box, heating of the borer weldment and heat dissipation course are influenced by the jig, in this course, the difference in temperature inside and outside the body of the box may cause thermal expansion, cold and out of shape and inconsistent while shrinking, and the mechanism brazed is a fast course, when the borer weldment reach and braze temperature, material of borer is wetted and the forming of the piecing probably only takes several seconds, borer weldment internal and external temperature inconsistent, lead to the fact welding and sewing

up the air vent, inserting the dreg while being easy extremely, even the welding seam fractures, the weldment scraps. In order to solve this problem, in the jig (see Fig. 3) Positioning plates front and back and body of the box design last cushion column (last 9) ,Positioning plate increase heat dissipation hole, counterweight design heat dissipation type and heat dissipation hole (illustrationally show 10) on the plateform ,The homogeneity problem that this measure has solved the borer weldment and heated and dispelled the heat, has improved the welding seam quality, have met the requirement of part airtight.

3 brief summaries

Vacuum braze jig design, want more complicated factors relatively that consider, under guaranteeing the condition required above in the stove, it after the weldment will be heated, connect and swell and relax to consider the gravity will be influenced, borer expect will appear trend that flow downwards, must notice jig and weldment grasp and put the form naturally; The jig structure should be as simple as possible, it is that one closes course carried on to braze, the concrete course can be seen, the simpler the jig is, the fewer unpredictable questions are, in this way jig dependability is high, the effectiveness is strong. In a word, should guarantee the following several respect to design especially while brazing the jig: Guarantee the weldment piecing interval of borer, as to equipment one of the aluminium and aluminium alloy, there is 0 in the piecing. 05- 0.The interval of 10 mm, the material of borer has the best flowability at this moment; Pay attention to inflation and shrink of jig and the weldment of group at the time of brazing temperature, consider the difference of the coefficient of expansion, guarantee the part coordinates each other; The jig brazes the influence of the course on the part minimumly, guarantee that does not influence the heat-conduction of the brazing area, do not hinder the flow of the material of borer.

Grasping strength and generally showing the torsion spanner to control by counting of the jig. Grasp strength and generally control it in 18913555906 or 13013744698

(5)The facelift of the appearance of the heat exchanger: The deformation after brazing to the vacuum of heat exchanger, generally adopt the mechanical law to correct.

Working technique:

1,Put, on having a facelift jig, regulate heat exchanger core body spiral shell pole have a facelift through trim panel to the body of core, make two diagonal length difference reach the pattern to require.

2,Unless it estimate heat exchanger the cores the bodies old for level level degrees of error, for instance, exceed 2mm error,should a fixed one side, with hand being light to pull another side go on relatively, until according with the fixed requirement.

3,Blowdown the incidental in the water pipe with the compressed air.

Check and have a facelift the size containing jig of workers used and accord with the demands for products pattern.

Operate on-the-spot craft file and production drawing complete, operation worker carry on operation according to craft requirement of file, for needing to beat the size of having a facelift and exist and operate barbarously, fill in the quality record conscientiously.

Test stone of the facelift products

Each assemble the size of centre-to-centre spacing of the hole, external dimension, the size of centre-to-centre spacing of the hole of angry room accords with the demands for products pattern, diagonal centre-to-centre spacing error to assemble hole smaller than 2mm, assemble hole in

below 2mm with core body one degree of errors of level at the loud parallel levels each.
There is not the file out of shape to repair the phenomenon to assemble the hole, the heat exchanger products have no deformation incurred because of having a facelift improperly and break-up defect, the body of core has not been knocked against.
(6)The water conservancy diversion board is welded: Adopt argon arc-welding way and weld the water conservancy diversion board of the heat exchanger, i.e. the large paper strip seal position of both ends of heat exchanger.
Apparatus, the instrument, frock jig:
Arc welder of argon
Auxiliary materials:
Weld the silk ER5356 with aluminium magnesium
The main point of movements:
Hand over item by item the daily apparatus at first
1.According to the relevant parameters of the regulating argon arcly machine of " apparatus operational procedure ".
2.To support board and main fact blocks of point of connection go on, weld, 4 points of connection require to weld, the pad is even and esthetic, can't leak and weld. Fetched upper a process semi-manufactured goods, welded the retainer plate and side plate, the about both sides all
3. Different products require the quantity of the pad is different, weld according to the technical requirement, the length of each solder joint is 6-8CM.
3,Get the hydroecium to the part that is got and complement one to carry on the inspection, and reject the unaccepted product. Must remove weldments in the superficial oil, coating before welding, lubricant and oxide film,etc.. The hydroecium semi-manufactured goods ' Press one) Show it on the mesa of job, go on and connect (make a reservation) according to the drawing requirement . Click and weld after adjusting the good phase place and putting. Beat and put the angry room in place with the mallet according to the drawing requirement loaded into one slice of troughs of main fact, then click and weld every extreme point to weld two points in both ends. The ones that take down and finish clicking welding always become and transfer to a process of making welded wholly:
a.The retainer plate welds upper and lower two sides and both ends and demands to weld wholly, the length of welding seam is 5-6CM.
b.Beat with wooden Chui main fact make their connect, weld with angry room surface cooperate closely by the blocks of trough, then weld wholly. The welding seam demands to seal, it is reliable, esthetic, even. Always become and weld and finish, write the number of going to work in what has been examined OK by oneself always becomes with the mark pen. And check the frequency inspection according to the control project that the management project stipulates.
Always become the body of core and put on the turnover car.
4.All is put in place to examine the processes done by oneself, OK product piles up neatly and transfers to the next process.
Notes:
1.Should handle with care while fetching and putting the products, the hydroecium is welded and carried and paid attention to handling in the course with care. Can't knock against, scratch. .
2.Argon arc-welding operator, must put on the women's head-ornaments putting on, glove, putting on work clothes, job shoes, burn and pay attention to depending on while operating the apparatus

that safe for ultraviolet ray and infrared ray that prevent from in the electric arc light, carry on the homework according to " apparatus operation regulation " requirement strictly.

Angry flow Contrast forms in parameter that consult " "

Weld the electric current Contrast forms in parameter that consult " "

Welding seam quality level

A products welding seam are even, unify, the width of main welding seam is within 8mm, the welding seam of the fittings does not allow to exceed 6mm except main welding seam, use the diameter 2mm welding rod.

2 welding seams demand to have obvious fish scale lines, the line is levelled smoothly, the line and line interval are 3mm.

3 main boards and height of welding seam of hydroecium do not exceed the main board height, it is 1.5mm to piece together and weld the height of welding seam of the hydroecium.

4 sharp and a welding seam straight line deviation does not exceed 1.5mm.

5 products welding seam length <the middle of 600mm have, connect, welding seam length>, 600mm only permit one piecing and transition take natural smooth midway.

The heat exchanger always becomes the quality level

All a products should guarantee the external dimension keep the same with sample, there are samples to be measured its President succeeding according to the sample, another foreign trade new product should have the three sides of quality testing department, the Ministry of Foreign Trade, technology department to show up together and can be confirmed.

2 if external dimension of the products and sample are wrong, the negative value of fetching its external dimension is accurate.

3 is carried out from the system of examining strictly, guarantee the product appearance quality of this process is qualified.

5 job mesa and put shelf must pad rubber, keep job mesa and put shelf to be clean, it is not so apt to scratch the incidental of the products as metal piece, grit,etc., put the shelf and forbid stepping on with the foot.

6 products should pay attention to protecting in processing and transportation, handle with care, should add the floorcloth between each spare part, prevent scratching or knocking against.

The heat exchanger products are according to making and protecting the requirement and going on followingly in processing.

Products in argon arc-welding, try, press, pack transshipment course of the process accomplish three points become always, first, piling up in transshipping the car highly can't exceed the car armrest, second, should put and protect and use the spacer between products and products, third, cover and cover dustproofly.

Various spare parts that welded on the hydroecium are smooth and having no burr in conformity with the surface, and should carry on chemical polishing treatment, a small amount of very manual polishing treatment of sample.

Heat exchanger water tank demand, cooperate with water mouth flat and water case lid flexible in usage, the part puts in storage and always becomes dispatched from the factory confirming its flexibility.

Panel beating workshop heat exchanger spare part cut board, roll over curved scribing, punching, making course want, keep bright and clean piece bright and clean, operation of scribing etc. goes on on another side. Notice the products protected, the mesa of job and putting the shelf to remove

aluminium bits in time, bright and clean piece mustn't have scratch, crackle and compression phenomenon.

The panel beating workshop should use the floorcloth while rolling over curved, do not allow to have crease and compression.

Heat exchanger hydroecium behind the polishing use the cleaner ' 34-40 ¡æ) Soak for 2-3 minutes, then put into and rinse while rinsing poorly in time, rinse, dry by doing the cloth, back-to-back, piece neat to stand, put, in turnover case, transship, put in hydroecium putting shelfing finally by piece, must put the floorcloth between the each - storeyed hydroeciums. The heat exchanger hydroecium is put in putting the shelf back-to-backly, one is put neatly by one, must isolate and prevent scratching with the floorcloth.

Hydroecium take two of inside and outside piece together method of welding, inside it is energetic to have, leak, order for welding seam to want, outside it is esthetic for welding seam to take, quality according to weld relevant requirement, hydroecium outer surface does not allow, have, row, hurt trace of striking sparks.

Support with the billet inside at the time of the hydroecium polishing of the heat exchanger, prevent the hydroecium from being out of shape.

(7)The sealing detection that the radiator always becomes: Person who be hunt leak ' Helium leak hunting of vacuum) . The whole system is mainly by the system of the vacuum tank, fill helium and retrieve the system, smoke the vacuum system, clear helium system, mend helium system, pneumatic transmission, assembly line transmission system, electric apparatus control system, helium mass spectrum leak detector etc. to make up. The leak hunting of water pressure: Ink examine, adopt compressed air way examine the heat exchanger ability of bearing pressure, let out and examine.

Homework order

Hand over item by item the daily apparatus at first.

Select corresponding stopping up frocks for use according to the type.

Start apparatus establish parameter (measure pressure: 0.180Mpa, inflates time: 15

Second, equilibrate time: 30 seconds, protect and press time: 25 seconds, warning limit: 0.01 Mpa) .

Will rivet the products well to put on the platform, stop up all open mouths by stopping up frocks OK.

Push the keypad and operate the key " Enter " Begin to measure; Push the operation key controlled on the box; The test result is judged: The acceptable product is on " The green light " ,NG products Bright " red light " .

Certified products neat to pile up, get turnover at the car, unaccepted product put bad product district wait for water to examine and judge.

And check the frequency inspection according to the control project that the following management project stipulates.

Check that always becomes the size of welding the jig and accords with the demands for products pattern.

Operate on-the-spot craft file and production drawing complete, operation worker carry on operation according to craft requirement of file, whether the products spare part received accord with the demands for quality level, fill in the quality record conscientiously.

Appearance quality is compared with each of welding seam standard, the welding seam should be

even and firm, esthetic. Each of products is in charge of flatly, scattered tropical zone is welding the course and can't damage and burn the phenomenon. Have not welded the dreg and other impurity in in type of the products after always becoming

Person who seal become welding seam try, pigeonhole by compressed air of 0.3Mpa, assuare, keep 1min leak always. The concrete requirement, for not leaking and clicking more than 4 o'clock to each welding seam of angry room of steel mould, do not leak and click more than 2 o'clock as to each welding seam of angry room of sand mould.

Method of inspection

Check in order to estimate Through " always become and try pressing leaking some records of counting of the process " Fixed carrying on the welding seam and leaking statistics that are clicked, and feedback the statistics in the related departments in time, leak the serious products and find out the reason and take measures as to the welding seam.

(8)The spraying, polishing: Wash to the surface of radiator, dries, the spraying, polishing, drying, improve products appearance quality.

Homework order

Hand over item by item the daily apparatus at first.

Get the paint and mediate the paint according to the products pattern requirement and paint manual requirement.

Turn on and regulate relevant apparatus parameters according to " apparatus operation regulation ".

Fetch and try pressing the products qualified to put in the mesa of job, polish and dispel the position of scratching on the side plate with the polishing machine. Then put, have a facelift platform, use, have a facelift tool go on about side plate whole and flat. U require type trough the productses of side plate it go on polish, have a facelift side plate,other in make require device productses cold. Become about side plate carry on with clearing cloth clean, hang, arrive hook upper reaches led to flow enter to dry one always. Adjusted the spray gun, the ones that enabled and squirted were painted vaporific, when the room has flowed to to spray paint to always becoming, spray paint in always becoming the surface. (whether spray gun move pace to be even, from muzzle to core body 20-30CM)

Spray paint and finish, examine and leak and gush out by oneself, if mend and gush out at once. Gush out good paint products air dry, take off at not getting in touch, look over, spray paint bad(shed column, paint tumour, colour difference) ,OK products put the dust cover in and put on the water inlet and outlet neatly in the certified products area, NG products putting the bad product area.

And check the frequency inspection according to the control project that the management project stipulates. Check whether worker operates operation on request, whether fill in the quality record conscientiously.

Appearance quality paint membrane to be intact even, color and luster have obvious difference, coating have rough skin, flow, register for, there is no outside impurity foreign matter. The products have not been knocked against.

As to the thing that the appearance of the products has surfaces air room which casts the defect of levelling etc., it must blow putty to deal with before spraying paint, and examine quality which shaves the putty according to each of standard.

(9)Delivery of packaging.

Homework order

1,Hand over item by item the daily apparatus at first.
2,Select the corresponding package packing box for use according to " parameter form of the products ".
3,Demand, get corresponding label, identification card according to products drawing, use, play date of production at yards of machine play by card identification.
4,Use the electric drill to punch appointed position of retainer plate and insert the rivet, insert the rivet and rivet the identification card on the retainer plate by smoking the core pincers. Whether the apparatus that the packaging uses is intact, whether the appearance size of packing box, identification used accord with the products requirement, certificate of quality identification with products conform, operate Engineer fill in the quality record conscientiously.
5,Check and pack the products access cap of angry room of quality to build dustproofly, one set of plastic bags before the products are cased, there are antivibration foams in the case, the packaging is firm, it is reliable to seal and pitch.
6,On criticizing the label card of the products in the retainer plate and booking the position.
7,Put the foam cushion in the carton, put at two corners of water inlet and outlet of hydroecium in first. Corresponding foam protect cushion, become, put case sets of two foam corner cushion into always radiator.
8,Seal carton both ends leave distance of 20-25CM tie up, bale, bring, set bale, detain well
Surplus cut off, tighten up, bale, bring, with rivet, keep pincers bale, deduct, rivet urgent.
9,Bale and finish the other case label on the card.
10,And check the frequency inspection according to the control project that the following management project stipulates.
11,Produce pack President Lu become neat to pile up, at turnover train, go through formalities of putting in storage.
2 heat exchanger products let out reason analysis
Quality index of the compound board
(1)Influence of the main element in material one layer of chemical composition of borer
Si content: To braze performance embody in borer material flowability, person who wet of layer, interval pack ability and weld the intensity compound board. In two yuan looks picture of Al-S alloy, temperature reaches 577 ¡æ, w (Si) =At 11 7% o'clock, the eutectic response takes place. Act as w (Si) ¡Ü is at 11 7% o'clock, alloy of two yuan melts temperature to reduce with rising of Si content. So, in the borer material layer when Si content is high, its melting point is low. When Si content too high, can make it cover layers of alloy melting point reduce, flowability fine not to wrap up, the interval packs ability strongly, but when it is spread to and welded the metal interface, and make the firm looks composition become certain, lead to the fact that is welded the metal to melt firmly, produce and melt losing. Si content high, density gradient heavy, melt, lose, inclined to to matrices alloy serious; When Si content is too low, produce the opposite result. It is 4004 aluminium alloy that the vacuum is brazed borer material layer which uses the compound board, its w (Si) Standard range 9 0%~10 5%. Mg content: Wrap up Mg to cover layers of alloy whether vacuum braze essential metal activator, inhale pharmaceutical, can exert a positive influence in strengthening the corrosion resistance of compound board at the same time. Mg begins to evaporate in above ¡æ550 in a large amount, form the atmosphere including Mg among the vacuum brazes the stoves. The magnesium vapour can already be combined with oxygen in remaining oxygen or vapor in the atmosphere of brazing, protect, heat part to be surface unlikely

to oxidize again, can permeate through, get part surface remove clean oxide film, remove it. So as to the vacuum braze the vacuum degree of the stove, when the vacuum degree is high, Mg of the standard content can play an enough role; And when the vacuum degree is low, need to control Mg content in upper limit or higher. W (Mg) of 4004 aluminium alloy =1 0%~2 0%. If the stove vacuum degree of vacuum is not fine can be appropriate magnesium is put inside the vacuum stove. Putting amount: 13905275903 or 13013744698 Cai east beautiful QQ: 87041989 SKYPE:jsyzcdj MSN:jsyzcdj@126.com **www.yzpst.com**

(2)The material of borer is one layer of thickness

Compound board thickness and borer material layers of settlement of thickness should be with bearing pressing to demand to match of heat exchanger, must combine the theory to calculate to make with production practices. Here point out when layers of thickness too thin, apt to cause, weld intensity to be low welding firmly bearing, pressing, up to standard of etc., welding the defect as borer material especially; When being too thick, can cause core layers of alloy thickness pass thin bearing, pressing, up to standard of, even presenting, melting, losing phenomenon lead to the fact and leak. So, borer material one layer of thickness and homogeneity weigh the important index of its quality, influence the heat exchanger to braze one of the important factors of quality too. One layer of thickness of material of borer is generally controlled in (10¡À 3) of the compound board thickness in practical application % should.

(3)Other quality requirements of compound board

Compound board another function of heat exchanger to act as the baffle of passway, bear the requirement of pigeonholing. So, there should not be influence it bears inherent, external defect pressed. Inherent defect such as air vent, inserting the dreg of one floor of alloy of core, and the material seam of layer of borer is bad; The external defect is except that surface described above can not be dealt with clean, the ones that have in the course of processing are knocked against wounded and scratching, will destroy metal continuity directly too when it exceeds one layer of thickness of material of borer deeply, lead to the fact the ability of bearing pressure drops.

2.3¡¡The heat exchanger brazes the craft system

The capital equipment that the heat exchanger produces is: The vacuum is brazed in the stove, the vacuum is brazed and mainly heated by heat radiation. And radiation conduct heat, have characterized law their, law, Boltzmann of Stephen:

The having type proves, need very high heat energy to conduct even if it is that very small temperature is bad at the time of the high temperature, i.e. the higher the heating temperature of vacuum is, the greater the heat needing transmitting is. Prove vacuum intensify pace want other heating way a lot slowly in the stove in the same cases. Necessary time is probably 3 times, 6 times of the salt bath stove of the air stove that the vacuum is heated. So, while making the heat exchanger and brazing the heating craft system, can't imitate air stove, salt bath stove and heating craft system of the atmosphere stove. The having type explains at the same time: The heat exchanger is brazed in the course, should slowly heat as much as possible, so that the internal and external temperature of the heat exchanger keep unanimity, otherwise influence the quality of brazing directly. To industrialization preheating definitely warm, keeping warm produce, hold, can make warm keeping warm, braze definitely warmly, keep warm and lose electrical power and lower the temperature, can improve the effectual technological process of production efficiency as well as, among them it is the key to influencing the heat exchanger to braze quality that the heat exchanger brazes and brazes temperature, temperature retention time, vacuum degree in the course.

(1)The heat exchanger brazes temperature: When temperature low, borer material does not reach essential temperature yet, borer flowability of material, person who soak relatively bad, apt to produce borer sew internal air vent, borer sew discontinous, timid defect of welding etc., make the heat exchanger borer weld the head intensity to reduce, the ability of bearing pressure is not up to standard of and produce and let out, will even cause and tear when being serious; When the heat exchanger brazes temperature high, the material of borer is totally melted and flowability is too big, apt to produce borer material oxidize, form air vent and hair detailed strength function in welding seam change badly, cause the material loss of the borer, melt one scene of crooked defects of losing, wing. A suitable one make, should pay attention to to flow, order solder while being warm, melting point of solder should than weld metal melting point to be low and 60 ¡æ about usually. At this moment, the liquid solder has good infiltration nature and scattering in welding the metal, can pack and braze the interval under the detailed strength function of mao well, and and welded the metal to produce good alloy function, form the high strength to connect.

(2)The heat exchanger brazes temperature retention time: Heat exchanger borer material wet and connect, form, need 1s change 2s nearly braze, so temperature retention time reach, braze by heat exchanger heart department temperature time and oxide film layer temperature need dissipate necessary time determine mainly. If temperature retention time is too short, department of heat exchanger centre temperature has not reached the temperature of brazing; Time too long, liquid borer material easy to make, weld metal melt, lose, the products collapse.

2.4¡¡Vacuum degree when the heat exchanger is brazed

When vacuum degree of high-temperature state low, stove residual O2 H2O oxidative gas apt to get up chemical reaction produce quality hard oxide film Al2O3 with Al. Al2O3 organizes densely, stability, melting point are high, it is difficult to decompose under the circumstances that the ordinary vacuum brazes temperature, make its mobile infiltration bad after the material of borer is oxidized; Weld the metal and oxidize, difficult to soak, thus cause the welding performance deterioration among the solder and matrices. So need to improve the vacuum degree when the heat exchanger is brazed as much as possible, reduce the content of oxidative gas such as O2, H2O, control the formulation amount of Al2O3. Generally require, the heat exchanger brazes the stove to adopt and control the temperature in the warm district more, the furnace temperature homogeneity is 3 ¡æ of ¡À, the working vacuum degree should guarantee not to be below 6.7* 10-3Pa, it must be in 10-4 orders of magnitude to smoke the terminal vacuum degree of the vacuum in advance.

2.5¡¡Environmental state when the heat exchanger is brazed

Humidity of environment will braze to radiator quality cause influence carry on radiator assemble, under high humidity, there will be more moisture that stay wing slice, on baffle and paper strip seal. Put heat exchanger assembled under the high humidity into vacuum stove to braze, the moisture will evaporate, release more gas, and the moisture breaking up within the heat exchanger products is evaporated, the gas is released is a slow course. The moisture needs steaming and generating heat in a large amount, influence the temperature within the heat exchanger; The moisture will also influence the vacuum degree; The moisture oxidizes the ones that aggravated aluminium, thus influence the quality of brazing of the heat exchanger. In carry on heat exchanger component surface deal with, assemble and products should keep sure environmental humidity braze, adopt oven go on, dry dry to process (can utilize, braze products well send out come hot to dry, it is here to dry the temperature of the room and control: 13013744698 or

18913555906) ,Control the content of moisture of surface of heat exchanger component caused because of the environmental humidity.

The main phenomenon of the defect is as follows, that the heat exchanger brazes

1 flows all over the placely

All over the place to it flows to be borer material flow through borer weld head in mother material thin borer material overburden formed braze.

(1)The reason flows all over the placely

The heat exchanger frock jig should be certain elasticity and steel degree while brazing temperature, make welding seam link place have suitable interval, form capillarity absorb, live in, melt the material of borer. It is not tight for the frock to insert, braze the chink of package too too big to keep the material of borer, produce the all over the place defect of flowing. Frock steel degree low, hot and out of shape and action of gravity cause, braze package bind chink increase heat, can't form the capillarity of the material of borer and lead to the fact too the material of borer flows all over the placely. It is that the radiation conducts heat that the vacuum is brazed, the hot capacity of the frock jig is old, it is low that the heat exchanger brazes the intensification speed of the part, it is long in a firm a liquid phase temperature block residence time of the material of borer, the material low melting point component of borer volatilizes more, the function time of pharmaceutical of borer is long too at the same time, the two further destroyed the surface tension of the material of liquid borer, improve borer material to mother person who wet of material excessively. The amount of stove put is large, the warm speed of going up and down is low, temperature retention time is long and the hot capacity of frock jig is large and the same, the material time when staying in liquid state of borer is long, it is to lengthen the liquid temperature retention time of material of borer that the speed of lowering the temperature is slow, will produce and flow all over the placely too. The function of pharmaceutical of borer is to reduce the superficial oxide film, reduce the surface tension of the material of liquid borer, improve the wetting of the material to mother of material of borer. Greater than control consumption on it last chalk at vacuum aluminium generally in: 13013744698 or 18913555906. Consumption still because form, surface area, load with stove quantity different and different of part. Chalk consumption heavy, borer material very good leading to the fact borer to be material all over the place to shed in person who wet of material to mother. Keep temperature warm to be high, liquid borer surface tension of material little, borer pharmaceutical reduce function of surface tension strengthen, wait for these factor result of comprehensive function cause borer to be material all over the place to shed. The work piece is long and leading to the fact that flows all over the placely in a firm a liquid phase temperature block residence time of the material of borer.

(2)Dispel the measure

Can increase the heat exchanger frock and insert strength, narrow and braze the package to join the chink. Improve the frock jig steel degree, does not become great to join the chink while guaranteeing the hot state. The fretwork lightens frock weight or replaces some steel products with the graphite, in order to reduce the hot capacity of the frock. Reduce the pharmaceutical consumption of the borer, should chase the stove and reduce the pharmaceutical consumption of the borer while brazing continuously. Adopt and go up and down stage by stage warmly, rise and lower the temperature on a firm liquid phase temperature block of material of borer fast, shorten and braze temperature retention time, reduce and braze the temperature of keeping warm, reduce the amount of stove put.

2 corrosion

It is sunken that the corrosion is mother the surface of material is fused and taken shape by the material of melted borer.

(1)Corrosion reason

Borer material and braze mother material mismatch, borer material and mother a certain group yuan of material form low melting point phase, reduce mother material some area of firm phase lines temperature. The hot capacity of the frock is large or the amount of stove put is large and causing the part to intensify the speed slowly, stay on a firm liquid phase temperature block of material of borer too long, hold in place with a net, formate low looks of melting point lead to the fact mother looks alloy some regional melting points reduce and melt in a certain temperature some borer material and a certain group yuan that mother take a fancy to. Furnace temperature even, borer weldment some temperature too high, braze temperature to be too high to lead to the fact, spread by borer material regional mother low melting point component of material melt. Go up and down on a firm liquid phase line block of material of borer warmly slowly. Braze temperature retention time too long.

(2)Dispel the measure

Solve the measure and usually change the borer material trade mark. Or intensify fast when close to the material melting point of borer, reduce the amount of stove put, lighten frock weight, reduce the temperature of brazing, shorten the temperature retention time that the heat exchanger brazes.

3 heat exchanger products braze the intensity low

(1)Reason

The heat exchanger brazes temperature retention time short, a certain group of yuan spread time to mother material short. In borer being material firm one liquid phase district ask, intensify time to be too long, borer material some group yuan volatilize more. Vacuum pressure too high or vacuum stove leakage rate heavy, borer material or mother material oxidize partly heat. The oxide film is not removed completely. But the component of the change borer material of excessive erosion when alkali is had of material of the material of borer or mother. There is few pharmaceutical consumption of borers, the wetting of the material of borer is not good.

(2)Dispel the measure

Lengthen the heat exchanger and braze temperature retention time, it fully finishes to enable and spread. Adopt and divide the block to intensify, intensify on a firm liquid phase block of material of borer fast, reduce the volatilizing of the yuan of borer material low melting point group. Reduce vacuum pressure, material of the material of borer or mother is oxidized once again when preventing heating. Check pressing the rising rate of the vacuum stove. Limit to 0.3 / S; Increase the lye density or temperature, or lengthen the time of losing of alkali, remove the oxide film completely. Reduce lye density or temperature ' Generally control it in 60 degrees of C) ,Shorten alkali time of losing, separate borer material or mother material alkali wash, prevent alkali from change borer component of material wash. Increase the pharmaceutical consumption of the borer, improve the wetting of the material of borer.

4 leaks and welds

Leak, weld it is borer weldment butt joint place borer that sew place have borer material or borer material melt loss and not chink of the seam that form.

(1)Reason

Borer material consumption is not enough for or join the chink greatly. Heat exchanger braze, intensify speed to be too heavy to lead to the fact part out of shape ambassador bind chink increase, can't form the capillarity. Borer pharmaceutical consumption heavy, borer person who wet of material very good to cause borer material loss or borer welding seam too wide. Block intensify speed to be slow in borer material firm one liquid phase line, borer material low melting point group yuan volatilize and change more material component of borer, have improve the remaining melting point of some borer material, has reduced the mutual diffusion function among the material of material of borer and mother. The amount of stove put is large or the frock is unreasonable in design. Frock too serious caloric receptivity too heavy, result in, intensify speed to be slow. Temperature retention time is long or the rate of cooling is slow, the volatilizing much of the yuan of borer material low melting point group. The material of borer is corroded, has changed its composition then changed the melting point.

(2)Dispel the measure

Increase borer material consumption, the clamping strength which increases the heat exchanger frock narrows the chink of junction. Heat exchanger increase, braze to go stress anneal process, intensify stage by stage and warm stage of setting up etc. package braze, intensify at above ¡æ500 fast. Reduce the consumption of pharmaceutical of borer, should chase the consumption that the stove reduce pharmaceutical of borer while brazing continuously. Reduce the amount of stove put, lighten frock weight, replace some stainless steel with graphite. Shorten the material alkali of the borer and corrode time, or adjust and corrode the craft parameter, the corrosion of the material of material of borer and mother should go on separately.

5 stitches of holes (air vent)

Braze the bubble melted in the course in the material of borer to form while solidifying in the hole of the surface, small title needle hole, the large title air vent.

(1)Reason

The vacuum degree be reached, require when the heat exchanger is brazed, the normal heat exchanger brazes the vacuum degree requirement in 2 0* 10-3Pa. Braze the high pressure in the stove, the bubble ease in the material of borer produces resistance greatly. Borer material composition incorrect, low melting point high vapour pigeonhole element to be content too high.

(2)Dispel the measure

Close to the borer material melting point place and establish and keep the platform warm in order to reduce and brazes the pressure in the stove. Reducing in the material of borer, the big vapour presses the element content.

6 borers of material are not melted completely

Borer material does not melt it is some borer material component that melt and leave high melting component melt all, it is that there is no melted defect in melting and the middle of top layer of the material of borer to see apparently.

(1)Reason

Heat exchanger products amount of stove loaded with heavy, or frock too serious hot capacity heavy, block intensify speed to be slow in borer material firm one liquid phase line, in the course of melting, in the vacuum environment, the low melting point component of the material of borer is vaporized too many, have changed the composition of the material of borer, make the remaining borer material melting point rise without melting.

(2)Dispel the measure

Intensify stage by stage, improve the intensification speed at last stage, set up and wait for warm section at 500 ¡æ, dispel work piece lagging of temperature in order to improve borer to be material firm one liquid phase line block intensify the speed, reduce the amount of stove put, it is the graphite to lighten frock weight or change some stainless steel, reduce the hot capacity of the frock in order to raise the intensification speed of work piece.

7 heat exchangers borer weldments are out of shape

(1)Reason

The heat exchanger brazes the speed of intensifying greatly, the too fast or hot stress of the release stress is too big, it makes the hot stress too big too to cool too fast. The frock steel degree is insufficient or puts the intensity of inserting insufficiently.

(2)Dispel the measure

Increase, braze to go stress anneal package braze; Adopt and intensify stage by stage, the warm platform of setting up etc., intensify while closing to brazing and keeping temperature warm fast; Control and lower the temperature stage by stage, it is slow and cold at the firm looks thread temperature of material of borer. Improve the frock steel degree and put the precision of inserting.

8,Fill out some bad interval of crack and has not been fill-uped.

The reason emerges:

(1) Heat exchanger connect design to be unreasonable, heat exchanger products spare part assemble interval to be too big too little, the part is crooked while assembling.

(2)Pharmaceutical of borer is improper, if the activity is bad, pharmaceutical of borer and needle material will melt temperature difference too big, borer pharmaceutical fill out crack to be ability getting bad, or gas protect gas purity low and vacuum vacuum degree low braze, braze.

(3)The material of borer is selected for use improperly, if the function of wetting of the borer material is bad, the borer is insufficient in material amount.

(4)The material of borer is found a room for improperly.

(5)The preparation is not good before brazing, not net such as clearing up.

(6)Whether braze hypothermia or not.

9 heat exchanger core body braze air vent produce reason:

(1)Connect the interval to choose improperly.

(2)The part can not be cleared up netly before brazing.

(3)Borer pharmaceutical go membrane function or protect gas go oxide to be function weak.

(4)The gas or borer material is overheated that the material of borer appears while brazing.

10,The borer sews and inserts the dreg to produce the reason:

(l)There is too much or too little pharmaceutical consumption of borers.

(2)Connect the interval to choose improperly.

(3)The material of borer is caulked from connecting the two sides.

(4)Melting the mismatch of temperature of material of borer and borer pharmaceutical.

(5)The pharmaceutical density of the borer is too big.

(6)It is not even to heat.

11,The borer sews and fractures to produce the reason:

(1)Because hot coefficients of expansion of the different kind of mothers material are different, it is too big to cool the internal stress formed in the course.

(2)The same kind of material braze, heat evenly, cause, cool course shrink inconsistently.

(3)When the material of borer is solidified, the part moves each other by mistake.

(4)The interval of borer material crystallization temperature is too big.
(5)The borer sews the fragility too big.
12,Mother material fractures and produces the reason:
(1)Mother crosses and burns or overheated material.
(2) Borer material permeate through among being material brilliant to mother, form the fragility looks.
(3)Do not heat evenly or cause too big internal stress because rigidity is grasped.
(4)The stress that work piece has internal stress to cause is corroded.
(5)Two hot coefficient of expansion difference too big and plasticity on the low side different kinds of mother material.
The reason is that 13 mothers material is produced by the corrosion:
(l)It is too high to braze temperature, temperature retention time is too long.
(2)Mother material and borer function of material too violent.
(3)Borer material amount is too much.
The material loss of the borer produces the reason:
(1)Braze temperature too high or temperature retention time is too long.
(2)The material position of borer is too improper to so that the capillarity has not arisen.
(3)Some interval is too big.
Conclusion
Through the above-mentioned analysis, braze a qualification rate for the vacuum which improves the heat exchanger, should do the following jobs well:
(1)Use heat exchanger raw materials should guarantee product quality, want from regular, the specialized factory buys; The heat exchanger is by wing slice, baffle, paper strip seal and sealing the head to make up, their materials are all aluminium alloy. Can use after it is qualified to examine the material again. Wing slice, baffle, paper strip seal need pickling before the body of modes in Chinese operatic music of equipment, remove dirt greasy dirt and top layer oxide film. Greasy dirt will decompose at vacuum high temperature, reduce borer connect stove vacuum degree in the stove, enable a slice of baffle of wing,etc. and oxidize etc.. Aluminium alloy top layer oxide film very dense, and oxide film melt specific humidity matrices their material high, it is difficult to melt when the borer is connected, thus influence the borer to connect quality.
(2)Braze the craft procedure and get the material ready according to the heat exchanger strictly, control good heat exchanger products spare part surface wash, punish, assemble, products dry, heat exchanger vacuum braze curve;
(3)Braze temperature, temperature retention time, vacuum degree,etc. and brazing the craft system to optimize and control strictly to the heat exchanger in practice;
(4)Control the good products and assemble the environmental humidity and keep the environment: On the winter humidity it is dry <60% RH, temperature is for 40¡À 5 ¡æ: The heat exchanger products must be dried before being assembled, dry and dry the craft and dry the products according to the heat exchanger, drying kiln rotational speed 200¡À 50r/min, dry temperature 200¡À 10 ¡æ.
(5)The key factor of brazing the qualification rate of vacuum stove is as follows, to improve the heat exchanger
1st, want the newspaper to confirm the platform and pay attention to the parameter of brazing according to different heat exchanger products

2,Should consider its intensity in design of the jig. Will give consideration to its rigidity, there should be certain elasticity, it is convenient to use and regulate, easy to operate, reduce the human factor (for example the boss is unwilling to send the bonus, worker's sense of responsibility to be strong) Influence.

3,Weather state when the borer is connected

When the borer is connected, ambient temperature of atmosphere and humidity will heat exchanger borer body lay concave laying concave intensity cause influence greatly to board wing type. While carrying on installation of heat exchanger under the large humidity, there will be more moisture that stay wing slice, on baffle and paper strip seal. Set people free modes in Chinese operatic music body that high humidity assemble vacuum stove borer answer, will release more gas. The wing type heat exchanger of the board needs to keep certain vacuum degree when the borer is connected in the borer connects the stove, so the gas that the borer releases slowly when being connected will influence the vacuum degree. Because the evaporation of the steam needs a large amount of heat, this will influence the temperature in the board wing type body of core of heat exchanger. Because the aluminium alloy sheet metal is easy to be oxidized after pickling, and its oxide melting point is different from raw materials, will influence the quality that the borer will be connected, and the level of the ambient temperature influences the superficial intensity of oxidizing of sheet metal of aluminium alloy directly. In board wing heat exchanger pickling of spare part, department load with and borer should keep sure ambient temperature and humidity connect.

4,The ones that reach braze temperature at most when the heat exchanger borer is connected. Heat exchanger wing slice and sheet metal have borer material, borer material melt, need certain temperature. The borer connects temperature not only influences the wetting of the material of borer but also influence the heat exchanger borer to weld the connection intensity of the head. If it is too low to braze temperature, then the flowability of the material of borer is bad, apt to cause welding emptily, heat exchanger borer sew inside deposit in air vent and insert dreg, make intensity reduce, easy to produce, let out, even know the hunch to tear when being serious; Temperature is too high, the borer material of heat exchanger is totally melted, it is apt to produce the air vent and the borer material is oxidized seriously.

5,The heat exchanger brazes temperature retention time. If can make sure the core body outside of heat exchanger and temperature of the middle remain unanimity throughout when the vacuum borer is connected, i.e. temperature slowly rises to the maximum temperature very much, slowly drop after keeping warm, then the heat exchanger borer can get very good assurance to connect quality. But consider the economic benefits, on the premise of can ensure the quality of products ing, should try hard to shorten the borer and connect time.

6,Transducer quantity and location of heat exchanger products temperature. In order to grasp the board wing type heat exchanger core body borer temperature of every parts when connecting, need a lot of temperature transducer measure every part of temperatures in time, can regulate vacuum braze borer answer temperature-controled form directly in time in this way.

7,In the course of brazing entirely, the vacuum degree can't be lower than 6.7* 10-3Pa.

Technological demand parameter form of the heat exchanger

Allow the biggest appearance mm

Systematic ' Hydraulic pressure or lubrication)

Ambient temperature
Working pressure Mpa
Flow L/min
Power KW of cooling
Press and lower bar
Hot side Side of cold
Import temperature
Export temperature
Density kg/m3
Viscosity pa/s of motive force
Specific heat holds kj/ (kg k)
Heat transfer coefficient W/ (m k)
Note: Cold side air-cooled, need parameter of offering, until user buy air blower by oneself, please offer the parameter of the air blower.
The remarks:
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