

电机公司文件号 HEC No.	0EA.622.040			电机公司版次 HEC Rev.	C
项目（业主）文件号 Project No.	N/A			项目（业主）版次 Project Rev.	N/A
文件类型 Document Categories	N/A	文件状态 Status of Document	N/A	重大产品标识 Important Product Identifier	N/A

焊接部件焊后消除应力退火工艺规范

PROCESS SPECIFICATION OF STRESS RELIEF ANNEALING FOR
WELDING PARTS

编制/日期 Prepared by/Date	葛光男 2019.10.18	校核/日期 Checked by/Date	刘毅 2019.10.18	审查/日期 Reviewed by/Date	霍岩 2019.10.18
会签/日期 Counter sign/Date	乔宏来 2019.10.18	会签/日期 Counter sign/Date	N/A	质保/日期 QA/Date	N/A
标准化/日期 Standardization/Date	卢从义 2019.10.18	审定/日期 Authorized by/Date	文道维 2019.10.18	批准/日期 Approved by/Date	李景 2019.10.18

Form No.: 标 00

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修订记录

Revision record

版次 Rev.	改版单号 Mod. Advice note No.	页 码 Page & Item	改 版 内 容 Modification content abstract	改版人/校核人 Prepared by& Reviewed by	日期 Date
A		首次发布 Initial issue		刘毅 Liu Yi 张立娟 Zhang Lijuan	2013.5.7 2013.5.7
B	2013 热处理组 G064	第 1、2 页 Page 1 and 2	对 1.2 条款重新进行了说明， 增加了新钢号 Add Chinese and English comparison	刘毅 Liu Yi 张立娟 Zhang Lijuan	2013.8.26 2013.8.26
C	2019 金属材料组 G0007	第 1-10 页、 第 14 页 Page 1-10 and 14	1、修订了 1.2 条款、3.1 条款、 4.1 条款、5.1.5 条款、5.1.10 条款、5.2.1 条款、第 6 条款； Revised clause 1.2, 3.1, 4.1, 5.1.5, 5.1.10, 5.2.1 and 6. 2、修订了表 1、表 2 以及表 3， 并将原表 4 改为附表； Revised table 1, table 2 table 4 and changed table 4 to schedule. 3、增加了引用标准、1.4 条款 和 6.4 条款； Added reference, clause 1.4 and clause 6.4. 4、修订了图 2，增加了图 3。 Revised figure 2 and added figure 3.	葛光男 Ge Guangnan 刘毅 Liu Yi	2019.10.18 2019.10.18



1 适用范围/SCOPE

1.1 本工艺规范自发布之日起, 替代现行《异种转轮焊后消除应力退火工艺守则》(60681-97)、《异种钢焊后消除应力退火工艺守则》(60682)、《普通电焊件退火工艺守则》(60680)、《18-8 型不锈钢出线盒焊后消除应力退火工艺守则》(WH60662)、《普通电焊件退火工艺守则》(60684) 工艺规范。

1.1 After the release of the process specification, all of the process specification 60681-97, 60682, 60680, WH 60662, 60684 will be replaced.

1.2 本工艺规范适用牌号/ Applicable steel designation

碳素钢: Q235、Q275 及其他同级别钢。

Carbon steel: Q235, Q275 and other steel of the same level.

低合金结构钢: Q355 (Q345)、S355、P355、Q420、Q460、Q500D、S500Q、S550Q、HD610CF 及其他同级别钢。

Low alloy structural steel: Q355 (Q345), S355, P355, Q420, Q460, Q500D, S500Q, S550Q, HD610CF and other steel of the same level.

铸钢: ZG200-400、ZG230-450、ZG270-500、ZG20Mn 及其他同级别钢。

Cast steel: ZG200-400, ZG230-450, ZG270-500, ZG20Mn and other steel of the same level.

锻钢: 20Mn、20SiMn、ASTM A668E、25Mn、20MnMo、ASTM A668H、SM570-F 及其他同级别钢。

Forged steel: 20Mn, 20SiMn, ASTM A668E, 25Mn, 20MnMo, ASTM A668H, SM570-F and other steel of the same level.

转轮用不锈钢材料: ZG04Cr13Ni4Mo、ZG06Cr13Ni4Mo、ZG04Cr13Ni5Mo、ZG06Cr13Ni5Mo、ZG04Cr16Ni5Mo 及其他同级别钢。

Stainless steel used for runner: ZG04Cr13Ni4Mo, ZG06Cr13Ni4Mo, ZG04Cr13Ni5Mo, ZG06Cr13Ni5Mo, ZG04Cr16Ni5Mo and other steel of the same level.

1.3 本工艺规范仅适用于采用手工电弧焊、熔化极气体保护焊、非熔化极气体保护焊或埋弧焊的焊后零部件退火用。

1.3 This specification applies only to annealing of parts which are welded with manual welding, MIG welding, Non-MIG welding and submerged arc welding.

1.4 本标准所涉及牌号的零部件焊后退火温度应低于原材料性能热处理温度。

1.4 The annealing temperature of the above steel parts shall be lower than the heat treatment temperature of raw materials.

1.5 上述牌号以外的零部件焊后退火工艺, 由材料应用研究室另行制定。

1.5 The annealing process of steel which is not mentioned above, will be prepared by Metal Material Technology Lab.

2 引用标准/REFERENCE

GB/T 6067	起重机械安全规程
GB/T 6067	Crane safety regulations
GB/T 10201	热处理合理用电导则
GB/T 10201	Regulations of proper usage of electricity in heat treatment industry
GB/T 12801	生产过程安全卫生要求总则
GB/T 12801	General principles for the requirements of safety and health in production process
GB 15735	金属热处理生产过程安全卫生要求
GB 15735	Requirements for the safety and health in production process of metal heat treatment
GB/Z 18718	热处理节能技术导则
GB/Z 18718	Technology heat energy saving guidelines
JB 8434	热处理环境保护技术要求
JB 8434	Heat treatment technical requirements for environmental protection

3 所用设备/Equipment

3.1 焊后零部件热处理在台车式加热炉中进行，热处理炉需经过 HEC 相关部门认证，各热处理炉参数如表 1 所示。

3.1 The annealing of weldments shall be performed in a car type heating furnace. Furnaces need to go through the certification of the HEC. The parameters of furnaces are shown in Table 1:

表 1 退火炉参数/Table 1 Furnace Parameters

炉子名称 Furnace	炉子有效加热区 长×宽×高 Furnace size L×W×H (m)	装炉量 Load capacity (T)	最高加热温度 Highest temperature (℃)	用途 Purpose
901 退火炉	7.5×6.5× 3.6	100	1050	退火 Annealing 正火 normalizing 回火 tempering
902 退火炉	3.5× 3.0× 1.8	20	1050	
903 退火炉	11.5× 5.5× 4.8	150	1050	
906 退火炉	10× 3.5× 2.5	50	1050	
905 退火炉	12× 7.1× 5.8	250	800	退火 Annealing 回火 tempering

4 准备工作/Preparation

4.1 热处理操作人员经 HEC 培训后, 通过 HEC 人力资源部门认证并具备热处理炉操作技能及相关理论知识方可上岗。

4.1 Operators need to go through the certification of the HEC Human Resources Department before employment.

4.2 热处理操作人员应熟悉本工艺规范及退火炉操作规程, 了解零部件应放位置及其要求, 热处理过程中严格执行热处理工艺, 不得违规操作。

4.2 Operators shall be familiar with this specification and the operating procedures of annealing furnace, and aware of location that parts should be placed and the requirements. Heat treatment process must be strictly enforced the specification.

4.3 清理干净退火炉台面, 准备好支撑用耐火砖或垫铁、废钢板等。

4.3 Clean furnace platform, prepare refractory bricks or horns, and scrap boards as supports.

4.4 检查退火炉的送气管道、烧嘴、机械部分、炉台、炉壁等部位是否正常。

4.4 Check the aspirated pipes, burners, mechanical parts, top and bottom of the furnace.

4.5 检查退火炉测温系统是否在有效检定期内。

4.5 Furnace temperature measurement system must be used during the certification period.

4.6 检查控温仪表及热电偶是否在有效检定期内。

4.6 Temperature instrumentations and thermocouples must be used during the certification period.

5 工艺过程/Process

5.1 普通焊接件退火/ Annealing for general weldments

5.1.1 装炉时必须考虑每炉退火焊接件的装炉量是否经济合理。工件堆放部位的长、宽、高和总重量不准超过退火炉的有效使用范围。并应尽可能将炉子装满, 以减少开炉次数, 节约能源, 同时必须保证生产周期。

5.1.1 When load furnace, it must be considered if the loading amount of annealing furnace is economically reasonable. The workpiece length, width, height and weight must not exceed the effective range of furnace. And fill the furnace as far as possible to reduce the times of running furnace and save energy, and ensure the production cycle.

5.1.2 如果焊接件数量很多, 必须分几炉退火时, 应按各焊接件最大焊接厚度及加工日期的先后, 将它们分成几批, 尽可能使焊接厚度与加工日期相近者为一批, 并考虑装炉堆放的合理性, 以缩短退火炉的使用时间及减少较薄工件的变形与氧化。

5.1.2 If there are lots of weldments to be treated, which must be divided into several furnaces to annealing, divide them into several groups by considering the maximum thickness of the weld and the scheduling date of machining. Arrange the workpieces with similar maximum weld thickness and scheduling date of machining in a group as far as possible. Consider the rationality of loading

to shorten the running time of annealing furnace and reduce the deformation and oxidation of thinner workpieces.

5.1.3 装炉前应逐个检查各待退火件的刚度，对于高温加热易引起变形的工件，应提前请原制造班组附加稳定支撑架。

5.1.3 The stiffness of workpiece to be annealed shall be inspected one by one. For the workpiece which can be easily distorted by high temperature heating, the stable support frame shall be attached by the original manufacturing team in advance.

5.1.4 将刚度较小的、轻的、薄的部件放在上部，但此时应在不影响大部件的刚度或在工艺守则允许的条件下进行。

5.1.4 Place the light, thin workpieces of small stiffness on the top, however, this shall not affect the stiffness of large workpieces or under the conditions allowed by the specifications.

5.1.5 为减少工件在炉内的温差与变形，各工件必须用耐火砖或垫铁垫平，炉子底部与工件垫高量至少为 500mm，工件与工件之间也需要用耐火砖或垫铁垫置稳固，垫高量至少为 100mm。垫铁应位于工件的坚实处，如立筋的下面，部件的具体支撑要求见工艺卡片。

5.1.5 To reduce the temperature difference in the furnace and prevent the workpiece from deformation, workpiece shall be placed stable and properly supported with firebricks or scrap, and the distance from the bottom of furnace shall be at least 500mm. Between workpieces, there are required to placed in stable and boosted at least 100mm~200mm. Horn should be located on a solid place. The specific requirements of workpiece support are shown on its process card.

5.1.6 当退火件带有合缝板时（如水轮发电机上机架中心体，其合缝板先加工，退火后不再加工），则应保留合缝板上所焊的搭板，并在退火前卸去所有螺杆与螺帽，将螺孔塞满石英绳，防止螺孔氧化变形。

5.1.6 Pieces with the seamed plate when annealing (such as hydro-generating center body on the upper spider, its seam be machined before annealing, and after annealing no longer machining) shall retain all the stabs on seam plate. Remove all the screws and nuts, and fill the holes with quartz rope to prevent oxidation of screw before annealing.

5.1.7 工艺要求退火后不再加工的和封闭的部件，应尽可能不将合缝板拆开，只有当退火炉容纳不了时，方可拆下其上某几个组件，但对合缝面需要保护好以免退火时氧化，其保护方法：不让热气流直接与加工表面接触，即在开启端焊上盖板时（其盖板尺寸稍大于孔的尺寸）中间应用石棉绳将其塞实或用细沙充实，盖板四周必须仔细的焊封。

5.1.7 Pieces which are no longer processed and closed after the annealing process, the seam plate shall not be opened. Only when the furnace can not accommodate, few components on it could be removed, but the seam side needs to be protected in order to avoid oxidation during annealing. The protection methods include: In order to protect the machined surface from heating by hot air, asbestos rope or fine sand shall be applied to fill inside when welding the top lid on the open side, meanwhile, all round of the top lid shall be welded carefully.



5.1.8 如需减少焊件的变形, 在工艺方面要求工件需与装焊夹具所焊的搭板一起退火, 不可将该项夹具或搭板去除。

5.1.8 To reduce the deformation of the weldment, it is forbidden to get the assembly or slab rid of if workpieces to be required to annealing with slab of assembly.

5.1.9 在退火过程中, 要随时监控记录表上炉内的温差, 尽量减少其波动。

5.1.9 During the annealing process, keep monitoring the furnace temperature on the record table to minimize its volatility.

5.1.10 加热、保温及冷却时应定时检查炉内各部分温度, 除炉子本身热电偶外, 必须至少加两支本体热电偶, 热电偶应置于炉内关键部件的最薄处及最厚处, 在升温及降温过程中要求 4.5m 内任何两点的温差不能超过 70℃, 必要时调整加热及冷却速度来保证温度偏差值。

5.1.10 Operators shall regularly check the temperature of various parts of the furnace during heating, holding and cooling time. In addition to the furnace body thermocouple, at least two additional thermocouples shall be fitted up; thermocouples shall be placed in the thinnest and thickest parts of the key components. body thermocouples shall be arranged in important components according to process notice requirements. During the process of heating and cooling, the temperature difference between any two thermocouples within 4.5m shall not be exceed 70℃. If necessary, adjust the heating and cooling rates to ensure the temperature deviation.

5.1.11 退火过程中禁止火焰直接接触工件。

5.1.11 The burner flame shall be prevented from direct contact with the workpiece during annealing process.

5.2 转轮焊后退火/Annealing for welding runner

5.2.1 转轮退火时应上冠朝下、下环朝上放置。如转轮直径大于 4m, 按专用工艺执行。

5.2.1 The upper crown shall be placed down and the lower ring shall be placed up for the runner. If the runner's diameter is greater than 4m, the annealing process should be according with special process.

5.2.2 转轮在炉内放置时, 应防止烧嘴火焰直接接触工件, 避免局部温度过高。

5.2.2 When the runner is placed in the furnace, the burner flame shall be prevented from direct contact with the workpiece. To avoid local high temperature, if necessary, protect the workpiece with a fire-board.

5.2.3 转轮上至少放置两支铠装热电偶, 所放位置应为转轮最薄及最厚截面或者关键位置。

5.2.3 At least two sheathed thermocouples shall be placed on the runner to be processed, the position shall be located on the thinnest and the thickest wall of the runner, or key positions.

5.2.4 在退火过程中, 要随时监控记录表上炉内的温差, 尽量减少其波动。

5.2.4 During the annealing process, keep monitoring the furnace temperature on the record table to minimize its volatility.

5.2.5 加热、保温及冷却时应定时检查炉内各部分的温度, 在升温及降温过程中要求 4.5m 内

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任何两点的温差不能超过 70℃，必要时调整加热及冷却速度来保证温度的偏差值。

5.2.5 Operators shall regularly check the temperature of various parts of the furnace during heating. During the process of heating and cooling, the temperature difference between any two thermocouples within 4.5m shall not be exceed 70℃. If necessary, adjust the heating and cooling rates to ensure the temperature deviation.

6 工艺参数/ Process parameters

6.1 Q500D、S500Q、S550Q、20MnMo、ASTM A668H 等调质钢焊后退火

6.1 Annealing for Q500D, S500Q, S550Q, 20MnMo, ASTM A668H steel weldments.

6.1.1 装炉温度/Temperature of loading furnace: $\leq 315^{\circ}\text{C}$

6.1.2 升温速度/Heating rate: $\leq 50^{\circ}\text{C/h}$ (喷嘴应间断点燃，并由少渐多)

6.1.3 保温温度/Holding temperature: $580^{\circ}\text{C} \pm 15^{\circ}\text{C}$

6.1.4 保温时间：按最大焊接厚度计算保温时间，见表 2。最后一只热电偶达到 565°C 开始计算保温时间。

6.1.4 Holding time: calculated by the maximum thickness of the weld, see table 2. The holding time begins when the last thermocouples reach 565°C .

6.1.5 冷却速度: $\leq 40^{\circ}\text{C/h}$, (通过逐渐关闭喷嘴及开启风门来实现)，不得一下全部关闭喷嘴，以免造成温度骤降，使降温速度超过规定要求。

6.1.5 Cooling rate: $\leq 40^{\circ}\text{C/h}$. All nozzles must not be shut down one time, so as not to cause a sudden drop in temperature and make the cooling rate exceed the requirements.

6.1.6 出炉温度: $\leq 315^{\circ}\text{C}$ 出炉空冷。

6.1.6 Temperature of out furnace: $\leq 315^{\circ}\text{C}$ could be air cooling.

6.1.7 当不可按 6.1.3 规定温度进行焊后热处理时，经工艺员认同可按表 3 以较长保温时间在较低温度下进行焊后热处理。

6.1.7 When the heat treatment temperature provided by §6.1.3 was not feasible, a longer holding time at a lower temperature by Table 3 is allowed after recognized by technician.

表 2 热处理最少保温时间/Table 2 Holding Time of PWHT

焊接厚度 Thickness of welds	$\leq 50\text{mm}$	$> 50\text{mm}$
保温时间 Holding time	2h	$> 50\text{mm}$ 后，2h+每增加 25mm 时间增加 15min (不足 25mm 按 25mm 计算) $> 50\text{mm}$, 2h + time increases 15min for each additional 25mm
注/notes: 1. 焊接厚度计算/Weld thickness calculation 对焊/butt: 焊接坡口深度/Depth of welding groove; 角焊/fillet: 角焊缝的腰高/Fillet weld throat high; 补焊/repair welding: 最大修补厚度/Maximum thickness of repair.		

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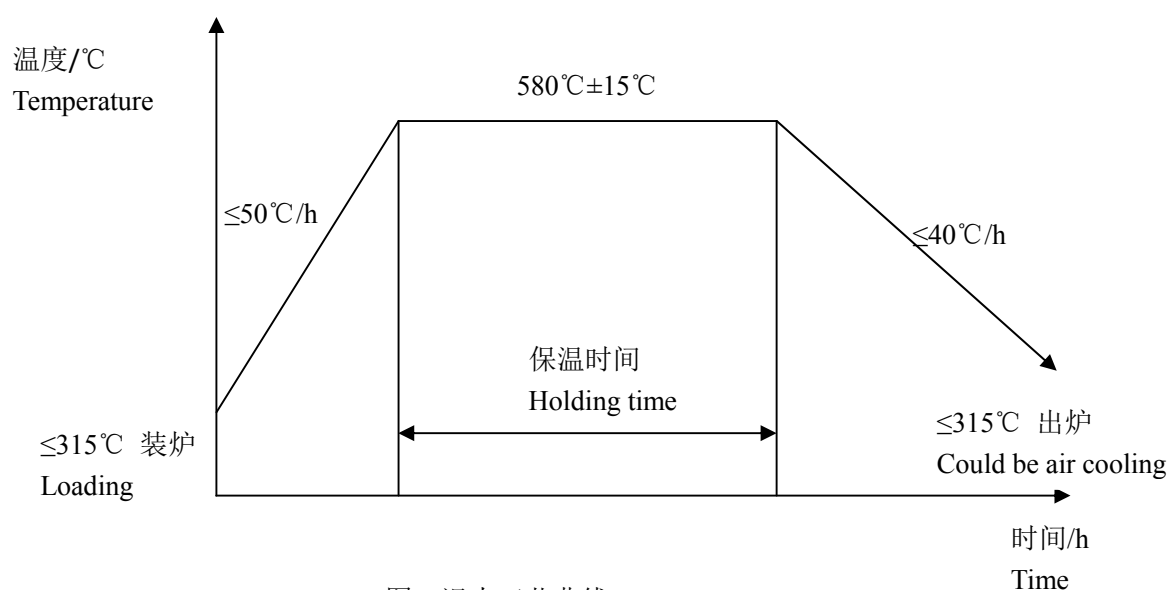
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表 3 焊后热处理备选工艺/Table 3 The Alternative PWHT Process

低于 580℃ 的温度降低值 (℃) The temperature decreases below 580 °C (°C)	焊接厚度 ≤25mm 降低温度后最少保温时间 (h) Weld thickness ≤25mm holding time after decrease temperature (h)
20	2.5
40	4
65	10
90	20
注: 表 3 所列焊接厚度 ≤25mm 最少保温时间, 当厚度大于 25mm 时, 厚度每增加 25mm, 最少保温时间应增加 15min。 Note: Holding time after decrease temperature was given when weld thickness ≤ 25mm in table 3. When weld thickness >25mm, time increases 15min for each additional 25mm.	

6.1.8 退火工艺曲线如图 1 所示/Annealing curve:



6.2 转轮及转轮用不锈钢焊后退火

6.2Annealing for stainless steel runner weldments.

6.2.1 装炉温度/Temperature of loading furnace: ≤150℃

6.2.2 升温速度/Heating rate: ≤50℃/h

6.2.3 均温温度/Uniform temperature: 450℃±20℃

6.2.4 均温时间/Uniform time: 3h~5h。

6.2.5 保温温度/Holding temperature: $580^{\circ}\text{C} \pm 15^{\circ}\text{C}$

6.2.6 保温时间: 按工件焊缝最大厚度计算, 每 25mm 保温 1h, 保温时间不得少于 2h, 最后一只热电偶达到 565°C 开始计算保温时间。

6.2.6 Holding time: according to the maximum thickness of the weld, 1 hour for each 25mm, and holding time shall be not less than 2 hours. The holding time begins when all the thermocouples reach 565°C .

6.2.7 冷却速度/Cooling rate: $\leq 40^{\circ}\text{C/h}$

6.2.8 出炉温度/Temperature of out furnace: $\leq 150^{\circ}\text{C}$

6.2.9 热处理升温及降温过程中 4.5m 内热电偶之间的温差不得高于 70°C 。

6.2.9 The temperature difference between every two thermocouples within 4.5m during heating and cooling procedures of heat treatment process shall be not higher than 70°C .

6.2.10 退火工艺曲线如图 2 所示/Annealing curve:

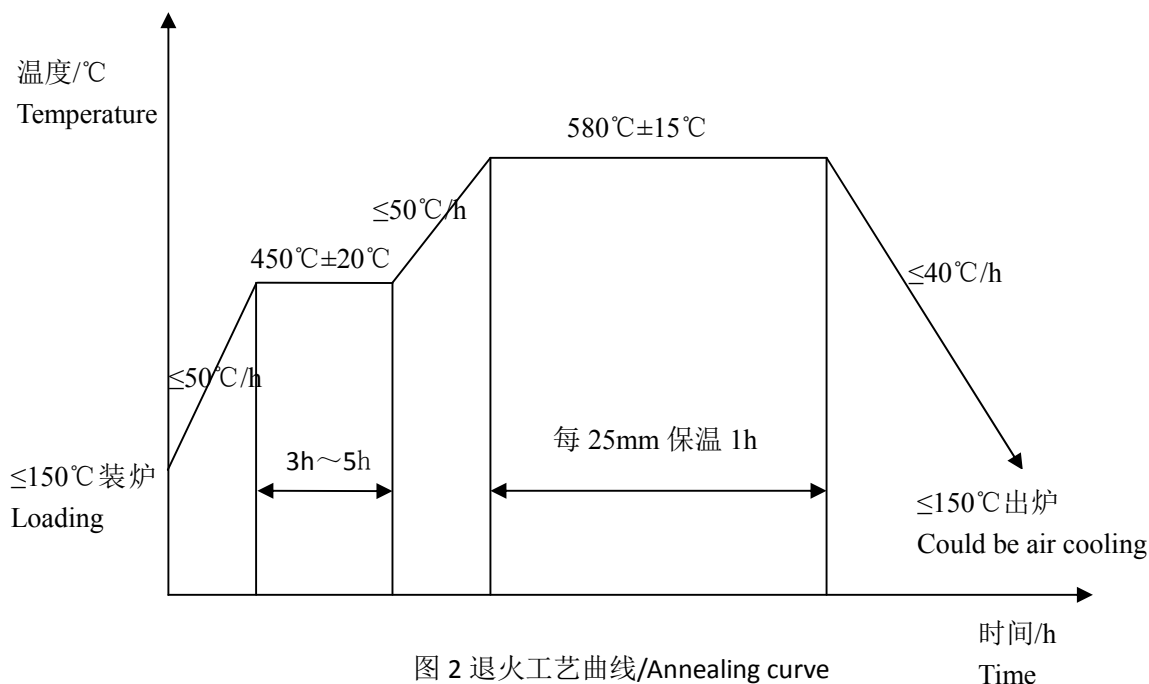


图 2 退火工艺曲线/Annealing curve

6.3 其它钢焊后退火

6.3 Annealing for other steel weldments

6.3.1 装炉温度/Temperature of loading furnace: $\leq 315^{\circ}\text{C}$

6.3.2 升温速度/Heating rate: $\leq 50^{\circ}\text{C/h}$ (喷嘴应间断点燃, 并由少渐多)

6.3.3 保温温度/Holding temperature: $600^{\circ}\text{C} \pm 15^{\circ}\text{C}$

6.3.4 保温时间: 按最大焊接厚度计算保温时间, 见表 2, 最后一只热电偶达到 585°C 开始计

算保温时间。

6.3.4 Holding time: calculated by the maximum thickness of the weld, see table 2. The holding time begins when all the thermocouples reach 585℃.

6.3.5 冷却速度: $\leq 40^{\circ}\text{C/h}$, (通过逐渐关闭喷嘴及开启风门来实现), 不得一下全部关闭喷嘴, 以免造成温度骤降, 使降温速度超过规定要求。

6.3.5 Cooling rate: $\leq 40^{\circ}\text{C/h}$. All nozzles must not be shut down one time, so as not to cause a sudden drop in temperature and make the cooling rate exceed the requirements.

6.3.6 出炉温度: $\leq 315^{\circ}\text{C}$ 出炉空冷。

6.3.6 Temperature of out furnace: $\leq 315^{\circ}\text{C}$ could be air cooling.

6.3.7 当不可能按 6.3.3 规定温度进行焊后热处理时, 经工艺员认同可按表 4 以较长保温时间在较低温度下进行焊后热处理。

6.3.7 When the heat treatment temperature provided by §6.3.3 was not feasible, a longer holding time at a lower temperature by Table 3 is allowed after recognized by technician.

表 4 焊后热处理备选工艺/Table 4 The Alternative PWHT Process

低于 600°C 的温度降低值 ($^{\circ}\text{C}$) The temperature decreases below 600°C ($^{\circ}\text{C}$)	焊接厚度 $\leq 25\text{mm}$ 降低温度后最少保温时间 (h) Weld thickness $\leq 25\text{mm}$ holding time after decrease temperature (h)
20	2.5
40	4
65	10
90	20
注: 表 3 所列为焊接厚度 $\leq 25\text{mm}$ 最少保温时间, 当厚度大于 25mm 时, 厚度每增加 25mm , 最少保温时间应增加 15min 。 Note: Holding time after decrease temperature was given when weld thickness $\leq 25\text{mm}$ in table 3. When weld thickness $> 25\text{mm}$, time increases 15min for each additional 25mm .	

6.3.8 热处理曲线如图 3 所示/Annealing curve:

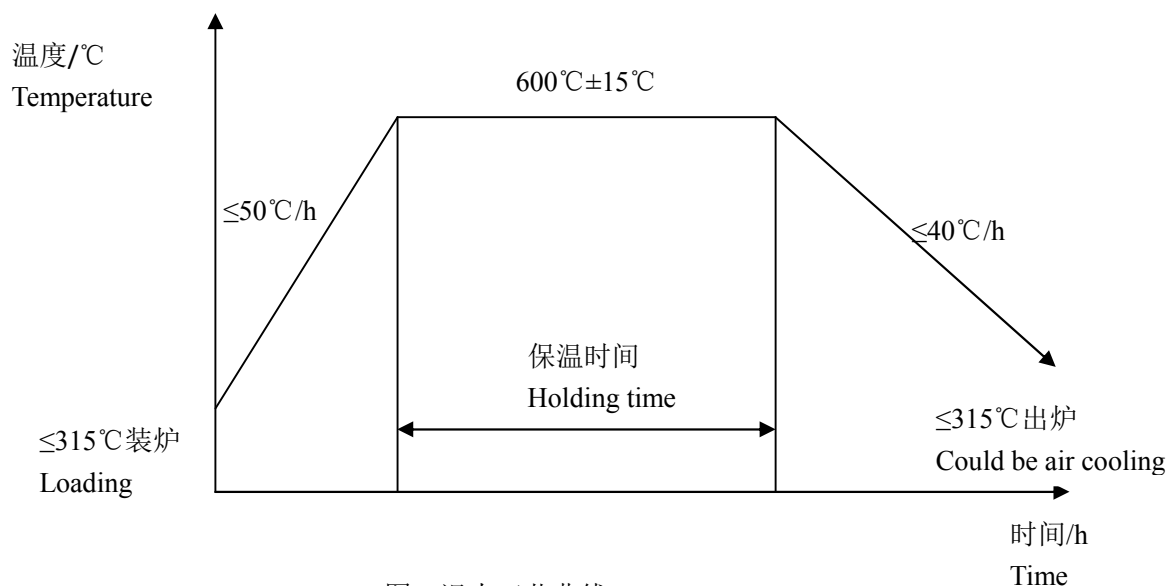


图 3 退火工艺曲线/Annealing curve

6.4 在退火过程中，如遇故障无法正常生产时，应按 6.4.1 条款或 6.4.2 条款进行处理。

6.4 In case of stopping gas or unable to maintain normal production, the annealing process should be deal with according to §6.4.1 and §6.4.2.

6.4.1 在升温及均温过程中出现故障无法正常生产时，若焊接部件降温速率满足工艺要求 ($\leq 40^{\circ}\text{C/h}$)，故障解除时，可按退火工艺曲线继续升温；若焊接部件降温速率不满足工艺要求，故障解除时，应降温至 $\leq 150^{\circ}\text{C}$ 后按退火工艺曲线执行。

6.4.1 When normal production can not be carried out during heating and uniform process, if the cooling rate of the welded parts meet the technological requirements ($\leq 40^{\circ}\text{C/h}$), the parts can be continued heating after trouble solved; if the cooling rate of the welded parts do not meet the technological requirements ($\leq 40^{\circ}\text{C/h}$), the parts should be cooled below 150°C and then heated according to the annealing curve.

6.4.2 在保温过程中出现故障无法正常生产时，若焊接部件降温速率满足工艺要求 ($\leq 40^{\circ}\text{C/h}$)，故障解除时，可按退火工艺曲线继续升温，保温时间为工艺要求保温时间减去故障前已保温时间；若焊接部件降温速率不满足工艺要求，故障解除时，应降温至 $\leq 150^{\circ}\text{C}$ 后按退火工艺曲线执行。

6.4.2 When normal production can not be carried out during holding process, if the cooling rate of the welded parts meet the technological requirements ($\leq 40^{\circ}\text{C/h}$), the parts can be continued heating after trouble solved and the holding time is specification requirements holding Time minus the holding time before trouble; if the cooling rate of the welded parts do not meet the technological requirements ($\leq 40^{\circ}\text{C/h}$), the parts should be cooled below 150°C and then heated according to the annealing curve.

7 检查记录/Inspection records

7.1 检查员需经过 HEC 人力资源部门认证后方可上岗。检查员需确认热处理温度自动记录仪表及所有热电偶在检定期内。

7.1 Inspectors need to go through the certification of the HEC Human Resources Department before employment, the professional qualification must be used during the certification period. Automatic temperature recording instruments and all thermocouples must be in the calibration period.

7.2 所有的热处理温度和时间要连续自动记录。热处理结束后, 操作者需填写“热处理记录卡”(见附表)。

7.2 All of the heat treatment temperature and time shall be continuously and automatically recorded. The operator should fill the "heat treatment record" (See Table 4) after heat treatment.

7.3 热处理过程中检查员应进行巡检, 严格监督热处理工艺过程的执行情况。

7.3 Inspectors shall carry out inspection during the heat treatment, Inspectors should be strict supervision of the implementation of the heat treatment process.

7.4 热处理完成后, “热处理记录卡”要附在“自动记录曲线”上, 热处理操作者在自动记录曲线上记下工作号、图号、工件名称、热处理日期、操作者姓名后, 交由工长签字盖章。检查员确认“热处理记录卡”填写真实准确且热处理过程无任何违规操作, 在“热处理记录卡”后盖检验章、签名、存档备查; 否则检查员有权拒绝检查。

7.4 After heat treatment, records shall be attached to "heat treatment record"; operators shall record the number of work, drawing number, part name, date of heat treatment and his name on the automatically recorded curve. Then it will be signed and sealed by foreman. Inspectors shall confirm "heat treatment record" filling in truth and accuracy, and heat treatment process without any illegal operations, then inspectors cover inspection stamps, signatures, and archived for future reference; otherwise inspectors have the right to refuse checks.

8 安全、节能与环境保护 /Requirements of Safety, Energy Conservation and Environmental Protection

8.1 安全技术要求/Safety requirements

热处理操作人员在热处理生产过程中必须遵守 GB/T 12801《生产过程安全卫生要求总则》的相关要求及 GB15735《金属热处理生产过程安全卫生要求》。同时必须遵守公司各项安全操作规程, 避免安全事故发生。

Workers must comply with requirements of GB/T 12801 "General health and safety requirements during production" and GB/T15735 " Requirements for the safety and health in production process of metal heat treatment" in the heat treatment process, and must also comply with all

safety rules to avoid accidents.

8.1.1 操作人员必须具有热处理资格证，辅助人员必须具备电气方面的基本知识。

8.1.1 Operators must have a heat treatment certificate. Support staff must have basic electrical knowledge.

8.1.2 操作前要熟悉热处理设备及其它工具、器具的使用方法，穿戴好必要的防护用品，必须认真检查设备的电气、测量仪表、机械保护装置是否准确、灵敏，传动部件运转是否正常，严禁设备带故障工作；务必对炉体安全性进行检查，确保炉子完好方可进行热处理操作。热处理过程中务必严格执行《退火炉安全操作规程》。

8.1.2 Before the operation, operators must be familiar with heat treatment equipment and other tools to use, wear the necessary protective equipment, examine if the electrical equipment, measuring instruments, mechanical protection device is in good condition. It is strictly prohibited that equipment runs with fault. Examine the heat treatment furnace before operation. Workers must comply with requirements of "Specifications for annealing furnace safety operation" in the heat treatment process.

8.1.3 热处理工要认真看清图纸要求及工艺要求，严格按照工艺规程操作。操作过程中严禁脱岗、空岗。

8.1.3 Operators shall read the requirements of drawings and technical seriously, and operate process strictly accordance with technical specification. Off-site is prohibited during the operation.

8.1.4 各种加热炉均不得超过最高额定温度和最大装炉量。

8.1.4 Every furnace shall not exceed its maximum rated temperature and maximum loading capacity.

8.1.5 应严格按 GB/T 6067《起重机械安全规程》操作起重机械。对吊具和吊绳应定期检查，对已达报废标准的吊具和吊绳必须强制更换。

8.1.5 The operation of lifting appliances shall be strictly in accordance with GB/T 6067 "crane safety regulations". The spreader and sling shall be regularly checked and mandatory replaced.

8.1.6 一般情况下，热处理工件及工装的吊运应在室温下进行，吊运热态的工件及工装应选用专用的吊具，严禁使用钢丝绳起吊灼热的工件，并且吊运前，应去除吊具表面的油和污物。当发现吊具有严重的变形或出现裂纹时应强制更换。

8.1.6 General, the workpiece and tooling shall be at room temperature for lifting. Special spreader should be used for the lifting of hot workpiece and tooling, before lifting cleanup the oil and dirt of spreader surface. The use of wire rope is prohibited for lifting hot workpiece. The spreader shall be mandatory replaced when a serious distortion or cracks were found.

8.1.7 燃气炉在点火前，应确认炉膛内没有可燃气体，而且必须在炉门完全打开的状态下才可以点火。

8.1.7 Before ignition of gas furnace, the furnace shall be free of flammable gas. And the door must



be fully open when ignite the furnace.

8.1.8 在热处理过程中, 加热件附近不得存放易燃、可燃物品。禁止用易燃、可燃物作临时支撑, 并应配备消防器材。

8.1.8In the heat treatment process, the flammable and combustible items should not be stored near heating area. It is prohibited the use of flammable and combustible items for temporary support. And there shall be equipped with fire equipment.

8.1.9 工作场地周围应保持整洁, 不得妨碍操作。

8.1.9Surrounding the workplace should be kept clean, shall not hinder the operation.

8.1.10 如发生设备事故, 应立即停止运转, 保持现场情况, 报有关部门检查、分析、处理。

8.1.10In case of equipment malfunction, equipment operation shall be stopped immediately, keeps the scene and reports relevant department to examine, analyze, and deal with.

8.2 节能要求/Energy Conservation Requirements

8.2.1 在操作过程中打开炉门时间不应过长, 减少相应热量损失。

8.2.1During operation, the time of opening the door shall not be too long, to reduce the heat loss.

8.2.2 尽可能利用炉子余热进行热处理。

8.2.2Use the waste heat of furnace to conduct the heat treatment as possible.

8.2.3 合理安排工作, 减少停炉时间。

8.2.3Reasonable to arrange work, reduce the shutdown time.

8.2.4 对于小批量热处理生产时, 若无特殊要求且满足合炉要求, 则按要求合炉生产。

8.2.4For small quantities of workpiece, if it is absence of special requirements and meet the requirements of compliance furnace, then conduct according to requirements of compliance furnace.

8.2.5 其他生产过程中的节能技术要求须严格按照 GB/T 10201 《热处理合理用电导则》及 GB/Z 18718 《热处理节能技术导则》等国家及行业的相关标准执行。

8.2.5Other requirements of energy conservation in the production process strictly complied with GB/T 10201 "Heat Treatment Guidelines for Rational Use of Electricity" and GB/Z 18718 "Technology Heat Energy Saving Guidelines" and other relevant national and industry standards.

8.3 环境保护要求/Environmental protection requirements

须严格按照 JB 8434 《热处理环境保护技术要求》等国家及行业的相关标准执行。

Environmental protection shall strictly comply with JB 8434 "Heat Treatment Technical Requirements for Environmental Protection" and other relevant national and industry standards.

8.4 本工艺规范未尽事宜, 按国家及行业内相关标准执行。

8.4Matters not covered in this specification, conduct comply with national and industry-related standards.

焊接部件焊后消除应力退火工艺规范

PROCESS SPECIFICATION OF STRESS RELIEF ANNEALING FOR WELDING PARTS

No./Rev.: 0EA.622.040/C

附表 热处理记录卡/ SCHEDULE HEAT TREATMENT RECORD

	热处理记录卡 HEAT TREATMENT RECORD						编号 NO:	
							第 页 共 页 PAGE OF	
工作号 ORDERID			部件名称 PART NAME			工艺文件编号 PROCEDURE NO.		
材料 MATERIAL		图号 DRAWING NO.		数量 QUANTITY		最大焊缝厚度 MAX. THICKNESS OF JOINT		
热处理参数 HEAT TREATMENT PARAMETERS								
	装炉温度 (°C) LOADING TEMPERATURE	加热速度 (°C/h) HEATING RATE	保持温度 (°C) HOLDING TEMPERATURE	保持时间 (h) HOLDING TIME	冷却速度 (°C/h) COOLING RATE	出炉温度 (°C) UNLOADING TEMPERATURE	本体偶之间最大温差 (°C) MAX. TEMPERATURE DIFFERENCE BETWEEN THERMOCOUPLES	
设定值 REQUIREMENT								
记录 RECORD								
装炉日期 LOADING DATE								
年 月 日								
热处理记录曲线编号 HEAT TREATMENT RECORD GRAPH NO.								
炉子名称 FURNACE NAME								
热 源 HEAT SOURCE								
本体热电偶数量 QUANTITY OF THERMOCOUPLE.								
本体热电偶编号 THERMOCOUPLE NO.								
备注 REMARK								
班 长 FOREMAN				检 查 INSPECTED BY				
编 制 ISSUED BY		日 期 DATE		校 核 CHECKED BY		日 期 DATE		