

PROCESS TABLE H - Aluminum High Pressure Die Cast

All requirements given below are subordinate to customer specific requirements.
 When performing the CQI-27 Casting Assessment the auditor shall verify foundry is conforming to customer requirements; including a customer approved Control Plan defining the agreed upon inspection testing and frequencies.
 *If minimum requirements are not met, provide supporting records to justify actual conditions.
 所有的需求给定下面是服从客户特定的需求。
 当执行CQI-27铸造评估审计师应当验证是否符合客户要求;铸造包括客户批准控制计划定义的检验检测和频率。
 *如果不满足最低要求,提供支持记录来证明实际情况。

What is the scope covered by this audit? The entire foundry? A specific product line? A specific part number? Other?
 这个审计覆盖的范围是什么?整个铸造?一个特定的产品行吗?一个特定的部分号码吗?其他的吗?

Describe the scope of the audit:
描述审计的范围:

Item 项	Category/Process Step 类别/过程步骤	Minimum Requirement最低要求	Observations / Comments about Actual Condition对 实际情况的观察/评论	Pass / Fail / Not Applicable 通过/失败/不适 用
1.0	Casting Design and Tooling铸造 设计和工具			
H1.1	Design Software设计软件	1. Casting plant must be compliant to customer specific software requirements. 2. Casting plant must have and maintain customer specific requirements for math data transfer for the tooling and for part Drawings / Models 1. 铸造工厂必须符合客户特定的软件需求。 2. 铸造工厂必须和维护客户特定要求数学为工具和数据传输部分图纸/模型。		
H1.2	FEA Analysis有限元分析	1. The design responsible party must complete an FEA (Finite Element Analysis) for the casting. The ultimate tensile strength, yield strength, and percent elongation used in the FEA must be over the lower limit of engineering requirement for the specified alloy for similar applications. 2. The foundry should know the specific features of the casting where maximum stresses exceed 50% of the Yield Strength. For purposes of this assessment, the expression "high stress" refers to any feature exceeding 50% of the Yield Strength. 3. Any high stress features identified in the FEA must be evaluated when casting simulations are reviewed, and when establishing product audits such as wall thickness, microstructure, hardness, x-ray, crack inspections. 1. 对设计负责,必须完成一个有限元分析(有限元分析)。极限抗拉强度、屈服强度和伸长百分比用于有限元分析必须在工程要求的下限为类似的应用程序指定的合金。 2. 铸件的铸造应该知道具体的特性,最大应力超过屈服强度的50%。本评估的目的,表达"高压"是指任何特性超过屈服强度的50%。 3.任何高应力特性的有限元分析时,必须评估铸造模拟,建立产品审计,如壁厚时,显微组织、硬度、x射线、裂缝检查。		
H1.3	Casting Simulation铸造模拟	1. The casting plant must use solidification modeling software such as MagmaSoft, AnyCasting, ProCast, EKK, FLOW-3D or similar software approved by the customer Product Engineering on the casting as part of the design process for the gating and venting system prior to tooling construction and prototype part submission. Simulation must include both fill and solidification analysis. 2. Results must be reviewed with the Customer Product Engineering. 3. At any high stress features in the FEA, the simulation should avoid hot spots, air entrapment, multiple metal fronts converging. 1. 铸造工厂必须使用凝固模拟软件如MagmaSoft anycast ProCast,EKK FLOW-3D或者类似的软件产品工程批准的客户铸造的浇口和排气系统的设计过程工具建设和原型之前提交一部分。必须包括填充和凝固模拟分析。 2. 结果必须审查与客户产品工程。 3.在任何高应力特性的有限元分析,模拟应避免热点,滞留空气,多个金属方面融合。		
H1.4	Single Cavity单腔	Single cavity dies are required. If the casting plant predicts a multi-cavity die will work, the proposal must be approved by customer Product Engineering. Casting simulations must support that multi-cavity would produce acceptable quality castings in all cavities. 单腔模具是必需的。如果铸件工厂预计多腔模具将工作,建议必须得到客户产品工程。铸造模拟必须支持,多腔会产生可接受的质量铸件在所有蛀牙。		
H1.5	Casting Datum铸造基准	1. If the casting plant creates the raw casting drawing, that drawing must be approved by the customer Product Engineering. 2. If the casting plant creates the tolerance limits between the raw casting drawing and any other drawing, those tolerance limits must be approved by the customer Product Engineering. 3. Whenever possible, the X-Y-Z datum surfaces used on the machined components should be the same X-Y-Z datum surfaces as the raw castings. This is for dimensional control purposes and minimizing datum shifts between the casting and machined surfaces (one of the causal factors related to thin-wall conditions). 4. The X-Y-Z raw casting datum surfaces should be on one piece of the tooling. 1. 如果铸造工厂创建原始铸造图纸,图纸必须经客户产品工程批准。 2. 如果铸件工厂创建原始铸造图之间的公差范围和其他绘画,这些公差范围必须得到客户产品工程。 3. 只要有可能,使用的x y z基准表面加工组件应该是一样的x y z基准表面原始铸件。这是维控制目的和最小化基准面变化之间的铸造和加工表面(薄壁条件)相关的因果因素之一。 4.x y z原始铸造基准表面应该是一个工具。		

Item 项	Category/Process Step 类别/过程步骤	Minimum Requirement最低要求	Observations / Comments about Actual Condition对实际情况的观察/评论	Pass / Fail / Not Applicable 通过/失败/不适用
H1.6	Die Material模具材料	<p>1. The die steel must meet industry standard material specification and be specified on the die detail drawings. Typical alloys are H11 and H13.</p> <p>1a. Minimum Requirement for insert materials is the NADCA Standard 207- (Latest Edition).</p> <p>1b. When Applicable the casting plant must be able to demonstrate compliance with Customer Specific Requirements for insert and cavity applications.</p> <p>2. The holding blocks must be made from steel with control of the material hardness to customer specific requirements. Typical alloys are P20, 4140, 8620.</p> <p>1. 模具钢必须符合行业标准材料规格和指定模具零件图。典型合金H11和H13。</p> <p>1a.最低要求插入材料NADCA标准207-(最新版)。</p> <p>1b.当适用于铸造工厂必须能够证明符合客户插入和腔应用程序的特定需求。</p> <p>2.拿着块与控制必须从钢铁材料的硬度对客户特定的需求。典型合金P20、4140、8620。</p>		
H1.7	Die Heat Treatment模具热处理	<p>1. Minimum requirement: Die steel must be heat treated in accordance with NADCA Standard 207- (Latest Edition).</p> <p>1b. When applicable the casting plant must be able to show compliance for the final hardness metallurgical properties and impact toughness.</p> <p>1. 最低要求:模具钢必须依照NADCA热处理标准207-(最新版)。</p> <p>1 b. 当适用于铸造工厂必须能够显示合规最后硬度冶金性能和冲击韧性。</p>		
H1.8	Die Design Approval模具设计的批准	<p>When applicable, the die design may be specified in whole or in part by the customer. For example, high wear features, such as sealing grooves, should be built as inserts.</p> <p>当适用时,模具设计可能是由客户指定的全部或部分。例如,高磨损特性,比如密封槽,应该建立插入。</p>		
H1.9	Die Vents死火山口	<p>1. Overflows should be located where simulations show the last places to fill.</p> <p>2. All dies should be vented to atmosphere unless the application includes vacuum assisted venting.</p> <p>3. All dies should have at least one chill vent or other customer requirements.</p> <p>1. 溢出应该坐落在模拟显示最后的地方填满。</p> <p>2. 所有模具应排放到大气中,除非应用程序包含真空辅助通风。</p> <p>3. 所有的模具都应该至少有一个冷却通风或其他客户的需求。</p>		
H1.10	Die Sealing Surface Validation 模具密封面验证	<p>The casting plant must be able to demonstrate the die sealing surface check on the production press. Use of a spotting press may be required by the customer.铸造工厂必须能够证明密封面检查在生产按死去。可能需要使用发现媒体的客户。</p>		
H1.11	Parting Line Shut Off Distance分型线关闭距离	<p>1. Minimum distance established from part edge to cavity insert with design review and approval by the casting plant.</p> <p>1b. Distances established based on industry standards or documented supplier practice.</p> <p>1. 最小距离建立边缘部分腔插入与设计审查和批准的铸造工厂。</p> <p>1 b. 距离建立基于行业标准或记录供应商的做法。</p>		
H1.12	Internal Die Cooling Circuit Design内部模具冷却回路设计	<p>Dies may be water cooled, oil cooled, or both, with regulated temperature and flow rates. The die must be designed with sufficient internal cooling circuits. These circuits must be confirmed with simulation software, and approved by the customer.</p> <p>模具可能是水冷、油冷或两者,调节温度和流速。模具必须有足够的内部冷却回路设计。必须确认这些电路仿真软件,得到客户的批准。</p>		
H1.13	Die Inspection (Such as End of run Inspection)模具检验(如运行检查结束)	<p>1. Check-sheet verification to account for potential issues outside of the standard Preventative Maintenance scope of work.</p> <p>2. Verification prior to releasing the die to production.</p> <p>3. Internal die water lines must be checked for mineral build up at every mold teardown. If build up is present, waterlines must be cleaned to remove deposits. Some customers may require water flow for each water circuit to be measured and documented.</p> <p>1. 检查表确认占潜在问题超出标准的预防性维护的工作范围。</p> <p>2. 验证之前释放模具生产。</p> <p>3. 内部模具水管必须检查的矿物建立在每一个模具拆卸。如果建立,水线删除必须清洁存款。有些客户可能需要为每个水水流电路测量和记录。</p>		
H1.14	Pre- Release Checklist Elements Tool Room 前发布清单元素工具间	<p>1. Confirmation of de-calcification of the water flow line.</p> <p>2. Water and hot oil plumbing flow checks.</p> <p>3. Thermocouple function check.</p> <p>4. Ejector pin function check.</p> <p>5. Core Condition.</p> <p>6. Other Items (Hydraulic Connections, Air line Connections, Vacuum valve Actuator Cylinders, Limit Switches).</p> <p>1. 确认脱钙的水流。</p> <p>2. 水和热油管道流检查。</p> <p>3. 热电偶功能检查。</p> <p>4. 推钉功能检查。</p> <p>5. 核心条件。</p> <p>6. 其他物品(液压连接、空气管路连接、真空阀门执行机构油缸、限位开关)。</p>		
H1.15	Tooling Maintenance 工具维护	<p>1. The life of the die is tracked based on number of cycles.</p> <p>2. There is an itemized list of regular maintenance items completed at pre-defined frequencies.</p> <p>3. Checksheet to track completion of regular maintenance.</p> <p>4. Abrasive systems (such as shot blast and hand grinding) not permitted for cleaning tooling. Non-abrasive systems (such as dry ice, high pressure water blast, solvent washing and ultrasonic) are required.</p> <p>1. 模具的生命跟踪是基于数量的周期。</p> <p>2. 有一个定期维护项目完成的分项列出预定义的频率。</p> <p>3. 检查表跟踪完成定期维护。</p> <p>4. 研磨系统(如喷丸和手磨)不允许清洁工具。无磨料系统(如干冰,高压水爆炸,溶剂清洗和超声)是必需的。</p>		

Item 项	Category/Process Step 类别/过程步骤	Minimum Requirement最低要求	Observations / Comments about Actual Condition对实际情况的观察/评论	Pass / Fail / Not Applicable 通过/失败/不适用
H1.16	Tool Changes工具的变化	<p>1. Replacement inserts (new steel), where there is a customer specific requirement, a PPAP approval may be required. Customer specific requirements may require a process change request submission with possible production trial run requirements.</p> <p>2. All tooling repair (welding, grinding, machining, insert replacement) requires dimensional verification (internal approval) prior to re-instituting the tool for production volumes.</p> <p>3. The supplier complies with all customer requirements related to which PPAP requirements are needed when tooling is corrected.</p> <p>1. 替换插入(新钢铁),客户具体要求,可能需要PPAP批准。客户具体要求可能需要与可能的生产过程变更请求提交试验要求。</p> <p>2. 所有工具修复(焊接、研磨、加工、插入替换)需要验证(内部批准)之前形势严峻产量的工具。</p> <p>3. 供应商遵守所有客户需求相关的工具时需要哪些PPAP要求纠正。</p>		
H1.17	Casting Traceability铸造可追溯性	<p>1. All castings produced must be identified with customer branding requirements, casting plant logo (as applicable), casting part number, cavity number, and cast date in designated locations per customer requirements.</p> <p>2. In some applications, traceability to both casting machine and/or measured process parameters specific to the casting may be required. Identification must be accurate and readily visible on non-machined surfaces, and must not interfere with parting lines, appearance, function, processing or assembly.</p> <p>1. 必须确定所有的铸件生产与客户品牌要求,铸造工厂标志(如适用),铸造零件号、腔数,每客户需求日期在指定位置。</p> <p>2. 在某些应用程序中,可追溯性铸造机和/或测量工艺参数可能需要特定于铸造。标识必须准确和容易可见未加工的表面,不得干扰分型线,外观,功能,加工或组装。</p>		
H1.18	Fixtures and Gages夹具和量具	<p>1. Gage and fixture plan must be reviewed and approved by customer. (May include in-line gage equipment for 100% check of critical dimensions as identified on part specification and/or part drawing.)</p> <p>2. The dimensional accuracy of all fixtures and gages must be per Customer requirements. Typically, all fixtures and gages shall be built to a tolerance that is 10% or less of part working tolerance. Some customers may require all fixtures and gages to be built to +/- 5 micron maximum accuracy (this refers to the actual gage, not the part).</p> <p>3. All surfaces of fixtures and gages which touch the part should be made from hard tool steel.</p> <p>4. The tips of all clamps on fixtures and gages may require to be built with replaceable tips.</p> <p>5. Variable gages must pass Gage R&R per AIAG or similar standard.</p> <p>6. All fixtures and gages must be certified periodically either by in-house if capable or by third party.</p> <p>1. 计量器和夹具计划必须审查和客户批准。(可能包括在线计100%的临界尺寸的检查确认设备规范和/或图纸部分)。</p> <p>2. 所有夹具和量具的尺寸精度必须每个客户的需求。通常,所有夹具和量具制造公差应当容忍10%或更少的部分工作。一些客户可能会要求所有夹具和量具建立最大精度+/-5微米(这是指实际计,而不是部分)。</p> <p>3. 所有表面接触部分的夹具和量具应由硬工具钢。</p> <p>4. 所有夹在夹具和量具可能需要建立与可替换的技巧。</p> <p>5. 变量量规必须通过每AIAG Gage R&R或类似的标准。</p> <p>6. 所有夹具和量具必须定期认证通过内部如果有能力或第三方。</p>		
2.0	Cast Machines铸造机			
H2.1	Machine Selection铸造机选择	<p>1. The die cast machine size must be determined using projected area/shot force calculations, preferably by using North American Die Casting Association (NADCA) PQ² software or other similar calculation methods.</p> <p>2. Shot Speeds and Pressures must be determined by using Flow Analysis Software.</p> <p>3. Verification that the machine's shot end has the capability to fill the die in the required time must be verified with NADCA PQ² software or similar calculations.</p> <p>1. 模铸机的大小必须确定使用投影面积/射力计算,最好是通过使用北美压铸协会(NADCA)PQ²软件或其他类似的计算方法。</p> <p>2. 拍摄速度和压力必须确定用流分析软件。</p> <p>3. 确认机器的镜头结束有能力填补模具在所需的时间必须与NADCA PQ²验证软件或类似的计算。</p>		
H2.2	Shot Force射力	<p>1. The shot force must be less than the clamping force.</p> <p>2. Preferred metal pressures are over 10,000 psi = 700 kg/cm² = 700 bar = 68.5 MPa.</p> <p>1. 射力必须小于锁模力。</p> <p>2. 首选金属压力超过10000 psi = 700公斤/平方厘米= 700 = 68.5 MPa。</p>		
H2.3	Shot Profile Control镜头配置文件控制	<p>1. Machine must have real time shot monitoring capability for shot speeds, positions, pressures, cycle time, slow shot velocity, fast shot velocity, intensification pressure, biscuit length, slow shot distance, intensification rise time.</p> <p>2. It is recommended cast machine have real time shot monitoring capability which is either tied into the extractor/robot control or creates an alarm when key parameters are beyond control limits.</p> <p>3. It is recommended that the entire shot curve be monitored, not just discrete points.</p> <p>1. 机器必须实时拍摄监视功能拍摄速度,位置,压力,周期时间,缓慢的速度,快速射击速度,增强压力,饼干长度,缓慢的拍摄距离,加副上升时间。</p> <p>2. 建议铸机有实时拍摄监视功能,绑定到器/机器人控制或创建一个关键参数超出控制范围时报警。</p> <p>3. 建议整个曲线被监控,不仅离散点。</p>		
H2.4	Low Inertia Shot End/Shot Deceleration低惯性拍摄结束/减速	Machines with a low inertia shot end or shot deceleration are recommended.机器与低惯性击球结束或减速。		
H2.5	Automatic Tie Bar自动领带夹	Machines with automatic tie bar adjustment are preferred.机器自动系杆调整是首选		

Item 项	Category/Process Step 类别/过程步骤	Minimum Requirement 最低要求	Observations / Comments about Actual Condition 对实际情况的观察/评论	Pass / Fail / Not Applicable 通过/失败/不适用
H2.6	Fill Percentage 填写百分比	The critical slow shot should be calculated using the percentage that minimizes wave formation and air during injection of the metal. Casting source should be able to show justification for using the percent fill that they picked. Some customers may require the fill percentage to be greater than 50%. 临界慢球应该使用最小化的百分比计算波的产生和空气在注入的金属。铸造来源应该能够显示使用百分比填补,他们选择的理由。有些客户可能需要填充比例大于50%。		
H2.7	Die Temperature Control 模具温度控制	1. Die cavity surface temperature must be audited with target values and tolerances. 2. Infrared Cameras, lasers, or touch probes can be used. 3. Thermocouples in the molds are recommended. The temperature should be continuously displayed. There should be an alarm to indicate when the temperature is out of range. Automatic temperature adjustment is preferred. 4. Die water flow should be maintained while the die is hot. 1. 模腔表面温度必须与目标审计值和公差。 2. 红外摄像机、激光或可以使用触摸探针。 3. 热电偶的模具。温度应该不断显示出来。应该有一个报警指示当温度范围。自动温度调节者优先。 4. 模具应该保持水流而模具是热的。		
H2.8	Plunger (Shot Tip) Lube 柱塞(拍摄技巧)润滑油	Plunger lubrication should have controls to avoid excessive plunger lubrication. Some customers may not allow plunger lube to be dispensed inside the shot sleeve. 柱塞润滑应该控制来避免过度润滑。有些客户可能不允许柱塞润滑油枪在里		
H2.9	Plunger (Shot Tips) 柱塞(技巧)	Shot tips should be water or oil cooled. 拍摄技巧应该是水或油冷。		
H2.10	Die Spray 模具喷雾	1. Auto spray systems are preferred. Spray heads should be programmable or dedicated to the die. For sprayers with fixed heads; each part should have its own spray head which is installed at die set-up. Confirmation of spray pattern must be visually observed as part of die set-up, or other opportunity prior to the start of production. 2. Spray heads requiring operator adjustment of flexible tubing and manual spraying should be avoided if possible. 3. If a central die spray system is used; it is preferred that the system pressures be controlled, and alarmed with panel lights or other alarms if out-of-control conditions exist. 4. It is preferred that there be a physical audit for the actual spray quantity per cycle. 1. 自动喷淋系统者优先。喷淋头应可编程或专用模具。与固定喷雾器头:每个部分应该有自己的喷淋头安装在模具设置。喷雾模式的确认必须在视觉上观察到的模设置,或其他机会的生产开始之前。 2. 喷淋头要求运营商调整灵活的油管和手动喷涂应避免如果可能的话。 3. 如果使用中央模具喷淋系统;它是首选,系统压力控制,并警告面板灯或其他警告如果失控的条件存在。 4. 这是首选,有物理审计实际每循环喷淋量。		
H2.11	Die Lube Ratio 模具润滑剂比	Die spray fluids must be formulated and controlled. Control method is pre-control chart. Measurement instrument is a refractometer or equivalent. 模具喷液体必须制定和控制。预控制图控制方法。测量仪是一种折射计或同等学历。		
H2.12	Air Blow-Off 空气排出	Excess water or lubricant must be blown off the cover die, ejector die, and any slides before metal injection. 多余的水或润滑剂必须刮掉模具表面,喷射器模具,任何幻灯片。		
H2.13	Extraction 提取	1. Each part may be cooled with water or air. 2. Extraction tools must be designed to utilize the biscuit or gating for clamping without touching the final casting product. 3. Automatic extraction is preferred. 4. It is preferred that automatic extractors be programmed to scrap castings when parameters, such as mold temperature, are out of range. 1. 每个部分可能与水或冷却空气。 2. 提取工具必须设计利用饼干或控制夹紧不碰最终铸件产品。 3. 自动提取是首选。 4. 首选,自动提取器被编程参数时废铸件,如模具温度,飞出他的射程。		
H2.14	Trimming 修剪	1. Each casting must be confirmed for proper position in the die before trimming. The preferred method to confirm proper part position in the trim die is a sensor. 2. To avoid mechanical distortion of parts, stroke control and energy absorption methods should be used. 1. 每个铸件模具在修剪前必须确认合适位置。首选方法确认适当的一部分在冲模中的位置是传感器。 2. 为了避免机械变形的部分,应该使用行程控制和能量吸收方法。		
3.0	Start-Up Procedures 启动程			
H3.1	Die Heat or Cooling 模具加热或冷却	1. Flow meters are recommended on the exits of all mold water/oil lines. 2. Water, air, oil lines must be hooked up as designed. Error proofed or color coded lines are required. 3. If external cooling is utilized, spray flow rates and location must be planned and measured. 1. 流量计推荐在所有模具的出口水/油线。 2. 水、空气、油线必须连接设计。错误橡皮或颜色编码线是必需的。 3. 如果使用外部冷却,喷流率和位置必须计划和测量。		
H3.2	Hot Oil Verification 热油验证	Confirm that the oil temperature is set at the specified temperature prior to the start of production. Recorded by a checklist. 确认油温设置在指定的温度下生产开始之前。记录清单。		
H3.3	Die Pre-Heat Temperature 模具预热温度	Confirm that the die cavity temperature is set correctly with the specific die. 确认模腔温度是正确设置与具体的模具。		
H3.4	Shot Parameter Verification 拍摄参数验证	Confirm that the shot end hydraulic controls are set correctly with the specific die. 确认拍摄结束液压控制正确地设置了特定的模具。		
H3.5	Die Spray System Verification 死喷淋系统验证	Confirm that the sprayer controls are set correctly with the specific die. 确认喷雾器控制是正确设置与具体的模具。		
H3.6	Scrap Standard Number of Pieces 废标准块的数量	The machine must alarm for either operator or automated scrapping based on cycle count from start-up. An accounting system for scrap parts after machine cycle interruptions must be in place. 机器必须为运营商或报警自动取消从启动基于循环计数。会计系统后废零件机周期中断必须到位。		
4.0	Metal Control 材料控制			

Item 项	Category/Process Step 类别/过程步骤	Minimum Requirement 最低要求	Observations / Comments about Actual Condition 对实际情况的观察/评论	Pass / Fail / Not Applicable 通过/失败/不适用
H4.1	Incoming/Returned Material Storage 输入/返回材料存储	Raw /Returned materials must be stored without mixing them in marked storage areas by type. 生/返回原料必须存储在标记存储区域没有混合类型。		
H4.2	Source of Material 材料来源	Primary metal may be required for some applications based on customer specific requirements. 主要材料对于某些应用程序可能需要根据客户的特定需求。		
H4.3	Metal Chemistry 金属化学	<p>1. Chemistry must be controlled at each key point in the process (melting, holding, and pouring).</p> <p>2. It is required to use ASTM E716 disk book molds (or approved equivalent) for chemistry samples.</p> <p>3. There must be a spectrometer on site for chemistry control. Industry Standards, such as ASTM E1251, must be followed for sampling, verification, standardization and calibration.</p> <p>4. The spectrometer must have certified Master calibration Standards which cover the range of each chemistry element being controlled. These Calibration Masters should be on site.</p> <p>5. A procedure must be posted near the spectrometer which clearly defines the permissible tolerance range of the Master calibration Standards.</p> <p>6. There must be control limits for all key elements of the material grade.</p> <p>7. The Sludge Factor must be measured and should be controlled below 2.0, preferably below 1.8. Maximum limit must be clarified prior to the start of production; and it will affect what are the Iron (Fe) and Manganese (Mn) specifications.</p> <p style="text-align: center;">$SF = \%Fe + 2X \%Mn + 3X \%Cr$.</p> <p>8. The recommended Iron:Manganese ratio target is 2:1.</p> <p>1. 化学过程中必须控制在每个关键点(熔化、持有和浇铸)。</p> <p>2. 这本书需要使用ASTM E716磁盘模具(或等效)批准化学样品。</p> <p>3. 必须有一个光谱仪化学控制现场。行业标准,如ASTM E1251,必须遵循抽样、验证、标准化和校准。</p> <p>4. 光谱仪必须认证主校准标准涵盖每个化学元素被控制的范围。这些校准的主人应该在现场。</p> <p>5. 附近的一个过程必须张贴的光谱仪,清楚地定义了允许的公差范围主校准标准。</p> <p>6. 必须有控制限制级的所有关键元素材料。</p> <p>7. 污泥的因素必须测量,应该控制低于2.0,最好低于1.8。最大限度必须澄清的生产开始之前,它会影响到哪些铁(Fe)和锰(Mn)规范。$SF = \%Fe + 2X \%Mn + 3X \%Cr$</p> <p>8. 推荐:铁锰目标比是2:1。</p>		
H4.4	Chemistry 化学	For any elements with customer specified mandatory limits, these limits must be reduced by the tolerance permitted on the Master calibration Standards. 对于任何元素与客户指定的强制性的限制,这些限制必须减少公差允许主校准标准。		
H4.5	Grain Refinement 晶粒细化	<p>The most frequent grain refinement additive is Titanium Boron.</p> <p>1. Grain refinement may be required by customer Product Engineering.</p> <p>最常见的晶粒细化剂是硼钛。</p> <p>1. 晶粒细化可能需要通过客户产品工程。</p>		
H4.6	Silicon Modification 硅改性	<p>The most frequent silicon modification element is Strontium.</p> <p>1. Silicon modification may be required by customer Product Engineering.</p> <p>最常见的硅改性元素锶。</p> <p>1. 硅改性可能需要通过客户产品工程。</p>		
H4.7	Degassing 脱气	<p>1. All metal should be rotary degassed before pouring. Degassing may be in a transfer ladle or in a holder at the cast machine. The preferred design of the degassing unit is a baffle plate or anti-vortex system.</p> <p>2. The use of cast machines with integral melter/holders is discouraged. It is often difficult to meet requirements for metal cleanliness and degassing. A minimum expectation is a baffled chamber with a rotary degassing unit running continuously.</p> <p>3. After rotary degassing, a vacuum gas sample must be taken in order to determine the specific gravity. Calculate specific gravity of sample using weight in air vs. weight in water method. The specific gravity must be within 0.10 of the theoretical maximum based on the chemistry of the alloy and a maximum of -27 inches of Mercury vacuum pressure. For many alloys, the theoretical maximum is around 2.70.</p> <p>4. Depending on customer-specific requirements, vacuum gas sample testing may not be required for each degassing cycle if the degassing unit monitors process parameters including flow rate, RPM, and gas pressure.</p> <p>1. 所有金属都应该旋转浇注前脱气。脱气可能是传输包或持有人在铸造机。首选的脱气装置的设计是一个隔板或本系统。</p> <p>2. 铸机的使用与整体熔化器/持有人是气馁。往往很难满足要求金属清洁和消毒。最低的期望是一个困惑室旋转脱气单元持续运行。</p> <p>3. 旋转脱气后,必须采取真空气体样本以确定比重。计算样品的比重在空气与重量的水使用重量的方法。比重必须在0.10的理论最大值基于合金的化学和最多-27英寸的水银真空压力。对于许多合金来说,理论最大大约是2.70。</p> <p>4. 根据客户的特定要求,真空气体样品测试可能不需要为每一个脱气周期如果德加单位监控工艺参数包括流量、转速、气体压力。</p>		
H4.8	Metal Transfer 金属过渡	<p>Molten metal from the melting furnaces may be tapped directly to go to the cast line, or it may be transferred to intermediate holders. If intermediate holders are used, they must have heat.</p> <p>熔融金属的熔化炉会直接去投线,或者它可能被转移到中间持有人。如果使用中间持有人,他们一定热量。</p>		
H4.9	Metal Transfer 金属过渡	<p>The temperature of metal being delivered to a cast machine holding furnace must be checked. The temperature of metal being delivered must be within internally specified control limits such that the cast machine holding furnace stays in specification. 金属被送到一个铸机的温度保温炉必须检查。金属的温度必须交付指定的内部控制范围内,铸机保温炉停留在规范。</p>		

Item 项	Category/Process Step 类别/过程步骤	Minimum Requirement 最低要求	Observations / Comments about Actual Condition 对实际情况的观察/评论	Pass / Fail / Not Applicable 通过/失败/不适用
H4.10	Holding Metal Treatment and Temperature Control 金属处理和温度控制	<p>1. Metal at the cast machine must be in holders. Holders must have heat.</p> <p>2. The temperature output must be readable by the machine operator. If the metal temperature in the holding furnace falls outside of the specified range, an alarm must be established to indicate an out of tolerance condition.</p> <p>4. Holding furnaces at the cast machines must be capable of controlling metal temperature at the metal extraction point to within +/- 5°C, unless the customer agrees to a wider range.</p> <p>1. 金属在铸机必须在持有者。持有者必须有热量。</p> <p>2. 温度必须由机器可读的输出操作符。如果保温炉中金属温度超出指定范围,必须建立警报,指示一个宽容的条件。</p> <p>4. 持有炉在铸机必须能够控制金属温度提取的点在+/- 5°C,除非客户同意更广泛。</p>		
H4.11	Metal Quality 金属质量	Charging raw materials or scrap into the auto pouring holders or ladles and running production out of them at the same time is prohibited. 收取原材料或取消自动浇注持有人或钢包和运行生产的同时是被禁止的。		
H4.12	Alloying 合金	Alloying into the auto pouring holders or ladles is allowed, but must be minimized in order to prevent defects such as inclusions. 合金在汽车倒持有人或钢包是允许的,但必须最小化,以防止夹杂物等缺陷。		
5.0	Cast In Place Inserts 现浇插入			
H5.1	Insert Source 插入源	<p>1. The customer Product Engineering must approve the source for cast in place inserts.</p> <p>2. The insert source must implement Full Compliance with the applicable template Process Table before PPAP. For example, a ductile iron bearing cap in a bedplate, the casting source must implement Full Compliance with the Ductile Iron Casting Process Table before PPAP.</p> <p>1. 客户产品工程必须批准的源代码在插入的地方。</p> <p>2. 插入源必须实现完全符合适用的模板在PPAP流程表。例如,球墨铸铁轴承盖在台板,铸造源必须实现完全符合球墨铸铁铸造工艺表在PPAP。</p>		
H5.2	Insert Process Control 插入过程控制	<p>1. Cast-in-place inserts must be pre-heated immediately prior to pouring metal into the die.</p> <p>2. The cast-in-place inserts must be completely dry. The volatiles content on the inserts must be audited, measured, and recorded.</p> <p>3. The cast-in-place inserts must be properly stored (maintained clean and dry).</p> <p>1. 场铸插入之前必须立即预浇注金属到模具。</p> <p>2. 场铸插入必须完全干燥。插入的挥发物含量必须审核,测量和记录。</p> <p>3. 场铸插入必须妥善保存(保持清洁和干燥)。</p>		
H5.3	Insert Audit 插入审核	<p>1. There must be a regular audit to section the castings to inspect the bonding of the cast in place insert with the aluminum. Audit results must be documented.</p> <p>2. Depending on customer design requirements, dye penetrant inspection may be required on machined castings to inspect for cracks (or contact separation) around the inserts. Audit results must be documented.</p> <p>1. 必须有一个定期审核部分铸件检查焊接的地方插入铝。审计结果必须记录。</p> <p>2. 根据客户的设计要求,可能需要着色渗透检验对机加工铸件检查插入裂缝(或接触分离)。审计结果必须记录。</p>		
6.0	Pouring/Casting Operation 浇注/铸造操作			
H6.1	Pouring Ladle Control 浇注包控制	<p>1. Ladles must be made of, or coated with, an insulating material.</p> <p>2. Time from metal extraction to casting shot must be minimized and controlled.</p> <p>3. Automatic pouring of molten metal into the shot sleeve is required. Manual pouring is not allowed.</p> <p>4. Pouring height into the shot sleeve must be minimized.</p> <p>5. Ladles must be free of residual "skull" material (aluminum film known to contain high concentration of oxides) before entering the dip well. Visual inspection criteria should be defined and posted in the work area.</p> <p>6. Best practice for Ladle design uses a dam (hole in the back) to hold back the dross as molten aluminum enters into the ladle.</p> <p>7. Metal ladles must be positioned where heat from the melt surface can keep the ladle hot when it is "parked" at the home position.</p> <p>1. 钢包必须做的,或涂有绝缘材料。</p> <p>2. 从金属提取到铸件必须最小化和控制。</p> <p>3. 自动浇注熔融金属的枪套是必需的。手工浇注是不允许的。</p> <p>4. 高度涌入枪套必须最小化。</p> <p>5. 钢包必须免费残余"头骨"的材料(铝膜含有高浓度的氧化物)进入下降之前。目视检查标准应当定义和发布工作区域。</p> <p>6. 最佳实践包设计使用一个大坝(洞)阻止铝液进入的渣滓桶。</p> <p>7. 金属钢包必须定位在熔体表面的热量可以使钢包热时家中"停"的位置。</p>		
H6.2	Dosing Furnace 加药炉	When pressure pour dosing furnaces are used, an inert gas or dry air may be used to pressurize the chamber. If air is used, the dew point must be less than -40° C, preferably below -80° C. 当使用压力倒剂量炉时,可以使用惰性气体或干燥的空气增压室。如果使用空气,露点必须小于-40°C,最好低于-80°C。		
H6.3	Launders 溜槽	Launders from dosing furnaces must be designed and maintained such that metal does not buildup in them. 溜槽从加药炉必须设计和维护这样的金属不累积。		
H6.4	Oxide Control 氧化控制	<p>1. Metal quality must be tested for oxide content. As a minimum verification PoDFA (Porous Disk Filter Analysis), or other analysis approved by customer.</p> <p>2. Dip wells must be frequently skimmed to minimize the dross accumulation.</p> <p>1. 金属氧化质量必须进行测试的内容。作为一个最低验证PoDFA(多孔圆盘过滤器分析),或其他分析得到客户批准。</p> <p>2. 倾斜井必须经常脱脂最小化渣滓积累。</p>		
H6.5	Machine Settings 机器的设置	It is recommended that equipment computer programs or mechanical limits for pouring and cycle times are protected from non-authorized changes so that only authorized personnel can change the program or settings. 建议设备计算机程序或机械限制浇注和周期免受未授权的修改,因此只有授权人员可以改变程序或设置。		
H6.6	Control Limits 控制限制	Cast machine should have real time closed loop monitoring which is either tied into the extractor/robot control or creates an alarm when key parameters are beyond control limits. Castings that are outside the control limits must be segregated for additional inspections. 铸机应该实时闭环监控是绑定到器/机器人控制或创建一个关键参数超出控制范围时报警。铸件必须隔离控制范围之外额外的检查。		

Item 项	Category/Process Step 类别/过程步骤	Minimum Requirement 最低要求	Observations / Comments about Actual Condition 对实际情况的观察/评论	Pass / Fail / Not Applicable 通过/失败/不适用
7.0	Inspection and Testing	检验和试验		
H7.1	Retained Material or Cleanliness Requirement 保留材料或清洁要求	Equipment must be available onsite to properly administer retained material inspection per customer requirements. 设备必须提供现场妥善管理保留材料检验每个客户的需求。		
H7.2	Dimensional Inspection - Part One 尺寸检验——第一部分	<p>1. As a minimum, the casting plant shall have a programmable Coordinate Measuring Machine (CMM) on site. The CMM must be run in an automatic mode. Where possible, the application of point cloud/laser scanning inspection technology is preferred. When used in combination with point cloud scanning technology, the CMM is considered the "gage of record" for dimensional measurements because of precision associated with the points measured.</p> <p>2. The casting plant shall maintain a CMM hit point map/drawing showing all CMM hit points that are agreed upon between the casting plant and the customer. (Point Cloud Inspection/laser scanning can be used in place of CMM inspection if agreed upon with customer Product Engineering).</p> <p>1. 最低,铸造工厂有一个可编程的坐标测量机(CMM)的网站。CMM必须在自动模式下运行。在可能的情况下,点云的应用/激光扫描检测技术者优先。当与点云扫描技术结合使用,CMM是维测量的"记录",因为与点相关联的测量精度。</p> <p>2. 铸造工厂应当保持CMM点地图/图显示所有CMM点铸造工厂和客户之间的约定。(点云检查/激光扫描可用于CMM检验如果与客户商定产品工程)。</p>		
H7.2 (Continued)	Dimensional Inspection - Part Two 尺寸检验——第二部分	<p>3. The CMM program must include checking the flatness of each individual raw casting datum surface if the datum pad is intended to be a flat surface. Preferably less than 0.250mm.</p> <p>4. Point cloud/laser scanning inspection must use the part-design datum construction to align the measurement data. Unless otherwise specified by the customer, "best-fit" data alignment is not allowed.</p> <p>5. The casting plant is responsible for comparing the scan with the 3D Math Model. In all cases the Point Cloud/laser scan must be aligned to the math model using the X-Y-Z raw casting datum surfaces. Results must be shared with customer Product Engineering and the responsible APQP Quality Engineer.</p> <p>6. Point Cloud/laser scanning inspection is recommended for prototype parts and PPAP parts as defined by the customer specific requirements. The scanning may be out-sourced.</p> <p>3. CMM程序必须包括检查每个原始铸造基准面的平面度,如果基准板的目的是成为一个平坦的表面。最好小于0.250毫米。</p> <p>4. 点云/激光扫描检查必须使用部分设计基准建设使测量数据。除非另有指定的客户,"最佳"数据对齐是不允许的。</p> <p>5. 铸造工厂负责比较扫描和三维数学模型。在所有情况下的点云/激光扫描必须一致使用x y z原始铸造基准表面数学模型。结果必须与客户共享产品工程和APQP质量工程师负责。</p> <p>6. 点云/激光扫描检查建议原型零件和PPAP部分所定义的客户特定需求。扫描可能之外。</p>		
H7.3	Wall Thickness 壁厚	<p>There must be regular audits to section raw castings for wall thickness verification; including any high stress features in the FEA. If the supplier is responsible for any machining, there must be regular audits to section machined castings for wall thickness verification.</p> <p>必须有定期审计部分原材料铸件壁厚验证,包括任何高应力特性的有限元分析。如果供应商负责任何加工,必须有定期审计部分加工铸件壁厚的验证。</p>		
H7.4	Internal Passages 内部通道	<p>Supplier is responsible to acquire proper non-destructive inspection tools to evaluate for blocked passages. This may include boroscopes, endoscopes, probes, fiber optics, flow meters, or X-ray.</p> <p>供应商负责获得适当的无损检验工具来评估堵住的通道。这可能包括内孔表面检查仪、内视镜、探测器、光纤,流量计,或者x射线。</p>		
H7.5	Dye Penetrant Check and NaOH Etch Castings 染料渗透检查和氢氧化钠腐蚀铸件	<p>1. There must be a regular audit to dye penetrant check (color check) or fluorescent penetrant inspection (FPI) entire casting or sections of castings specified by customer; including any high stress features in the FEA.</p> <p>2. There must be on-site capability to cut and NaOH etch castings for internal inspections. (NaOH is sodium hydroxide, also called caustic soda.)</p> <p>1. 必须有一个定期审计染料渗透检查(颜色检查)或荧光渗透检验(FPI)整个铸件铸造或部分由客户指定,包括任何高应力特性的有限元分析。</p> <p>2. 现场必须有能力削减和氢氧化钠腐蚀铸件内部检查。(氢氧化钠是氢氧化钠,也称为烧碱。)</p>		
H7.6	X-ray x射线	<p>1. The supplier shall have a real time fluoroscopic/X-ray unit on-site.</p> <p>2. X-ray equipment must be capable of measuring the sensitivity and resolution so that the system can be proven to meet customer requirements defined by product design record.</p> <p>3. X-ray audits must include any high stress features in the FEA.</p> <p>4. For some applications, automated defect recognition may be required.</p> <p>1. 供应商应当有一个实时荧光/x光机现场。</p> <p>2. x光设备必须能够测量灵敏度和分辨率,这样系统可以定义证明满足客户需求产品的设计记录。</p> <p>3. x射线审计必须包括任何高应力特性的有限元分析。</p> <p>4. 对于某些应用程序,可能需要自动缺陷识别。</p>		
H7.7	Repairs 维修	<p>1. Customer must approve any salvage repair procedures. Casting repairs, such as welding, epoxy, Devcon, and impregnation, are not permitted, unless approved by customer Product Engineering.</p> <p>2. If repairs are allowed, repair method and procedures must be approved by Customer Product Engineering.</p> <p>3. If straightening is allowed, a customer Product Engineering approved method is required, normally with a fixtured, automated process. Manual methods should not be used.</p> <p>1. 客户必须批准任何抢救修复过程。铸造的维修,如焊接、环氧、得复康,浸渍,是不允许的,除非客户产品工程批准。</p> <p>2. 如果允许维修,修复方法和程序必须得到客户产品工程。</p> <p>3. 如果允许矫直,客户产品工程批准的方法是必需的,通常用夹具,自动化的过程。不应使用手工方法。</p>		
8.0	Material Properties	材料特性		

Item 项	Category/Process Step 类别/过程步骤	Minimum Requirement 最低要求	Observations / Comments about Actual Condition 对实际情况的观察/评论	Pass / Fail / Not Applicable 通过/失败/不适用
H8.1	Laboratory Location 实验室的位置	The supplier shall have a metallurgical lab located on-site with capabilities to analyze chemistries, hardness, microstructure, area fraction porosity, dendritic arm spacing (DAS), silicon particle size, and any other features specified by customer Product Engineering. 供应商应当有一个冶金实验室位于现场与功能分析化学、硬度、显微组织、区域部分孔隙度、树突臂间距(DAS)、硅颗粒大小,和任何其他特性由客户指定产品工程。		
H8.2	Material Property Testing 材料性能测试	Material property testing must be defined per customer design records. Mechanical properties testing must be available, preferably on site. Mechanical property testing must include ultimate tensile strength, yield strength, and percent elongation. Some customers may require yield strength to be measured by an extensometer attached to the specimen. If retest or replacement is necessary must be with agreement of the customer Product Engineering. Testing begins with prototypes and continues through regular production. 必须定义材料属性测试每个客户的设计记录。机械性能测试必须可用,最好现场。机械性能测试必须包括极限抗拉强度、屈服强度、延伸率百分比。有些客户可能需要屈服强度是衡量一个伸长计连接到标本。如果重新测试或更换是必要的,必须与客户的协议产品工程。测试原型开始,延续到正常生产。		
H8.3	Mechanical Property 机械性能	The casting source must prepare test bars from a location approved by customer Product Engineering. For example, these might be cut from a casting or from a separately cast bar. Mechanical properties are often required from test bars cut from actual castings in an area designated on the engineering drawing or in the part quality document. The test bar location in the casting will be dimensioned from casting features. 铸造源必须准备测试条客户产品工程批准从一个位置。例如,这些可能是分别从铸造或酒吧。机械性能通常需要从测试条从实际铸件在一块为工程图纸或部分质量文档。铸造试棒位置将准尺寸从铸造特性。		
H8.4	Microstructure Analysis 微观结构分析	1. Metallurgical examination is to be done by the supplier prior to any component testing to insure microstructure meets engineering drawing specifications. 2. A metallograph image analyzer is preferred. 3. Reference photographs must be readily available at the metallograph for all microstructure requirements. 4. Microstructure audits must include any high stress features in the FEA. 1. 冶金测试之前由供应商完成任何组件测试,以确保组织满足工程制图规范。 2. 金相显微镜图像分析仪优先。 3. 参考照片必须在所有组织的金相照片现成的需求。 4. 组织审核必须包括任何高应力特性的有限元分析。		
H8.5	Hardness Testing 硬度测试	1. Hardness testing is to be done per ASTM E10. Supplier site must have certified Master blocks for auditing the calibration of the hardness tester. 2. The Tolerance range for the Master block must be posted on the hardness tester. 3. The Tolerance range for the Master must not exceed +/- 3%. 4. The customer specified range for hardness must be reduced by the tolerance allowed on the hardness Master block. 5. Unless Product Engineering specifies otherwise, Brinell hardness test using a 500Kg load, 10 mm diameter indenter, and 30 second dwell time. 6. Hardness to be measured at a specified location from customer Product Engineering. 7. If hardness readings are out of specification, all castings in the Lot shall be hardness tested with any out-of-specification castings rejected. 1. 硬度测试是要做/ ASTM E10。 审核供应商的网站必须有认证主块硬度计的校准。 2. 公差范围必须贴在主块硬度计。 3. 主要的容差范围不得超过+/- 3%。 4. 客户指定范围必须降低硬度公差允许的主块。 5. 除非产品工程指定否则,使用500公斤负载布氏硬度试验,硬度计压头10毫米直径,30秒的停留时间。 6. 硬度是衡量从客户产品工程在指定的位置。 7. 如果硬度读数的规范,所有铸件很多应与任何超标铸件硬度测试拒绝。		
H8.6	Corrosion Testing 腐蚀测试	The casting plant shall demonstrate the corrosion rate of metal shall not exceed Maximum rate as customer requirement. If applicable and required by the customer, the corrosion test shall be salt spray (Reference ASTM B117) and humidity as customer requirement. 铸造工厂应当证明金属的腐蚀速率不得超过最大速度和客户要求。如果适用,所要求的客户,应当盐雾腐蚀试验(参考ASTM B117)和湿度客户要求。		
9	Leak Testing 泄漏测试			
H9.1	Leak Test Requirement 泄漏试验要求	1. Acceptable methods for testing are: air under water, pressure decay, mass flow. 2. For applications where 100% verification is required it is preferred that pressure decay or mass flow systems be used. Some customers may require 100% air under water. 3. Leak rate specification must be defined on the product engineering document. 4. It is preferred the internal volumes for each cavity be leak tested separately. 5. It is preferred castings be thoroughly dried before going to air decay leak test. An in-line drier may be needed. 6. Some castings may also require 100% flow testing. If flow testing is required, this must be automated equipment. Using round balls or probes is acceptable if customer Product Engineering agrees. 1. 可接受的测试方法有:空气下的水,压力衰减,质量流量。 2. 100%需要验证应用程序的首选,压力衰减或质量流量系统被使用。有些客户可能需要100%的空气下的水。 3. 泄漏率规范必须定义产品工程文档。 4. 最好每个空腔的内卷分别泄漏测试。 5. 首选铸件是彻底干在空气衰减泄漏试验。可能需要一个在线干燥。 6. 一些铸件可能还需要100%的流量测试。如果流测试是必需的,这一定是自动化设备。使用圆形球或探针是可以接受的,如果客户产品工程同意。		

Item 项	Category/Process Step 类别/过程步骤	Minimum Requirement最低要求	Observations / Comments about Actual Condition对 实际情况的观察/评论	Pass / Fail / Not Applicable 通过/失败/不适
H9.2	Water Dunk Capability 水浸能力	It is preferred that the casting plant have a water dunk capability on site for determining the location of leaks on air decay rejects. The water temperature must be at least 20C. 首选,铸造工厂有水浸能力现场确定泄漏空气衰减拒绝的位置。水温必须至少20 c。		