



Cladding-Technology-Shanxi-Co.,-Ltd- CLADDING-ITP-003-Cladding-Tee-ITP

堆焊三通分支成形与堆焊层质量控制检验计划

Inspection and Test Plan for Branch Forming and Cladding Layer Quality Control of Welded Tees

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1. 目的 Purpose

本检验计划旨在规范科雷丁技术（山西）有限公司在堆焊三通分支成形及堆焊层质量控制过程中的检验活动，确保 TIG/MIG 堆焊工艺在法兰、管件、钢管、轴套管等零部件制造与修复过程中满足设计要求和质量标准。

This inspection and test plan is designed to standardize the inspection activities during the branch forming and cladding layer quality control processes of CLADDING-Technology-Shanxi-Co.,-Ltd, ensuring that TIG/MIG cladding processes meet design requirements and quality standards in the manufacturing and repair of flanges, pipe fittings, steel pipes, shaft sleeves and other components.



2. 适用范围 Scope

本计划适用于公司以下业务场景：

This plan applies to the following business scenarios of the company:

- 堆焊三通分支成形工艺（TIG/MIG）
- Branch forming process of welded tees (TIG/MIG)
- 法兰堆焊、管件堆焊、钢管堆焊
- Flange cladding, pipe fitting cladding, steel pipe cladding
- 轴套管堆焊修复
- Shaft sleeve cladding repair
- 模具堆焊修复
- Mold cladding repair
- 基于电弧增材制造的金属零部件近净成形
- Near-net-shape forming of metal components based on arc additive manufacturing

3. 职责 Responsibilities

| 部门/岗位 | Department/Position | 职责 | Responsibilities |

| 生产部 | Production Department | 执行堆焊工艺，配合检验工作 | Execute cladding processes and cooperate with inspection work |

| 质量部 | Quality Department | 组织检验活动，记录检验结果 | Organize inspection activities and record inspection results |

| 工艺部 | Process Department | 制定工艺参数，提供技术支持 | Develop process parameters and provide technical support |

| 设备部 | Equipment Department | 确保设备状态良好 | Ensure equipment is in good condition |

| 检验员 | Inspector | 执行具体检验项目 | Execute specific inspection items |

4. 检验内容与程序 Inspection Content and Procedures

4.1 来料检验 Incoming Material Inspection

| 检验项目 | Inspection Item | 检验标准 | Inspection Standard | 检验方法 | Inspection Method |
频次 | Frequency | 记录 | Record |

| 基材化学成分 | Base material chemical composition | GB/T 223 系列 | Spectrometer analysis |
每批次 | Each batch | 材料检验报告 | Material inspection report |



| 基材力学性能 | Base material mechanical properties | GB/T 228 | Tensile test | 每批次 | Each batch | 材料检验报告 | Material inspection report |

| 焊丝化学成分 | Welding wire chemical composition | GB/T 8110 | Spectrometer analysis | 每批次 | Each batch | 焊丝检验报告 | Welding wire inspection report |

| 焊丝直径 | Welding wire diameter | GB/T 8110 | Caliper measurement | 每批次 | Each batch | 焊丝检验报告 | Welding wire inspection report |

| 基材表面状态 | Base material surface condition | 技术协议 | Visual inspection | 每批次 | Each batch | 来料检验记录 | Incoming inspection record |

4.2 设备与工装准备检验 Equipment and Tooling Preparation Inspection

| 检验项目 | Inspection Item | 检验标准 | Inspection Standard | 检验方法 | Inspection Method | 频次 | Frequency | 记录 | Record |

| 焊机参数设置 | Welding machine parameter setting | 工艺文件 | Parameter verification | 每次作业前 | Before each operation | 设备点检记录 | Equipment check record |

| 送丝系统状态 | Wire feeding status | 设备维护规程 | Visual and functional check | 每次作业前 | Before each operation | 设备点检记录 | Equipment check record |

| 保护气体流量 | Shielding gas flow rate | 工艺文件 | Flowmeter reading | 每次作业前 | Before each operation | 设备点检记录 | Equipment check record |

| 工装夹具精度 | Fixture accuracy | 技术协议 | Dimensional measurement | 每次作业前 | Before each operation | 工装检验记录 | Fixture inspection record |

| 工件定位精度 | Workpiece positioning accuracy | 技术协议 | Dimensional measurement | 每次作业前 | Before each operation | 工装检验记录 | Fixture inspection record |

4.3 堆焊三通分支成形过程检验 Branch Forming Process Inspection

| 检验项目 | Inspection Item | 检验标准 | Inspection Standard | 检验方法 | Inspection Method | 频次 | Frequency | 记录 | Record |

| 首层堆焊尺寸 | First layer cladding dimension | 工艺文件 | Caliper measurement | 首件 | First article | 首件检验记录 | First article inspection record |

| 层间温度 | Interpass temperature | 工艺文件 | Infrared thermometer | 每层堆焊前 | Before each layer | 过程检验记录 | Process inspection record |

| 稀释率控制 | Dilution rate control | $\leq 15\%$ (TIG) / $\leq 25\%$ (MIG) | Cross-section analysis | 每批次 | Each batch | 稀释率检测报告 | Dilution rate test report |



| 堆焊层厚度 | Cladding layer thickness | 工艺文件 | Ultrasonic measurement | 每层 | Each layer | 过程检验记录 | Process inspection record |

| 分支角度 | Branch angle | 技术协议 | Angle gauge | 每件 | Each piece | 过程检验记录 | Process inspection record |

| 焊缝成型质量 | Weld bead appearance quality | JB/T 4730.1 | Visual inspection | 每件 | Each piece | 外观检验记录 | Appearance inspection record |

| 未熔合检查 | Lack of fusion check | JB/T 4730.1 | Visual inspection | 每件 | Each piece | 外观检验记录 | Appearance inspection record |

4.4 堆焊层质量控制检验 Cladding Layer Quality Control Inspection

| 检验项目 | Inspection Item | 检验标准 | Inspection Standard | 检验方法 | Inspection Method | 频次 | Frequency | 记录 | Record |

| 堆焊层硬度 | Cladding layer hardness | 技术协议 | HV1000 | 每批次 | Each batch | 硬度检测报告 | Hardness test report |

| 堆焊层化学成分 | Cladding layer chemical composition | 技术协议 | Spectrometer analysis | 每批次 | Each batch | 化学成分检测报告 | Chemical composition test report |

| 堆焊层金相组织 | Cladding layer microstructure | 技术协议 | Metallographic analysis | 每批次 | Each batch | 金相检验报告 | Metallographic inspection report |

| 堆焊层与基材结合强度 | Bonding strength between cladding layer and base material | 技术协议 | Peel test | 每批次 | Each batch | 结合强度检测报告 | Bonding strength test report |

| 堆焊层致密性 | Cladding layer density | 技术协议 | Archimedes method | 每批次 | Each batch | 致密性检测报告 | Density test report |

| 堆焊层耐磨性 | Cladding layer wear resistance | 技术协议 | Pin-on-disk test | 每批次 | Each batch | 耐磨性检测报告 | Wear resistance test report |

4.5 无损检测 Non-Destructive Testing

| 检验项目 | Inspection Item | 检验标准 | Inspection Standard | 检验方法 | Inspection Method | 频次 | Frequency | 记录 | Record |

| 外观检查 | Visual inspection | JB/T 4730.1 | VT | 100% | 100% | 外观检验报告 | Visual inspection report |

| 渗透检测 | Penetrant testing | JB/T 4730.5 | PT | 100% | 100% | 渗透检测报告 | Penetrant test report |



| 磁粉检测 | Magnetic particle testing | JB/T 4730.4 | MT | 100% | 100% | 磁粉检测报告 |
Magnetic particle test report |

| 超声波检测 | Ultrasonic testing | JB/T 4730.3 | UT | 按技术协议 | Per technical agreement | 超
声波检测报告 | Ultrasonic test report |

| 射线检测 | Radiographic testing | JB/T 4730.2 | RT | 按技术协议 | Per technical agreement |
射线检测报告 | Radiographic test report |

4.6 尺寸检验 Dimensional Inspection

| 检验项目 | Inspection Item | 检验标准 | Inspection Standard | 检验方法 | Inspection Method |
频次 | Frequency | 记录 | Record |

| 堆焊层厚度 | Cladding layer thickness | 技术协议 | Ultrasonic measurement | 100% | 100% |
尺寸检验报告 | Dimensional inspection report |

| 堆焊层宽度 | Cladding layer width | 技术协议 | Caliper measurement | 100% | 100% | 尺寸检
验报告 | Dimensional inspection report |

| 三通分支角度 | Tee branch angle | 技术协议 | Angle gauge | 100% | 100% | 尺寸检验报告 |
Dimensional inspection report |

| 三通分支位置 | Tee branch position | 技术协议 | Coordinate measurement | 100% | 100% | 尺
寸检验报告 | Dimensional inspection report |

| 堆焊层表面粗糙度 | Cladding layer surface roughness | 技术协议 | Roughness tester | 100% |
100% | 尺寸检验报告 | Dimensional inspection report |

| 整体尺寸 | Overall dimensions | 技术协议 | Coordinate measurement machine | 100% | 100% |
尺寸检验报告 | Dimensional inspection report |

4.7 最终检验 Final Inspection

| 检验项目 | Inspection Item | 检验标准 | Inspection Standard | 检验方法 | Inspection Method |
频次 | Frequency | 记录 | Record |

| 标识完整性 | Marking completeness | 技术协议 | Visual inspection | 100% | 100% | 最终检验
报告 | Final inspection report |

| 包装状态 | Packaging condition | 技术协议 | Visual inspection | 100% | 100% | 最终检验报告
| Final inspection report |

| 文件完整性 | Documentation completeness | 技术协议 | Document review | 100% | 100% | 最
终检验报告 | Final inspection report |



| 客户特殊要求 | Customer special requirements | 技术协议 | Per agreement | 100% | 100% | 最终检验报告 | Final inspection report |

5. 不合格品处理 Nonconforming Product Handling

当检验发现不合格品时，按以下程序处理：

When nonconforming products are identified during inspection, handle according to the following procedures:

- 检验员填写不合格品报告，标注不合格项目、数量及严重程度
- Inspector completes nonconforming product report, marking nonconforming items, quantity and severity
- 质量部组织评审，确定处置方式（返工、返修、让步接收或报废）
- Quality Department organizes review to determine disposition method (rework, repair, concession acceptance or scrap)
- 返工/返修后需重新检验，检验项目不低于原检验要求
- After rework/repair, re-inspection is required with inspection items not less than original requirements
- 让步接收需经客户书面确认
- Concession acceptance requires written confirmation from customer
- 不合格品处理记录纳入质量档案
- Nonconforming product handling records are included in quality archives

6. 检验记录与报告 Inspection Records and Reports

所有检验活动应形成完整记录，包括：

All inspection activities shall generate complete records, including:

- 检验日期、检验人员
- Inspection date, inspector
- 检验项目、检验标准
- Inspection items, inspection standards
- 检验方法、检测设备
- Inspection methods, inspection equipment
- 检验结果、判定结论
- Inspection results, judgment conclusions
- 不合格品处理记录
- Nonconforming product handling records



7. 监督考核 Supervision and Assessment

质量部每月对本检验计划的执行情况进行监督检查，考核内容包括：

Quality Department conducts monthly supervision and inspection on the implementation of this inspection plan, assessment content includes:

- 检验项目执行率
- Inspection item execution rate
- 检验记录完整性
- Inspection record completeness
- 不合格品发现率
- Nonconforming product detection rate
- 客户投诉情况
- Customer complaint situation

8. 附则 Supplementary Provisions

- 本检验计划由质量部负责解释和修订
- This inspection plan is interpreted and revised by Quality Department
- 本检验计划自发布之日起生效
- This inspection plan takes effect from the date of release
- 当相关标准或客户要求发生变化时，应及时修订本计划
- When relevant standards or customer requirements change, this plan shall be revised promptly

编制 Prepared by: 质量部 Quality Department

审核 Reviewed by: 工艺部 Process Department

批准 Approved by: 技术负责人 Technical Director

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