



Cladding-Technology-Shanxi-Co.,-Ltd- CLADDING-ITP-001-Cladding-Flange- ITP

堆焊法兰检验与试验计划

Inspection and Test Plan for Cladding Flanges

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1 目的 Purpose

本文件规定了科雷丁技术（山西）有限公司堆焊法兰产品从原材料下料到成品出厂的全过程检验与试验要求，明确各工序的检验项目、检验方法、验收标准及 H/W/R 点设置，确保产品质量符合客户要求和相关技术标准。

This document specifies the inspection and test requirements for cladding flange products of Cladding-Technology-Shanxi-Co.,-Ltd from raw material cutting to finished product delivery, clarifies inspection items, inspection methods, acceptance criteria and H/W/R point settings at each process, to ensure product quality meets customer requirements and relevant technical standards.



2 适用范围 Scope

本文件适用于公司所有堆焊法兰产品的制造过程质量控制，包括但不限于：

- 碳钢/合金钢法兰 TIG 堆焊
- 不锈钢法兰 MIG 堆焊
- 双金属梯度法兰增材制造
- 法兰表面强化堆焊修复

This document applies to quality control of all cladding flange products manufactured by the company, including but not limited to:

- Carbon steel/alloy steel flange TIG cladding
- Stainless steel flange MIG cladding
- Bimetallic gradient flange additive manufacturing
- Flange surface strengthening cladding repair

3 职责 Responsibilities

| 部门/岗位 | 职责 | Department/Position | Responsibility |

| 质量部 | 制定检验计划、执行检验、记录数据、出具报告 | Quality Department | Develop inspection plan, execute inspection, record data, issue reports |

| 生产部 | 配合检验工作、整改不合格项 | Production Department | Cooperate with inspection, rectify non-conformities |

| 技术部 | 提供工艺参数、技术支持 | Technology Department | Provide process parameters, technical support |

| 采购部 | 确保原材料质量合格 | Procurement Department | Ensure raw material quality compliance |

4 检验与试验计划 Inspection and Test Plan

4.1 符号说明 Symbol Description

| 符号 | 含义 | Symbol | Meaning |

| H 点 | 见证点，需客户/第三方见证方可进行下一工序 | Hold Point | Witness point, next process cannot proceed without customer/third-party witness |

| W 点 | 见证点，需通知客户/第三方到场见证 | Witness Point | Witness point, notify customer/third-party to attend |



| R 点 | 记录点，需保留完整记录备查 | Record Point | Record point, complete records must be retained for review |

4.2 全流程检验计划 Full Process Inspection Plan

| 序号 | 工序名称 | 检验项目 | 检验方法 | 验收标准 | 检验点 | No. | Process | Inspection Item | Inspection Method | Acceptance Criteria | Inspection Point |

| 1 | 原材料入库检验 | 化学成分、力学性能、外观质量 | 光谱分析、拉伸试验、目视检查 | 符合 GB/T 1233 或客户技术要求 | H | 1 | Raw Material Receiving Inspection | Chemical composition, mechanical properties, appearance quality | Spectral analysis, tensile test, visual inspection | Comply with GB/T 1233 or customer technical requirements | H |

| 2 | 下料检验 | 尺寸精度、坡口角度、表面质量 | 卡尺测量、角度尺测量、目视检查 | 尺寸公差 $\pm 0.5\text{mm}$ ，坡口角度偏差 $\leq \pm 1^\circ$ | W | 2 | Cutting Inspection | Dimensional accuracy, bevel angle, surface quality | Caliper measurement, angle gauge measurement, visual inspection | Dimensional tolerance $\pm 0.5\text{mm}$, bevel angle deviation $\leq \pm 1^\circ$ | W |

| 3 | 焊前准备检验 | 坡口清理、组对间隙、定位焊质量 | 目视检查、塞尺测量 | 坡口无油污锈迹，间隙 2-3mm，定位焊无缺陷 | R | 3 | Pre-weld Preparation Inspection | Bevel cleaning, assembly gap, tack weld quality | Visual inspection, feeler gauge measurement | Bevel free from oil and rust, gap 2-3mm, tack weld defect-free | R |

| 4 | TIG 堆焊过程检验 | 焊接电流、电压、焊接速度、层间温度 | 电流表、电压表、红外测温仪 | 电流 80-120A，电压 18-22V，层间温度 $\leq 150^\circ\text{C}$ | W | 4 | TIG Cladding Process Inspection | Welding current, voltage, welding speed, interpass temperature | Ammeter, voltmeter, infrared thermometer | Current 80-120A, voltage 18-22V, interpass temperature $\leq 150^\circ\text{C}$ | W |

| 5 | MIG 堆焊过程检验 | 焊接电流、电压、送丝速度、保护气流量 | 电流表、电压表、流量计 | 电流 200-300A，电压 28-32V，气流量 15-20L/min | W | 5 | MIG Cladding Process Inspection | Welding current, voltage, wire feed speed, shielding gas flow | Ammeter, voltmeter, flow meter | Current 200-300A, voltage 28-32V, gas flow 15-20L/min | W |

| 6 | 堆焊层外观检验 | 焊缝成形、表面缺陷、稀释率 | 目视检查、放大镜观察、金相分析 | 焊缝平整，无裂纹气孔，稀释率 $\leq 15\%$ | H | 6 | Cladding Layer Appearance Inspection | Weld formation, surface defects, dilution rate | Visual inspection, magnifying glass observation, metallographic analysis | Weld smooth, no cracks or porosity, dilution rate $\leq 15\%$ | H |

| 7 | 无损检测 | 表面裂纹、内部缺陷 | 渗透检测 PT、超声波检测 UT | 符合 NB/T 47013 标准，无裂纹等线性缺陷 | H | 7 | Non-destructive Testing | Surface cracks, internal defects | Penetrant testing PT, ultrasonic testing UT | Comply with NB/T 47013 standard, no linear defects such as cracks | H |



| 8 | 硬度测试 | 堆焊层硬度、过渡区硬度 | 洛氏硬度计、维氏硬度计 | 堆焊层硬度符合设计要求，过渡区硬度梯度平缓 | R | 8 | Hardness Test | Cladding layer hardness, transition zone hardness | Rockwell hardness tester, Vickers hardness tester | Cladding layer hardness meets design requirements, transition zone hardness gradient smooth | R |

| 9 | 尺寸检验 | 堆焊层厚度、法兰整体尺寸 | 千分尺、卡尺、三坐标测量 | 堆焊层厚度偏差 $\pm 0.2\text{mm}$ ，法兰尺寸符合图纸要求 | W | 9 | Dimensional Inspection | Cladding layer thickness, overall flange dimensions | Micrometer, caliper, CMM | Cladding layer thickness deviation $\pm 0.2\text{mm}$, flange dimensions meet drawing requirements | W |

| 10 | 金相检验 | 组织形态、稀释率、结合质量 | 金相显微镜、能谱分析 | 组织均匀，无未熔合，稀释率 $\leq 15\%$ | R | 10 | Metallographic Inspection | Microstructure, dilution rate, bonding quality | Metallographic microscope, EDS analysis | Uniform structure, no lack of fusion, dilution rate $\leq 15\%$ | R |

| 11 | 性能测试 | 拉伸强度、冲击韧性、弯曲性能 | 万能试验机、冲击试验机、弯曲试验机 | 符合客户技术要求或相关标准 | H | 11 | Performance Test | Tensile strength, impact toughness, bending performance | Universal testing machine, impact testing machine, bending testing machine | Comply with customer technical requirements or relevant standards | H |

| 12 | 防腐处理检验 | 涂层厚度、附着力、外观 | 涂层测厚仪、划格法、目视检查 | 涂层厚度 $\geq 60\mu\text{m}$ ，附着力 ≤ 1 级 | R | 12 | Anti-corrosion Treatment Inspection | Coating thickness, adhesion, appearance | Coating thickness gauge, cross-cut test, visual inspection | Coating thickness $\geq 60\mu\text{m}$, adhesion $\leq \text{Grade } 1$ | R |

| 13 | 包装出厂检验 | 标识、防护、文件齐全性 | 目视检查、文件核对 | 标识清晰，防护到位，文件齐全 | W | 13 | Packaging and Delivery Inspection | Marking, protection, document completeness | Visual inspection, document verification | Clear marking, adequate protection, complete documents | W |

4.3 关键控制点说明 Key Control Point Description

H 点控制要求 Hold Point Control Requirements

H 点为关键质量控制点，未经客户或第三方检验机构见证确认，不得进行下一工序。涉及 H 点的工序包括：

- 原材料入库检验：确保原材料质量符合技术要求
- 堆焊层外观检验：确认堆焊质量达到设计要求
- 无损检测：确保产品内部无缺陷
- 性能测试：验证产品力学性能满足使用要求

H points are critical quality control points. The next process cannot proceed without witness confirmation by customer or third-party inspection agency. Processes involving H points include:



- Raw material receiving inspection: Ensure raw material quality meets technical requirements
- Cladding layer appearance inspection: Confirm cladding quality meets design requirements
- Non-destructive testing: Ensure no internal defects in products
- Performance test: Verify mechanical properties meet usage requirements

W 点控制要求 Witness Point Control Requirements

W 点为重要质量控制点，需提前通知客户或第三方到场见证。涉及 W 点的工序包括：

- 下料检验：确认原材料尺寸和坡口质量
- 堆焊过程检验：监控焊接参数和工艺执行
- 尺寸检验：验证产品几何尺寸符合要求
- 包装出厂检验：确认产品标识和防护状态

W points are important quality control points. Customer or third-party must be notified in advance to attend witness. Processes involving W points include:

- Cutting inspection: Confirm raw material dimensions and bevel quality
- Cladding process inspection: Monitor welding parameters and process execution
- Dimensional inspection: Verify product geometric dimensions meet requirements
- Packaging and delivery inspection: Confirm product marking and protection status

R 点控制要求 Record Point Control Requirements

R 点为记录控制点，需保留完整的检验记录备查。涉及 R 点的工序包括：

- 焊前准备检验：记录组对参数和定位焊状态
- 硬度测试：记录各区域硬度值
- 金相检验：保存金相照片和分析报告
- 防腐处理检验：记录涂层参数和检测结果

R points are record control points. Complete inspection records must be retained for review. Processes involving R points include:

- Pre-weld preparation inspection: Record assembly parameters and tack weld status
- Hardness test: Record hardness values at each zone
- Metallographic inspection: Retain metallographic photos and analysis reports
- Anti-corrosion treatment inspection: Record coating parameters and test results

5 不合格品控制 Non-conforming Product Control

5.1 不合格品判定 Non-conformity Determination

检验过程中发现的不合格品，按以下原则判定：

- 轻微缺陷：不影响产品使用性能，可修复后使用



- 严重缺陷：影响产品使用性能，需返工或报废

Non-conforming products found during inspection shall be determined according to the following principles:

- Minor defects: Do not affect product performance, can be repaired and used
- Serious defects: Affect product performance, require rework or scrap

5.2 不合格品处理 Non-conformity Disposal

| 缺陷类型 | 处理方式 | Defect Type | Disposal Method |

| 外观缺陷 | 打磨修复或重新堆焊 | Appearance defects | Grinding repair or re-cladding |

| 尺寸超差 | 机械加工修正 | Dimensional deviation | Machining correction |

| 内部缺陷 | 挖补重焊或报废 | Internal defects | Digging and re-welding or scrap |

| 性能不合格 | 调整工艺参数重新堆焊 | Performance non-compliance | Adjust process parameters and re-cladding |

6 检验记录与报告 Inspection Records and Reports

6.1 记录要求 Record Requirements

所有检验记录应包含以下内容：

- 产品名称、规格型号、数量
- 检验日期、检验人员
- 检验项目、检验方法、检验结果
- 判定结论、处理意见

All inspection records shall include the following content:

- Product name, specification model, quantity
- Inspection date, inspector
- Inspection items, inspection methods, inspection results
- Determination conclusion, disposal opinion

6.2 报告要求 Report Requirements

检验报告应包含以下内容：

- 产品基本信息
- 检验项目清单
- 检验结果汇总
- 不合格项及处理情况



- 质量结论

Inspection reports shall include the following content:

- Basic product information
- Inspection item list
- Inspection results summary
- Non-conformities and disposal status
- Quality conclusion

7 监督考核 Supervision and Assessment

7.1 内部审核 Internal Audit

质量部每季度对本检验计划执行情况进行内部审核，重点检查：

- H/W/R 点执行到位情况
- 检验记录完整性
- 不合格品处理及时性

Quality Department shall conduct internal audit of this inspection plan execution quarterly, focusing on:

- H/W/R point execution status
- Inspection record completeness
- Non-conformity disposal timeliness

7.2 考核指标 Assessment Indicators

| 考核项目 | 目标值 | Assessment Item | Target Value |

| 一次检验合格率 | $\geq 95\%$ | First inspection pass rate | $\geq 95\%$ |

| 客户投诉率 | $\leq 1\%$ | Customer complaint rate | $\leq 1\%$ |

| 检验记录完整率 | 100% | Inspection record completeness rate | 100% |

8 附则 Supplementary Provisions

8.1 文件管理 Document Management

质量部负责编制、修订和解释，经总经理批准后实施。

This document shall be compiled, revised and interpreted by Quality Department, and implemented after approval by General Manager.



8.2 修订记录 Revision History

版本号	修订日期	修订内容	Version	Revision Date	Revision Content
A/0	2025-01-01	首次发布	A/0	2025-01-01	First issue

8.3 相关文件 Related Documents

- CLADDING-QP-001 质量手册 Quality Manual
- CLADDING-WI-001 焊接工艺规程 Welding Procedure Specification
- CLADDING-WI-002 无损检测作业指导书 NDT Work Instruction

编制 **Prepared by:** 质量部 Quality Department

审核 **Reviewed by:** 技术部 Technology Department

批准 **Approved by:** 总经理 General Manager

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