



Cladding-Technology-Shanxi-Co.,-Ltd- CLADDING-ITP-006-Cladding-Coupling- ITP

科雷丁技术（山西）有限公司

Cladding-Technology-Shanxi-Co.,-Ltd

| 文件编号 | CLADDING-ITP-006 |

| 文件名称 | 堆焊管箍螺纹加工与质量检验程序 |

| Thread Machining and Quality Inspection Procedure for Cladded Pipe Coupling |

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1. 目的 Purpose

本程序规定了堆焊管箍产品螺纹加工、堆焊层质量检验与密封试验的操作要求、检验标准及记录管理，确保堆焊管箍产品符合客户技术要求及行业标准，满足管道连接密封性要求。

This procedure specifies the operational requirements, inspection standards and record management for thread machining, cladding layer quality inspection and sealing test of cladded pipe



coupling products, ensuring that clad pipe coupling products meet customer technical requirements and industry standards, and satisfy pipeline connection sealing requirements.

2. 适用范围 Scope

本程序适用于科雷丁技术（山西）有限公司生产的各类堆焊管箍产品，包括碳钢基体堆焊不锈钢管箍、双金属堆焊管箍、合金钢堆焊管箍等。

This procedure applies to various clad pipe coupling products manufactured by Cladding-Technology-Shanxi-Co.,-Ltd, including carbon steel substrate stainless steel clad pipe coupling, bimetallic clad pipe coupling, alloy steel clad pipe coupling, etc.

3. 职责 Responsibilities

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

| 生产部 | Production Department | 负责堆焊管箍螺纹加工操作，执行工艺参数控制 |
Responsible for thread machining operation of clad pipe coupling, execute process parameter control |

| 质量部 | Quality Department | 负责堆焊层质量检验、密封试验及质量记录管理 |
Responsible for cladding layer quality inspection, sealing test and quality record management |

| 技术部 | Technical Department | 负责工艺文件编制、技术问题解决及工艺改进 |
Responsible for process document preparation, technical problem resolution and process improvement |

| 设备部 | Equipment Department | 负责加工设备维护保养，确保设备精度满足加工要求 |
Responsible for machining equipment maintenance, ensure equipment accuracy meets machining requirements |

4. 管理内容与程序 Management Content and Procedure

4.1 螺纹加工要求 Thread Machining Requirements

4.1.1 加工前准备 Pre-machining Preparation

堆焊管箍在进行螺纹加工前，必须完成以下准备工作：

Before thread machining, the clad pipe coupling must complete the following preparations:

- 确认堆焊层已通过外观检验及无损检测，检验报告齐全
- Confirm that the cladding layer has passed visual inspection and NDT, and inspection reports are complete
- 核对堆焊管箍基体尺寸、堆焊层厚度符合图纸要求



- Verify that the substrate dimensions and cladding layer thickness of the clad pipe coupling meet drawing requirements
- 检查堆焊层表面无裂纹、气孔、夹渣等缺陷
- Check that the cladding layer surface has no cracks, porosity, slag inclusion and other defects
- 确认加工基准面平整，无变形
- Confirm that the machining datum surface is flat and free of deformation

4.1.2 螺纹加工参数 Thread Machining Parameters

参数项目 Parameter Item 技术要求 Technical Requirement
螺纹规格 Thread Specification 按图纸要求，常用 NPT、BSP、UN 系列 According to drawing requirements, commonly NPT, BSP, UN series
螺纹精度 Thread Accuracy 6H/6g 或按客户指定等级 6H/6g or as specified by customer
切削速度 Cutting Speed 碳钢基体：30-50m/min；不锈钢堆焊层：15-25m/min Carbon steel substrate: 30-50m/min; Stainless steel cladding layer: 15-25m/min
进给量 Feed Rate 0.1-0.3mm/r，根据螺纹规格调整 0.1-0.3mm/r, adjusted according to thread specification
冷却方式 Cooling Method 强制冷却，使用专用切削液 Forced cooling, use special cutting fluid
加工余量 Machining Allowance 堆焊层保留量 $\geq 0.5\text{mm}$ Cladding layer retention $\geq 0.5\text{mm}$

4.1.3 加工过程控制 Machining Process Control

- 采用专用工装夹具固定堆焊管箍，确保加工定位准确
- Use special fixtures to fix the clad pipe coupling, ensure accurate machining positioning
- 加工过程中密切监控切削状态，防止堆焊层剥落
- Closely monitor cutting condition during machining, prevent cladding layer spalling
- 每加工 5 件产品进行一次螺纹通止规检验
- Perform thread go/no-go gauge inspection every 5 pieces
- 加工完成后清理螺纹内腔，去除切屑及冷却液残留
- Clean thread cavity after machining, remove chips and cutting fluid residue

4.2 堆焊层质量检验 Cladding Layer Quality Inspection

4.2.1 外观检验 Visual Inspection

检验项目 Inspection Item 检验标准 Inspection Standard
表面质量 Surface Quality 无裂纹、气孔、夹渣、未熔合等缺陷 No cracks, porosity, slag inclusion, lack of fusion and other defects



| 堆焊层厚度 | Cladding Layer Thickness | 符合图纸要求，偏差 $\pm 0.2\text{mm}$ | Meet drawing requirements, deviation $\pm 0.2\text{mm}$ |

| 稀释率 | Dilution Rate | $\leq 15\%$ (TIG 堆焊) ; $\leq 25\%$ (MIG 堆焊) | $\leq 15\%$ (TIG cladding); $\leq 25\%$ (MIG cladding) |

| 表面粗糙度 | Surface Roughness | $R_a \leq 6.3\mu\text{m}$ | $R_a \leq 6.3\mu\text{m}$ |

| 几何尺寸 | Geometric Dimensions | 符合图纸公差要求 | Meet drawing tolerance requirements |

4.2.2 无损检测 Non-Destructive Testing

| 检测方法 | Testing Method | 检测比例 | Testing Ratio | 合格标准 | Acceptance Standard |

| 渗透检测 PT | Penetrant Testing | 100% | 无裂纹显示 | No crack indication |

| 磁粉检测 MT | Magnetic Particle Testing | 100% (铁磁性材料) | 无裂纹显示 | No crack indication |

| 超声波检测 UT | Ultrasonic Testing | 按客户要求或 10%抽检 | 无超标缺陷 | No excessive defects |

| 射线检测 RT | Radiographic Testing | 按客户要求 | 符合 NB/T 47013 标准 | Meet NB/T 47013 standard |

4.2.3 硬度检验 Hardness Testing

| 检验位置 | Testing Position | 硬度要求 | Hardness Requirement | 检测方法 | Testing Method |

| 堆焊层 | Cladding Layer | 按材料牌号要求，如 304 不锈钢：HV ≤ 220 | According to material grade requirement, e.g. 304 stainless steel: HV ≤ 220 | HV 洛氏硬度计 | HV Rockwell Hardness Tester |

| 热影响区 | Heat Affected Zone | 基体硬度 $\pm 20\text{HV}$ | Substrate hardness $\pm 20\text{HV}$ | HV 洛氏硬度计 | HV Rockwell Hardness Tester |

| 基体 | Substrate | 符合基体材料标准 | Meet substrate material standard | HV 洛氏硬度计 | HV Rockwell Hardness Tester |

4.2.4 化学成分分析 Chemical Composition Analysis

对堆焊层进行化学成分分析，确保堆焊材料成分符合设计要求：

Perform chemical composition analysis on the cladding layer to ensure the cladding material composition meets design requirements:

| 材料牌号 | Material Grade | C | Cr | Ni | Mo | Mn | Si |

| 304 不锈钢 | 304 Stainless Steel | ≤ 0.08 | 18.0-20.0 | 8.0-11.0 | - | ≤ 2.00 | ≤ 1.00 |

| 316 不锈钢 | 316 Stainless Steel | ≤ 0.08 | 16.0-18.0 | 10.0-14.0 | 2.00-3.00 | ≤ 2.00 | ≤ 1.00 |



| 双相钢 2205 | Duplex Steel 2205 | ≤ 0.03 | 22.0-23.0 | 4.5-6.5 | 2.5-3.5 | ≤ 2.00 | ≤ 1.00 |

4.3 密封试验 Sealing Test

4.3.1 试验前准备 Pre-test Preparation

- 确认堆焊管箍螺纹加工合格，螺纹表面无损伤
- Confirm that the cladded pipe coupling thread machining is qualified, thread surface has no damage
- 清洁堆焊管箍内外表面，去除油污、切屑等杂质
- Clean the inner and outer surfaces of the cladded pipe coupling, remove oil, chips and other impurities
- 检查试验设备、仪表校准状态，确保在有效期内
- Check the calibration status of test equipment and instruments, ensure within validity period
- 准备试验记录表格，填写产品编号、规格等信息
- Prepare test record forms, fill in product number, specification and other information

4.3.2 气密性试验 Pneumatic Tightness Test

| 试验项目 | Test Item | 技术要求 | Technical Requirement |

| 试验介质 | Test Medium | 压缩空气或氮气 | Compressed air or nitrogen |

| 试验压力 | Test Pressure | 1.1 倍设计压力或按客户要求 | 1.1 times design pressure or as required by customer |

| 保压时间 | Holding Time | ≥ 30 分钟 | ≥ 30 minutes |

| 合格标准 | Acceptance Standard | 无泄漏，压力降 $\leq 1\%$ | No leakage, pressure drop $\leq 1\%$ |

| 检测方法 | Detection Method | 肥皂水检漏或压力传感器监测 | Soap water leak detection or pressure sensor monitoring |

4.3.3 水压试验 Hydrostatic Test

| 试验项目 | Test Item | 技术要求 | Technical Requirement |

| 试验介质 | Test Medium | 清洁水 | Clean water |

| 试验压力 | Test Pressure | 1.5 倍设计压力或按客户要求 | 1.5 times design pressure or as required by customer |

| 保压时间 | Holding Time | ≥ 10 分钟 | ≥ 10 minutes |

| 合格标准 | Acceptance Standard | 无渗漏、无变形 | No leakage, no deformation |

| 检测方法 | Detection Method | 目视检查及压力监测 | Visual inspection and pressure monitoring |



4.3.4 密封面检验 Sealing Surface Inspection

- | 检验项目 | Inspection Item | 检验标准 | Inspection Standard |
- | 密封面粗糙度 | Sealing Surface Roughness | $Ra \leq 1.6\mu m$ | $Ra \leq 1.6\mu m$ |
- | 密封面平面度 | Sealing Surface Flatness | $\leq 0.05mm$ | $\leq 0.05mm$ |
- | 密封面缺陷 | Sealing Surface Defects | 无划伤、凹坑、裂纹 | No scratches, pits, cracks |
- | 密封面宽度 | Sealing Surface Width | 符合图纸要求 | Meet drawing requirements |

4.4 不合格品处理 Non-conforming Product Disposition

4.4.1 螺纹加工不合格 Thread Machining Non-conformance

- | 不合格类型 | Non-conformance Type | 处理方式 | Disposition Method |
- | 螺纹尺寸超差 | Thread Dimension Out of Tolerance | 返修或报废 | Rework or scrap |
- | 螺纹表面损伤 | Thread Surface Damage | 修复或报废 | Repair or scrap |
- | 堆焊层剥落 | Cladding Layer Spalling | 重新堆焊或报废 | Re-cladding or scrap |

4.4.2 堆焊层检验不合格 Cladding Layer Inspection Non-conformance

- | 不合格类型 | Non-conformance Type | 处理方式 | Disposition Method |
- | 表面裂纹 | Surface Crack | 打磨消除或重新堆焊 | Grinding removal or re-cladding |
- | 气孔超标 | Excessive Porosity | 补焊或重新堆焊 | Weld repair or re-cladding |
- | 硬度不合格 | Hardness Non-conformance | 热处理或重新堆焊 | Heat treatment or re-cladding |
- | 成分不合格 | Composition Non-conformance | 重新堆焊 | Re-cladding |

4.4.3 密封试验不合格 Sealing Test Non-conformance

- | 不合格类型 | Non-conformance Type | 处理方式 | Disposition Method |
- | 气密性泄漏 | Pneumatic Leakage | 查找泄漏点，修复后重新试验 | Locate leakage point, repair and retest |
- | 水压试验渗漏 | Hydrostatic Leakage | 查找渗漏点，修复后重新试验 | Locate leakage point, repair and retest |
- | 密封面不合格 | Sealing Surface Non-conformance | 研磨修复或报废 | Grinding repair or scrap |



5. 监督考核 Supervision and Assessment

5.1 过程监督 Process Supervision

- 质量部每日对螺纹加工过程进行巡检，检查工艺参数执行情况
- Quality Department conducts daily patrol inspection of thread machining process, check process parameter implementation
- 质量部对堆焊层检验结果进行统计，每月形成质量分析报告
- Quality Department compiles cladding layer inspection results, forms monthly quality analysis report
- 技术部每季度对工艺文件进行评审，根据生产实际情况进行优化
- Technical Department reviews process documents quarterly, optimizes according to actual production conditions

5.2 考核指标 Assessment Indicators

考核项目	Assessment Item	目标值	Target Value	考核周期	Assessment Cycle	
螺纹加工一次合格率	Thread Machining First Pass Rate	$\geq 95\%$	$\geq 95\%$	月度	Monthly	
堆焊层检验合格率	Cladding Layer Inspection Pass Rate	$\geq 98\%$	$\geq 98\%$	月度	Monthly	
密封试验合格率	Sealing Test Pass Rate	$\geq 99\%$	$\geq 99\%$	月度	Monthly	
客户投诉率	Customer Complaint Rate	$\leq 0.5\%$	$\leq 0.5\%$	季度	Quarterly	

6. 附则 Supplementary Provisions

6.1 相关文件 Related Documents

文件编号	Document Number	文件名称	Document Title	
CLADDING-ITP-001	CLADDING-ITP-001	堆焊工艺控制程序	Cladding Process Control Procedure	
CLADDING-ITP-002	CLADDING-ITP-002	无损检测管理程序	NDT Management Procedure	
CLADDING-ITP-003	CLADDING-ITP-003	设备维护保养程序	Equipment Maintenance Procedure	
CLADDING-ITP-004	CLADDING-ITP-004	不合格品控制程序	Non-conforming Product Control Procedure	
CLADDING-ITP-005	CLADDING-ITP-005	质量记录管理程序	Quality Record Management Procedure	



6.2 相关记录 Related Records

| 记录编号 | Record Number | 记录名称 | Record Title | 保存期限 | Retention Period |
| CLADDING-REC-006-01 | CLADDING-REC-006-01 | 螺纹加工检验记录 | Thread
Machining Inspection Record | 产品寿命期 | Product Lifetime |
| CLADDING-REC-006-02 | CLADDING-REC-006-02 | 堆焊层质量检验报告 | Cladding
Layer Quality Inspection Report | 产品寿命期 | Product Lifetime |
| CLADDING-REC-006-03 | CLADDING-REC-006-03 | 密封试验记录 | Sealing Test Record |
产品寿命期 | Product Lifetime |
| CLADDING-REC-006-04 | CLADDING-REC-006-04 | 不合格品处理记录 | Non-conforming
Product Disposition Record | 3 年 | 3 Years |

6.3 修订记录 Revision History

| 版本号 | Version | 修订日期 | Revision Date | 修订内容 | Revision Content | 修订人 | Revised
By |

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