



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

科雷丁技术（山西）有限公司

CLADDING-TECHNOLOGY-SHANXI-CO.,-LTD

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Thread Machining and Cladding Layer Quality Inspection Process Specification for Cladded Pipe Clamps	
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堆焊管箍螺纹加工与堆焊层质量检验工艺规程

Thread Machining and Cladding Layer Quality Inspection Process Specification for Cladded Pipe Clamps

1. 目的 Purpose

本规程规定了科雷丁技术（山西）有限公司堆焊管箍产品的螺纹加工工艺要求及堆焊层质量检验方法，确保产品螺纹精度符合设计要求，堆焊层质量满足 TIG/MIG 精密堆焊技术标准，保证法兰堆焊、管件堆焊、钢管堆焊、轴套管堆焊等产品的可靠性和使用寿命。

This specification defines the thread machining process requirements and cladding layer quality inspection methods for cladded pipe clamp products of Cladding-Technology-Shanxi-Co.,-Ltd, ensuring that thread accuracy meets design requirements and cladding layer quality satisfies TIG/MIG precision cladding technical standards, guaranteeing the reliability and service life of flange cladding, pipe fitting cladding, steel pipe cladding, and shaft sleeve cladding products.

2. 适用范围 Scope

本规程适用于公司生产的各类堆焊管箍产品，包括：

This specification applies to various types of cladded pipe clamp products manufactured by the company, including:

- 法兰堆焊管箍 Flange cladding pipe clamps
- 管件堆焊管箍 Pipe fitting cladding pipe clamps
- 钢管堆焊管箍 Steel pipe cladding pipe clamps
- 轴套管堆焊管箍 Shaft sleeve cladding pipe clamps
- 模具堆焊修复管箍 Mold cladding repair pipe clamps

涉及 TIG 堆焊、MIG 堆焊及电弧增材制造工艺制备的堆焊层质量检验。

Covering cladding layer quality inspection for TIG cladding, MIG cladding, and arc additive manufacturing processes.



3. 职责 Responsibilities

部门/岗位	职责描述	Department/Position	Responsibility Description
生产部	执行螺纹加工与堆焊层检验操作	Production Department	Execute thread machining and cladding layer inspection operations
质量部	制定检验标准，监督检验过程，出具检验报告	Quality Department	Establish inspection standards, supervise inspection process, issue inspection reports
技术部	编制工艺文件，提供技术支持	Technical Department	Compile process documents, provide technical support
设备部	维护加工设备与检测设备	Equipment Department	Maintain machining and inspection equipment
检验员	按本规程执行具体检验工作	Inspector	Execute specific inspection work according to this specification

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

4.1 螺纹加工工艺要求 Thread Machining Process Requirements

4.1.1 加工前准备 Pre-machining Preparation

螺纹加工前，操作人员应完成以下准备工作：

Before thread machining, operators shall complete the following preparations:

- 确认堆焊管箍已完成 TIG/MIG 堆焊工序，堆焊层表面经打磨处理，表面粗糙度 $Ra \leq 3.2\mu m$
- Confirm that the cladded pipe clamp has completed TIG/MIG cladding process, cladding layer surface has been ground, surface roughness $Ra \leq 3.2\mu m$
- 检查堆焊层外观质量，确认无裂纹、气孔、夹渣等缺陷



- Inspect cladding layer appearance quality, confirm no cracks, porosity, inclusions or other defects
- 核对产品图纸，确认螺纹规格、精度等级及技术要求
- Verify product drawings, confirm thread specification, accuracy grade and technical requirements
- 检查加工设备状态，确认刀具、量具处于有效校准期内
- Check equipment status, confirm tools and measuring instruments are within valid calibration period

4.1.2 螺纹加工参数 Thread Machining Parameters

堆焊管箍螺纹加工应采用专用螺纹刀具，加工参数如下：

Cladded pipe clamp thread machining shall use dedicated thread cutting tools, machining parameters are as follows:

螺纹规格	切削速度	进给量	切削深度	Thread Specification	Cutting Speed	Feed Rate	Cutting Depth
M20×1.5	30-40m/min	1.5mm/r	0.3-0.5mm	M20×1.5	30-40m/min	1.5mm/r	0.3-0.5mm
M27×2.0	25-35m/min	2.0mm/r	0.4-0.6mm	M27×2.0	25-35m/min	2.0mm/r	0.4-0.6mm
M36×2.0	20-30m/min	2.0mm/r	0.4-0.6mm	M36×2.0	20-30m/min	2.0mm/r	0.4-0.6mm
M48×2.0	18-25m/min	2.0mm/r	0.5-0.7mm	M48×2.0	18-25m/min	2.0mm/r	0.5-0.7mm

注：具体参数应根据堆焊层材料硬度及刀具状态适当调整。

Note: Specific parameters shall be appropriately adjusted according to cladding layer material hardness and tool condition.

4.1.3 螺纹精度要求 Thread Accuracy Requirements

堆焊管箍螺纹加工精度应符合以下要求：

Cladded pipe clamp thread machining accuracy shall meet the following requirements:

- 螺纹精度等级：6H/6g（普通级）或 5H/5g（精密级）
- Thread accuracy grade: 6H/6g (general grade) or 5H/5g (precision grade)
- 螺纹中径公差：按 GB/T 192-2003 标准执行
- Thread pitch diameter tolerance: Execute according to GB/T 192-2003 standard



- 螺纹牙型角: $60^{\circ}\pm 15'$
- Thread profile angle: $60^{\circ}\pm 15'$
- 螺纹表面粗糙度: $Ra\leq 1.6\mu m$
- Thread surface roughness: $Ra\leq 1.6\mu m$
- 螺纹有效长度: 按图纸要求, 公差 $\pm 0.5mm$
- Thread effective length: Per drawing requirements, tolerance $\pm 0.5mm$

4.1.4 加工过程控制 Machining Process Control

- 加工过程中应使用切削液进行冷却润滑, 防止堆焊层过热
- Cutting fluid shall be used for cooling and lubrication during machining to prevent cladding layer overheating
- 每加工 5-10 件产品, 应检查一次螺纹精度
- Thread accuracy shall be checked once every 5-10 pieces produced
- 发现刀具磨损异常时, 应立即更换刀具并重新调整加工参数
- When abnormal tool wear is detected, tools shall be immediately replaced and machining parameters readjusted
- 加工完成后, 应清除螺纹内的切屑和切削液残留
- After machining, chips and cutting fluid residue in threads shall be cleaned

4.2 堆焊层质量检验工艺 Cladding Layer Quality Inspection Process

4.2.1 外观检验 Visual Inspection

堆焊层外观检验应在良好照明条件下进行, 检验内容包括:

Cladding layer visual inspection shall be conducted under good lighting conditions, inspection items include:

- 堆焊层表面应平整, 无肉眼可见的裂纹、气孔、夹渣
- Cladding layer surface shall be smooth, no visible cracks, porosity, inclusions
- 堆焊层与基体金属结合良好, 无未熔合、未焊透现象
- Cladding layer shall be well bonded with base metal, no lack of fusion or incomplete penetration
- 堆焊层厚度均匀, 符合图纸要求
- Cladding layer thickness shall be uniform, meeting drawing requirements
- 堆焊层表面粗糙度 $Ra\leq 6.3\mu m$ (未加工面)
- Cladding layer surface roughness $Ra\leq 6.3\mu m$ (unmachined surface)

检验方法: 目视检查, 必要时使用 5-10 倍放大镜辅助观察。



Inspection method: Visual inspection, magnifying glass of 5-10 times shall be used for auxiliary observation when necessary.

4.2.2 尺寸检验 Dimensional Inspection

堆焊层尺寸检验项目及方法：

Cladding layer dimensional inspection items and methods:

检验项目	检验方法	允许偏差	Inspection Item	Inspection Method	Allowable Deviation
堆焊层厚度	超声波测厚仪	+0.5mm/0	Cladding layer thickness	Ultrasonic thickness gauge	+0.5mm/0
堆焊层宽度	游标卡尺	±0.5mm	Cladding layer width	Vernier caliper	±0.5mm
堆焊层高度	高度尺	±0.3mm	Cladding layer height	Height gauge	±0.3mm
堆焊层圆度	千分表	≤0.2mm	Cladding layer roundness	Dial indicator	≤0.2mm

4.2.3 硬度检验 Hardness Inspection

堆焊层硬度检验要求：

Cladding layer hardness inspection requirements:

- 检验位置：堆焊层表面及堆焊层与基体过渡区
- Inspection position: Cladding layer surface and transition zone between cladding layer and base metal
- 检验方法：里氏硬度计或维氏硬度计
- Inspection method: Lee hardness tester or Vickers hardness tester
- 检验点数：每件产品不少于 3 个测点
- Number of test points: No less than 3 test points per product
- 硬度要求：按产品图纸或技术协议规定执行
- Hardness requirement: Execute according to product drawing or technical agreement

4.2.4 无损检测 Non-destructive Testing

堆焊层无损检测项目及标准：

Cladding layer non-destructive testing items and standards:



检测方法	检测标准	合格等级	Inspection Method	Inspection Standard	Acceptance Level
磁粉检测 MT	JB/T 6061	II级	Magnetic particle testing MT	JB/T 6061	Level II
渗透检测 PT	JB/T 6062	I级	Penetrant testing PT	JB/T 6062	Level I
超声波检测 UT	JB/T 4730	II级	Ultrasonic testing UT	JB/T 4730	Level II

检测时机：堆焊完成后进行外观检验，合格后进行无损检测。

Testing timing: Visual inspection after cladding, non-destructive testing after visual inspection qualification.

4.2.5 金相检验 Metallographic Inspection

堆焊层金相检验要求：

Cladding layer metallographic inspection requirements:

- 取样位置：堆焊层横截面
- Sampling position: Cladding layer cross-section
- 检验内容：堆焊层组织、稀释率、结合界面
- Inspection content: Cladding layer structure, dilution rate, bonding interface
- 稀释率要求：TIG 堆焊 $\leq 15\%$ ，MIG 堆焊 $\leq 20\%$
- Dilution rate requirement: TIG cladding $\leq 15\%$, MIG cladding $\leq 20\%$
- 结合界面：无裂纹、未熔合等缺陷
- Bonding interface: No cracks, lack of fusion or other defects

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

5.1 检验记录 Inspection Records

每次检验应填写《堆焊管箍检验记录表》，记录内容包括：

Each inspection shall fill in the "Cladded Pipe Clamp Inspection Record Form", record content includes:

- 产品编号、规格型号 Product number, specification model



- 检验日期、检验人员 Inspection date, inspector
- 螺纹加工精度检验结果 Thread machining accuracy inspection results
- 堆焊层外观检验结果 Cladding layer visual inspection results
- 堆焊层尺寸检验结果 Cladding layer dimensional inspection results
- 硬度检验结果 Hardness inspection results
- 无损检测结果 Non-destructive testing results

5.2 检验报告 Inspection Report

质量部应根据检验记录编制《堆焊管箍质量检验报告》，报告内容包括：

Quality Department shall compile "Cladded Pipe Clamp Quality Inspection Report" based on inspection records, report content includes:

- 产品基本信息 Product basic information
- 检验项目及结果 Inspection items and results
- 不合格项处理情况 Non-conforming items handling status
- 检验结论 Inspection conclusion
- 检验人员签字 Inspector signature

6. 不合格品处理 Non-conforming Product Handling

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

螺纹加工不合格品的处理：

Handling of thread machining non-conforming products:

- 螺纹尺寸超差：可返修的应返修，不可返修的报废处理
- Thread dimensional deviation: Those that can be repaired shall be repaired, those that cannot be repaired shall be scrapped
- 螺纹表面缺陷：轻微缺陷可打磨修复，严重缺陷报废处理
- Thread surface defects: Minor defects can be ground repaired, serious defects shall be scrapped
- 螺纹精度不合格：重新调整加工参数后返工
- Thread accuracy non-conformance: Rework after readjusting machining parameters

6.2 堆焊层不合格 Cladding Layer Non-conformance

堆焊层不合格品的处理：



Handling of cladding layer non-conforming products:

- 表面裂纹、气孔：打磨去除后重新堆焊
- Surface cracks, porosity: Grind off and re-clad
- 稀释率超标：调整堆焊参数后重新堆焊
- Excessive dilution rate: Re-clad after adjusting cladding parameters
- 结合不良：清除不合格堆焊层后重新堆焊
- Poor bonding: Remove non-conforming cladding layer and re-clad
- 硬度不合格：分析原因后调整工艺参数重新堆焊
- Hardness non-conformance: Analyze cause and re-clad after adjusting process parameters

7. 监督考核 Supervision and Assessment

7.1 过程监督 Process Supervision

质量部应对螺纹加工和堆焊层检验过程进行监督，监督内容包括：

Quality Department shall supervise thread machining and cladding layer inspection processes, supervision content includes:

- 操作人员是否按本规程执行操作
- Whether operators execute operations according to this specification
- 检验记录是否完整、准确
- Whether inspection records are complete and accurate
- 设备、量具是否处于正常状态
- Whether equipment and measuring instruments are in normal condition

7.2 考核指标 Assessment Indicators

考核项目	目标值	考核周期	Assessment Item	Target Value	Assessment Period
螺纹加工合格率	≥98%	月度	Thread machining qualification rate	≥98%	Monthly
堆焊层一次检验合格率	≥95%	月度	Cladding layer first inspection qualification rate	≥95%	Monthly



检验记录完整率	100%	月度	Inspection record completeness rate	100%	Monthly
客户投诉率	≤1%	季度	Customer complaint rate	≤1%	Quarterly

8. 附则 Supplementary Provisions

8.1 相关文件 Related Documents

- CLADDING-MPS-001 《TIG 堆焊工艺规程》 TIG Cladding Process Specification
- CLADDING-MPS-002 《MIG 堆焊工艺规程》 MIG Cladding Process Specification
- CLADDING-MPS-003 《增材制造质量控制程序》 Additive Manufacturing Quality Control Procedure
- CLADDING-MPS-004 《法兰堆焊作业指导书》 Flange Cladding Work Instruction
- CLADDING-MPS-005 《管件堆焊作业指导书》 Pipe Fitting Cladding Work Instruction

8.2 记录表格 Record Forms

- CLADDING-FRM-006-01 《堆焊管箍检验记录表》 Cladded Pipe Clamp Inspection Record Form
- CLADDING-FRM-006-02 《堆焊管箍质量检验报告》 Cladded Pipe Clamp Quality Inspection Report
- CLADDING-FRM-006-03 《不合格品处理单》 Non-conforming Product Disposition Form

8.3 修订记录 Revision History

版本号	修订日期	修订内容	Version	Revision Date	Revision Content
A/0	2024-01-01	首次发布	A/0	2024-01-01	First release

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