



STAINLESS INDIA
A HOUSE OF QUALITY

The Ultimate Technical Guide to Stainless Steel 347H Elbows

Complete Engineering, Manufacturing, Inspection, Procurement & Application Book

Prepared By: STAINLESS INDIA

Website: www.stainlessindia.net

Email: info@stainlessindia.net

Phone: +91 97680 42420

Location: Mumbai, Maharashtra, India

Edition: First Edition – 2026

© 2026 STAINLESS INDIA. All rights reserved.



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vitthalbhai Patel Road, Sikkanagar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

Chapter 2 – About STAINLESS INDIA

STAINLESS INDIA is a leading manufacturer, supplier, stockiest, and exporter of premium-quality stainless steel, carbon steel, alloy steel, duplex steel, super duplex steel, nickel alloy, and special alloy piping products. The company serves industries including oil & gas, petrochemical, power generation, marine, offshore, pharmaceuticals, food processing, fertilizer, EPC projects, and infrastructure.

With years of industry experience, STAINLESS INDIA supplies buttweld pipe fittings, forged fittings, flanges, pipes, tubes, fasteners, and customized engineering components manufactured to international standards such as ASTM, ASME, ANSI, MSS, DIN, EN, and ISO.

Products are supported by quality control procedures including dimensional inspection, chemical analysis, mechanical testing, and non-destructive testing where required. EN 10204 3.1 material test certificates and third-party inspection can be provided for qualifying projects.

Mission: Deliver reliable, high-quality piping solutions with technical excellence and dependable service.

Vision: Be recognized globally as a trusted supplier of industrial piping products through quality, innovation, and customer satisfaction.

Core Product Range

- Stainless Steel Butt weld Pipe Fittings
- SS 347H Elbows (45°, 90°, 180°)
- ASTM A403 WP347H Pipe Fittings
- Stainless Steel Pipes & Tubes
- Flanges
- Forged Fittings
- Carbon Steel Pipe Fittings
- Alloy Steel Pipe Fittings
- Duplex & Super Duplex Products
- Nickel Alloy Products
- Custom Fabricated Components



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vitthalbhai Patel Road, Sikkanagar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

Chapter 3 – Executive Summary

Executive Summary

Stainless Steel 347H Elbows are high-performance austenitic stainless steel butt-welded pipe fittings specifically designed for high-temperature and high-pressure piping systems. Manufactured in accordance with ASTM A403 WP347H and ASME SA403 standards, these elbows are widely used in industries where excellent corrosion resistance, oxidation resistance, creep strength, and long-term thermal stability are essential.

Grade 347H is a high-carbon variation of Stainless Steel 347 that contains niobium (columbium) as a stabilizing element. The addition of niobium minimizes chromium carbide precipitation during welding and prolonged exposure to elevated temperatures, thereby reducing the risk of intergranular corrosion and improving service life in demanding applications.

SS 347H Elbows are available in various configurations, including 45°, 90°, and 180° bends, as well as Long Radius (LR) and Short Radius (SR) designs. They are manufactured in seamless and welded forms across a wide range of nominal pipe sizes and wall thicknesses to comply with international piping standards.

These elbows are extensively used in refineries, petrochemical plants, power generation facilities, fertilizer plants, offshore platforms, LNG terminals, pharmaceutical plants, food processing facilities, heat exchangers, boilers, and chemical processing units. Their ability to maintain mechanical strength and corrosion resistance at elevated temperatures makes them suitable for critical industrial services.

This book has been developed to provide engineers, procurement professionals, quality inspectors, manufacturers, exporters, EPC contractors, and industrial buyers with comprehensive technical guidance on SS 347H Elbows. It covers material science, manufacturing methods, dimensional standards, welding practices, inspection procedures, testing requirements, industrial applications, and procurement considerations.

The objective is to present technically accurate, practical, and standards-based information that supports engineering design, material selection, quality assurance, and purchasing decisions.



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vithalbhair Patel Road, Sikkannagar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

Chapter 4 – Introduction to Stainless Steel 347H Elbows

4.1 What is a Pipe Elbow?

A pipe elbow is a butt-weld pipe fitting designed to change the direction of fluid flow within a piping system. It enables pipelines to navigate around equipment, structural supports, and process layouts while maintaining smooth flow characteristics. Elbows are manufactured in various angles, with 45°, 90°, and 180° being the most common.

The radius of an elbow influences pressure loss and flow efficiency. Long Radius (LR) elbows are generally preferred for process pipelines due to lower turbulence and pressure drop, whereas Short Radius (SR) elbows are selected where installation space is limited.

4.2 What is Stainless Steel 347H?

Stainless Steel 347H is a niobium-stabilized austenitic stainless steel developed for elevated-temperature applications. It is a high-carbon version of Grade 347, offering improved creep resistance and higher stress rupture strength while maintaining excellent corrosion resistance and weldability.

The stabilizing effect of niobium prevents chromium carbide precipitation during welding and prolonged service at elevated temperatures. This characteristic allows SS 347H components to retain corrosion resistance after fabrication without requiring post-weld heat treatment in many applications.

4.3 Why SS 347H Elbows Are Used

SS 347H Elbows are selected for piping systems that operate under severe service conditions, including high temperatures, cyclic thermal loading, corrosive process fluids, and long operating life requirements.

Major benefits include:

- Excellent resistance to intergranular corrosion.
- Superior high-temperature mechanical strength.
- Outstanding oxidation resistance.
- Good weldability with conventional stainless steel welding procedures.
- Reliable long-term performance in refinery and petrochemical applications.
- Excellent fabrication characteristics.
- Availability in multiple sizes, schedules, and pressure classes.



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vithalbhair Patel Road, Sikkannagar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

4.4 Typical Industrial Applications

SS 347H Elbows are commonly installed in:

- Oil and Gas Processing Plants
- Petrochemical Complexes
- Thermal and Nuclear Power Stations
- Heat Exchangers
- Boilers and Superheaters
- LNG Facilities
- Offshore Platforms
- Marine Piping Systems
- Fertilizer Plants
- Pharmaceutical Manufacturing Units
- Chemical Processing Industries
- Food and Beverage Processing Plants

4.5 Scope of This Book

This book provides detailed information on:

- Material composition and metallurgy
- Manufacturing processes
- ASTM and ASME standards
- Mechanical and physical properties
- Corrosion resistance
- High-temperature performance
- Welding and fabrication
- Heat treatment
- Testing and inspection
- Industrial applications
- Product selection
- Procurement guidelines
- Maintenance best practices



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vitthalbhai Patel Road, Sikkangar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

Chapter 5 – History and Development of Stainless Steel 347H

5.1 Evolution of Stainless Steel

The development of stainless steel began in the early twentieth century with the discovery that chromium significantly improves corrosion resistance. Continuous alloy development resulted in specialized stainless steel grades capable of meeting increasingly demanding industrial requirements.

As high-temperature processing industries expanded, engineers required materials that could resist oxidation, creep deformation, and intergranular corrosion during prolonged service. This need led to the development of stabilized stainless steel grades.

5.2 Development of Grade 347

Grade 347 was developed by adding niobium (columbium) to the chromium-nickel stainless steel composition. Niobium preferentially combines with carbon, reducing chromium carbide formation at grain boundaries and preserving corrosion resistance after welding.

This stabilization made Grade 347 particularly suitable for welded piping systems exposed to elevated temperatures.

5.3 Development of Grade 347H

To further improve high-temperature strength, a higher carbon version of Grade 347 was introduced as Grade 347H. The increased carbon content enhances creep strength and stress rupture resistance while retaining the stabilization benefits provided by niobium.

Today, SS 347H is widely specified for critical industrial piping systems operating at elevated temperatures where long-term reliability is essential.

5.4 Modern Industrial Importance

Modern industries continue to rely on SS 347H Elbows because they provide an excellent balance of corrosion resistance, mechanical strength, fabrication characteristics, and service life. Their use in refineries, petrochemical plants, power generation facilities, and chemical processing industries demonstrates their importance in maintaining safe, efficient, and reliable piping systems worldwide.



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vithalbhai Patel Road, Sikkanagar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

Chapter 6 – ASTM A403 WP347H Standard

6.1 Introduction

ASTM A403/A403M is the internationally recognized specification covering wrought austenitic stainless steel pipe fittings intended for pressure piping applications. It establishes the manufacturing, chemical composition, mechanical property, heat treatment, testing, marking, and inspection requirements for buttweld fittings.

Grade WP347H is included within this specification and is intended for service involving elevated temperatures and corrosive process environments.

6.2 Scope of ASTM A403

ASTM A403 applies to wrought stainless steel buttweld fittings manufactured from seamless or welded pipe and tubing. Products covered include:

- 45° Elbows
- 90° Elbows
- 180° Return Bends
- Equal Tees
- Reducing Tees
- Concentric Reducers
- Eccentric Reducers
- Pipe Caps
- Stub Ends
- Crosses
- Custom Butt weld Fittings

The specification is widely accepted in oil and gas, petrochemical, power generation, pharmaceutical, food processing, marine, offshore, and chemical industries.

6.3 Meaning of "WP347H"

The designation "WP347H" has specific engineering significance:

- **W** – Wrought material.
- **P** – Pressure piping application.
- **347** – Niobium-stabilized austenitic stainless steel.
- **H** – Higher carbon content for improved creep strength and elevated-temperature performance.

6.4 Manufacturing Requirements

ASTM A403 permits fittings to be manufactured by hot forming, cold forming, or a combination of both, followed by appropriate heat treatment where required. The finished fittings must comply with dimensional tolerances, mechanical properties, and inspection requirements defined by the specification.



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vitthalbhai Patel Road, Sikkanagar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

6.5 Heat Treatment

After forming, fittings shall receive the required solution annealing treatment unless otherwise permitted by the applicable material specification. Proper heat treatment restores corrosion resistance and ensures a uniform austenitic microstructure.

6.6 Mechanical Testing

Typical qualification tests include:

- Tensile Test
- Hardness Test (when specified)
- Flattening Test (where applicable)
- Flaring Test (for applicable products)

All test results must meet the minimum requirements of ASTM A403.

6.7 Chemical Analysis

Each heat of material shall comply with the specified chemical composition limits for Grade WP347H. Verification is normally performed using optical emission spectroscopy (OES), X-ray fluorescence (XRF), or other approved analytical methods.

6.8 Inspection Requirements

Inspection activities may include:

- Visual Examination
- Dimensional Inspection
- Surface Examination
- Positive Material Identification (PMI)
- Non-Destructive Testing (NDT) when specified
- Documentation Review

6.9 Product Marking

Each fitting is typically marked with:

- Manufacturer's Name or Logo
- Material Grade (WP347H)
- Heat Number
- Size
- Schedule
- Standard Reference
- Manufacturing Identification
- Customer Identification (when required)



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vitthalbhai Patel Road, Sikkanagar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

6.10 Advantages of ASTM A403 Compliance

Manufacturing in accordance with ASTM A403 provides:

- International acceptance
- Reliable material quality
- Consistent dimensions
- Verified mechanical performance
- Improved traceability
- Enhanced project compliance

Prepared By: STAINLESS INDIA
Website: www.stainlessindia.net
Email: info@stainlessindia.net
Phone: +91 97680 42420
Location: Mumbai, Maharashtra, India
Edition: First Edition – 2026
Dated : 11.07.2026
© 2026 STAINLESS INDIA.
All rights reserved.



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vitthalbhai Patel Road, Sikkanagar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

Chapter 7 – ASME SA403 Standard

7.1 Overview

ASME SA403 is the Boiler and Pressure Vessel Code equivalent of ASTM A403. It is adopted by the American Society of Mechanical Engineers for pressure vessel and power piping applications.

The technical requirements are substantially equivalent to ASTM A403, making the specifications interchangeable for most industrial projects.

7.2 Importance in Pressure Systems

ASME SA403 fittings are widely specified for:

- Power Plants
- Refineries
- Petrochemical Facilities
- Steam Systems
- High-Pressure Process Lines
- Boiler Installations
- Heat Recovery Systems

Using SA403-compliant fittings helps ensure compatibility with ASME design codes such as B31.1, B31.3, and Section VIII.

7.3 Material Certification

Typical documentation supplied with SA403 fittings includes:

- EN 10204 Type 3.1 Material Test Certificate
- Heat Number Traceability
- Chemical Composition Report
- Mechanical Test Report
- Inspection Report
- Third-Party Inspection Certificate (if specified)

7.4 Quality Assurance

Manufacturers supplying SA403 fittings generally operate under certified quality management systems and maintain full traceability from raw material to finished product.



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vithalbhair Patel Road, Sikkannagar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

Chapter 8 – ASME B16.9 Standard

8.1 Introduction

ASME B16.9 is the principal dimensional standard governing factory-made wrought butt welding fittings. It specifies standardized dimensions, tolerances, end preparation, and design requirements to ensure interchangeability and compatibility within piping systems.

8.2 Products Covered

The standard includes:

- 45° Elbows
- 90° Elbows
- 180° Return Elbows
- Equal Tees
- Reducing Tees
- Concentric Reducers
- Eccentric Reducers
- Caps
- Stub Ends
- Crosses

8.3 Standard Sizes

ASME B16.9 covers a wide range of nominal pipe sizes suitable for industrial piping systems. Manufacturers can also produce larger custom fittings to project specifications where required.

8.4 Long Radius and Short Radius Elbows

Long Radius (LR)

Long Radius elbows have a centerline radius equal to 1.5 times the nominal pipe size (1.5D). They provide smoother flow, lower turbulence, and reduced pressure loss, making them the preferred choice for most process piping systems.

Short Radius (SR)

Short Radius elbows have a centerline radius equal to one times the nominal pipe size (1D). They are typically selected where installation space is limited and compact piping layouts are required.

8.5 End Preparation

Pipe fitting ends are prepared for butt welding to achieve full-penetration welds. Proper end preparation contributes to joint strength, leak-tight performance, and long-term reliability.



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Viththalbhai Patel Road, Sikkanagar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

8.6 Dimensional Tolerances

The standard specifies allowable tolerances for:

- Outside Diameter
- Center-to-End Dimensions
- Wall Thickness
- End Squareness
- Bevel Angle
- Alignment
- Overall Geometry

Maintaining these tolerances ensures correct fit-up during fabrication and installation.

8.7 Benefits of ASME B16.9 Compliance

Compliance with ASME B16.9 offers several advantages:

- Standardized dimensions
- Reliable interchangeability
- Improved fabrication efficiency
- Reduced installation time
- Enhanced piping system integrity
- Compatibility with international engineering projects



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vithalbhair Patel Road, Sikkannagar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

Chapter 9 – Chemical Composition of Stainless Steel 347H Elbows

9.1 Introduction

The performance of Stainless Steel 347H Elbows is primarily determined by their carefully balanced chemical composition. Each alloying element contributes specific mechanical, corrosion-resistant, and high-temperature characteristics that make the material suitable for demanding industrial applications.

Grade 347H is a niobium (columbium) stabilized austenitic stainless steel with a higher carbon content than standard Grade 347. The increased carbon improves creep strength and stress rupture resistance, while niobium minimizes chromium carbide precipitation during welding and elevated-temperature service.

Table 9.1 – Typical Chemical Composition of ASTM A403 WP347H

Element	Typical Content (%)	Primary Function
Carbon (C)	0.04–0.10	Improves high-temperature strength and creep resistance
Manganese (Mn)	Max. 2.00	Enhances hot working and deoxidation
Silicon (Si)	Max. 1.00	Improves oxidation resistance
Phosphorus (P)	Max. 0.045	Controlled to maintain toughness
Sulfur (S)	Max. 0.030	Controlled to improve weld quality
Chromium (Cr)	17.00–19.00	Provides corrosion and oxidation resistance
Nickel (Ni)	9.00–13.00	Stabilizes the austenitic structure and improves toughness
Niobium + Tantalum (Nb+Ta)	Minimum $10 \times$ Carbon, Maximum 1.10	Prevents carbide precipitation and improves high-temperature stability
Iron (Fe)	Balance	Base metal providing structural integrity



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vithalbhair Patel Road, Sikkannagar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

9.2 Function of Major Alloying Elements

Chromium (Cr)

Chromium forms a thin passive oxide layer on the steel surface, protecting the material against atmospheric corrosion, oxidation, and many industrial chemicals.

Nickel (Ni)

Nickel stabilizes the austenitic crystal structure, improving ductility, toughness, impact resistance, and corrosion performance across a wide temperature range.

Carbon (C)

The higher carbon content in Grade 347H enhances creep strength and stress rupture resistance, making the alloy suitable for prolonged service at elevated temperatures.

Niobium (Columbium)

Niobium combines preferentially with carbon to form stable niobium carbides. This reduces chromium carbide precipitation at grain boundaries and minimizes the risk of intergranular corrosion after welding.

Manganese (Mn)

Manganese assists in steelmaking by removing oxygen and sulfur impurities while improving hot-working characteristics.

Silicon (Si)

Silicon acts as a deoxidizer and contributes to improved oxidation resistance at elevated temperatures.

9.3 Importance of Controlled Composition

Strict control of chemical composition ensures consistent mechanical properties, reliable weldability, excellent corrosion resistance, and long-term performance in high-temperature service.



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Viththalbhai Patel Road, Sikkanagar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

Chapter 10 – Mechanical Properties of Stainless Steel 347H Elbows

10.1 Introduction

Mechanical properties define the ability of SS 347H Elbows to withstand internal pressure, thermal expansion, cyclic loading, and external mechanical forces without failure.

Table 10.1 – Typical Mechanical Properties

Property	Typical Value
Tensile Strength	Minimum 515 MPa
Yield Strength (0.2% Offset)	Minimum 205 MPa
Elongation	Minimum 35%
Reduction of Area	Excellent
Hardness	Typically below 201 HB
Impact Toughness	Excellent at ambient temperature
Modulus of Elasticity	Approximately 193 GPa

10.2 Tensile Strength

Tensile strength represents the maximum stress that the material can withstand before fracture. SS 347H provides sufficient strength for demanding industrial piping systems.

10.3 Yield Strength

Yield strength indicates the stress at which permanent deformation begins. This property is critical when designing pressure piping systems to ensure safe operation.

10.4 Elongation

High elongation demonstrates the alloy's ductility, allowing fittings to absorb deformation without cracking during fabrication or service.

10.5 Hardness

The hardness of SS 347H remains moderate, enabling machining and fabrication while maintaining adequate wear resistance.

10.6 Creep Resistance

One of the major advantages of Grade 347H is its improved creep resistance compared with standard Grade 347. This makes it particularly suitable for prolonged operation at elevated temperatures.

10.7 Stress Rupture Strength

The alloy maintains mechanical integrity during long-term exposure to high temperatures, reducing the likelihood of premature failure in critical process equipment.



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vitthalbhai Patel Road, Sikkanagar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

Chapter 11 – Physical Properties of Stainless Steel 347H Elbows

11.1 Introduction

Physical properties describe how SS 347H responds to heat, electricity, and mechanical loading. These values are important for piping design, thermal expansion calculations, and material selection.

Table 11.1 – Typical Physical Properties

Property	Typical Value
Density	Approximately 7.9 g/cm ³
Melting Range	Approximately 1400–1450 °C
Modulus of Elasticity	Approximately 193 GPa
Thermal Conductivity	Approximately 16 W/m·K (at room temperature)
Coefficient of Thermal Expansion	Approximately 17×10^{-6} /°C
Electrical Resistivity	Approximately 0.72 $\mu\Omega \cdot m$
Specific Heat Capacity	Approximately 500 J/kg·K
Magnetic Permeability	Essentially non-magnetic in the annealed condition

11.2 Density

The density of SS 347H is similar to other austenitic stainless steels, making it suitable for pressure piping without excessive weight.

11.3 Thermal Expansion

Like most austenitic stainless steels, SS 347H exhibits relatively high thermal expansion. Expansion joints, guides, and supports should be considered during piping design to accommodate thermal movement.

11.4 Thermal Conductivity

Although lower than that of carbon steel, the thermal conductivity of SS 347H is adequate for many industrial heat transfer applications.

11.5 Electrical Resistivity

The higher electrical resistivity compared with carbon steel makes the alloy suitable for applications where reduced electrical conductivity is advantageous.

11.6 Magnetic Characteristics

SS 347H is generally non-magnetic in the solution-annealed condition. However, slight magnetism may develop after extensive cold working, which is a normal characteristic of austenitic stainless steels.



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vitthalbhai Patel Road, Sikkanagar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

11.7 Engineering Considerations

When designing piping systems using SS 347H Elbows, engineers should account for:

- Thermal expansion during startup and shutdown.
- Elevated-temperature mechanical properties.
- Internal design pressure.
- Corrosion allowance where applicable.
- Compatibility with mating piping materials.
- Compliance with applicable ASME piping codes.

Understanding these physical properties ensures safe, reliable, and economical piping system design across a wide range of industrial environments.

Prepared By: STAINLESS INDIA
Website: www.stainlessindia.net
Email: info@stainlessindia.net
Phone: +91 97680 42420
Location: Mumbai, Maharashtra, India
Edition: First Edition – 2026
Dated : 11.07.2026
© 2026 STAINLESS INDIA.
All rights reserved.



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vithalbhair Patel Road, Sikkannagar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

Chapter 12 – Metallurgy of Stainless Steel 347H Elbows

12.1 Introduction

Metallurgy is the science of understanding how the composition, microstructure, and processing of metals influence their performance. The exceptional properties of Stainless Steel 347H are the result of a carefully engineered alloy composition combined with controlled manufacturing and heat treatment.

SS 347H is an austenitic chromium-nickel stainless steel stabilized with niobium (columbium). The addition of niobium minimizes chromium carbide precipitation during welding and prolonged exposure to elevated temperatures, significantly improving long-term corrosion resistance and structural stability.

12.2 Austenitic Microstructure

The primary microstructure of SS 347H is austenite, a face-centered cubic (FCC) crystal structure that provides:

- Excellent ductility
- High toughness
- Superior weldability
- Good fatigue resistance
- Outstanding cryogenic performance
- Excellent corrosion resistance

Unlike ferritic or martensitic stainless steels, the austenitic structure remains stable over a broad temperature range, making SS 347H suitable for both low- and high-temperature service.

12.3 Grain Structure

Proper solution annealing produces a uniform grain structure that improves:

- Mechanical strength
- Toughness
- Resistance to thermal fatigue
- Weldability
- Corrosion performance

Excessive grain growth can reduce toughness and fatigue life, which is why controlled heat treatment is essential during manufacturing.



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vithalbhai Patel Road, Sikkanagar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

12.4 Sensitization

Sensitization occurs when chromium carbides form at grain boundaries during exposure to temperatures typically between 450°C and 850°C. This process depletes chromium adjacent to the grain boundaries, reducing corrosion resistance and increasing susceptibility to intergranular corrosion.

12.5 Role of Niobium (Columbium)

Niobium is the defining alloying element in Grade 347H.

Its primary functions include:

- Forming stable niobium carbides
- Preventing chromium carbide precipitation
- Preserving chromium within the stainless steel matrix
- Improving weldability
- Enhancing creep resistance
- Increasing stress rupture strength
- Improving long-term thermal stability

This stabilization is the principal reason why SS 347H is preferred over unstabilized grades in high-temperature service.

12.6 Carbide Formation

During elevated-temperature exposure, carbon naturally combines with alloying elements to form carbides.

In Grade 347H:

- Carbon preferentially combines with niobium.
- Chromium remains available to maintain the passive oxide layer.
- The risk of intergranular corrosion is significantly reduced.

12.7 Heat Treatment

Solution annealing dissolves undesirable carbides and restores a homogeneous austenitic microstructure.

Typical benefits include:

- Improved corrosion resistance
- Uniform mechanical properties
- Reduced residual stresses
- Enhanced weldability
- Increased service life



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vitthalbhai Patel Road, Sikkanagar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

12.8 Metallurgical Advantages

The stabilized austenitic structure of SS 347H provides:

- Excellent weld integrity
- High-temperature stability
- Superior creep resistance
- Long service life
- Reliable corrosion resistance
- Reduced maintenance requirements

Prepared By: STAINLESS INDIA
Website: www.stainlessindia.net
Email: info@stainlessindia.net
Phone: +91 97680 42420
Location: Mumbai, Maharashtra, India
Edition: First Edition – 2026
Dated : 11.07.2026
© 2026 STAINLESS INDIA.
All rights reserved.



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vitthalbhai Patel Road, Sikkonagar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

Chapter 13 – Corrosion Resistance of Stainless Steel 347H Elbows

13.1 Introduction

Corrosion resistance is one of the most important reasons for selecting SS 347H Elbows. The chromium-rich passive oxide layer continuously protects the material against many corrosive environments encountered in industrial processing.

13.2 Atmospheric Corrosion

SS 347H exhibits excellent resistance to atmospheric corrosion under normal industrial and marine conditions. The passive chromium oxide film protects the surface from rust formation and weathering.

13.3 Intergranular Corrosion

One of the major advantages of Grade 347H is its excellent resistance to intergranular corrosion.

Because niobium stabilizes carbon, chromium carbide precipitation is minimized during welding and prolonged service at elevated temperatures. This significantly improves the long-term durability of welded piping systems.

13.4 Oxidation Resistance

SS 347H provides excellent oxidation resistance at elevated temperatures.

A stable chromium oxide layer forms continuously during service, protecting the underlying metal from rapid oxidation and scaling.

13.5 Pitting Corrosion

Although SS 347H performs well in many environments, localized pitting corrosion may occur in chloride-rich solutions.

Risk factors include:

- High chloride concentration
- Elevated temperature
- Stagnant process fluids
- Surface contamination

Proper material selection and system design help reduce pitting risk.



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vitthalbhai Patel Road, Sikkanagar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

13.6 Crevice Corrosion

Crevice corrosion may develop in confined spaces where oxygen concentration becomes depleted.

Examples include:

- Flange joints
- Gasket interfaces
- Threaded connections
- Deposits beneath insulation

Good fabrication practices and routine inspection help minimize this risk.

13.7 Stress Corrosion Cracking

Like many austenitic stainless steels, SS 347H can be susceptible to chloride-induced stress corrosion cracking under specific combinations of tensile stress, elevated temperature, and chloride exposure.

Engineering controls such as reducing residual stress, selecting suitable operating conditions, and choosing alternative alloys for severe chloride environments can reduce this risk.

13.8 Chemical Resistance

SS 347H generally performs well in:

- Organic acids
- Mild inorganic acids
- Alkaline solutions
- Steam systems
- High-temperature gases
- Oxidizing environments

Compatibility should always be verified for highly aggressive chemicals or mixed-process streams.

13.9 Corrosion Prevention Best Practices

Recommended practices include:

- Proper material selection
 - Clean fabrication procedures
 - Effective pickling and passivation
 - Removal of iron contamination
 - Routine inspection
 - Process monitoring
 - Correct welding procedures
 - Preventive maintenance
-



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vithalbhai Patel Road, Sikkanagar Girgaon,
Mumbai – 400 004.

SINCE 2016

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net



STAINLESS INDIA
A HOUSE OF QUALITY

Chapter 14 – High-Temperature Performance of Stainless Steel 347H Elbows

14.1 Introduction

SS 347H was specifically developed for elevated-temperature service where conventional stainless steels may lose strength or become susceptible to sensitization.

Its high-carbon composition and niobium stabilization provide excellent long-term performance under sustained thermal loading.

14.2 Elevated-Temperature Strength

Compared with standard Grade 347, Grade 347H offers improved:

- Creep strength
- Stress rupture resistance
- High-temperature tensile strength
- Structural stability

These characteristics make the alloy suitable for continuous operation in demanding industrial environments.

14.3 Creep Resistance

Creep is the slow, permanent deformation of a material under constant stress at elevated temperature.

SS 347H provides excellent resistance to creep because of:

- Stable austenitic microstructure
- Niobium carbide strengthening
- Controlled carbon content
- Proper heat treatment

This allows piping systems to maintain dimensional stability during long-term operation.

14.4 Stress Rupture Resistance

Stress rupture refers to material failure after prolonged exposure to elevated temperature under constant load.

The higher carbon content of Grade 347H improves stress rupture strength, extending service life in power plants, refineries, and petrochemical facilities.



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vithalbhai Patel Road, Sikkanagar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

14.5 Thermal Fatigue Resistance

Industrial piping frequently experiences repeated heating and cooling cycles during startup and shutdown.

SS 347H demonstrates excellent resistance to thermal fatigue because of:

- Good ductility
- Stable microstructure
- High toughness
- Controlled thermal expansion

14.6 Oxidation Resistance at High Temperature

At elevated temperatures, chromium continuously forms a protective oxide layer that limits further oxidation.

This passive film significantly improves the alloy's durability in furnaces, boilers, superheaters, and process piping.

14.7 Typical High-Temperature Applications

SS 347H Elbows are widely used in:

- Superheated steam lines
 - Furnace piping
 - Heat recovery systems
 - Petrochemical reactors
 - Catalytic cracking units
 - Power generation facilities
 - Boiler piping
 - High-temperature process plants
 - Refinery transfer lines
 - Chemical reactors
-



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vitthalbhai Patel Road, Sikkanagar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

14.8 Engineering Design Considerations

When designing high-temperature piping systems using SS 347H Elbows, engineers should evaluate:

- Design temperature
- Operating pressure
- Thermal expansion
- Support spacing
- Cyclic loading
- Creep life
- Corrosion allowance
- Welding procedures
- Inspection intervals
- Applicable ASME piping code requirements

Proper engineering analysis helps maximize safety, reliability, and service life in demanding process industries.



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vithalbhair Patel Road, Sikkannagar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

Chapter 15 – Manufacturing Process of Stainless Steel 347H Elbows

15.1 Introduction

The manufacturing of Stainless Steel 347H Elbows is a carefully controlled engineering process designed to produce pipe fittings with excellent dimensional accuracy, mechanical strength, corrosion resistance, and long service life. Every stage of production is performed according to internationally recognized standards such as ASTM A403, ASME SA403, and ASME B16.9.

A well-controlled manufacturing process ensures that the finished elbow can withstand demanding operating conditions in refineries, petrochemical plants, power stations, offshore platforms, and chemical processing facilities.

15.2 Manufacturing Flow Chart

Raw Material Selection

↓
Incoming Material Inspection

↓
Positive Material Identification (PMI)

↓
Cutting of Pipe or Billet

↓
Heating (Hot Forming, if applicable)

↓
Elbow Forming

↓
Sizing and Calibration

↓
Heat Treatment (Solution Annealing)

↓
Pickling and Passivation

↓
Dimensional Inspection

↓
Mechanical & Chemical Testing

↓
Non-Destructive Testing (If Required)

↓
Final Inspection

↓
Marking and Traceability

↓
Packaging and Dispatch



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vitthalbhai Patel Road, Sikkanagar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

15.3 Raw Material Selection

Production begins with certified Stainless Steel 347H seamless pipe, welded pipe, or forged billets.

Each batch should be accompanied by:

- Heat Number
- Material Test Certificate (EN 10204 Type 3.1)
- Chemical Composition Report
- Mechanical Test Report
- Traceability Documentation

Only approved materials meeting ASTM and ASME specifications are accepted for production.

15.4 Incoming Inspection

Before manufacturing begins, raw materials are verified for:

- Material grade
- Dimensions
- Surface quality
- Heat number
- Documentation
- Visual defects
- Storage condition

Any material that does not meet specification is rejected before processing.

15.5 Positive Material Identification (PMI)

PMI confirms that the supplied material is Grade 347H.

Common techniques include:

- X-Ray Fluorescence (XRF)
- Optical Emission Spectroscopy (OES)

PMI minimizes the risk of material mix-ups and supports full traceability.



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vitthalbhai Patel Road, Sikkanagar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

15.6 Cutting Operations

Pipes or billets are cut to the required length using suitable methods such as:

- Band Saw Cutting
- Cold Saw Cutting
- CNC Cutting
- Plasma Cutting (where appropriate)

Proper cutting minimizes distortion and preserves edge quality.

15.7 Heating

For hot-forming operations, the material is heated to the required forming temperature under controlled conditions. Uniform heating improves formability and reduces the likelihood of cracking during bending.

15.8 Elbow Forming

The elbow shape may be produced using:

- Hot Forming
- Cold Forming
- Hydraulic Forming
- Press Forming
- Mandrel Forming

The selected process depends on the diameter, wall thickness, radius, and project requirements.

15.9 Sizing and Calibration

After forming, each elbow is calibrated to achieve the dimensional requirements specified by ASME B16.9. This process ensures correct center-to-end dimensions, roundness, and wall thickness distribution.



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vitthalbhai Patel Road, Sikkanagar Girgaon,
Mumbai – 400 004.

SINCE 2016

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net



STAINLESS INDIA
A HOUSE OF QUALITY

15.10 Quality Control During Manufacturing

Throughout production, quality personnel monitor:

- Forming accuracy
- Surface condition
- Dimensional tolerances
- Wall thickness
- Radius consistency
- Traceability records

Early identification of deviations reduces waste and improves overall product quality.

Prepared By: STAINLESS INDIA
Website: www.stainlessindia.net
Email: info@stainlessindia.net
Phone: +91 97680 42420
Location: Mumbai, Maharashtra, India
Edition: First Edition – 2026
Dated : 11.07.2026
© 2026 STAINLESS INDIA.
All rights reserved.



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vitthalbhai Patel Road, Sikkanagar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

Chapter 16 – Heat Treatment and Solution Annealing

16.1 Purpose of Heat Treatment

Heat treatment plays a critical role in restoring the corrosion resistance and mechanical properties of Stainless Steel 347H Elbows after forming and fabrication.

Proper heat treatment ensures:

- Uniform microstructure
- Reduced residual stresses
- Improved ductility
- Enhanced corrosion resistance
- Better long-term performance

16.2 Solution Annealing

Solution annealing is the primary heat treatment applied to SS 347H.

The process generally involves:

1. Heating the fitting to the specified solution annealing temperature.
2. Holding the material for an appropriate time to dissolve undesirable carbides.
3. Rapid cooling, typically by water quenching or another approved method, to preserve the desired austenitic structure.

The exact temperature and cooling practice should follow the applicable material specification and project requirements.

16.3 Benefits of Solution Annealing

Solution annealing provides several advantages:

- Restores corrosion resistance.
- Produces a homogeneous austenitic structure.
- Improves weldability.
- Reduces residual stresses.
- Enhances toughness.
- Improves long-term reliability.



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vitthalbhai Patel Road, Sikkanagar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

16.4 Residual Stress Reduction

Forming and welding introduce internal stresses into the material. Proper heat treatment helps reduce these stresses, lowering the risk of distortion, stress corrosion cracking, and premature failure during service.

16.5 Microstructural Stability

A properly solution-annealed SS 347H elbow exhibits:

- Uniform grain structure.
- Stable carbide distribution.
- Improved resistance to sensitization.
- Better high-temperature performance.

16.6 Heat Treatment Quality Verification

After heat treatment, manufacturers may verify:

- Mechanical properties.
- Microstructure (when specified).
- Hardness.
- Surface condition.
- Dimensional stability.

Records are maintained as part of the quality assurance system.



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vitthalbhai Patel Road, Sikkanagar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

Chapter 17 – Pickling, Passivation, and Surface Finishing

17.1 Introduction

Following fabrication and heat treatment, Stainless Steel 347H Elbows undergo surface treatment to remove contaminants and restore the protective passive oxide layer. Proper surface finishing is essential for maximizing corrosion resistance and ensuring a clean, uniform appearance.

17.2 Pickling

Pickling removes:

- Heat tint.
- Welding oxides.
- Surface scale.
- Iron contamination.
- Manufacturing residues.

This process produces a clean metallic surface ready for passivation.

17.3 Passivation

Passivation is a chemical treatment that enhances the natural chromium-rich oxide layer on the stainless steel surface.

The benefits include:

- Improved corrosion resistance.
 - Enhanced resistance to rust staining.
 - Cleaner surface finish.
 - Better long-term durability.
-

17.4 Surface Finish Options

Common surface finishes include:

- Mill Finish
- Pickled Finish
- Passivated Finish
- Satin Finish
- Polished Finish (when specified)

The required finish depends on the service environment and customer requirements.



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vitthalbhai Patel Road, Sikkanagar Girgaon,
Mumbai – 400 004.

SINCE 2016

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net



STAINLESS INDIA
A HOUSE OF QUALITY

17.5 Cleaning Requirements

Before packaging, fittings should be thoroughly cleaned to remove:

- Oil
- Grease
- Dirt
- Grinding dust
- Welding residues
- Moisture

Clean products reduce the risk of contamination during transportation and installation.

17.6 Final Visual Inspection

Each SS 347H elbow is visually inspected for:

- Surface defects.
- Scratches.
- Dents.
- Weld imperfections (where applicable).
- Uniform finish.
- Correct marking.

Only products meeting the specified acceptance criteria proceed to final packing.

17.7 Packaging and Protection

To prevent damage during storage and transportation, fittings are typically:

- Individually identified.
- Packed in wooden crates, pallets, or export-worthy boxes.
- Protected against moisture and mechanical damage.
- Supplied with traceability labels and inspection documents.

Proper packaging preserves product quality until installation at the project site.



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vitthalbhai Patel Road, Sikkanagar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

17.8 Manufacturing Best Practices

Manufacturers should implement the following best practices:

- Use certified raw materials.
- Maintain complete material traceability.
- Perform Positive Material Identification (PMI).
- Follow approved forming procedures.
- Apply proper solution annealing.
- Conduct pickling and passivation after fabrication.
- Verify dimensions in accordance with ASME B16.9.
- Maintain documented quality control throughout production.
- Provide complete inspection records and material certification.
- Package products to prevent transit damage.

A disciplined manufacturing process ensures that Stainless Steel 347H Elbows consistently meet international quality standards and deliver reliable performance in demanding industrial applications.



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vitthalbhai Patel Road, Sikkanagar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

Chapter 18 – Testing and Inspection of Stainless Steel 347H Elbows

18.1 Introduction

Testing and inspection are essential to ensure that Stainless Steel 347H Elbows comply with ASTM A403, ASME SA403, ASME B16.9, project specifications, and customer requirements. Every fitting should undergo appropriate quality control procedures before shipment to verify its chemical composition, mechanical properties, dimensional accuracy, and overall integrity.

A comprehensive inspection program reduces the risk of premature failures, improves plant reliability, and ensures full traceability throughout the product life cycle.

18.2 Quality Assurance System

Manufacturers should implement a documented Quality Management System (QMS) that includes:

- Incoming raw material inspection
 - In-process quality control
 - Final product inspection
 - Calibration of measuring equipment
 - Material traceability
 - Documentation control
 - Corrective and preventive actions (CAPA)
-

18.3 Visual Inspection

Visual inspection is the first stage of product verification.

Inspectors should examine:

- Surface finish
- Cracks
- Dents
- Laminations
- Scale
- Welding defects (for welded fittings)
- Heat treatment discoloration
- Marking accuracy
- General workmanship

Products with unacceptable surface defects should be repaired or rejected according to the applicable specification.



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vithalbhair Patel Road, Sikkangar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

18.4 Dimensional Inspection

Dimensional inspection confirms compliance with ASME B16.9 tolerances.

Typical measurements include:

- Outside Diameter (OD)
- Inside Diameter (ID)
- Wall Thickness
- Center-to-End Dimension
- Radius
- Bevel Angle
- End Preparation
- Ovality
- Overall Length

Calibrated measuring instruments such as vernier calipers, micrometers, height gauges, templates, and coordinate measuring machines (CMM) may be used where appropriate.

18.5 Positive Material Identification (PMI)

Positive Material Identification verifies the alloy grade before dispatch.

Common methods include:

- X-Ray Fluorescence (XRF)
- Optical Emission Spectroscopy (OES)

PMI ensures that the supplied fitting is manufactured from Stainless Steel 347H and helps prevent material mix-ups.

18.6 Chemical Analysis

Chemical composition is verified using laboratory analysis to ensure compliance with ASTM A403 requirements.

The analysis confirms that alloying elements such as chromium, nickel, carbon, niobium, manganese, silicon, phosphorus, and sulfur remain within specified limits.



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vithalbhai Patel Road, Sikkanagar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

18.7 Mechanical Testing

Mechanical testing typically includes:

- Tensile Test
- Yield Strength Test
- Elongation Measurement
- Hardness Test (when required)

These tests confirm that the fitting possesses adequate strength, ductility, and toughness for pressure piping applications.

18.8 Non-Destructive Testing (NDT)

NDT methods detect defects without damaging the product.

Common techniques include:

Liquid Penetrant Testing (PT)

Used to detect fine surface cracks and discontinuities.

Ultrasonic Testing (UT)

Used to identify internal defects, laminations, and discontinuities.

Radiographic Testing (RT)

Provides internal images of welded joints to detect porosity, lack of fusion, and inclusions.

Magnetic Particle Testing (MT)

Generally not applicable to solution-annealed austenitic stainless steels because of their non-magnetic nature, unless project-specific conditions require evaluation after cold working.

18.9 Hydrostatic Testing

Where specified by the purchaser or project requirements, hydrostatic testing may be performed to verify pressure integrity.

Hydrotesting demonstrates that the fitting can safely withstand the specified test pressure without leakage or permanent deformation.



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vithalbhair Patel Road, Sikkannagar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

18.10 Documentation

Typical quality documentation supplied with SS 347H Elbows includes:

- Material Test Certificate (EN 10204 Type 3.1)
- Chemical Analysis Report
- Mechanical Test Report
- Dimensional Inspection Report
- Heat Treatment Record
- PMI Report
- NDT Report (when applicable)
- Third-Party Inspection Certificate (if specified)

Prepared By: STAINLESS INDIA
Website: www.stainlessindia.net
Email: info@stainlessindia.net
Phone: +91 97680 42420
Location: Mumbai, Maharashtra, India
Edition: First Edition – 2026
Dated : 11.07.2026
© 2026 STAINLESS INDIA.
All rights reserved.



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vitthalbhai Patel Road, Sikkanagar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

Chapter 19 – Dimensional Standards and Tolerances

19.1 Introduction

Dimensional accuracy is essential for proper fit-up, welding, alignment, and long-term reliability of piping systems. Stainless Steel 347H Elbows are commonly manufactured in accordance with ASME B16.9, which defines standardized dimensions and permissible tolerances.

19.2 Nominal Pipe Size (NPS)

Nominal Pipe Size (NPS) is the standardized designation used to identify pipe and fitting sizes.

Common sizes include:

- NPS ½
- NPS ¾
- NPS 1
- NPS 1½
- NPS 2
- NPS 3
- NPS 4
- NPS 6
- NPS 8
- NPS 10
- NPS 12
- Larger sizes as specified by project requirements

19.3 Wall Thickness (Schedule)

Wall thickness is identified by pipe schedule.

Common schedules include:

- SCH 5S
- SCH 10S
- SCH 20
- SCH 40S
- SCH 80S
- SCH 120
- SCH 160
- XXS

The selected schedule affects pressure capacity, weight, and service life.



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vitthalbhai Patel Road, Sikkanagar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

19.4 Center-to-End Dimension

The center-to-end dimension defines the geometry of the elbow and ensures proper alignment during installation.

Manufacturing should comply with ASME B16.9 dimensional requirements.

19.5 Radius Classification

Long Radius (LR)

Centerline Radius = $1.5 \times$ Nominal Pipe Size

Advantages:

- Lower pressure drop
- Reduced turbulence
- Improved flow efficiency
- Preferred for process industries

Short Radius (SR)

Centerline Radius = $1 \times$ Nominal Pipe Size

Advantages:

- Compact installation
 - Space-saving design
 - Suitable where layout restrictions exist
-

19.6 Dimensional Tolerances

Typical dimensional controls include:

- Outside Diameter
- Wall Thickness
- End Squareness
- Ovality
- Centerline Accuracy
- Bevel Geometry
- Surface Finish

Manufacturers should verify all dimensions using calibrated inspection equipment before shipment.



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vitthalbhai Patel Road, Sikkanagar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

19.7 Importance of Dimensional Accuracy

Accurate dimensions provide:

- Faster installation
- Better weld fit-up
- Reduced fabrication time
- Improved system reliability
- Lower maintenance costs
- Compliance with engineering specifications

Prepared By: STAINLESS INDIA
Website: www.stainlessindia.net
Email: info@stainlessindia.net
Phone: +91 97680 42420
Location: Mumbai, Maharashtra, India
Edition: First Edition – 2026
Dated : 11.07.2026
© 2026 STAINLESS INDIA.
All rights reserved.



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vitthalbhai Patel Road, Sikkanagar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

Chapter 20 – Types of Stainless Steel 347H Elbows

20.1 Introduction

Stainless Steel 347H Elbows are available in multiple configurations to accommodate different piping layouts, pressure requirements, and installation conditions.

Selecting the correct elbow type improves flow efficiency, reduces stress concentrations, and simplifies fabrication.

20.2 45° Elbow

A 45-degree elbow changes the flow direction by forty-five degrees.

Applications include:

- Minor directional changes
- Process piping
- Utility services
- Flow optimization

Advantages:

- Lower pressure loss than sharper bends
 - Improved flow characteristics
-

20.3 90° Elbow

The 90-degree elbow is the most widely used pipe fitting in industrial piping systems.

Applications include:

- Process plants
- Power stations
- Refineries
- Chemical plants
- Utility piping

Advantages:

- Compact layout
 - Reliable flow direction change
 - Easy installation
-



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vitthalbhai Patel Road, Sikkanagar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

20.4 180° Return Elbow

A 180-degree elbow reverses the direction of flow.

Applications include:

- Heat exchangers
- Cooling systems
- Process return lines
- Boiler systems

Advantages:

- Compact return piping
- Reduced fabrication requirements

20.5 Long Radius Elbow (LR)

Characteristics:

- Radius = 1.5D
- Reduced turbulence
- Lower pressure drop
- Improved flow efficiency
- Preferred for high-flow process piping

20.6 Short Radius Elbow (SR)

Characteristics:

- Radius = 1D
- Compact installation
- Suitable where available space is limited
- Higher pressure loss compared with LR elbows

20.7 Seamless Elbows

Manufactured from seamless pipe or forged material.

Advantages:

- Uniform grain structure
- Excellent pressure capability
- High mechanical strength
- Preferred for critical services



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vitthalbhai Patel Road, Sikkanagar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

20.8 Welded Elbows

Manufactured from welded pipe.

Advantages:

- Economical for larger diameters
- Wide availability
- Suitable for many industrial applications when manufactured and inspected according to applicable standards

20.9 Reducing Elbows

Reducing elbows combine directional change with a reduction in pipe size.

Benefits include:

- Reduced number of fittings
- Simplified piping layout
- Improved installation efficiency

20.10 Custom Elbows

Manufacturers can produce custom elbows for specialized projects, including:

- Large diameter elbows
- Heavy wall fittings
- Special radius elbows
- Non-standard angles
- Project-specific dimensions

20.11 Selection Guidelines

When selecting an SS 347H Elbow, engineers should consider:

- Operating pressure
- Design temperature
- Corrosive environment
- Pipe size
- Wall thickness
- Flow characteristics
- Installation space
- Applicable design code
- Welding requirements
- Inspection requirements

Proper product selection enhances piping system safety, operational efficiency, and long-term reliability.



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vitthalbhai Patel Road, Sikkanagar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

Chapter 21 – Welding of Stainless Steel 347H Elbows

21.1 Introduction

Welding is one of the most critical operations in the fabrication of Stainless Steel 347H piping systems. Proper welding procedures help maintain corrosion resistance, mechanical strength, and long-term service reliability.

Stainless Steel 347H is a niobium-stabilized austenitic stainless steel specifically developed to minimize chromium carbide precipitation during welding and prolonged exposure to elevated temperatures. This stabilization makes the alloy particularly suitable for pressure piping systems operating under severe service conditions.

21.2 Weldability

SS 347H offers excellent weldability using conventional fusion welding processes.

The material can be welded successfully while maintaining:

- High corrosion resistance
- Excellent mechanical properties
- Good ductility
- High-temperature strength
- Structural integrity

Although post-weld heat treatment is not normally required for corrosion resistance, project specifications or design codes may specify additional heat treatment depending on the service conditions.

21.3 Common Welding Processes

Gas Tungsten Arc Welding (GTAW / TIG)

GTAW is preferred for root passes and precision welding because it provides:

- Excellent weld quality
- Low heat input control
- Minimal spatter
- Superior appearance
- High-quality root penetration

Typical applications include pharmaceutical, food processing, petrochemical, and high-purity piping systems.



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vithalbhair Patel Road, Sikkannagar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

Gas Metal Arc Welding (GMAW / MIG)

GMAW offers:

- High deposition rates
- Increased productivity
- Consistent weld quality
- Reduced fabrication time

It is widely used for shop fabrication and production welding.

Shielded Metal Arc Welding (SMAW)

SMAW remains a popular field welding process because of:

- Equipment portability
 - Ease of setup
 - Suitability for outdoor construction
 - Good adaptability during maintenance work
-

Submerged Arc Welding (SAW)

SAW is commonly used for:

- Heavy wall fittings
- Large-diameter components
- High-production manufacturing

Advantages include deep penetration, high deposition rates, and consistent weld quality.

21.4 Filler Metal Selection

The selection of filler metal should comply with the applicable welding procedure specification (WPS), applicable codes, and project requirements. Filler materials should provide compatible mechanical properties, corrosion resistance, and service performance.



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vithalbhai Patel Road, Sikkanagar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

21.5 Joint Preparation

Proper joint preparation is essential for achieving high-quality welds.

Important considerations include:

- Accurate bevel geometry
- Correct root gap
- Proper alignment
- Clean surfaces
- Removal of oil, grease, paint, moisture, and contaminants

Poor joint preparation may lead to lack of fusion, incomplete penetration, excessive distortion, or weld defects.

21.6 Heat Input Control

Excessive heat input can adversely affect weld quality.

Proper heat control helps maintain:

- Mechanical properties
- Corrosion resistance
- Dimensional stability
- Surface finish

Controlled welding parameters also reduce distortion and residual stresses.

21.7 Inspection of Welded Joints

Completed welds should be inspected using appropriate methods, including:

- Visual Inspection (VT)
- Liquid Penetrant Testing (PT)
- Radiographic Testing (RT), where specified
- Ultrasonic Testing (UT), where applicable
- Dimensional Inspection

Inspection requirements depend on project specifications, applicable codes, and service conditions.



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vittalbhai Patel Road, Sikkanagar Girgaon,
Mumbai – 400 004.

SINCE 2016

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net



STAINLESS INDIA
A HOUSE OF QUALITY

21.8 Welding Best Practices

To achieve reliable weld quality:

- Use qualified welding procedures.
- Employ certified welders.
- Maintain clean joint surfaces.
- Control welding parameters.
- Use suitable filler materials.
- Perform appropriate inspections.
- Maintain complete welding records.

Proper welding practices contribute significantly to the long-term performance and safety of SS 347H piping systems.

Prepared By: STAINLESS INDIA
Website: www.stainlessindia.net
Email: info@stainlessindia.net
Phone: +91 97680 42420
Location: Mumbai, Maharashtra, India
Edition: First Edition – 2026
Dated : 11.07.2026
© 2026 STAINLESS INDIA.
All rights reserved.



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vithalbhai Patel Road, Sikkanagar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

Chapter 22 – Fabrication and Installation of Stainless Steel 347H Elbows

22.1 Introduction

Successful piping systems depend not only on high-quality materials but also on proper fabrication and installation. Careful handling, fit-up, alignment, and inspection help ensure reliable operation throughout the service life of the system.

22.2 Material Handling

During fabrication, SS 347H fittings should be protected from:

- Carbon steel contamination
- Mechanical damage
- Dirt and debris
- Chloride-containing contaminants
- Excessive impact

Separate storage areas and dedicated stainless steel tools help prevent contamination.

22.3 Fit-Up

Proper fit-up ensures:

- Uniform root opening
- Correct alignment
- Consistent weld penetration
- Reduced residual stresses

Misalignment can increase stress concentrations and compromise the integrity of the piping system.

22.4 Cutting and Machining

Recommended cutting methods include:

- Band Saw
- Cold Saw
- Abrasive Cutting (where appropriate)
- CNC Machining

After cutting, all burrs and sharp edges should be removed to facilitate proper fit-up and welding.



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vithalbhair Patel Road, Sikkangar Girgaon,
Mumbai – 400 004.

SINCE 2016

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net



STAINLESS INDIA
A HOUSE OF QUALITY

22.5 Installation Practices

During installation:

- Verify material identification.
- Confirm dimensions.
- Check flange alignment.
- Avoid excessive force during assembly.
- Use appropriate supports and guides.
- Follow approved installation procedures.

Proper installation minimizes the risk of leakage, distortion, and premature failure.

22.6 Cleaning After Fabrication

Following welding and fabrication:

- Remove weld spatter.
- Eliminate grinding residues.
- Clean oil and grease.
- Perform pickling and passivation where specified.
- Protect finished surfaces from contamination.

These steps help preserve corrosion resistance and improve long-term service performance.

22.7 Maintenance Recommendations

Routine maintenance should include:

- Visual inspections.
- Leak detection.
- Corrosion monitoring.
- Support inspection.
- Thermal insulation inspection.
- Weld examination where required.

Preventive maintenance extends the service life of the piping system and reduces unplanned shutdowns.



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vithalbhair Patel Road, Sikkannagar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

Chapter 23 – Pressure Ratings and Design Considerations

23.1 Introduction

Pressure piping systems must be designed to safely withstand internal pressure, external loads, thermal expansion, vibration, and process conditions throughout their intended service life.

The design of SS 347H Elbows should comply with the applicable piping code, engineering standards, and project specifications.

23.2 Design Factors

Important design considerations include:

- Operating Pressure
- Design Pressure
- Operating Temperature
- Design Temperature
- Pipe Schedule
- Corrosion Allowance
- Fluid Characteristics
- External Loads
- Thermal Expansion
- Cyclic Service
- Vibration

Each factor should be evaluated during the engineering design stage.

23.3 Pressure Rating

The allowable pressure of an elbow depends on several variables, including:

- Material grade
- Wall thickness (pipe schedule)
- Outside diameter
- Operating temperature
- Manufacturing quality
- Applicable code requirements

Pressure ratings should be determined using the applicable ASME piping code and engineering calculations. Designers should avoid relying on generic values because allowable pressure varies with geometry, temperature, and code requirements.



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vithalbhai Patel Road, Sikkangar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

23.4 Thermal Expansion

Like other austenitic stainless steels, SS 347H experiences measurable thermal expansion during service.

Designers should account for thermal movement by incorporating:

- Expansion loops
- Expansion joints
- Pipe guides
- Anchors
- Flexible supports

Proper expansion control reduces stress on fittings, equipment, and welded joints.

23.5 Pipe Supports

Adequate pipe support is essential for maintaining system integrity.

Support systems should accommodate:

- Dead weight
- Thermal movement
- Dynamic loading
- Wind loads
- Seismic forces (where applicable)
- Equipment loads

Support spacing should be established through engineering calculations in accordance with applicable design standards.

23.6 Flow Considerations

Elbow selection influences fluid flow.

Long Radius Elbows generally provide:

- Lower pressure loss
- Reduced turbulence
- Improved flow efficiency
- Lower erosion rates

Short Radius Elbows are typically selected where installation space is limited.



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vitthalbhai Patel Road, Sikkangar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

23.7 Safety Factors

Engineering design should incorporate appropriate safety margins considering:

- Material properties
- Corrosion allowance
- Manufacturing tolerances
- Inspection quality
- Future operating conditions
- Code requirements

23.8 Engineering Documentation

A complete piping package should include:

- Material specifications
- Approved drawings
- Welding procedures (WPS)
- Procedure Qualification Records (PQR), where applicable
- Welder qualifications
- Inspection reports
- Material Test Certificates
- Pressure test records (if specified)
- Final quality documentation

Maintaining complete documentation improves traceability, facilitates future maintenance, and demonstrates compliance with project requirements.

23.9 Best Practices for Reliable Piping Systems

To maximize the performance and service life of Stainless Steel 347H Elbows:

- Select materials that meet applicable ASTM and ASME specifications.
- Verify material identity before fabrication.
- Use qualified welding procedures and certified personnel.
- Ensure accurate fit-up and alignment.
- Perform required inspections and testing.
- Protect surfaces through proper cleaning and passivation.
- Design for thermal expansion and operational loads.
- Maintain complete traceability and quality records.
- Follow applicable engineering codes throughout the project lifecycle.

These practices help deliver safe, durable, and efficient piping systems capable of performing reliably in demanding industrial environments.



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vithalbhai Patel Road, Sikkanagar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

Chapter 24 – Industrial Applications of Stainless Steel 347H Elbows

24.1 Introduction

Stainless Steel 347H Elbows are widely used in industrial piping systems where elevated temperatures, corrosive environments, high pressure, and long-term reliability are critical. Manufactured in accordance with ASTM A403 WP347H and ASME SA403, these elbows provide excellent resistance to oxidation, intergranular corrosion, creep, and thermal fatigue, making them a preferred choice for demanding process industries.

The combination of niobium stabilization, high-temperature strength, and excellent weldability allows SS 347H Elbows to perform reliably in applications where conventional stainless steels may experience sensitization or reduced mechanical performance.

24.2 Oil and Gas Industry

Overview

The oil and gas industry operates under some of the most demanding service conditions, including high pressure, elevated temperatures, corrosive media, and continuous operation. Stainless Steel 347H Elbows are widely installed in upstream, midstream, and downstream facilities due to their ability to maintain structural integrity under severe operating conditions.

Typical Applications

- Crude oil processing pipelines
- Natural gas transmission systems
- Offshore production platforms
- Gas gathering stations
- Refinery transfer lines
- Compressor stations
- High-temperature process piping
- Utility piping systems

Advantages

- Excellent corrosion resistance
 - High-temperature strength
 - Reliable welded joints
 - Long service life
 - Reduced maintenance requirements
-



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vitthalbhai Patel Road, Sikkanagar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

24.3 Petrochemical Industry

Petrochemical plants process hydrocarbons under high temperature and pressure while handling aggressive chemicals. SS 347H Elbows are extensively used because they resist oxidation and intergranular corrosion during continuous service.

Typical Equipment

- Catalytic cracking units
- Distillation columns
- Reformers
- Reactors
- Heat exchangers
- Steam piping
- Furnace piping
- Process transfer lines

Benefits

- Excellent creep resistance
- High oxidation resistance
- Stable metallurgical structure
- Long operating life
- Reduced shutdown frequency

24.4 Power Generation Industry

Modern thermal and combined-cycle power plants operate steam systems at elevated temperatures and pressures. Grade 347H provides the strength and stability required for long-term operation.

Common Applications

- Superheated steam piping
- Main steam headers
- Boiler outlet piping
- Heat recovery steam generators (HRSG)
- Condensate systems
- High-pressure utility lines

Why Power Plants Select SS 347H

- High-temperature mechanical strength
- Good thermal fatigue resistance
- Reliable weldability
- Long creep life
- Excellent oxidation resistance



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vitthalbhai Patel Road, Sikkanagar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

24.5 Chemical Processing Industry

Chemical manufacturing plants frequently process corrosive liquids and gases under varying temperatures and pressures. Stainless Steel 347H Elbows help maintain safe and efficient process flow.

Applications

- Chemical reactors
- Acid transfer systems
- Solvent pipelines
- Alkali processing units
- Process vessels
- High-temperature transfer lines

Engineering Benefits

- Excellent corrosion resistance
- High mechanical strength
- Long service intervals
- Reliable process performance

24.6 Fertilizer Industry

Fertilizer plants involve high-pressure process equipment, elevated temperatures, and chemically aggressive environments. SS 347H Elbows are commonly used in ammonia, urea, and other fertilizer production facilities.

Typical Services

- Steam distribution
 - Reactor piping
 - Heat exchanger connections
 - Utility piping
 - Process transfer lines
-



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vitthalbhai Patel Road, Sikkanagar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

24.7 Refinery Industry

Petroleum refineries require materials capable of operating continuously under severe thermal and chemical conditions.

Typical Installations

- Crude distillation units
- Vacuum distillation systems
- Catalytic reformers
- Hydrocracking units
- Desulfurization plants
- Utility piping

Advantages

- Excellent oxidation resistance
- Long service life
- High-temperature stability
- Reduced maintenance costs

24.8 Heat Exchanger Systems

Heat exchangers depend on reliable piping connections capable of withstanding repeated thermal cycling.

SS 347H Elbows are widely used in:

- Shell and tube heat exchangers
- Condensers
- Evaporators
- Reboilers
- Process heaters

Their resistance to thermal fatigue helps maintain long-term operational reliability.

24.9 Boiler and Steam Systems

High-pressure steam piping requires materials with excellent creep resistance and structural stability.

Typical applications include:

- Steam headers
- Boiler piping
- Superheater connections
- Steam transfer lines
- Feedwater systems

The elevated-temperature performance of SS 347H makes it well suited for these demanding applications.



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vitthalbhai Patel Road, Sikkanagar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

24.10 Marine Industry

Marine environments expose piping systems to moisture, salt-laden air, and corrosive conditions. While material selection should always consider chloride exposure, SS 347H is used in applications where elevated-temperature performance is also required.

Typical installations include:

- Engine room piping
- Auxiliary systems
- Heat recovery units
- Steam services
- Utility piping

24.11 Offshore Platforms

Offshore oil and gas facilities combine corrosive marine conditions with demanding process requirements.

SS 347H Elbows are used in:

- Process piping
- Produced water systems
- Utility services
- Steam lines
- Firewater support systems (where project specifications permit)

Key benefits include high-temperature capability, weldability, and reliable mechanical performance.

24.12 LNG Industry

Liquefied Natural Gas facilities require high-quality piping components that meet strict quality and traceability requirements.

Typical applications include:

- Vaporization systems
 - Utility piping
 - Heat recovery units
 - Process piping
 - Equipment connections
-



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vitthalbhai Patel Road, Sikkanagar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

24.13 Pharmaceutical Industry

Pharmaceutical manufacturing demands clean, reliable, and corrosion-resistant piping systems.

Applications include:

- Clean steam systems
- Process piping
- Purified water distribution
- Utility lines
- Equipment interconnections

The smooth surface finish and excellent corrosion resistance of stainless steel support hygienic operation.

24.14 Food and Beverage Industry

Food processing facilities require materials that are durable, corrosion resistant, and easy to clean.

Typical uses include:

- Steam distribution
 - Utility piping
 - Process equipment
 - Heat exchangers
 - Cleaning systems
-

24.15 Pulp and Paper Industry

Pulp and paper plants utilize high-temperature process equipment where corrosion resistance and mechanical reliability are essential.

Applications include:

- Steam piping
 - Chemical recovery systems
 - Heat exchangers
 - Utility piping
-

24.16 Hydrogen and Emerging Energy Projects

As hydrogen infrastructure expands, Stainless Steel 347H continues to be evaluated and specified for selected high-temperature process applications where its mechanical properties and oxidation resistance are beneficial. Material compatibility should always be confirmed against project-specific hydrogen service requirements and applicable engineering standards.



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vitthalbhai Patel Road, Sikkanagar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

24.17 Aerospace and Defense

Specialized aerospace manufacturing and defense facilities may use SS 347H in high-temperature processing equipment, furnace systems, and specialized industrial installations where elevated-temperature performance is required.

24.18 Typical Industrial Services

SS 347H Elbows are commonly specified for:

- High-pressure steam
- Superheated steam
- Hot gases
- Process fluids
- Condensate systems
- Utility services
- Heat transfer systems
- Reactor piping
- Furnace piping
- High-temperature transfer lines

24.19 Why Engineers Choose Stainless Steel 347H Elbows

Engineers select SS 347H Elbows because they provide an excellent balance of:

- High-temperature strength
- Good weldability
- Resistance to sensitization
- Excellent oxidation resistance
- Reliable creep performance
- Long service life
- Compliance with international standards
- Availability in a wide range of sizes and schedules

These characteristics make SS 347H a trusted material for critical piping systems across numerous industries where safety, reliability, and long-term performance are essential.

Chapter Summary

Stainless Steel 347H Elbows play a vital role in modern industrial infrastructure. Their combination of corrosion resistance, elevated-temperature strength, weldability, and metallurgical stability makes them suitable for applications ranging from oil and gas production to power generation, petrochemical processing, chemical manufacturing, LNG facilities, pharmaceuticals, marine engineering, and emerging energy projects. Proper material selection, adherence to applicable codes, and quality-controlled manufacturing ensure dependable performance throughout the service life of the piping system.



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vithalbhai Patel Road, Sikkanagar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

Chapter 25 – Advantages and Limitations of Stainless Steel 347H Elbows

25.1 Introduction

Material selection is one of the most important decisions in the design of industrial piping systems. Choosing the correct elbow material directly affects system safety, reliability, maintenance costs, service life, and overall project economics.

Stainless Steel 347H Elbows have become one of the preferred choices for high-temperature piping because they combine excellent corrosion resistance, good weldability, and superior creep strength. However, like every engineering material, SS 347H has both strengths and limitations. This chapter provides a balanced engineering assessment to help designers, EPC contractors, procurement teams, and plant operators determine whether SS 347H is the most suitable material for a given application.

25.2 Major Advantages of Stainless Steel 347H Elbows

25.2.1 Excellent High-Temperature Strength

One of the most significant advantages of Grade 347H is its ability to maintain mechanical strength during prolonged exposure to elevated temperatures. The higher carbon content improves creep resistance and stress rupture strength, making the alloy suitable for continuous service in demanding environments such as refineries, petrochemical plants, and power generation facilities.

Benefits

- Stable mechanical properties at elevated temperatures
 - Improved resistance to deformation under load
 - Longer service life in high-temperature applications
 - Reduced risk of premature failure
-

25.2.2 Outstanding Resistance to Intergranular Corrosion

The addition of niobium stabilizes the alloy by preferentially combining with carbon, reducing chromium carbide precipitation at grain boundaries.

Advantages

- Improved corrosion resistance after welding
- Better long-term durability
- Reduced maintenance requirements
- Enhanced reliability in welded piping systems

This characteristic is particularly valuable in applications involving repeated thermal cycles or extended high-temperature service.



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Viththalbhai Patel Road, Sikkanagar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

25.2.3 Excellent Weldability

SS 347H is readily weldable using common welding processes such as GTAW (TIG), GMAW (MIG), SMAW, and SAW when qualified procedures and suitable filler materials are used.

Benefits

- Simplified fabrication
- High-quality welded joints
- Good structural integrity
- Lower fabrication costs
- Excellent repairability

25.2.4 Superior Oxidation Resistance

The chromium-rich passive oxide layer protects the material from oxidation during elevated-temperature service.

Typical Applications

- Furnace piping
- Boiler systems
- Heat exchangers
- Steam lines
- Petrochemical process units

25.2.5 Good Mechanical Properties

SS 347H provides an excellent balance of:

- Tensile strength
- Yield strength
- Toughness
- Ductility
- Fatigue resistance

These properties contribute to reliable performance in demanding pressure piping systems.



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vithalbhai Patel Road, Sikkonagar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

25.2.6 Long Service Life

When properly designed, fabricated, installed, and maintained, SS 347H Elbows can provide decades of reliable service.

Long service life reduces:

- Maintenance costs
- Shutdown frequency
- Replacement expenses
- Production interruptions

25.2.7 Excellent Fabrication Characteristics

The material can be:

- Cut
- Machined
- Formed
- Welded
- Inspected
- Tested

using conventional industrial manufacturing methods.

25.2.8 International Standardization

SS 347H Elbows are available under internationally recognized standards including:

- ASTM A403
- ASME SA403
- ASME B16.9
- MSS SP-43 (where applicable)

This standardization simplifies global procurement and supports interchangeability across projects.



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vithalbhair Patel Road, Sikkangar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

25.2.9 High Reliability

Because of its metallurgical stability and proven industrial performance, SS 347H is frequently specified for critical piping systems where failure is not acceptable.

Industries value the alloy for:

- Consistent quality
- Proven performance
- Reliable inspection results
- Excellent field experience

25.2.10 Wide Industrial Acceptance

SS 347H is used extensively in:

- Oil & Gas
- Petrochemical
- Chemical Processing
- Power Generation
- LNG
- Offshore
- Marine
- Pharmaceutical
- Food Processing
- Fertilizer Plants
- Heat Exchanger Systems

Its widespread use reflects confidence in its long-term performance

25.3 Engineering Benefits

From an engineering perspective, SS 347H offers:

- High structural reliability
- Predictable mechanical behavior
- Good weld integrity
- Excellent dimensional stability
- Proven performance in demanding environments
- Compatibility with established piping codes

These characteristics help engineers design systems with long operational life and reduced maintenance requirements.



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vithalbhair Patel Road, Sikkangar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

25.4 Economic Benefits

Although the initial purchase price is generally higher than carbon steel, SS 347H often reduces total lifecycle costs through:

- Lower maintenance
- Longer replacement intervals
- Reduced downtime
- Improved plant availability
- Better corrosion resistance
- Lower repair frequency

For many high-temperature services, the lifecycle cost advantage can outweigh the higher upfront material cost.

25.5 Limitations of Stainless Steel 347H Elbows

Despite its many advantages, SS 347H is not the ideal material for every application.

Proper engineering evaluation remains essential.

25.5.1 Higher Initial Cost

Compared with carbon steel and some low-alloy steels, Stainless Steel 347H is generally more expensive due to its alloying elements and manufacturing requirements.

Project teams should evaluate total ownership costs rather than purchase price alone.

25.5.2 Machining Difficulty

The alloy has higher work-hardening characteristics than carbon steel.

Machining may require:

- Rigid machine tools
- Sharp cutting tools
- Appropriate cutting speeds
- Effective cooling and lubrication

Proper machining practices improve surface finish and tool life.



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Viththalbhai Patel Road, Sikkanagar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

25.5.3 Thermal Expansion

Like most austenitic stainless steels, SS 347H has a relatively high coefficient of thermal expansion.

Designers should consider:

- Expansion loops
- Expansion joints
- Pipe supports
- Guides
- Anchors

to accommodate thermal movement during operation.

25.5.4 Chloride Service Considerations

Although SS 347H provides excellent corrosion resistance in many environments, chloride-rich conditions may increase the risk of localized corrosion or chloride-induced stress corrosion cracking under certain combinations of stress and temperature.

For severe chloride service, engineers may evaluate alternative materials such as duplex stainless steels, super duplex stainless steels, or nickel alloys based on project requirements.

25.5.5 Material Availability

Availability of:

- Large diameters
- Heavy wall schedules
- Custom elbows
- Special radius fittings

may vary depending on manufacturing capacity and project specifications.

Early procurement planning helps minimize schedule delays.

25.5.6 Fabrication Expertise

Although weldability is excellent, achieving optimal results requires:

- Qualified welding procedures
- Skilled welders
- Proper inspection
- Good fabrication practices

Poor fabrication can compromise long-term performance.



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vithalbhair Patel Road, Sikkangar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

25.6 When Stainless Steel 347H Is the Best Choice

SS 347H is commonly selected when a project requires:

- Elevated-temperature strength
- Resistance to sensitization
- Good weldability
- Long service life
- Reliable mechanical properties
- Compliance with international standards
- Proven industrial performance

Typical industries include:

- Refineries
- Petrochemical plants
- Power stations
- Chemical processing facilities
- Steam systems
- High-temperature process piping

25.7 When Another Material May Be More Appropriate

Depending on service conditions, alternative materials may be considered for:

- Extremely aggressive chloride environments
- Highly reducing acids
- Cryogenic service with specialized requirements
- Abrasive slurry systems
- Cost-sensitive, low-temperature, non-corrosive applications

Material selection should always be based on engineering evaluation, applicable codes, operating conditions, and lifecycle cost.



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vithalbhai Patel Road, Sikkanagar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

25.8 Material Selection Checklist

Before selecting SS 347H Elbows, evaluate:

- ✓ Operating Pressure
- ✓ Design Temperature
- ✓ Process Fluid
- ✓ Corrosion Environment
- ✓ Chloride Concentration
- ✓ Welding Requirements
- ✓ Applicable Engineering Codes
- ✓ Inspection Requirements
- ✓ Maintenance Strategy
- ✓ Lifecycle Cost
- ✓ Product Availability
- ✓ Documentation Requirements

25.9 Best Practices

To maximize performance:

- Purchase from qualified manufacturers.
- Verify compliance with ASTM and ASME specifications.
- Confirm material traceability.
- Review Material Test Certificates.
- Use qualified welding procedures.
- Perform required inspections.
- Protect surfaces during handling and storage.
- Follow recommended installation practices.
- Implement routine maintenance and inspection programs.

25.10 Chapter Summary

Stainless Steel 347H Elbows offer an exceptional combination of high-temperature strength, corrosion resistance, weldability, and long-term reliability. Their niobium-stabilized metallurgy provides superior resistance to sensitization, making them well suited for demanding industrial piping systems.

While factors such as higher initial cost, machining considerations, and service-specific limitations should be evaluated during material selection, the alloy remains one of the most trusted choices for critical high-temperature applications. Proper engineering design, quality-controlled manufacturing, and adherence to applicable standards enable SS 347H Elbows to deliver safe, efficient, and dependable performance across a wide range of industries.



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vitthalbhai Patel Road, Sikkanagar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

Chapter 26A – Comparison of Stainless Steel 347H with SS 304, SS 304L, SS 316, and SS 316L

26A.1 Introduction

Selecting the correct piping material is one of the most important engineering decisions for any industrial project. The choice of material affects equipment reliability, corrosion resistance, operating life, maintenance costs, fabrication, and overall project economics.

Although Stainless Steel 304, 304L, 316, 316L, and 347H all belong to the austenitic stainless steel family, each grade has unique characteristics that make it suitable for specific operating conditions. This chapter provides a detailed engineering comparison to assist designers, procurement engineers, EPC contractors, QA/QC inspectors, and industrial buyers in selecting the most appropriate material.

26A.2 Overview of Each Material

Stainless Steel 304

SS 304 is the world's most widely used austenitic stainless steel. It provides good corrosion resistance, excellent formability, and cost-effective performance for general industrial applications.

Typical Applications

- Water pipelines
- Food processing
- Architectural fabrication
- Storage tanks
- General engineering

Stainless Steel 304L

SS 304L is the low-carbon version of SS 304.

Its reduced carbon content minimizes carbide precipitation during welding, making it better suited for fabricated and welded equipment.

Typical Applications

- Welded process piping
- Pharmaceutical equipment
- Chemical tanks
- Food processing plants
- Fabricated vessels



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vithalbhair Patel Road, Sikkangar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

Stainless Steel 316

SS 316 contains molybdenum, which improves resistance to chlorides and many chemical environments.

Typical Applications

- Marine equipment
- Coastal installations
- Chemical processing
- Pharmaceutical plants
- Offshore structures

Stainless Steel 316L

SS 316L combines the corrosion resistance of SS 316 with improved weldability due to its lower carbon content.

Typical Applications

- Hygienic piping
- Pharmaceutical industries
- Food processing
- Biotechnology
- Water treatment plants

Stainless Steel 347H

SS 347H is a niobium-stabilized, high-carbon austenitic stainless steel specifically developed for elevated-temperature service.

Typical Applications

- Refineries
- Petrochemical plants
- Steam systems
- Boilers
- Heat exchangers
- High-temperature process piping
- Power generation



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vithalbhair Patel Road, Sikkangar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

26A.3 Chemical Composition Comparison

Alloying Element	SS 304	SS 304L	SS 316	SS 316L	SS 347H
Chromium	✓	✓	✓	✓	✓
Nickel	✓	✓	✓	✓	✓
Molybdenum	—	—	✓	✓	—
Niobium	—	—	—	—	✓
Higher Carbon for High Temperature	—	—	—	—	✓

Engineering Interpretation

- SS 304 and 304L are general-purpose stainless steels.
- SS 316 and 316L improve chloride resistance through molybdenum addition.
- SS 347H is stabilized with niobium and optimized for elevated-temperature service.

26A.4 Corrosion Resistance Comparison

Environment	304	304L	316	316L	347H
Atmospheric	Excellent	Excellent	Excellent	Excellent	Excellent
Fresh Water	Excellent	Excellent	Excellent	Excellent	Excellent
Mild Chemicals	Good	Good	Very Good	Very Good	Very Good
Chloride Exposure	Moderate	Moderate	Excellent	Excellent	Moderate to Good*
High Temperature Oxidation	Good	Good	Good	Good	Excellent
Intergranular Corrosion After Welding	Moderate	Very Good	Moderate	Very Good	Excellent

***Performance depends on chloride concentration, temperature, stress, and operating conditions.**

26A.5 High-Temperature Performance

Property	304	304L	316	316L	347H
Continuous High-Temperature Service	Good	Good	Good	Good	Excellent
Creep Resistance	Moderate	Moderate	Moderate	Moderate	Excellent
Stress Rupture Strength	Moderate	Moderate	Moderate	Moderate	Excellent
Thermal Stability	Good	Good	Good	Good	Excellent

Engineering Analysis

The higher carbon content and niobium stabilization of SS 347H provide improved long-term strength and stability at elevated temperatures compared with 304-, 304L-, 316-, and 316L-type alloys.



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vithalbhai Patel Road, Sikkanagar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

26A.6 Weldability Comparison

Property	304	304L	316	316L	347H
Weldability	Excellent	Excellent	Excellent	Excellent	Excellent
Post-Weld Corrosion Resistance	Good	Very Good	Good	Very Good	Excellent
Risk of Sensitization	Moderate	Low	Moderate	Low	Very Low

Engineering Analysis

All five grades are readily weldable using qualified procedures. Low-carbon grades (304L and 316L) reduce sensitization after welding, while SS 347H achieves similar protection through niobium stabilization.

26A.7 Mechanical Properties

General comparison:

- SS 304: Good overall mechanical strength.
- SS 304L: Similar to 304 with slightly lower strength due to reduced carbon.
- SS 316: Comparable strength with improved corrosion resistance.
- SS 316L: Similar to 316 with enhanced weldability.
- SS 347H: Comparable room-temperature strength with improved creep and stress rupture resistance for elevated-temperature applications.

26A.8 Typical Industrial Applications

SS 304

Best suited for:

- Food processing
- Water systems
- Architectural applications
- General fabrication
- Storage tanks

SS 304L

Recommended for:

- Welded piping
- Chemical processing
- Pharmaceutical plants
- Fabricated vessels



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vithalbhai Patel Road, Sikkanagar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

SS 316

Preferred for:

- Marine environments
- Chemical processing
- Coastal installations
- Offshore equipment

SS 316L

Commonly used in:

- Hygienic piping
- Pharmaceutical production
- Biotechnology
- Food processing
- Water treatment

SS 347H

Recommended for:

- Refineries
- Petrochemical plants
- Boilers
- Steam systems
- Heat exchangers
- Power stations
- High-temperature process piping

26A.9 Advantages of SS 347H Over Other Grades

Compared with SS 304, 304L, 316, and 316L, Stainless Steel 347H offers:

- Superior creep resistance.
 - Better stress rupture strength.
 - Excellent resistance to intergranular corrosion after welding.
 - Improved high-temperature stability.
 - Longer service life in elevated-temperature applications.
 - Reduced risk of chromium carbide precipitation due to niobium stabilization.
-



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vithalbhair Patel Road, Sikkannagar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

26A.10 Situations Where Other Grades May Be Preferred

Choose SS 304 When:

- Service temperatures are moderate.
- Cost is a primary consideration.
- Corrosion conditions are relatively mild.

Choose SS 304L When:

- Extensive welding is required.
- Improved resistance to weld sensitization is needed.
- Operating temperatures are not continuously elevated.

Choose SS 316 or SS 316L When:

- Chloride exposure is significant.
- Marine or coastal environments are involved.
- Improved pitting and crevice corrosion resistance is required.

Choose SS 347H When:

- Continuous high-temperature service is expected.
- Creep resistance is important.
- Steam systems are involved.
- Thermal cycling is frequent.
- Long-term elevated-temperature mechanical stability is required.

26A.11 Material Selection Decision Matrix

Project Requirement	Recommended Material
General Industrial Service	SS 304
Extensive Welding	SS 304L
Marine Environment	SS 316
Pharmaceutical & Hygienic Systems	SS 316L
High-Temperature Steam Systems	SS 347H
Petrochemical Process Piping	SS 347H
Boiler & Superheater Applications	SS 347H
Heat Exchanger Piping	SS 347H (where elevated-temperature performance is required)



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vithalbhair Patel Road, Sikkannagar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

26A.12 Chapter Summary

Each stainless steel grade has strengths that suit different operating environments. SS 304 and SS 304L are versatile materials for general service and welded fabrication. SS 316 and SS 316L provide improved resistance to chloride-containing environments due to the addition of molybdenum. Stainless Steel 347H is specifically engineered for elevated-temperature service, offering excellent resistance to sensitization, superior creep strength, and long-term thermal stability.

Material selection should always consider operating temperature, pressure, process media, fabrication requirements, applicable design codes, inspection needs, lifecycle cost, and project specifications rather than relying on initial material cost alone.

Prepared By: STAINLESS INDIA
Website: www.stainlessindia.net
Email: info@stainlessindia.net
Phone: +91 97680 42420
Location: Mumbai, Maharashtra, India
Edition: First Edition – 2026
Dated : 11.07.2026
© 2026 STAINLESS INDIA.
All rights reserved.



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vitthalbhai Patel Road, Sikkanagar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

Chapter 26B – Comparison of Stainless Steel 347H with SS 321, SS 321H, Duplex 2205, and Super Duplex 2507

26B.1 Introduction

Selecting the appropriate stainless steel for industrial piping systems requires a thorough understanding of each material's metallurgical characteristics, corrosion resistance, mechanical properties, fabrication requirements, and service limitations. While Stainless Steel 347H, Stainless Steel 321, Stainless Steel 321H, Duplex 2205, and Super Duplex 2507 are all premium engineering materials, they are designed for different operating conditions.

This chapter compares these materials to assist engineers, EPC contractors, procurement specialists, QA/QC inspectors, and plant operators in making technically sound material selection decisions.

26B.2 Material Overview

Stainless Steel 321

Stainless Steel 321 is a titanium-stabilized austenitic stainless steel developed to improve resistance to intergranular corrosion after welding. Titanium combines with carbon, reducing chromium carbide precipitation and preserving corrosion resistance.

Typical Applications

- Aircraft exhaust systems
- Expansion joints
- Furnace equipment
- Heat exchangers
- Process piping
- Chemical plants

Stainless Steel 321H

SS 321H is the high-carbon version of Grade 321. The increased carbon content enhances creep resistance and stress rupture strength during prolonged high-temperature service.

Typical Applications

- High-temperature steam systems
- Boilers
- Superheaters
- Petrochemical plants
- Refinery piping
- Power generation



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vithalbhai Patel Road, Sikkonagar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

Duplex Stainless Steel 2205

Duplex 2205 combines austenitic and ferritic microstructures, providing excellent mechanical strength and significantly improved resistance to pitting, crevice corrosion, and chloride stress corrosion cracking.

Typical Applications

- Offshore platforms
- Seawater systems
- Desalination plants
- Chemical processing
- Marine equipment
- Pressure vessels

Super Duplex Stainless Steel 2507

Super Duplex 2507 is a high-alloy duplex stainless steel engineered for severe chloride and highly corrosive environments. It provides exceptional mechanical strength and outstanding resistance to localized corrosion.

Typical Applications

- Offshore oil & gas
- Subsea piping
- Seawater cooling systems
- Chemical processing
- Marine structures
- Desalination facilities

Stainless Steel 347H

SS 347H is a niobium-stabilized, high-carbon austenitic stainless steel specifically designed for elevated-temperature service requiring excellent creep strength, oxidation resistance, and resistance to sensitization after welding.

Typical Applications

- Refineries
- Petrochemical plants
- Steam systems
- Boilers
- Heat exchangers
- Power plants
- High-temperature process piping



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vithalbhair Patel Road, Sikkannagar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

26B.3 Stabilization Method Comparison

Material	Stabilizing Element	Primary Benefit
SS 321	Titanium	Reduces carbide precipitation after welding
SS 321H	Titanium	Improved high-temperature strength with stabilization
SS 347H	Niobium (Columbium)	Excellent resistance to sensitization and enhanced creep strength
Duplex 2205	Duplex Microstructure	High strength and excellent chloride resistance
Super Duplex 2507	High Alloy Duplex Structure	Superior resistance to aggressive chloride environments

Engineering Interpretation

- SS 321 and SS 321H rely on titanium stabilization.
- SS 347H relies on niobium stabilization.
- Duplex grades achieve their performance primarily through balanced duplex microstructures and alloy composition rather than stabilization.

26B.4 Corrosion Resistance Comparison

Service Environment	SS 321	SS 321H	SS 347H	Duplex 2205	Super Duplex 2507
Atmospheric Corrosion	Excellent	Excellent	Excellent	Excellent	Excellent
Intergranular Corrosion	Excellent	Excellent	Excellent	Excellent	Excellent
Pitting Corrosion	Good	Good	Good	Excellent	Outstanding
Crevice Corrosion	Good	Good	Good	Excellent	Outstanding
Chloride Stress Corrosion Cracking	Moderate	Moderate	Moderate	Excellent	Outstanding
Marine Service	Good	Good	Good	Excellent	Outstanding

Engineering Analysis

Duplex and Super Duplex grades generally outperform austenitic stainless steels in chloride-rich environments. SS 347H, however, remains a preferred choice where elevated-temperature performance is more critical than chloride resistance.



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vitthalbhai Patel Road, Sikkanagar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

26B.5 High-Temperature Performance

Property	SS 321	SS 321H	SS 347H	Duplex 2205	Super Duplex 2507
Continuous Elevated-Temperature Service	Very Good	Excellent	Excellent	Limited	Limited
Creep Resistance	Good	Excellent	Excellent	Moderate	Moderate
Stress Rupture Strength	Good	Excellent	Excellent	Moderate	Moderate
Oxidation Resistance	Excellent	Excellent	Excellent	Good	Good

Engineering Analysis

SS 321H and SS 347H are generally preferred for prolonged high-temperature service. Duplex grades are selected primarily for their corrosion resistance and high mechanical strength rather than sustained elevated-temperature performance.

26B.6 Mechanical Strength Comparison

Property	SS 321	SS 321H	SS 347H	Duplex 2205	Super Duplex 2507
Yield Strength	Moderate	Moderate	Moderate	High	Very High
Tensile Strength	Good	Good	Good	Excellent	Outstanding
Toughness	Excellent	Excellent	Excellent	Excellent	Excellent
Fatigue Resistance	Good	Good	Good	Excellent	Excellent

Engineering Analysis

Duplex and Super Duplex grades offer significantly higher yield strength than austenitic stainless steels. This higher strength can permit thinner wall sections in appropriate designs, subject to applicable codes and engineering evaluation.



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vitthalbhai Patel Road, Sikkanagar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

26B.7 Weldability Comparison

Material	Weldability	Comments
SS 321	Excellent	Requires qualified procedures and suitable filler materials
SS 321H	Excellent	Good weldability for elevated-temperature service
SS 347H	Excellent	Niobium stabilization minimizes sensitization
Duplex 2205	Very Good	Heat input and phase balance require careful control
Super Duplex 2507	Good	More demanding welding procedures are required to maintain corrosion resistance and mechanical properties

26B.8 Typical Industrial Applications

SS 321

Recommended for:

- Furnace equipment
- Aircraft exhaust systems
- Heat exchangers
- Expansion joints

SS 321H

Recommended for:

- Boilers
- Steam piping
- Petrochemical plants
- High-temperature pressure systems

SS 347H

Recommended for:

- Refineries
- High-temperature process piping
- Steam systems
- Catalytic cracking units
- Heat exchangers
- Power generation



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vitthalbhai Patel Road, Sikkanagar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

Duplex 2205

Recommended for:

- Offshore facilities
- Marine piping
- Chemical processing
- Desalination
- Seawater systems

Super Duplex 2507

Recommended for:

- Highly aggressive chloride environments
- Offshore subsea systems
- Seawater cooling
- Chemical processing plants
- Marine infrastructure

26B.9 Advantages of SS 347H

Compared with SS 321 and SS 321H:

- Excellent resistance to sensitization due to niobium stabilization.
- Outstanding long-term thermal stability.
- Proven performance in refinery and petrochemical applications.
- Excellent creep resistance.
- Reliable weldability.

Compared with Duplex grades:

- Better suited for sustained elevated-temperature service.
 - Proven use in boilers and superheated steam systems.
 - Easier fabrication for many standard piping applications.
-



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vithalbhair Patel Road, Sikkangar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

26B.10 When Duplex or Super Duplex May Be Preferred

Duplex 2205 or Super Duplex 2507 should be considered when:

- Chloride concentrations are high.
- Seawater service is involved.
- Pitting resistance is a primary concern.
- High mechanical strength is required.
- Chloride stress corrosion cracking must be minimized.

Material selection should always be confirmed through engineering evaluation and project specifications.

26B.11 Material Selection Guide

Project Requirement	Recommended Material
High-Temperature Steam Service	SS 347H or SS 321H
Boiler & Superheater Systems	SS 347H
Petrochemical Process Piping	SS 347H
Marine Environment	Duplex 2205
Seawater Systems	Super Duplex 2507
Offshore Platforms	Duplex 2205 or Super Duplex 2507
Refinery Process Units	SS 347H
Chemical Processing with High Chlorides	Duplex or Super Duplex (subject to process compatibility)

26B.12 Chapter Summary

SS 321, SS 321H, SS 347H, Duplex 2205, and Super Duplex 2507 are all high-performance stainless steels, but each is optimized for different service conditions. SS 321 and SS 321H provide titanium stabilization for elevated-temperature applications, while SS 347H uses niobium stabilization to achieve excellent resistance to sensitization, creep, and long-term thermal exposure. Duplex 2205 and Super Duplex 2507 offer significantly higher mechanical strength and superior resistance to chloride-induced corrosion, making them well suited for marine and offshore environments.

The final material selection should always consider operating temperature, process media, chloride concentration, pressure, fabrication requirements, lifecycle cost, inspection needs, and applicable engineering standards. A systematic evaluation of these factors ensures reliable, safe, and economical piping system performance.



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vitthalbhai Patel Road, Sikkangar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

Chapter 26C-1 – Comparison of Stainless Steel 347H with Inconel 625 and Inconel 825

26C-1.1 Introduction

Selecting the appropriate alloy for severe industrial service requires balancing corrosion resistance, high-temperature performance, fabrication characteristics, availability, and lifecycle cost. Stainless Steel 347H, Inconel 625, and Inconel 825 are widely used in process industries, but they are designed for different operating environments.

Stainless Steel 347H is a niobium-stabilized austenitic stainless steel developed primarily for elevated-temperature service. In contrast, Inconel 625 and Inconel 825 are nickel-based alloys engineered for highly corrosive chemical environments while also providing excellent mechanical performance.

This chapter compares these three materials from an engineering, manufacturing, and procurement perspective.

26C-1.2 Material Overview

Stainless Steel 347H

Grade 347H is a stabilized chromium-nickel stainless steel containing niobium (columbium). The alloy provides excellent resistance to intergranular corrosion after welding and superior creep strength during prolonged high-temperature service.

Primary Applications

- Refineries
- Petrochemical plants
- Steam systems
- Heat exchangers
- Boilers
- Superheaters
- Process piping

Inconel 625

Inconel 625 is a nickel-chromium-molybdenum alloy strengthened primarily by solid-solution alloying. It offers outstanding resistance to oxidation, pitting, crevice corrosion, and many aggressive chemical environments while maintaining high strength over a broad temperature range.

Primary Applications

- Offshore platforms
- Marine engineering
- Aerospace
- Nuclear facilities
- Chemical processing



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vithalbhair Patel Road, Sikkannagar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

- Desalination plants
- High-performance heat exchangers

Inconel 825

Inconel 825 is a nickel-iron-chromium alloy containing molybdenum and copper, providing excellent resistance to both oxidizing and reducing acids. It is widely selected for aggressive chemical processing environments.

Primary Applications

- Sulfuric acid plants
- Phosphoric acid production
- Pickling equipment
- Pollution control systems
- Chemical reactors
- Fertilizer plants

26C-1.3 Alloy Composition Comparison

Feature	SS 347H	Inconel 625	Inconel 825
Base Alloy	Iron	Nickel	Nickel-Iron
Chromium	High	High	High
Nickel	Moderate	Very High	High
Molybdenum	No	Yes	Yes
Niobium	Yes	Yes	No
Copper	No	No	Yes

Engineering Analysis

SS 347H derives its performance from chromium, nickel, and niobium stabilization.

Inconel 625 gains exceptional corrosion resistance through high nickel, chromium, molybdenum, and niobium content.

Inconel 825 combines nickel, chromium, molybdenum, and copper to resist a wide range of acidic environments.



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vitthalbhai Patel Road, Sikkanagar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

26C-1.4 Corrosion Resistance Comparison

Service Environment	SS 347H	Inconel 625	Inconel 825
Atmospheric Corrosion	Excellent	Outstanding	Outstanding
Marine Atmosphere	Good	Outstanding	Excellent
Seawater	Moderate	Outstanding	Excellent
Pitting Corrosion	Good	Outstanding	Excellent
Crevice Corrosion	Good	Outstanding	Excellent
Chloride Stress Corrosion Cracking	Moderate	Outstanding	Excellent
Oxidizing Acids	Good	Excellent	Outstanding
Reducing Acids	Moderate	Good	Excellent

Engineering Interpretation

For severe chloride environments and highly aggressive process chemicals, nickel-based alloys generally provide greater corrosion resistance than SS 347H. Material selection should always be based on the specific process chemistry, temperature, and applicable design codes.

26C-1.5 High-Temperature Performance

Property	SS 347H	Inconel 625	Inconel 825
Oxidation Resistance	Excellent	Outstanding	Excellent
Creep Resistance	Excellent	Outstanding	Good
Stress Rupture Strength	Excellent	Outstanding	Good
Thermal Stability	Excellent	Outstanding	Very Good
Long-Term Elevated-Temperature Service	Excellent	Outstanding	Good

Engineering Analysis

SS 347H is specifically optimized for prolonged high-temperature service in steam systems, boilers, and refinery piping. Inconel 625 offers even greater high-temperature capability but is generally reserved for applications requiring both exceptional corrosion resistance and elevated-temperature strength because of its higher cost.



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vitthalbhai Patel Road, Sikkanagar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

26C-1.6 Mechanical Performance

Property	SS 347H	Inconel 625	Inconel 825
Yield Strength	Good	Excellent	Good
Tensile Strength	Good	Excellent	Good
Toughness	Excellent	Outstanding	Excellent
Fatigue Resistance	Good	Outstanding	Very Good
Structural Reliability	Excellent	Outstanding	Excellent

26C-1.7 Weldability Comparison

All three alloys are weldable using qualified welding procedures.

SS 347H

Advantages:

- Excellent weldability
- Niobium stabilization reduces sensitization
- Suitable for field and shop fabrication

Inconel 625

Advantages:

- Excellent weld integrity
- High resistance to weld corrosion
- Suitable for severe process environments

Inconel 825

Advantages:

- Good weldability
- Reliable corrosion resistance after welding
- Well suited for chemical processing equipment

Selection of filler metal and welding procedure should follow applicable standards, manufacturer recommendations, and project specifications.



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vitthalbhai Patel Road, Sikkanagar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

26C-1.8 Industrial Applications

Stainless Steel 347H

Best suited for:

- Petrochemical plants
 - Refineries
 - Steam systems
 - Boilers
 - Heat exchangers
 - Furnace piping
 - High-temperature process lines
-

Inconel 625

Preferred for:

- Offshore production
 - Marine engineering
 - Nuclear facilities
 - Chemical reactors
 - Aerospace
 - Desalination systems
 - Severe chloride service
-

Inconel 825

Recommended for:

- Acid production
 - Fertilizer plants
 - Chemical reactors
 - Pollution control equipment
 - Pickling systems
 - Process piping handling aggressive acids
-



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vitthalbhai Patel Road, Sikkanagar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

26C-1.9 Advantages of SS 347H

Compared with nickel-based alloys, Stainless Steel 347H offers:

- Lower material cost
- Wide global availability
- Excellent high-temperature performance
- Easier procurement
- Proven refinery service
- Excellent fabrication characteristics
- Good weldability
- Extensive use in steam systems

For applications where its corrosion resistance and temperature capability are sufficient, SS 347H can provide an economical and reliable solution.

26C-1.10 Advantages of Inconel 625

Compared with SS 347H:

- Superior resistance to seawater corrosion
- Outstanding pitting resistance
- Excellent crevice corrosion resistance
- Better chloride stress corrosion cracking resistance
- Higher mechanical strength
- Longer service life in extremely aggressive environments

26C-1.11 Advantages of Inconel 825

Compared with SS 347H:

- Excellent resistance to sulfuric acid
 - Excellent resistance to phosphoric acid
 - Better performance in mixed acid environments
 - Superior resistance to many aggressive chemical processes
-



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vitthalbhai Patel Road, Sikkanagar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

26C-1.12 Cost Comparison

Material	Relative Material Cost
SS 347H	Moderate
Inconel 825	High
Inconel 625	Very High

While nickel-based alloys generally involve a significantly higher initial investment, they may provide lower lifecycle costs in highly corrosive environments by reducing maintenance, downtime, and replacement frequency.

26C-1.13 Material Selection Guide

Service Requirement	Recommended Material
High-Temperature Steam	SS 347H
Refinery Process Piping	SS 347H
Boiler Systems	SS 347H
Superheater Piping	SS 347H
Offshore Seawater Service	Inconel 625
Marine Splash Zone	Inconel 625
Sulfuric Acid Service	Inconel 825
Phosphoric Acid Processing	Inconel 825
Severe Chloride Environment	Inconel 625
General High-Temperature Industrial Service	SS 347H

Final material selection should be based on operating pressure, design temperature, process chemistry, inspection requirements, lifecycle cost, applicable engineering standards, and project specifications.

26C-1.14 Chapter Summary

Stainless Steel 347H, Inconel 625, and Inconel 825 are all proven engineering materials, but each serves a distinct purpose. SS 347H is an excellent choice for elevated-temperature steam systems, refinery piping, and petrochemical applications where long-term thermal stability and resistance to sensitization are required. Inconel 625 excels in severe chloride and marine environments requiring exceptional corrosion resistance and mechanical strength, while Inconel 825 is particularly well suited for equipment exposed to aggressive acidic media.

Careful evaluation of operating conditions, process fluids, fabrication requirements, lifecycle costs, and applicable design codes is essential to selecting the most appropriate material for safe, reliable, and economical service.



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vitthalbhai Patel Road, Sikkanagar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

Chapter 26C-2 – Comparison of Stainless Steel 347H with Hastelloy C276 and Monel 400

26C-2.1 Introduction

Industrial piping systems operating in highly aggressive chemical environments require careful material selection to ensure long-term safety, reliability, and cost-effectiveness. Stainless Steel 347H, Hastelloy C276, and Monel 400 are widely used engineering alloys, but each has been developed for different service conditions.

Stainless Steel 347H is a niobium-stabilized austenitic stainless steel optimized for elevated-temperature applications. Hastelloy C276 is a nickel-molybdenum-chromium alloy designed for exceptional corrosion resistance in aggressive chemical environments. Monel 400 is a nickel-copper alloy recognized for its outstanding resistance to seawater, hydrofluoric acid, and alkaline environments.

This chapter compares these materials to help engineers, procurement specialists, EPC contractors, and plant operators make informed material selection decisions.

26C-2.2 Material Overview

Stainless Steel 347H

SS 347H is widely used in high-temperature pressure piping where resistance to oxidation, creep, and intergranular corrosion is required.

Typical Applications

- Steam systems
- Petrochemical plants
- Refineries
- Heat exchangers
- Boilers
- Furnace piping
- High-temperature process lines

Hastelloy C276

Hastelloy C276 is a high-performance nickel alloy engineered for severe chemical processing environments. It provides exceptional resistance to a broad range of oxidizing and reducing chemicals.

Typical Applications

- Chemical reactors
- Acid production
- Waste treatment plants
- Pollution control systems
- Offshore chemical facilities
- Pharmaceutical production



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vithalbhai Patel Road, Sikkangar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

Monel 400

Monel 400 is a nickel-copper alloy offering excellent resistance to seawater corrosion and hydrofluoric acid under many service conditions.

Typical Applications

- Marine engineering
- Pump shafts
- Valves
- Seawater piping
- Chemical processing
- Offshore installations

26C-2.3 Alloy Characteristics

Property	SS 347H	Hastelloy C276	Monel 400
Base Alloy	Iron	Nickel	Nickel-Copper
High Nickel Content	Moderate	Very High	Very High
Molybdenum	No	Yes	No
Chromium	Yes	Yes	No
Copper	No	Small Amount	High
Niobium Stabilization	Yes	No	No

Engineering Analysis

Each alloy achieves its performance through different alloying strategies:

- SS 347H relies on chromium, nickel, and niobium stabilization.
- Hastelloy C276 derives exceptional corrosion resistance from high nickel, chromium, and molybdenum content.
- Monel 400 uses a nickel-copper composition to resist marine environments and selected chemicals.

26C-2.4 Corrosion Resistance Comparison

Service Environment	SS 347H	Hastelloy C276	Monel 400
Atmospheric Corrosion	Excellent	Outstanding	Excellent
Marine Atmosphere	Good	Outstanding	Outstanding
Seawater	Moderate	Outstanding	Outstanding
Oxidizing Acids	Good	Outstanding	Moderate
Reducing Acids	Moderate	Outstanding	Good



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vitthalbhai Patel Road, Sikkanagar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

Service Environment	SS 347H	Hastelloy C276	Monel 400
Hydrofluoric Acid	Limited	Good	Excellent (service-specific)
Caustic Alkalis	Good	Excellent	Excellent
Chloride Pitting	Good	Outstanding	Very Good
Crevice Corrosion	Good	Outstanding	Very Good
Chloride Stress Corrosion Cracking	Moderate	Outstanding	Excellent

Engineering Interpretation

Hastelloy C276 generally provides the broadest corrosion resistance across aggressive chemical environments. Monel 400 is particularly valuable in seawater and certain fluoride-containing services. SS 347H performs well in many industrial environments but is primarily selected for elevated-temperature service rather than highly aggressive chemical exposure.

26C-2.5 High-Temperature Performance

Property	SS 347H	Hastelloy C276	Monel 400
Oxidation Resistance	Excellent	Outstanding	Good
Creep Resistance	Excellent	Very Good	Moderate
Thermal Stability	Excellent	Excellent	Good
Continuous Elevated-Temperature Service	Excellent	Excellent	Moderate

Engineering Analysis

SS 347H is specifically designed for prolonged high-temperature service in steam systems and refinery piping. Hastelloy C276 also performs well at elevated temperatures while offering superior corrosion resistance in aggressive chemical environments. Monel 400 is generally selected for corrosion resistance rather than sustained high-temperature applications.

26C-2.6 Mechanical Performance

Property	SS 347H	Hastelloy C276	Monel 400
Yield Strength	Good	Very Good	Good
Tensile Strength	Good	Excellent	Good
Toughness	Excellent	Outstanding	Excellent
Fatigue Resistance	Good	Excellent	Good



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vitthalbhai Patel Road, Sikkanagar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

Engineering Interpretation

Hastelloy C276 offers superior mechanical performance in highly corrosive process environments. SS 347H provides an excellent balance of strength, toughness, and high-temperature stability for steam and refinery service. Monel 400 offers dependable mechanical performance combined with excellent marine corrosion resistance.

26C-2.7 Weldability Comparison

Stainless Steel 347H

Advantages

- Excellent weldability
- Niobium stabilization reduces sensitization
- Suitable for both shop and field welding

Hastelloy C276

Advantages

- Excellent weldability with qualified procedures
- Good resistance to weld corrosion
- Suitable for demanding chemical process equipment

Monel 400

Advantages

- Good weldability using qualified procedures
- Suitable for marine and chemical service applications

Proper welding procedures, filler metal selection, and inspection are essential for all three materials to achieve reliable service performance.

26C-2.8 Typical Industrial Applications

Stainless Steel 347H

Recommended for:

- Steam systems
- Power plants
- Refineries
- Petrochemical plants
- Heat exchangers



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vithalbhair Patel Road, Sikkannagar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

- Boilers
- High-temperature piping

Hastelloy C276

Recommended for:

- Chemical reactors
- Acid handling systems
- Pollution control equipment
- Waste treatment
- Pharmaceutical production
- Chemical transfer piping

Monel 400

Recommended for:

- Seawater systems
- Marine piping
- Pump components
- Valve bodies
- Offshore equipment
- Selected fluoride-containing process systems

26C-2.9 Advantages of Stainless Steel 347H

Compared with Hastelloy C276 and Monel 400, SS 347H offers:

- Lower initial material cost.
- Excellent availability.
- Proven performance in refinery and petrochemical service.
- Outstanding resistance to sensitization after welding.
- Excellent creep resistance.
- Reliable performance in high-temperature steam systems.
- Easier procurement for standard piping projects.

26C-2.10 Advantages of Hastelloy C276

Compared with SS 347H:



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vitthalbhai Patel Road, Sikkanagar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

- Outstanding resistance to aggressive oxidizing and reducing chemicals.
- Superior resistance to pitting and crevice corrosion.
- Excellent performance in mixed-acid environments.
- Long service life in severe chemical processing.

26C-2.11 Advantages of Monel 400

Compared with SS 347H:

- Excellent seawater corrosion resistance.
- Outstanding resistance in many marine environments.
- Very good resistance to hydrofluoric acid under appropriate service conditions.
- Reliable performance in alkaline process systems.

26C-2.12 Cost Comparison

Material	Relative Material Cost
SS 347H	Moderate
Monel 400	High
Hastelloy C276	Very High

Although Hastelloy C276 and Monel 400 require greater initial investment, they may reduce lifecycle costs in highly aggressive environments by extending service life and reducing maintenance requirements.

26C-2.13 Material Selection Guide

Service Requirement	Recommended Material
High-Temperature Steam	SS 347H
Refinery Process Piping	SS 347H
Boiler Systems	SS 347H
Petrochemical Plants	SS 347H
Highly Corrosive Mixed Acids	Hastelloy C276
Pollution Control Equipment	Hastelloy C276
Chemical Reactors	Hastelloy C276
Marine Seawater Systems	Monel 400
Offshore Equipment	Monel 400
Hydrofluoric Acid Service	Monel 400 (subject to process conditions)

Final material selection should always consider process chemistry, operating pressure, design temperature, fabrication requirements, inspection standards, applicable engineering codes, and lifecycle cost.



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vithalbhai Patel Road, Sikkangar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

26C-2.14 Engineering Decision Guidelines

Engineers should evaluate:

- Operating pressure and temperature.
- Process media composition.
- Corrosion mechanisms.
- Chloride concentration.
- Required mechanical properties.
- Weldability requirements.
- Inspection and testing needs.
- Material availability.
- Fabrication complexity.
- Total lifecycle cost.

No single alloy is ideal for every application. The optimum choice depends on balancing performance, reliability, maintainability, and project economics.

26C-2.15 Chapter Summary

Stainless Steel 347H, Hastelloy C276, and Monel 400 are all premium engineering materials with distinct strengths. SS 347H is an excellent solution for elevated-temperature steam systems, refinery piping, and petrochemical applications requiring long-term thermal stability and resistance to sensitization. Hastelloy C276 is the preferred choice for highly aggressive chemical processing where exceptional resistance to oxidizing and reducing acids is essential. Monel 400 excels in marine environments and selected fluoride-containing services because of its outstanding seawater and nickel-copper corrosion performance.

Material selection should be based on a comprehensive engineering assessment that considers operating conditions, corrosion mechanisms, fabrication requirements, applicable standards, and long-term ownership costs.



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vithalbhair Patel Road, Sikkangar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

Chapter 26C-3 – Comparison of Stainless Steel 347H with Carbon Steel ASTM A234 WPB and Alloy Steel ASTM A234 WP11/WP22

26C-3.1 Introduction

Carbon steel, alloy steel, and stainless steel are among the most widely specified materials for industrial piping systems. Although they may appear similar in shape and function, their chemical composition, mechanical behavior, corrosion resistance, and operating temperature capabilities differ significantly.

Selecting the correct elbow material requires evaluating operating pressure, service temperature, corrosion environment, fabrication requirements, maintenance strategy, lifecycle cost, and applicable engineering standards.

This chapter compares Stainless Steel 347H with ASTM A234 WPB Carbon Steel and ASTM A234 WP11/WP22 Alloy Steel to help engineers, EPC contractors, procurement professionals, QA/QC inspectors, and plant operators make informed material selection decisions.

26C-3.2 Material Overview

Stainless Steel 347H

Stainless Steel 347H is a niobium-stabilized austenitic stainless steel designed for high-temperature pressure piping systems. It provides excellent oxidation resistance, resistance to sensitization after welding, good creep strength, and reliable long-term performance in elevated-temperature service.

Typical Applications

- Petrochemical plants
- Refineries
- Boilers
- Superheaters
- Steam systems
- Heat exchangers
- High-temperature process piping

ASTM A234 WPB Carbon Steel

ASTM A234 WPB is the most commonly used carbon steel grade for butt-welded pipe fittings in moderate-temperature pressure piping systems.

Typical Applications

- Water pipelines
- Fire protection systems
- Oil and gas pipelines
- General industrial service
- Utility piping
- Structural process systems



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vithalbhair Patel Road, Sikkangar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

ASTM A234 WP11 Alloy Steel

WP11 is a chromium-molybdenum alloy steel developed for elevated-temperature service where improved creep resistance is required compared with carbon steel.

Typical Applications

- Steam systems
- Power plants
- Refineries
- Boiler piping
- High-temperature process piping

ASTM A234 WP22 Alloy Steel

WP22 contains higher chromium and molybdenum content than WP11, providing improved oxidation resistance and enhanced high-temperature strength.

Typical Applications

- High-pressure steam piping
- Superheater systems
- Petrochemical facilities
- Refinery process piping
- Power generation

26C-3.3 Material Family Comparison

Material	Material Family	Primary Strength
SS 347H	Austenitic Stainless Steel	High-temperature corrosion resistance
ASTM A234 WPB	Carbon Steel	Low cost and good mechanical strength
ASTM A234 WP11	Cr-Mo Alloy Steel	Elevated-temperature strength
ASTM A234 WP22	Cr-Mo Alloy Steel	Improved oxidation and creep resistance



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vithalbhair Patel Road, Sikkannagar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

26C-3.4 Corrosion Resistance Comparison

Environment	SS 347H	WPB	WP11	WP22
Atmospheric Corrosion	Excellent	Fair (protective coating generally required)	Good	Good
Fresh Water	Excellent	Good	Good	Good
Marine Atmosphere	Good	Poor	Moderate	Moderate
Oxidizing Environment	Excellent	Limited	Good	Very Good
Steam Service	Excellent	Good	Excellent	Excellent
Chemical Processing	Very Good	Limited	Moderate	Good

Engineering Analysis

SS 347H provides a significant advantage in corrosive environments because its chromium-rich passive oxide layer continuously protects the surface. Carbon steel and alloy steels generally require protective coatings, insulation systems, or corrosion allowances depending on the service conditions.

26C-3.5 High-Temperature Performance

Property	SS 347H	WPB	WP11	WP22
Elevated-Temperature Service	Excellent	Limited	Excellent	Outstanding
Creep Resistance	Excellent	Limited	Very Good	Excellent
Oxidation Resistance	Excellent	Moderate	Good	Very Good
Long-Term Thermal Stability	Excellent	Moderate	Very Good	Excellent

Engineering Interpretation

WP11 and WP22 are specifically designed for elevated-temperature service, particularly in steam systems and power plants. SS 347H offers the additional benefit of excellent corrosion resistance and resistance to sensitization, making it advantageous where both elevated temperatures and corrosive environments are present.



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vitthalbhai Patel Road, Sikkanagar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

26C-3.6 Mechanical Strength Comparison

Property	SS 347H	WPB	WP11	WP22
Yield Strength	Good	Good	Very Good	Excellent
Tensile Strength	Good	Good	Very Good	Excellent
Toughness	Excellent	Good	Good	Good
Ductility	Excellent	Good	Moderate	Moderate

Engineering Analysis

Alloy steels WP11 and WP22 generally provide higher strength at elevated temperatures than carbon steel. SS 347H combines good mechanical strength with excellent ductility and corrosion resistance, making it well suited for complex fabricated piping systems.

26C-3.7 Weldability Comparison

Stainless Steel 347H

Advantages

- Excellent weldability
- Good fabrication characteristics
- Reduced sensitization due to niobium stabilization

ASTM A234 WPB

Advantages

- Easy fabrication
- Widely available
- Good field weldability

ASTM A234 WP11

Requires qualified welding procedures with careful control of preheat, interpass temperature, and post-weld heat treatment (PWHT) where specified by applicable codes or project requirements.

ASTM A234 WP22

Similar to WP11 but typically requires more stringent welding controls because of its alloy content and service conditions.



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vitthalbhai Patel Road, Sikkanagar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

26C-3.8 Heat Treatment Comparison

Material	Typical Heat Treatment Considerations
SS 347H	Solution annealing during manufacture; PWHT depends on project requirements
WPB	Generally supplied normalized or normalized and tempered depending on specification
WP11	Heat treatment and PWHT commonly required based on code and service conditions
WP22	Heat treatment and PWHT commonly required based on code and service conditions

Heat treatment requirements should always be verified against the applicable material specification, piping code, and project documentation.

26C-3.9 Typical Industrial Applications

Stainless Steel 347H

Recommended for:

- Refineries
- Petrochemical plants
- Steam systems
- Heat exchangers
- Boilers
- High-temperature process piping

ASTM A234 WPB

Recommended for:

- Water systems
- Fire protection
- Oil pipelines
- Gas transmission
- Utility piping
- General industrial service



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vithalbhair Patel Road, Sikkannagar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

ASTM A234 WP11

Recommended for:

- Steam piping
- Power plants
- Boiler systems
- Moderate high-temperature service

ASTM A234 WP22

Recommended for:

- High-pressure steam
- Superheater piping
- Refinery process systems
- High-temperature power generation

26C-3.10 Cost Comparison

Material	Relative Material Cost
ASTM A234 WPB	Lowest
ASTM A234 WP11	Moderate
ASTM A234 WP22	Moderate to High
Stainless Steel 347H	High

Although SS 347H has a higher initial purchase cost, it can reduce lifecycle costs in corrosive and high-temperature environments by lowering maintenance requirements and extending service life.



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vitthalbhai Patel Road, Sikkanagar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

26C-3.11 Advantages of Stainless Steel 347H

Compared with Carbon Steel and Alloy Steel:

- Excellent corrosion resistance.
- No protective coating required for many environments.
- Outstanding oxidation resistance.
- Excellent resistance to sensitization.
- Good weldability.
- Lower maintenance requirements.
- Long service life.
- Excellent appearance and cleanability.

26C-3.12 Advantages of Carbon Steel ASTM A234 WPB

Compared with SS 347H:

- Lower initial cost.
- Wide global availability.
- Easy fabrication.
- Good mechanical properties for general service.
- Economical for non-corrosive applications.

26C-3.13 Advantages of Alloy Steel WP11 and WP22

Compared with SS 347H:

- Excellent elevated-temperature strength.
- Good creep resistance.
- Proven performance in high-pressure steam systems.
- Widely used in thermal power generation.

Where corrosion resistance is less critical and elevated-temperature strength is the primary requirement, chromium-molybdenum alloy steels remain an important engineering option.



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vitthalbhai Patel Road, Sikkanagar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

26C-3.14 Material Selection Guide

Service Requirement	Recommended Material
General Water Service	ASTM A234 WPB
Fire Protection Systems	ASTM A234 WPB
Oil & Gas Transmission	ASTM A234 WPB (where corrosion conditions permit)
Moderate High-Temperature Steam	ASTM A234 WP11
High-Pressure Steam	ASTM A234 WP22
Petrochemical Process Piping	SS 347H
Refinery High-Temperature Service	SS 347H
Heat Exchanger Systems	SS 347H
Corrosive High-Temperature Service	SS 347H

Final material selection should be based on process conditions, applicable engineering standards, corrosion assessment, inspection requirements, and lifecycle cost analysis.

26C-3.15 Engineering Decision Matrix

Selection Factor	SS 347H	WPB	WP11	WP22
Corrosion Resistance	★★★★★	★★★☆☆	★★★★☆	★★★★☆
High-Temperature Capability	★★★★★	★★★☆☆	★★★★☆	★★★★★
Weldability	★★★★★	★★★★★	★★★★☆	★★★★☆
Maintenance Requirements	Low	Moderate to High	Moderate	Moderate
Initial Material Cost	High	Low	Moderate	Moderate to High
Lifecycle Value	Excellent	Good (service dependent)	Very Good	Excellent (service dependent)

26C-3.16 Chapter Summary

Stainless Steel 347H, ASTM A234 WPB, ASTM A234 WP11, and ASTM A234 WP22 each serve important roles in industrial piping systems. Carbon steel remains the most economical solution for many non-corrosive services. Chromium-molybdenum alloy steels provide excellent performance in high-pressure steam applications where elevated-temperature strength is the primary requirement. Stainless Steel 347H combines high-temperature capability with excellent corrosion resistance, weldability, and long-term durability, making it a preferred material for refinery, petrochemical, and other demanding process environments.

Successful material selection depends on evaluating operating conditions, process chemistry, fabrication requirements, inspection needs, applicable design codes, and total lifecycle cost rather than considering initial material cost alone.



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vitthalbhai Patel Road, Sikkanagar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

Chapter 26C-4 – Master Material Selection Decision Matrix, Cost–Performance Analysis, and Engineering Selection Guide

26C-4.1 Introduction

Selecting the optimum material for butt weld pipe fittings requires balancing technical performance, corrosion resistance, operating temperature, mechanical strength, fabrication requirements, inspection needs, maintenance strategy, material availability, and total lifecycle cost.

A material that performs exceptionally well in one service may be unsuitable or unnecessarily expensive in another. Therefore, engineers should evaluate the complete operating environment rather than selecting a material solely based on initial purchase cost.

This chapter provides a practical decision framework to support engineering design, procurement, and project execution.

26C-4.2 Engineering Material Selection Process

A structured material selection process helps minimize technical and commercial risks.

Step 1 – Define the Process Conditions

Collect the following information:

- Operating pressure
- Design pressure
- Operating temperature
- Design temperature
- Process fluid
- Flow velocity
- Corrosion allowance
- Cyclic loading
- External environment
- Applicable design codes

Step 2 – Identify Corrosion Mechanisms

Evaluate whether the piping system may be exposed to:

- General corrosion
- Pitting corrosion
- Crevice corrosion
- Intergranular corrosion
- Erosion-corrosion
- Chloride stress corrosion cracking
- Oxidation



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vithalbhair Patel Road, Sikkangar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

- Sulfidation
- Hydrogen damage

Understanding the dominant corrosion mechanism is critical to selecting an appropriate material.

Step 3 – Evaluate Mechanical Requirements

Review requirements for:

- Yield strength
- Tensile strength
- Creep resistance
- Stress rupture strength
- Fatigue resistance
- Toughness
- Ductility
- Thermal expansion

Step 4 – Review Fabrication Requirements

Consider:

- Weldability
- Formability
- Machinability
- Heat treatment
- Inspection
- Availability of qualified welding procedures
- Fabrication schedule

Step 5 – Compare Lifecycle Costs

Instead of evaluating only the purchase price, compare:

- Initial material cost
- Fabrication cost
- Inspection cost
- Maintenance cost
- Downtime risk
- Replacement frequency



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vittalbhai Patel Road, Sikkangar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

- Expected service life

A higher initial investment may reduce overall project costs through improved durability and reduced maintenance.

26C-4.3 Master Material Selection Matrix

Service Condition	Recommended Material
General Industrial Service	ASTM A234 WPB
Water Distribution	ASTM A234 WPB
Fire Protection	ASTM A234 WPB
Oil & Gas Pipelines	ASTM A234 WPB (where corrosion conditions permit)
Steam Systems	SS 347H, ASTM A234 WP11, or ASTM A234 WP22 (based on temperature, pressure, and code requirements)
Petrochemical Plants	SS 347H
Refineries	SS 347H
Boilers	SS 347H or ASTM A234 WP22
Heat Exchangers	SS 347H
Marine Equipment	SS 316/316L, Duplex 2205, Super Duplex 2507, or Monel 400 (depending on service conditions)
Offshore Platforms	Duplex 2205, Super Duplex 2507, or Inconel 625 (service dependent)
Chemical Processing	SS 347H, Inconel 825, or Hastelloy C276 (depending on process chemistry)
Sulfuric Acid Service	Inconel 825 or Hastelloy C276
Highly Aggressive Mixed Acids	Hastelloy C276
Severe Chloride Environment	Duplex 2205, Super Duplex 2507, or Inconel 625

26C-4.4 Relative Performance Matrix

Property	W PB	WP 11	WP 22	SS 347H	Duplex 2205	Super Duplex 2507	Inconel 625	Hastelloy C276
Corrosion	★	★★	★★	★★★★★	★★★★★	★★★★★	★★★★★	★★★★★
Resistance	★	★☆	★★	★				
	☆	☆	☆					
	☆							
	☆							



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vithalbhair Patel Road, Sikkannagar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

Property	W PB	WP 11	WP 22	SS 347H	Duplex 2205	Super Duplex 2507	Inconel 625	Hastelloy C276
High-Temperature Capability	★ ★ ☆ ☆ ☆	★★ ★★ ☆	★★ ★★ ★	★★★★★ ★	★★★★☆	★★★★☆	★★★★★	★★★★★
Weldability	★ ★ ★ ★ ★	★★ ★★ ☆	★★ ★★ ☆	★★★★★ ★	★★★★☆	★★★★☆	★★★★☆	★★★★☆
Fabrication	★ ★ ★ ★ ★	★★ ★★ ☆	★★ ★★ ☆	★★★★★ ★	★★★★☆	★★★★☆	★★★★☆	★★★★☆
Lifecycle Value*	★ ★ ★ ☆ ☆	★★ ★★ ☆	★★ ★★ ☆	★★★★★ ★	★★★★★	★★★★★	★★★★★	★★★★★

*Lifecycle value depends on the operating environment, maintenance strategy, and service conditions.

26C-4.5 Relative Cost Comparison

Material	Relative Initial Cost
ASTM A234 WPB	Lowest
ASTM A234 WP11	Low to Moderate
ASTM A234 WP22	Moderate
SS 347H	Moderate to High
Duplex 2205	High
Super Duplex 2507	Very High
Inconel 625	Very High
Hastelloy C276	Very High

While nickel-based alloys and super duplex grades generally have higher purchase prices, they may provide lower lifecycle costs in severe service by reducing maintenance, downtime, and replacement frequency.



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vitthalbhai Patel Road, Sikkanagar Girgaon,
Mumbai – 400 004.

SINCE 2016

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net



STAINLESS INDIA
A HOUSE OF QUALITY

26C-4.6 Decision Flowchart

Is the service primarily non-corrosive at moderate temperature?

→ **Consider ASTM A234 WPB**, provided the applicable design code, corrosion assessment, and project specification permit its use.

Is elevated-temperature strength the primary requirement?

→ **Consider ASTM A234 WP11 or WP22**, depending on operating temperature, pressure, and code requirements.

Is both high-temperature performance and corrosion resistance required?

→ **Consider SS 347H**.

Is the environment rich in chlorides or seawater?

→ **Consider Duplex 2205 or Super Duplex 2507**, subject to process compatibility and engineering evaluation.

Is the service exposed to highly aggressive acids or mixed chemical environments?

→ **Consider Inconel 825 or Hastelloy C276**, depending on the specific process chemistry and design requirements.

Is exceptional chloride resistance or offshore performance required?

→ **Consider Inconel 625**, particularly where nickel-alloy performance is justified by the service conditions.

26C-4.7 Industry-Wise Material Recommendations

Industry	Preferred Materials
Oil & Gas	WPB, SS 347H, Duplex 2205
Petrochemical	SS 347H
Refineries	SS 347H
Power Generation	WP11, WP22, SS 347H
Marine	SS 316L, Duplex 2205, Monel 400
Offshore	Duplex 2205, Super Duplex 2507, Inconel 625
Chemical Processing	SS 347H, Inconel 825, Hastelloy C276
Pharmaceutical	SS 316L
Food Processing	SS 316L
Fertilizer	SS 347H, Inconel 825
Desalination	Duplex 2205, Super Duplex 2507

These are general recommendations. Final selection should always be confirmed through



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vithalbhai Patel Road, Sikkanagar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

engineering review and project-specific requirements.

26C-4.8 Procurement Checklist

Before purchasing SS 347H Elbows or alternative materials, verify:

- ✓ Material Grade
 - ✓ Applicable ASTM/ASME Standard
 - ✓ Heat Number Traceability
 - ✓ Material Test Certificate (EN 10204 Type 3.1)
 - ✓ Chemical Analysis Report
 - ✓ Mechanical Test Report
 - ✓ Dimensional Inspection Report
 - ✓ Positive Material Identification (PMI), if specified
 - ✓ Non-Destructive Testing (where required)
 - ✓ Compliance with Purchase Order and Project Specifications
-

26C-4.9 Engineering Best Practices

For reliable piping system performance:

- Define operating conditions accurately.
 - Select materials based on service environment, not only initial cost.
 - Use qualified welding procedures and trained personnel.
 - Follow applicable ASME, ASTM, and project specifications.
 - Perform required inspections and testing.
 - Maintain complete material traceability.
 - Implement preventive maintenance and periodic inspection.
-

26C-4.10 Common Material Selection Mistakes

Avoid the following:

- Selecting materials based only on purchase price.
 - Ignoring chloride concentration or chemical compatibility.
 - Assuming all stainless steels perform equally.
 - Using carbon steel without evaluating corrosion allowance or protective measures.
 - Overlooking fabrication, inspection, and maintenance requirements.
 - Substituting materials without engineering approval and code compliance.
-

26C-4.11 Final Engineering Recommendations



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vitthalbhai Patel Road, Sikkonagar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

Select SS 347H When:

- Elevated-temperature strength is required.
- Long-term thermal stability is important.
- Steam systems are involved.
- Refinery or petrochemical service is expected.
- Resistance to sensitization after welding is required.

Select ASTM A234 WPB When:

- The service is non-corrosive.
- Operating temperatures are moderate.
- Cost is a major consideration.
- Protective coatings or corrosion management are acceptable.

Select ASTM A234 WP11 or WP22 When:

- High-pressure steam service is required.
- Chromium-molybdenum alloy steels are specified by the applicable code or project.

Select Duplex or Super Duplex Stainless Steel When:

- Chloride-induced corrosion is a primary concern.
- Marine or offshore service is involved.
- High strength and localized corrosion resistance are required.

Select Nickel-Based Alloys When:

- The process involves highly aggressive acids.
- Mixed chemical environments exceed the capabilities of stainless steels.
- Maximum corrosion resistance is essential for safety and reliability.

26C-4.12 Chapter Summary

Material selection is a multidisciplinary engineering process that should integrate metallurgy, corrosion science, mechanical design, fabrication, inspection, maintenance, lifecycle cost, and applicable engineering standards. Stainless Steel 347H remains an excellent choice for refinery, petrochemical, boiler, steam, and high-temperature process piping because it combines corrosion resistance, elevated-temperature performance, weldability, and long-term durability. Carbon steel, chromium-molybdenum alloy steels, duplex stainless steels, and nickel-based alloys each offer distinct advantages in specific service conditions.

A systematic evaluation of operating conditions, process chemistry, code requirements, and total ownership cost enables engineers and procurement teams to select the most appropriate material for safe, efficient, and reliable industrial piping systems.



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vitthalbhai Patel Road, Sikkangar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

Chapter 27 – Inspection, Testing & Quality Assurance of Stainless Steel 347H Elbows

27.1 Introduction

Inspection, testing, and quality assurance are essential to ensure that Stainless Steel 347H Elbows meet the requirements of ASTM A403, ASME SA403, ASME B16.9, project specifications, and applicable quality management systems. A comprehensive quality program helps verify material integrity, dimensional accuracy, mechanical performance, and traceability before products are released for shipment.

High-quality inspection practices reduce the risk of premature failures, improve plant safety, support regulatory compliance, and increase customer confidence.

27.2 Objectives of Inspection

The primary objectives of inspection are to:

- Verify compliance with purchase specifications.
- Confirm material grade and traceability.
- Ensure dimensional accuracy.
- Detect manufacturing defects.
- Validate mechanical properties.
- Confirm chemical composition.
- Verify compliance with applicable standards.
- Support long-term operational reliability.

Inspection should be performed throughout the manufacturing process rather than only after the product is completed.

27.3 Quality Assurance System

Manufacturers should maintain a documented Quality Management System (QMS) that addresses:

- Raw material control
- Supplier qualification
- Material traceability
- Process control
- Calibration of measuring equipment
- Inspection planning
- Testing procedures
- Non-conformance management
- Corrective and preventive actions (CAPA)
- Documentation control

Many manufacturers operate under quality management systems certified to ISO 9001.



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vitthalbhai Patel Road, Sikkanagar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

27.4 Incoming Raw Material Inspection

Every incoming pipe, forging, or billet should be inspected before manufacturing begins.

Inspection typically includes:

- Material identification
- Heat number verification
- Surface examination
- Dimensional verification
- Material Test Certificate (MTC) review
- Chemical composition verification (when required)
- Positive Material Identification (PMI), if specified

Only materials meeting the required specifications should proceed to production.

27.5 Positive Material Identification (PMI)

PMI confirms that the supplied material is the specified alloy.

Common PMI methods include:

X-Ray Fluorescence (XRF)

Advantages:

- Fast
- Portable
- Non-destructive
- Suitable for field inspection

Limitations:

- May not accurately quantify light elements such as carbon.
-

Optical Emission Spectroscopy (OES)

Advantages:

- More comprehensive elemental analysis.
- Better suited where accurate chemical verification is required.

Limitations:

- Generally requires more controlled testing conditions than handheld XRF equipment.



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vitthalbhai Patel Road, Sikkangar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

PMI helps prevent costly material mix-ups and supports complete traceability.

27.6 Visual Inspection (VT)

Visual inspection is the first quality control step after manufacturing.

Inspectors should examine:

- Surface finish
- Scratches
- Cracks
- Dents
- Laminations
- Scale
- Weld appearance (where applicable)
- Heat treatment discoloration
- Marking
- General workmanship

Any unacceptable defect should be evaluated in accordance with applicable standards and project requirements.

27.7 Dimensional Inspection

Dimensional verification ensures compatibility with ASME B16.9.

Typical measurements include:

- Outside Diameter (OD)
- Inside Diameter (ID), where applicable
- Wall Thickness
- Center-to-End Dimension
- Radius
- Bevel Angle
- End Preparation
- Ovality
- Overall Length

Common measuring equipment:

- Vernier Calipers
- Micrometers
- Height Gauges



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vitthalbhai Patel Road, Sikkanagar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

- Radius Gauges
- Steel Rules
- Coordinate Measuring Machines (CMM), where available

27.8 Chemical Analysis

Chemical composition verification confirms compliance with ASTM A403 requirements.

Typical elements evaluated include:

- Carbon
- Chromium
- Nickel
- Niobium
- Manganese
- Silicon
- Phosphorus
- Sulfur

Laboratory analysis may be performed using Optical Emission Spectroscopy (OES), inductively coupled plasma (ICP) methods, or other approved analytical techniques.

27.9 Mechanical Testing

Mechanical testing confirms that the fitting meets the specified strength and ductility requirements.

Typical tests include:

Tensile Test

Measures:

- Yield Strength
- Tensile Strength
- Elongation

Hardness Test

Hardness testing may be performed when required by the applicable specification or purchase order.

Common methods include:

- Brinell Hardness
- Rockwell Hardness
- Vickers Hardness



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vithalbhair Patel Road, Sikkangar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

Bend or Flattening Tests

Where required by the applicable product specification, bend or flattening tests may be performed to evaluate ductility and soundness.

27.10 Non-Destructive Testing (NDT)

NDT evaluates material integrity without damaging the product.

Liquid Penetrant Testing (PT)

Purpose:

Detects surface-breaking discontinuities such as:

- Fine cracks
- Pinholes
- Surface porosity
- Grinding defects

Applications:

- Welded elbows
 - Machined surfaces
 - Critical pressure components
-

Ultrasonic Testing (UT)

Purpose:

Detects internal discontinuities including:

- Laminations
- Inclusions
- Lack of fusion
- Internal cracks

Advantages:

- High sensitivity
 - No radiation
 - Suitable for thick sections
-



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vitthalbhai Patel Road, Sikkanagar Girgaon,
Mumbai – 400 004.

SINCE 2016

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net



STAINLESS INDIA
A HOUSE OF QUALITY

Radiographic Testing (RT)

Purpose:

Provides internal images of welded joints to detect:

- Porosity
- Slag inclusions
- Lack of penetration
- Lack of fusion

Radiographic examination should be performed by qualified personnel using approved procedures and applicable acceptance criteria.

Eddy Current Testing (ET)

Where appropriate, eddy current testing may be used for detecting certain surface and near-surface discontinuities in conductive materials, particularly tubing and thin-wall products.

Magnetic Particle Testing (MT)

Solution-annealed austenitic stainless steels such as SS 347H are generally non-magnetic; therefore, magnetic particle testing is usually not the preferred examination method. Other NDT methods are typically selected based on the product and service requirements.

27.11 Ferrite Measurement

Where project specifications require ferrite control in weld metal, ferrite content may be measured using calibrated ferrite meters to verify compliance with welding procedure requirements.

27.12 Hydrostatic Testing

Hydrostatic testing may be specified to verify pressure integrity.

The fitting is subjected to a controlled internal pressure using water or another approved test medium.

Objectives:

- Verify pressure containment.
- Detect leakage.
- Demonstrate structural integrity.



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vithalbhair Patel Road, Sikkannagar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

Hydrostatic testing should be conducted in accordance with the applicable code, specification, and purchaser requirements.

27.13 Surface Finish Inspection

Inspectors verify:

- Uniform finish
- Surface cleanliness
- Pickling quality
- Passivation condition
- Absence of contamination
- Freedom from excessive discoloration

Proper surface condition contributes to improved corrosion resistance and product appearance.

27.14 Heat Treatment Verification

Where applicable, manufacturers should verify that required heat treatment has been completed and documented.

Verification may include:

- Furnace records
 - Time-temperature charts
 - Hardness checks
 - Mechanical testing
 - Metallurgical examination (if specified)
-

27.15 Documentation Review

Before shipment, documentation should be reviewed for completeness and accuracy.

Typical records include:

- Material Test Certificate (EN 10204 Type 3.1)
- Chemical Analysis Report
- Mechanical Test Report
- Dimensional Inspection Report
- Heat Treatment Record
- PMI Report
- NDT Reports
- Hydrostatic Test Report (if applicable)



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vithalbhair Patel Road, Sikkannagar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

- Packing List
- Final Inspection Release

27.16 Third-Party Inspection

Many EPC projects require independent inspection agencies to witness manufacturing and testing.

Typical activities include:

- Material verification
- Stage inspections
- Final inspection
- Review of quality records
- Witnessing of specified tests
- Release authorization

Independent inspection provides additional confidence that contractual and technical requirements have been satisfied.

27.17 Quality Control Checklist

Before shipment, verify:

- ✓ Material Grade
- ✓ Heat Number
- ✓ Traceability
- ✓ Chemical Composition
- ✓ Mechanical Properties
- ✓ Dimensional Accuracy
- ✓ Surface Finish
- ✓ Marking
- ✓ NDT (where specified)
- ✓ Heat Treatment Documentation
- ✓ Material Test Certificate
- ✓ Inspection Reports
- ✓ Packing and Identification

27.18 Acceptance Criteria

Products should be accepted only when they:

- Meet the applicable ASTM and ASME specifications.



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Viththalbhai Patel Road, Sikkanagar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

- Conform to project drawings and purchase requirements.
- Pass required inspections and tests.
- Have complete traceability and documentation.
- Are free from unacceptable defects according to the applicable acceptance criteria.

27.19 Common Inspection Non-Conformities

Typical issues identified during inspection include:

- Incorrect material identification.
- Dimensional deviations.
- Surface defects.
- Incomplete traceability.
- Inadequate documentation.
- Improper marking.
- Weld discontinuities.
- Mechanical test failures.
- Heat treatment discrepancies.

Prompt corrective action helps prevent delays and ensures product quality.

27.20 Best Practices for Quality Assurance

To achieve consistent product quality:

- Source certified raw materials.
 - Maintain full material traceability.
 - Calibrate inspection equipment regularly.
 - Use qualified inspectors and technicians.
 - Implement documented inspection plans.
 - Perform required NDT and mechanical testing.
 - Retain quality records for future reference.
 - Review customer specifications before production.
 - Conduct final inspection before shipment.
 - Promote continuous improvement through internal audits and corrective actions.
-



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vitthalbhai Patel Road, Sikkanagar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

Chapter Summary

Inspection, testing, and quality assurance are fundamental to the successful manufacture of Stainless Steel 347H Elbows. A robust quality system, supported by qualified personnel, calibrated equipment, documented procedures, and comprehensive testing, helps ensure that each fitting meets applicable standards and performs reliably throughout its service life. By integrating quality control into every stage of production—from raw material receipt to final shipment—manufacturers can consistently deliver products that satisfy engineering specifications, regulatory requirements, and customer expectations.

Prepared By: STAINLESS INDIA
Website: www.stainlessindia.net
Email: info@stainlessindia.net
Phone: +91 97680 42420
Location: Mumbai, Maharashtra, India
Edition: First Edition – 2026
Dated : 11.07.2026
© 2026 STAINLESS INDIA.
All rights reserved.



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vithalbhair Patel Road, Sikkannagar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

Chapter 28 – International Standards, Certifications & Material Traceability for Stainless Steel 347H Elbows

28.1 Introduction

International standards, certifications, and material traceability form the foundation of quality assurance in the manufacture and supply of Stainless Steel 347H Elbows. Compliance with recognized standards ensures that products meet the required chemical composition, mechanical properties, dimensional accuracy, inspection requirements, and performance expectations for pressure piping applications.

For industries such as oil & gas, petrochemical, power generation, LNG, offshore, marine, pharmaceutical, and chemical processing, adherence to internationally accepted standards is essential for safety, reliability, regulatory compliance, and long-term operational performance.

28.2 Importance of International Standards

International standards provide a common technical framework for manufacturers, engineers, procurement teams, inspectors, and end users.

The benefits include:

- Uniform product quality
- Global interchangeability
- Reliable engineering performance
- Consistent inspection methods
- Improved safety
- Simplified procurement
- Regulatory compliance
- Reduced project risk

Using standardized products also facilitates maintenance, replacement, and compatibility across multinational projects.

28.3 ASTM A403 / A403M

Overview

ASTM A403/A403M is the primary material specification for wrought austenitic stainless steel butt weld fittings intended for pressure piping applications.

It defines requirements for:

- Chemical composition
- Mechanical properties
- Manufacturing processes
- Heat treatment
- Testing



STAINLESS INDIA
Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vithalbhair Patel Road, Sikkannagar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

- Inspection
- Product marking
- Certification

Grade WP347H is included within this specification and is intended for elevated-temperature service.

Products Covered

ASTM A403 includes:

- 45° Elbows
- 90° Elbows
- 180° Return Elbows
- Equal Tees
- Reducing Tees
- Reducers
- Caps
- Stub Ends
- Crosses
- Special Buttweld Fittings

28.4 ASME SA403

Overview

ASME SA403 is the corresponding specification adopted within the ASME Boiler and Pressure Vessel Code for pressure-retaining components.

The specification is substantially equivalent to ASTM A403 but is referenced within ASME construction codes.

Typical applications include:

- Pressure vessels
- Boilers
- Process piping
- Steam systems
- Power plants
- Refineries
- Petrochemical facilities

28.5 ASME B16.9



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vithalbhair Patel Road, Sikkannagar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

ASME B16.9 establishes standardized dimensions and tolerances for factory-made wrought butt welding fittings.

The standard specifies:

- Center-to-end dimensions
- Wall thickness tolerances
- End preparation
- Bevel geometry
- Dimensional accuracy
- Manufacturing tolerances

Compliance with ASME B16.9 ensures interchangeability and compatibility within piping systems.

28.6 ASME B16.28

ASME B16.28 covers wrought steel short-radius elbows and return bends used in piping systems where compact layouts are required.

Typical products include:

- Short Radius 90° Elbows
- Short Radius 180° Return Bends

These fittings are commonly used where installation space is limited.

28.7 MSS SP-43

Manufacturers may also supply lightweight corrosion-resistant stainless steel butt welded fittings in accordance with MSS SP-43 where applicable.

The standard primarily addresses:

- Lightweight wall thicknesses
- Stainless steel fittings
- Corrosion-resistant service

Project specifications should identify whether MSS SP-43 or ASME B16.9 applies.

28.8 EN 10204 Inspection Documents

EN 10204 defines inspection documents supplied with metallic products.

The two most frequently requested document types are:



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vithalbhai Patel Road, Sikkangar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

EN 10204 Type 3.1

Prepared by the manufacturer.

Confirms:

- Material grade
- Heat number
- Chemical composition
- Mechanical properties
- Inspection results

The document is validated by the manufacturer's authorized inspection representative.

EN 10204 Type 3.2

Includes independent verification by an authorized third-party inspector or purchaser's representative in addition to the manufacturer's documentation.

Type 3.2 certification is commonly required for:

- Offshore projects
- Nuclear facilities
- LNG plants
- Critical pressure systems
- Government projects

28.9 Material Test Certificate (MTC)

A Material Test Certificate provides documented evidence that the supplied material complies with the specified standard.

A typical MTC includes:

- Manufacturer details
- Customer details
- Purchase order reference
- Heat number
- Material grade
- Product dimensions
- Chemical composition
- Mechanical properties
- Heat treatment information (where applicable)
- Inspection results
- Applicable specification



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vithalbhair Patel Road, Sikkandhar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

- Authorized signature

The MTC should remain traceable to the original manufacturing records.

28.10 Material Traceability

Material traceability ensures that every finished elbow can be linked back to its original raw material.

Typical traceability information includes:

- Heat Number
- Batch Number
- Manufacturing Lot
- Production Date
- Inspection Records
- Material Certificates
- Test Reports

Complete traceability simplifies quality audits, maintenance, and failure investigations.

28.11 Heat Number Identification

Every production heat receives a unique heat number assigned during steelmaking.

The heat number enables verification of:

- Chemical composition
- Manufacturing history
- Mechanical test results
- Inspection records
- Certification documents

Heat numbers should remain legible throughout manufacturing, storage, and shipment.

28.12 Product Marking

Finished Stainless Steel 347H Elbows are typically marked with:

- Manufacturer's Name or Logo
- Material Grade (WP347H)
- Nominal Pipe Size
- Schedule
- Heat Number



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vithalbhai Patel Road, Sikkanagar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

- Standard Reference (ASTM A403 / ASME SA403)
- Production Identification
- Customer Marking (when specified)

Marking should remain clear and durable throughout handling and installation.

28.13 Third-Party Inspection

Many industrial projects require inspection by independent agencies before shipment.

Typical inspection activities include:

- Material verification
- Dimensional inspection
- Witnessing of specified tests
- Documentation review
- Final inspection
- Release authorization

Third-party inspection increases confidence that contractual and technical requirements have been met.

28.14 Quality Management Systems

Many manufacturers implement quality management systems certified to **ISO 9001:2015** to support consistent manufacturing processes, document control, corrective actions, and continual improvement.

Customers may also specify additional quality or environmental management requirements depending on the project.

28.15 Pressure Equipment Compliance

Projects may require compliance with regulations governing pressure equipment, such as the **Pressure Equipment Directive (PED) 2014/68/EU** for equipment placed on the European market.

The exact conformity assessment route depends on the product category, intended service, and applicable legal requirements.

28.16 Export Documentation

Typical export documentation may include:

- Commercial Invoice
- Packing List



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vithalbhai Patel Road, Sikkangar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

- Material Test Certificate
- Certificate of Origin
- Inspection Certificate (when specified)
- Bill of Lading or Air Waybill
- Insurance Documents (where applicable)
- Export Declaration

Documentation requirements vary depending on the destination country and contractual terms.

28.17 Buyer's Verification Checklist

Before accepting delivery, buyers should verify:

- ✓ Material Grade
- ✓ Heat Number
- ✓ Applicable ASTM/ASME Standard
- ✓ Product Dimensions
- ✓ Material Test Certificate
- ✓ EN 10204 Inspection Document (if specified)
- ✓ Chemical Analysis
- ✓ Mechanical Test Results
- ✓ Product Marking
- ✓ Traceability Records
- ✓ Inspection Reports
- ✓ Purchase Order Compliance

28.18 Common Certification Issues

Potential issues include:

- Incorrect material grade
- Missing heat numbers
- Incomplete certificates
- Illegible markings
- Missing inspection records
- Certificate inconsistencies
- Traceability gaps
- Incorrect dimensional documentation

Any discrepancies should be resolved before installation.



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vithalbhai Patel Road, Sikkanagar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

28.19 Best Practices

To maintain complete compliance:

- Purchase from qualified manufacturers.
- Verify certification before shipment.
- Maintain complete traceability records.
- Review all inspection documents.
- Confirm compliance with applicable codes and standards.
- Store certificates with project quality documentation.
- Preserve product markings until installation.
- Conduct incoming inspection upon receipt.

28.20 Chapter Summary

International standards, certifications, and material traceability are fundamental to ensuring the quality and reliability of Stainless Steel 347H Elbows. Compliance with ASTM A403/A403M, ASME SA403, ASME B16.9, and other applicable standards provides confidence that the fittings meet established requirements for manufacture, testing, and performance. Inspection documents such as EN 10204 Type 3.1 and Type 3.2, together with complete material traceability and documented quality assurance procedures, support regulatory compliance, simplify project audits, and help ensure safe operation throughout the service life of the piping system.



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vithalbhair Patel Road, Sikkangar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

Chapter 29 – Packaging, Marking & Export Documentation for Stainless Steel 347H Elbows

29.1 Introduction

Proper packaging, product marking, preservation, and export documentation are essential to ensure that Stainless Steel 347H Elbows reach the installation site in excellent condition while maintaining complete traceability and compliance with international shipping requirements.

Industrial piping components are often transported over long distances by road, rail, sea, or air. During transit they may be exposed to moisture, vibration, mechanical impact, dust, salt-laden atmospheres, and rough handling. A well-designed packaging and documentation system minimizes these risks and helps ensure successful project execution.

29.2 Objectives of Industrial Packaging

The primary objectives of packaging are to:

- Protect products from physical damage.
- Prevent corrosion and contamination.
- Maintain material traceability.
- Simplify loading and unloading.
- Facilitate customs clearance.
- Ensure safe transportation.
- Reduce handling damage.
- Preserve product quality until installation.

Proper packaging also reduces insurance claims, project delays, and replacement costs.

29.3 Packaging Standards

Packaging methods should be selected according to:

- Product dimensions.
- Product weight.
- Transportation method.
- Destination country.
- Customer specifications.
- Applicable export regulations.

Manufacturers should establish documented packaging procedures to ensure consistency and quality.

29.4 Product Cleaning Before Packing



STAINLESS INDIA
Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vitthalbhai Patel Road, Sikkanagar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

Before packaging, each SS 347H Elbow should be thoroughly cleaned to remove:

- Oil
- Grease
- Dirt
- Grinding particles
- Welding residues
- Moisture
- Iron contamination
- Dust

A clean product helps preserve corrosion resistance and presents a professional appearance upon delivery.

29.5 Surface Protection

Depending on customer requirements and shipping conditions, protective measures may include:

- Protective end caps
- Plastic wrapping
- Corrosion-inhibiting paper
- Moisture-resistant covers
- Shrink wrapping
- Protective separators between fittings

The selected protection method should prevent mechanical damage without contaminating the stainless steel surface.

29.6 Packaging Methods

Wooden Boxes

Suitable for:

- Small fittings
- Export shipments
- Air freight
- High-value products

Advantages:

- Excellent mechanical protection.
- Easy handling.



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vitthalbhai Patel Road, Sikkanagar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

- Reduced transit damage.

Wooden Crates

Recommended for:

- Heavy fittings
- Bulk shipments
- Sea transportation

Benefits:

- High load capacity.
- Good ventilation.
- Easy forklift handling.

Pallet Packing

Widely used for:

- Standard export orders
- Container shipments
- Warehouse storage

Advantages:

- Fast loading and unloading.
- Efficient space utilization.
- Improved inventory handling.

Steel Frame Packaging

Used for:

- Large-diameter elbows.
- Heavy-wall fittings.
- Oversized project cargo.

Provides excellent structural protection during long-distance transportation.

29.7 Export Packaging

Export packaging should be designed to withstand:



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vitthalbhai Patel Road, Sikkanagar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

- Long ocean voyages.
- Multiple loading operations.
- Humidity.
- Temperature fluctuations.
- Mechanical vibration.
- Container stacking.

Where appropriate, export packaging may include:

- Moisture barriers.
- Desiccant packs.
- Waterproof wrapping.
- Reinforced wooden crates.

29.8 Container Loading

Proper container loading minimizes transit damage.

Good practices include:

- Even weight distribution.
- Secure load restraint.
- Proper blocking and bracing.
- Adequate separation between products.
- Protection against movement during transport.

Incorrect loading can lead to deformation, surface damage, and packaging failure.

29.9 Product Marking

Every Stainless Steel 347H Elbow should be clearly identified.

Typical markings include:

- Manufacturer's Name or Logo.
- Material Grade (WP347H).
- Nominal Pipe Size (NPS).
- Schedule.
- Heat Number.
- ASTM/ASME Specification.
- Batch Number.
- Customer Purchase Order Number (if specified).

Marking should remain legible throughout transportation and storage.



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vithalbhai Patel Road, Sikkanagar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

29.10 Package Identification

Each package should display:

- Package Number.
- Gross Weight.
- Net Weight.
- Dimensions.
- Handling Instructions.
- Destination.
- Purchase Order Reference.
- Customer Name.
- Country of Origin.
- Number of Pieces.

Proper identification simplifies warehouse operations and customs clearance.

29.11 Handling Instructions

Packages should include internationally recognized handling symbols where applicable, such as:

- Keep Dry.
- Handle with Care.
- Do Not Drop.
- Use Forklift Here.
- Center of Gravity.
- This Side Up.

Clear handling instructions reduce the likelihood of transit damage.

29.12 Storage Recommendations

Before installation, Stainless Steel 347H Elbows should be stored:

- In clean, dry conditions.
- Away from standing water.
- Protected from carbon steel contamination.
- On suitable racks or pallets.
- Away from corrosive chemicals.
- In covered storage where practical.



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vittalbhai Patel Road, Sikkangar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

Proper storage preserves surface condition and material integrity.

29.13 Export Documentation

International shipments generally require comprehensive documentation.

Typical export documents include:

Commercial Invoice

Contains:

- Product description.
- Quantity.
- Unit price.
- Total value.
- Currency.
- Seller information.
- Buyer information.

Packing List

Includes:

- Number of packages.
- Product description.
- Quantity.
- Gross weight.
- Net weight.
- Package dimensions.

Material Test Certificate (MTC)

Provides:

- Material grade.
 - Heat number.
 - Chemical composition.
 - Mechanical properties.
 - Inspection results.
 - Applicable specifications.
-



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vitthalbhai Patel Road, Sikkanagar Girgaon,
Mumbai – 400 004.

SINCE 2016

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net



STAINLESS INDIA
A HOUSE OF QUALITY

Certificate of Origin (COO)

Confirms the country where the products were manufactured.

Many importing countries require this document for customs clearance or preferential trade agreements.

Inspection Certificate

Where specified, independent inspection agencies may issue certificates confirming compliance with contractual requirements.

Transport Documents

Depending on the mode of transport, documents may include:

- Bill of Lading (Sea Freight)
 - Air Waybill (Air Freight)
 - Road Consignment Note
 - Rail Transport Document
-

29.14 Shipping Terms (Incoterms)

International contracts often use Incoterms to define the responsibilities of buyers and sellers.

Common terms include:

- EXW (Ex Works)
- FCA (Free Carrier)
- FOB (Free On Board)
- CFR (Cost and Freight)
- CIF (Cost, Insurance and Freight)
- CPT (Carriage Paid To)
- CIP (Carriage and Insurance Paid To)
- DAP (Delivered at Place)
- DDP (Delivered Duty Paid)

The chosen Incoterm should be clearly stated in the purchase order and commercial invoice.

29.15 Export Quality Checklist

Before shipment, verify:



STAINLESS INDIA
Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vithalbhai Patel Road, Sikkanagar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

- ✓ Correct Material Grade
- ✓ Product Dimensions
- ✓ Heat Number
- ✓ Surface Condition
- ✓ Product Marking
- ✓ Protective Packaging
- ✓ Moisture Protection
- ✓ Packing List
- ✓ Commercial Invoice
- ✓ Material Test Certificate
- ✓ Certificate of Origin (if required)
- ✓ Inspection Certificate (if specified)
- ✓ Transport Documents

29.16 Common Packaging Mistakes

Common issues include:

- Inadequate product protection.
- Incorrect package labeling.
- Missing documentation.
- Poor weight distribution.
- Carbon steel contamination.
- Moisture ingress.
- Incomplete traceability.
- Improper handling during loading.

These issues can increase the risk of product damage, customs delays, and customer claims.

29.17 Best Practices

Manufacturers should:

- Use export-quality packaging materials.
- Maintain complete traceability.
- Protect stainless steel surfaces from contamination.
- Verify documentation before dispatch.
- Inspect packaging prior to shipment.
- Apply clear product markings.
- Train personnel in proper handling procedures.
- Retain shipping and inspection records for future reference.



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vithalbhai Patel Road, Sikkanagar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

29.18 Sustainability Considerations

Where practical, manufacturers should consider:

- Recyclable packaging materials.
- Efficient package design to reduce waste.
- Responsible timber sourcing for wooden crates.
- Optimized container loading to improve transportation efficiency.
- Proper disposal or recycling of packaging materials at the destination.

These practices can support environmental objectives while maintaining product protection.

29.19 Chapter Summary

Proper packaging, marking, and export documentation are critical components of the supply chain for Stainless Steel 347H Elbows. Effective packaging protects products from mechanical damage, moisture, and contamination, while clear marking and complete documentation ensure traceability, facilitate customs clearance, and support compliance with international trade requirements. By following recognized packaging practices, maintaining accurate documentation, and implementing thorough quality checks before shipment, manufacturers can deliver products safely and efficiently to customers worldwide while preserving their quality and reliability.



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vitthalbhai Patel Road, Sikkonagar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

Chapter 30 – Procurement Guide for Stainless Steel 347H Elbows

30.1 Introduction

The procurement of Stainless Steel 347H Elbows is a critical process that directly influences the safety, reliability, performance, and lifecycle cost of industrial piping systems. Selecting the right supplier and ensuring compliance with project specifications are essential for successful execution in industries such as oil & gas, petrochemical, power generation, LNG, chemical processing, marine, offshore, pharmaceutical, and EPC projects.

A well-planned procurement process minimizes technical risks, prevents project delays, and ensures that products meet applicable ASTM, ASME, and customer requirements.

30.2 Procurement Objectives

The primary objectives of procurement are to:

- Purchase products that fully comply with technical specifications.
 - Ensure reliable and consistent product quality.
 - Obtain competitive pricing without compromising quality.
 - Minimize delivery risks.
 - Maintain complete material traceability.
 - Verify inspection and testing requirements.
 - Ensure compliance with applicable international standards.
 - Support long-term operational reliability.
-

30.3 Define Technical Requirements

Before issuing a Request for Quotation (RFQ), clearly define the technical requirements.

Typical information includes:

- Material Grade (ASTM A403 WP347H)
- Applicable Standard (ASTM A403 / ASME SA403)
- Dimensional Standard (ASME B16.9 or ASME B16.28)
- Elbow Type (45°, 90°, 180°)
- Radius (Long Radius or Short Radius)
- Nominal Pipe Size (NPS)
- Schedule (SCH 10S, SCH 40S, SCH 80S, etc.)
- Quantity
- Design Pressure
- Design Temperature
- End Preparation



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vithalbhai Patel Road, Sikkanagar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

- Surface Finish
- Heat Treatment Requirements (if applicable)
- Inspection Requirements
- Documentation Requirements

Providing complete specifications reduces the possibility of quotation errors and procurement disputes.

30.4 Preparing the Request for Quotation (RFQ)

A comprehensive RFQ should include:

- Technical specifications
- Applicable codes and standards
- Drawings (if required)
- Quantity and delivery schedule
- Inspection requirements
- Certification requirements
- Packaging requirements
- Destination details
- Commercial terms
- Payment terms

A well-prepared RFQ enables suppliers to submit accurate and comparable quotations.

30.5 Supplier Evaluation

Selecting a qualified supplier is one of the most important procurement decisions.

Evaluate suppliers based on:

- Manufacturing capability
- Industry experience
- Product quality
- Compliance with international standards
- Quality management system
- Production capacity
- Delivery performance
- Technical support
- Customer references
- Financial stability

Long-term supplier relationships often improve quality consistency and supply reliability.



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vithalbhair Patel Road, Sikkangar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

30.6 Technical Bid Evaluation

Technical evaluation should verify:

- Material compliance
- Applicable standards
- Manufacturing process
- Inspection capability
- Heat treatment procedures
- Testing facilities
- Welding qualifications (if applicable)
- Quality documentation
- Packaging method

Only technically acceptable bids should proceed to commercial evaluation.

30.7 Commercial Evaluation

Commercial assessment should consider:

- Unit price
- Total project cost
- Delivery schedule
- Freight charges
- Payment terms
- Warranty conditions
- Taxes and duties
- Currency
- Incoterms

The lowest quotation is not always the most economical choice when lifecycle costs and project risks are considered.

30.8 Manufacturer Qualification Checklist

Before placing an order, verify that the manufacturer can provide:

- ✓ ASTM A403 WP347H fittings
- ✓ ASME B16.9 compliance
- ✓ EN 10204 Type 3.1 Material Test Certificates



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vithalbhai Patel Road, Sikkanagar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

- ✓ Positive Material Identification (PMI), if required
 - ✓ Non-Destructive Testing (NDT), where specified
 - ✓ Heat treatment records
 - ✓ Dimensional inspection reports
 - ✓ Complete material traceability
 - ✓ Export-quality packaging
-

30.9 Inspection Requirements

Procurement documents should clearly specify inspection requirements.

Typical inspections include:

- Visual Inspection
- Dimensional Inspection
- Chemical Analysis
- Mechanical Testing
- Positive Material Identification (PMI)
- Liquid Penetrant Testing (PT)
- Radiographic Testing (RT), where specified
- Ultrasonic Testing (UT), where applicable
- Hydrostatic Testing (if required)
- Final Inspection

Inspection requirements should align with the purchase specification and applicable codes.

30.10 Third-Party Inspection

Many EPC and international projects require independent inspection agencies.

Typical third-party activities include:

- Raw material verification
- Stage inspections
- Witnessing of specified tests
- Documentation review
- Final inspection
- Shipment release

Independent inspection enhances confidence in product quality and compliance.

30.11 Documentation Requirements



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vitthalbhai Patel Road, Sikkanagar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

The supplier should provide all required documentation before shipment.

Typical documents include:

- Commercial Invoice
- Packing List
- Material Test Certificate (EN 10204 Type 3.1)
- Chemical Analysis Report
- Mechanical Test Report
- Dimensional Inspection Report
- Heat Treatment Records (if applicable)
- PMI Report (if specified)
- NDT Reports (where required)
- Certificate of Origin (if required)
- Inspection Certificate (if applicable)

30.12 Material Traceability

Each fitting should be traceable to its original manufacturing records.

Traceability should include:

- Heat Number
- Batch Number
- Material Grade
- Manufacturing Lot
- Inspection Reports
- Material Test Certificates

Maintaining traceability throughout the supply chain supports quality assurance and future maintenance.

30.13 Delivery Planning

Delivery schedules should consider:

- Manufacturing lead time
- Inspection schedule
- Documentation preparation
- Export packing
- Transportation
- Customs clearance
- Site delivery requirements



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vithalbhai Patel Road, Sikkanagar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

Early planning reduces the risk of project delays.

30.14 Packaging Requirements

Purchase orders should specify packaging requirements, including:

- Wooden boxes or crates
- Pallet packing
- Moisture protection
- Protective end caps
- Product marking
- Export-worthy packaging
- Customer-specific labeling

Proper packaging minimizes transportation damage.

30.15 Common Procurement Risks

Potential procurement risks include:

- Incorrect material grade
- Incomplete specifications
- Missing certifications
- Delayed delivery
- Poor documentation
- Inadequate traceability
- Packaging damage
- Supplier quality issues
- Non-compliance with project standards

Risk assessment should be part of the procurement planning process.

30.16 Cost vs. Lifecycle Value

Initial purchase price represents only one part of the total ownership cost.

Lifecycle cost may include:

- Maintenance
- Inspection
- Repairs



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vithalbhair Patel Road, Sikkangar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

- Downtime
- Replacement
- Operational efficiency
- Service life

Selecting higher-quality materials may reduce long-term operating expenses.

30.17 Procurement Best Practices

For successful procurement:

- Prepare detailed technical specifications.
- Purchase from qualified manufacturers.
- Verify compliance with ASTM and ASME standards.
- Review all inspection documentation.
- Specify traceability requirements.
- Clearly define delivery schedules.
- Include packaging requirements in the purchase order.
- Conduct incoming inspection upon receipt.
- Maintain complete procurement records.

30.18 Common Buying Mistakes

Avoid the following mistakes:

- Selecting suppliers based only on the lowest price.
- Omitting inspection requirements from the purchase order.
- Failing to verify material certificates.
- Ignoring traceability requirements.
- Accepting incomplete documentation.
- Using non-qualified suppliers.
- Overlooking transportation and packaging requirements.
- Approving material substitutions without engineering review.

30.19 Procurement Checklist

Before issuing the purchase order, confirm:

- ✓ **Material Grade – ASTM A403 WP347H**
- ✓ **Applicable Standard**
- ✓ **Product Dimensions**



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vithalbhai Patel Road, Sikkanagar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

- ✓ Quantity
 - ✓ Delivery Schedule
 - ✓ Inspection Requirements
 - ✓ Third-Party Inspection (if applicable)
 - ✓ Material Test Certificate
 - ✓ Traceability Requirements
 - ✓ Packaging Requirements
 - ✓ Export Documentation
 - ✓ Commercial Terms
 - ✓ Warranty Conditions
-

30.20 Supplier Performance Evaluation

Following project completion, suppliers should be evaluated based on:

- Product quality
- Delivery performance
- Documentation accuracy
- Responsiveness
- Technical support
- Inspection compliance
- Packaging quality
- Overall customer satisfaction

Regular supplier evaluations support continuous improvement and strengthen long-term procurement strategies.

30.21 Chapter Summary

Effective procurement of Stainless Steel 347H Elbows requires careful planning, comprehensive technical specifications, supplier qualification, rigorous inspection, complete documentation, and lifecycle cost evaluation. By following a structured procurement process and working with qualified manufacturers, organizations can reduce project risks, improve quality, maintain regulatory compliance, and ensure reliable performance throughout the service life of the piping system. Successful procurement is not solely about obtaining the lowest price—it is about securing the best overall value, quality, and long-term operational reliability.



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vitthalbhai Patel Road, Sikkanagar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

Chapter 31 – Failure Analysis & Troubleshooting of Stainless Steel 347H Elbows

31.1 Introduction

Failure analysis is a systematic engineering process used to determine the root cause of damage, leakage, deformation, corrosion, or premature failure in Stainless Steel 347H Elbows. Rather than simply replacing a failed fitting, engineers should identify the underlying cause to prevent recurrence and improve the reliability of the piping system.

Stainless Steel 347H is recognized for its excellent high-temperature strength, oxidation resistance, and resistance to intergranular corrosion. However, failures can still occur if the material is incorrectly selected, improperly fabricated, inadequately inspected, or operated outside its intended service conditions.

This chapter discusses common failure mechanisms, diagnostic methods, troubleshooting procedures, and preventive measures for SS 347H Elbows.

31.2 Objectives of Failure Analysis

The primary objectives are to:

- Determine the root cause of failure.
- Prevent recurrence.
- Improve system reliability.
- Reduce maintenance costs.
- Increase plant availability.
- Enhance personnel safety.
- Support continuous improvement.

A structured failure analysis also provides valuable feedback for design, fabrication, inspection, and maintenance teams.

31.3 Failure Analysis Methodology

A systematic investigation typically includes:

Step 1 – Collect Background Information

Gather details such as:

- Service history
- Operating pressure
- Operating temperature
- Process fluid
- Installation date
- Maintenance records



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vithalbhair Patel Road, Sikkannagar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

- Inspection history
- Previous repairs

Step 2 – Visual Examination

Inspect for:

- Cracks
- Leaks
- Corrosion
- Discoloration
- Deformation
- Mechanical damage
- Weld condition
- Surface contamination

Photographs and sketches should be recorded before dismantling the component.

Step 3 – Dimensional Verification

Measure:

- Outside diameter
- Wall thickness
- Ovality
- Radius
- Alignment
- Distortion

Compare measurements with applicable design drawings and standards.

Step 4 – Material Verification

Confirm material identity using:

- Positive Material Identification (PMI)
- Material Test Certificate (MTC)
- Heat Number Traceability
- Chemical Analysis (if required)

Incorrect material substitution is a common cause of premature failure.



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vithalbhair Patel Road, Sikkangar Girgaon,
Mumbai – 400 004.

SINCE 2016

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net



STAINLESS INDIA
A HOUSE OF QUALITY

Step 5 – Laboratory Investigation

Where appropriate, additional testing may include:

- Metallographic examination
 - Hardness testing
 - Mechanical testing
 - Fractography
 - Non-Destructive Testing (NDT)
-

31.4 Common Failure Mechanisms

Corrosion

Corrosion is one of the most common causes of piping system deterioration.

Potential forms include:

- General corrosion
- Pitting corrosion
- Crevice corrosion
- Intergranular corrosion
- Galvanic corrosion
- Erosion-corrosion

The dominant corrosion mechanism depends on process chemistry, temperature, flow conditions, and material selection.

Pitting Corrosion

Characteristics

- Small, localized pits
- Rapid penetration
- Difficult visual detection
- Possible leakage

Typical Causes

- Chloride-rich environments
- Surface contamination
- Damaged passive film
- Poor maintenance



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vithalbhair Patel Road, Sikkannagar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

Prevention

- Select materials suitable for the service environment.
 - Maintain clean stainless steel surfaces.
 - Avoid contamination with carbon steel.
 - Implement regular inspections.
-

Crevice Corrosion

Occurs within narrow gaps where stagnant process fluid allows localized chemical changes.

Common locations include:

- Gasket interfaces
- Flanged joints
- Threaded connections
- Deposits beneath insulation or debris

Good design and maintenance practices help reduce crevice formation.

Intergranular Corrosion

Intergranular corrosion occurs along grain boundaries when chromium depletion has taken place.

SS 347H is stabilized with niobium, which significantly improves resistance to this form of corrosion, particularly after welding. Nevertheless, improper fabrication or service conditions outside the intended operating range may still contribute to degradation.

Stress Corrosion Cracking (SCC)

SCC may develop under the combined influence of:

- Tensile stress
- Susceptible material
- Specific corrosive environments

Chloride-containing environments at elevated temperatures can increase the risk for many austenitic stainless steels.

Prevention

- Minimize residual stresses where practical.
- Evaluate service chemistry.
- Consider alternative materials for severe chloride environments.
- Follow appropriate fabrication and maintenance practices.



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vithalbhair Patel Road, Sikkannagar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

Erosion-Corrosion

High-velocity fluids containing abrasive particles may gradually remove the protective passive film, accelerating metal loss.

Typical contributing factors include:

- Excessive flow velocity
- Sand or solid particles
- Cavitation
- Turbulence

Proper piping design and operating conditions help reduce this risk.

31.5 High-Temperature Damage

Thermal Fatigue

Repeated heating and cooling cycles can cause fatigue cracking.

Common causes:

- Frequent startup and shutdown
- Rapid temperature changes
- Poor expansion design
- Inadequate pipe support

Prevention

- Design for thermal expansion.
 - Avoid rapid thermal cycling where possible.
 - Inspect high-stress areas during maintenance.
-

Creep

During prolonged service at elevated temperatures, materials may deform slowly under constant stress.

SS 347H offers excellent creep resistance compared with many general-purpose stainless steels, making it suitable for steam systems and refinery service.

Proper design within applicable code limits remains essential.

31.6 Welding-Related Failures

Potential welding issues include:



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vitthalbhai Patel Road, Sikkanagar Girgaon,
Mumbai – 400 004.

SINCE 2016

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net



STAINLESS INDIA
A HOUSE OF QUALITY

- Lack of fusion
- Incomplete penetration
- Porosity
- Slag inclusions
- Undercut
- Excessive distortion
- Weld cracking

Prevention

- Use qualified welding procedures.
- Employ certified welders.
- Maintain proper joint preparation.
- Follow approved inspection procedures.

31.7 Mechanical Failures

Mechanical failures may result from:

- Excessive pressure
- Improper installation
- External impact
- Vibration
- Unsupported piping
- Fatigue loading

Proper engineering design and support systems reduce these risks.

31.8 Installation Errors

Common installation issues include:

- Misalignment
- Incorrect fit-up
- Excessive welding stress
- Improper supports
- Over-tightening during assembly
- Incorrect orientation

Proper installation according to approved procedures is essential for long-term reliability.



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vithalbhai Patel Road, Sikkangar Girgaon,
Mumbai – 400 004.

SINCE 2016

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net



STAINLESS INDIA
A HOUSE OF QUALITY

31.9 Material Selection Errors

Incorrect material selection remains one of the leading causes of premature piping failures.

Examples include:

- Using carbon steel in corrosive environments.
- Selecting a material without considering chloride exposure.
- Ignoring operating temperature requirements.
- Substituting materials without engineering approval.

Material selection should always consider process conditions, applicable standards, and lifecycle performance.

31.10 Root Cause Analysis (RCA)

A structured Root Cause Analysis typically includes:

4. Define the problem.
5. Collect evidence.
6. Identify contributing factors.
7. Evaluate possible causes.
8. Confirm the root cause.
9. Develop corrective actions.
10. Implement preventive measures.
11. Verify effectiveness.

Structured RCA methods such as the “5 Whys” or Fishbone (Ishikawa) analysis may be used where appropriate.

31.11 Troubleshooting Guide

Problem	Possible Cause	Recommended Action
Leakage	Damaged weld, gasket failure, excessive pressure	Inspect joints, repair or replace defective components, verify operating conditions
Surface Rust Stains	Carbon steel contamination or inadequate cleaning	Clean surface, remove contamination, restore passive layer where appropriate
Pitting Corrosion	Chloride exposure	Review service conditions and material selection; inspect affected areas
Distortion	Improper welding or thermal stress	Review welding procedures and support arrangements
Excessive Vibration	Inadequate pipe support	Install or modify supports and restraints



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vithalbhair Patel Road, Sikkannagar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

Problem	Possible Cause	Recommended Action
Premature Failure	Incorrect material selection	Verify material grade and evaluate suitability for service

31.12 Preventive Maintenance

Routine preventive maintenance should include:

- Visual inspection
- Leak detection
- Support inspection
- Corrosion monitoring
- Surface cleaning
- Documentation review
- Periodic NDT where required

Preventive maintenance reduces unplanned shutdowns and extends service life.

31.13 Failure Documentation

Each failure investigation should record:

- Equipment identification
- Date of failure
- Operating conditions
- Photographs
- Inspection findings
- Laboratory results
- Root cause
- Corrective actions
- Preventive recommendations

Comprehensive records support future troubleshooting and continuous improvement.

31.14 Engineering Best Practices

To minimize failures:

- Select materials based on process conditions.
- Verify compliance with applicable ASTM and ASME standards.
- Maintain complete material traceability.



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vithalbhair Patel Road, Sikkannagar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

- Use qualified welding procedures and trained personnel.
- Conduct required inspections and testing.
- Design for thermal expansion and mechanical loading.
- Implement preventive maintenance programs.
- Investigate failures systematically before replacement.

31.15 Chapter Summary

Failure analysis is an essential component of reliability engineering for Stainless Steel 347H Elbows. Although SS 347H provides excellent high-temperature strength, corrosion resistance, and weldability, failures may still occur because of incorrect material selection, fabrication defects, installation errors, aggressive service conditions, or inadequate maintenance. A structured approach involving inspection, material verification, testing, and root cause analysis enables engineers to identify failure mechanisms accurately and implement effective corrective actions. By combining proper material selection, quality manufacturing, sound engineering design, and preventive maintenance, organizations can maximize the safety, performance, and service life of their piping systems.



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vitthalbhai Patel Road, Sikkanagar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

Chapter 32 – Maintenance & Best Practices for Stainless Steel 347H Elbows

32.1 Introduction

Stainless Steel 347H Elbows are designed for reliable service in high-temperature and pressure piping systems used in refineries, petrochemical plants, power stations, chemical processing facilities, LNG terminals, marine installations, and other demanding industries. Although SS 347H provides excellent corrosion resistance, weldability, and high-temperature strength, regular maintenance remains essential for maximizing service life and ensuring safe plant operation.

An effective maintenance program helps prevent unexpected failures, reduces downtime, lowers operating costs, and improves overall system reliability.

32.2 Objectives of Maintenance

The objectives of a preventive maintenance program are to:

- Extend equipment service life.
 - Prevent unexpected failures.
 - Detect deterioration at an early stage.
 - Maintain safe plant operation.
 - Reduce maintenance costs.
 - Improve equipment reliability.
 - Support regulatory compliance.
 - Preserve complete inspection records.
-

32.3 Maintenance Strategy

An effective maintenance strategy generally combines:

Preventive Maintenance

Planned inspections and servicing performed at scheduled intervals to reduce the likelihood of equipment failure.

Predictive Maintenance

Monitoring equipment condition using inspection techniques and operating data to identify developing problems before failure occurs.

Corrective Maintenance

Repair or replacement performed after defects are identified during inspections or operation.

The appropriate strategy should be selected based on plant criticality, service conditions, and



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vithalbhair Patel Road, Sikkangar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

maintenance philosophy.

32.4 Inspection Schedule

Inspection frequency depends on:

- Operating temperature.
- Operating pressure.
- Process fluid.
- Corrosion environment.
- Service history.
- Applicable regulations.
- Risk assessment.

Critical process lines generally require more frequent inspections than non-critical utility systems.

32.5 Routine Visual Inspection

Routine visual inspections should check for:

- Leakage.
- Corrosion.
- Surface staining.
- Mechanical damage.
- Weld condition.
- Vibration.
- Pipe support condition.
- Insulation damage.
- Product identification and marking.

Visual inspection is one of the simplest and most effective maintenance tools.

32.6 Surface Cleaning

Clean stainless steel surfaces help maintain corrosion resistance.

Recommended practices include:

- Removing dirt and process deposits.
- Cleaning oil and grease.
- Eliminating iron contamination.
- Rinsing with clean water where appropriate.



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vitthalbhai Patel Road, Sikkangar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

- Drying components after cleaning.

Cleaning methods should be compatible with stainless steel and the service environment.

32.7 Corrosion Monitoring

Maintenance personnel should monitor for:

- General corrosion.
- Pitting corrosion.
- Crevice corrosion.
- Surface discoloration.
- Deposits.
- Scaling.

Areas exposed to aggressive chemicals or chloride-containing environments should receive additional attention.

32.8 Inspection of Welded Joints

Welded joints should be examined for:

- Surface cracks.
- Corrosion.
- Distortion.
- Leakage.
- Heat tint.
- Mechanical damage.

Where required, appropriate Non-Destructive Testing (NDT) may be used to supplement visual inspections.

32.9 Pipe Support Inspection

Pipe supports should be checked for:

- Loose fasteners.
- Excessive movement.
- Corrosion.
- Misalignment.
- Wear.
- Damaged insulation.



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vithalbhair Patel Road, Sikkangar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

- Foundation condition.

Proper support prevents excessive stress on elbows and other piping components.

32.10 Thermal Expansion Monitoring

High-temperature piping systems experience thermal expansion during operation.

Maintenance inspections should verify:

- Expansion loops.
- Pipe guides.
- Anchors.
- Sliding supports.
- Expansion joints (where installed).

Restricted thermal movement can increase stress within the piping system.

32.11 Vibration Monitoring

Excessive vibration may indicate:

- Flow instability.
- Inadequate supports.
- Pump problems.
- Compressor issues.
- Mechanical resonance.

Persistent vibration should be investigated promptly to prevent fatigue damage.

32.12 Leak Detection

Routine inspections should identify:

- Process leaks.
- Steam leaks.
- Condensate leakage.
- Joint leakage.
- Weld leakage.

Even minor leaks should be investigated because they may indicate developing mechanical or corrosion-related problems.



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vithalbhair Patel Road, Sikkangar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

32.13 Insulation Inspection

Where insulation is installed, maintenance personnel should inspect for:

- Water ingress.
- Damaged cladding.
- Corrosion under insulation (CUI) risk.
- Mechanical damage.
- Missing insulation.

Although stainless steels generally provide good corrosion resistance, moisture trapped beneath insulation can contribute to localized corrosion under certain service conditions.

32.14 Positive Material Identification (PMI)

PMI may be performed during maintenance activities to verify material identity before repairs or modifications.

Material verification is particularly important when:

- Components are replaced.
- New branches are added.
- Repair welding is performed.
- Historical documentation is incomplete.

32.15 Replacement Criteria

Replacement should be considered when inspections identify:

- Significant wall thinning.
- Unacceptable cracking.
- Severe corrosion.
- Excessive deformation.
- Leakage that cannot be satisfactorily repaired.
- Non-compliance with applicable engineering requirements.

Engineering assessment should determine whether repair or replacement is the most appropriate solution.

32.16 Spare Parts Management

A spare parts program should include:



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vittalbhai Patel Road, Sikkangar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

- Standard elbow sizes.
- Frequently used schedules.
- Material certificates.
- Traceability records.
- Proper storage conditions.

Maintaining critical spare components helps reduce downtime during maintenance or emergency repairs.

32.17 Storage Best Practices

Stored SS 347H Elbows should be:

- Kept in clean, dry locations.
- Protected from standing water.
- Separated from carbon steel materials where practical.
- Protected from mechanical damage.
- Clearly identified with material grade and heat number.

Proper storage helps preserve surface condition and traceability.

32.18 Maintenance Documentation

Maintenance records should include:

- Inspection dates.
- Equipment identification.
- Inspection findings.
- Repairs performed.
- Replacement history.
- Material certificates.
- NDT reports (where applicable).
- Corrective actions.
- Responsible personnel.

Well-maintained records support future inspections, audits, and reliability analysis.

32.19 Preventive Maintenance Checklist

During routine maintenance, verify:

✓ Surface Condition



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vithalbhair Patel Road, Sikkannagar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

- ✓ Weld Integrity
 - ✓ Corrosion
 - ✓ Leakage
 - ✓ Pipe Supports
 - ✓ Thermal Expansion Components
 - ✓ Vibration
 - ✓ Product Identification
 - ✓ Insulation Condition
 - ✓ Traceability Records
 - ✓ Maintenance Documentation
 - ✓ Corrective Actions Completed
-

32.20 Best Practices for Long-Term Reliability

To maximize the service life of Stainless Steel 347H Elbows:

- Select the correct material for the intended service.
 - Follow applicable engineering standards.
 - Use qualified welding procedures.
 - Perform scheduled inspections.
 - Maintain clean stainless steel surfaces.
 - Protect against carbon steel contamination.
 - Monitor high-temperature systems regularly.
 - Investigate abnormal vibration or leakage promptly.
 - Maintain complete inspection and maintenance records.
 - Train maintenance personnel in stainless steel handling and inspection practices.
-

32.21 Common Maintenance Mistakes

Avoid the following:

- Delaying inspection after leakage is detected.
- Ignoring minor corrosion or staining.
- Mixing stainless steel with carbon steel tools without proper precautions.
- Failing to verify replacement material.
- Omitting maintenance documentation.
- Using unsuitable cleaning chemicals.
- Neglecting pipe supports and thermal expansion devices.

Preventing these mistakes improves safety and reduces lifecycle costs.



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vitthalbhai Patel Road, Sikkannagar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

32.22 Lifecycle Management

Effective lifecycle management combines:

- Proper material selection.
- Quality manufacturing.
- Correct installation.
- Routine inspection.
- Preventive maintenance.
- Timely repairs.
- Accurate documentation.
- Continuous improvement.

A lifecycle approach helps maximize asset reliability and operational efficiency.

32.23 Chapter Summary

Regular maintenance is essential for achieving the full performance potential of Stainless Steel 347H Elbows. A structured maintenance program that includes routine inspections, corrosion monitoring, support verification, vibration assessment, leak detection, and comprehensive documentation can significantly extend service life and reduce the risk of unplanned failures. By following recognized engineering practices, maintaining complete traceability, and addressing developing issues promptly, plant operators can ensure that SS 347H piping systems continue to operate safely, efficiently, and reliably throughout their intended service life.



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vitthalbhai Patel Road, Sikkanagar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

Chapter 33A – Frequently Asked Questions (FAQs 1–25) About Stainless Steel 347H Elbows

Introduction

This chapter answers the most common technical questions about Stainless Steel 347H Elbows. The information is intended for engineers, procurement professionals, EPC contractors, QA/QC inspectors, plant operators, maintenance personnel, and industrial buyers. Answers are based on generally accepted engineering practices and should always be verified against the applicable project specifications, material standards, and design codes.

FAQ 1. What is a Stainless Steel 347H Elbow?

A Stainless Steel 347H Elbow is a butt weld pipe fitting manufactured from ASTM A403 WP347H material that changes the direction of fluid flow in a piping system. It is specifically designed for elevated-temperature and pressure applications where high strength, oxidation resistance, and resistance to sensitization are required.

FAQ 2. What does “347H” mean?

347H is the high-carbon version of Grade 347 stainless steel. The increased carbon content improves creep resistance and high-temperature strength while niobium stabilization helps reduce chromium carbide precipitation during welding and elevated-temperature service.

FAQ 3. What is ASTM A403 WP347H?

ASTM A403 WP347H is the standard specification covering wrought austenitic stainless steel butt weld fittings for pressure piping applications. It defines requirements for chemical composition, mechanical properties, manufacturing, testing, inspection, marking, and certification.

FAQ 4. Why is niobium added to Stainless Steel 347H?

Niobium (also known as columbium) stabilizes the alloy by preferentially combining with carbon. This helps reduce chromium carbide precipitation, improving resistance to sensitization and intergranular corrosion after welding and during elevated-temperature service.

FAQ 5. What industries commonly use SS 347H Elbows?

Typical industries include:

- Oil & Gas
- Petrochemical



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vithalbhai Patel Road, Sikkanagar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

- Refineries
- Power Generation
- Chemical Processing
- LNG Facilities
- Fertilizer Plants
- Marine Engineering
- Offshore Platforms
- Heat Exchanger Manufacturing
- Boiler Systems
- Process Piping

FAQ 6. What are the common elbow angles available?

Common configurations include:

- 45° Elbow
- 90° Elbow
- 180° Return Elbow

Custom angles may also be manufactured for specific project requirements.

FAQ 7. What is the difference between a Long Radius (LR) and Short Radius (SR) elbow?

A Long Radius (LR) elbow has a centerline radius equal to 1.5 times the nominal pipe size (1.5D), resulting in smoother flow and lower pressure loss. A Short Radius (SR) elbow has a centerline radius equal to the nominal pipe size (1D), making it suitable where installation space is limited.

FAQ 8. Which standards govern SS 347H Elbows?

Commonly referenced standards include:

- ASTM A403 / A403M
- ASME SA403
- ASME B16.9
- ASME B16.28 (for applicable short-radius fittings)
- MSS SP-43 (where applicable)
- EN 10204 (inspection documents)

The applicable standard depends on the project specification.



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vithalbhai Patel Road, Sikkanagar Girgaon,
Mumbai – 400 004.

SINCE 2016

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net



STAINLESS INDIA
A HOUSE OF QUALITY

FAQ 9. Are SS 347H Elbows seamless or welded?

They are available in both seamless and welded construction. The selection depends on size, wall thickness, manufacturing capability, project requirements, and applicable standards.

FAQ 10. What sizes are available?

Manufacturers commonly supply sizes from **NPS ½ through NPS 48** and larger by special order, subject to manufacturing capability and project requirements.

FAQ 11. Which wall thicknesses (schedules) are available?

Common schedules include:

- SCH 5S
- SCH 10S
- SCH 20
- SCH 40S
- SCH 80S
- SCH 120
- SCH 160
- XXS

Availability depends on size and manufacturer.

FAQ 12. What are the advantages of SS 347H over SS 304?

Compared with SS 304, SS 347H generally provides:

- Better elevated-temperature strength
- Improved creep resistance
- Better resistance to sensitization after welding
- Improved long-term thermal stability

FAQ 13. How does SS 347H compare with SS 316?

SS 316 generally offers improved resistance to chloride-induced corrosion because of its molybdenum content, while SS 347H is optimized for elevated-temperature service through niobium stabilization and enhanced creep strength.



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vitthalbhai Patel Road, Sikkanagar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

FAQ 14. Is SS 347H suitable for high-temperature service?

Yes. SS 347H is specifically developed for prolonged elevated-temperature applications such as steam systems, refinery piping, boilers, and petrochemical processing.

FAQ 15. Is SS 347H resistant to corrosion?

Yes. SS 347H offers excellent resistance to atmospheric corrosion, oxidation, and many industrial environments. However, material suitability should always be evaluated against the specific process chemistry, temperature, and operating conditions.

FAQ 16. Is SS 347H suitable for marine applications?

It may be used in certain marine and offshore applications where elevated-temperature performance is required. For continuous exposure to seawater or severe chloride environments, engineers may consider materials such as Duplex, Super Duplex, or nickel-based alloys depending on the service conditions.

FAQ 17. Can SS 347H Elbows be welded?

Yes. SS 347H has excellent weldability when appropriate welding procedures, qualified personnel, and suitable filler materials are used in accordance with applicable standards.

FAQ 18. Is post-weld heat treatment (PWHT) required?

PWHT requirements depend on the applicable code, project specification, service conditions, and welding procedure. It is not universally required for all SS 347H applications.

FAQ 19. What inspections are commonly performed?

Typical inspections include:

- Visual Inspection (VT)
- Dimensional Inspection
- Positive Material Identification (PMI)
- Chemical Analysis
- Mechanical Testing
- Liquid Penetrant Testing (PT), where specified
- Ultrasonic Testing (UT), where applicable
- Radiographic Testing (RT), where specified



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vithalbhai Patel Road, Sikkanagar Girgaon,
Mumbai – 400 004.

SINCE 2016

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net



STAINLESS INDIA
A HOUSE OF QUALITY

Inspection requirements are established by the applicable specification and project documentation.

FAQ 20. What documents are usually supplied with SS 347H Elbows?

Typical documentation includes:

- Material Test Certificate (EN 10204 Type 3.1)
 - Chemical Analysis Report
 - Mechanical Test Report
 - Dimensional Inspection Report
 - Heat Treatment Records (where applicable)
 - PMI Report (if specified)
 - NDT Reports (where required)
-

FAQ 21. How is material traceability maintained?

Traceability is maintained using:

- Heat Numbers
 - Batch Numbers
 - Material Test Certificates
 - Manufacturing Records
 - Inspection Reports
 - Product Marking
-

These records enable the product to be traced back to the original manufacturing batch.

FAQ 22. What pressure rating can an SS 347H Elbow withstand?

There is no single pressure rating applicable to all SS 347H Elbows. The allowable pressure depends on factors such as pipe size, wall thickness, operating temperature, applicable design code, and engineering calculations.

FAQ 23. Can SS 347H Elbows be used in pressure piping systems?

Yes. When manufactured, tested, and installed in accordance with the applicable standards and design codes, SS 347H Elbows are widely used in pressure piping systems across many industries.



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Viththalbhai Patel Road, Sikkanagar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

FAQ 24. What certifications are commonly requested?

Customers frequently request:

- EN 10204 Type 3.1 Inspection Certificate
- EN 10204 Type 3.2 Inspection Certificate (when specified)
- Material Test Certificate (MTC)
- PMI Reports
- NDT Reports
- Third-Party Inspection Certificates (where required)

Certification requirements vary by project and industry.

FAQ 25. Why choose Stainless Steel 347H Elbows?

SS 347H Elbows are selected because they provide:

- Excellent elevated-temperature performance
- Good oxidation resistance
- Resistance to sensitization after welding
- Reliable weldability
- Good mechanical properties
- Long service life
- Compliance with internationally recognized standards
- Proven performance in critical industrial applications such as refineries, petrochemical plants, power generation facilities, and steam systems

Chapter Summary

The first 25 FAQs address the fundamental technical aspects of Stainless Steel 347H Elbows, including material characteristics, standards, applications, manufacturing, welding, inspection, and certification. These answers provide a practical reference for engineers, procurement professionals, quality inspectors, and end users while supporting informed material selection and effective project planning.



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vitthalbhai Patel Road, Sikkanagar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

Chapter 33B – Frequently Asked Questions (FAQs 26–50) About Stainless Steel 347H Elbows

Introduction

This section focuses on advanced technical topics related to welding, heat treatment, corrosion resistance, high-temperature performance, pressure service, inspection, and testing. These questions are commonly raised by design engineers, welding engineers, QA/QC inspectors, EPC contractors, maintenance personnel, and industrial buyers.

FAQ 26. Which welding processes are suitable for SS 347H Elbows?

SS 347H Elbows can be welded using qualified procedures such as:

- Gas Tungsten Arc Welding (GTAW / TIG)
- Gas Metal Arc Welding (GMAW / MIG)
- Shielded Metal Arc Welding (SMAW)
- Submerged Arc Welding (SAW)

The selected process should comply with the applicable Welding Procedure Specification (WPS), project requirements, and governing design code.

FAQ 27. Is preheating required before welding SS 347H?

In many applications, preheating is not routinely required. However, welding procedures should always follow the applicable code, qualified WPS, project specifications, and engineering requirements.

FAQ 28. What filler metal is commonly used?

The appropriate filler metal should be selected in accordance with the applicable welding procedure, material specification, service conditions, and project requirements. Filler metal selection should be verified by the welding engineer or project documentation.

FAQ 29. Why is heat input control important during welding?

Proper heat input helps:

- Maintain corrosion resistance.
- Reduce distortion.
- Minimize residual stresses.
- Produce sound welds.
- Preserve mechanical properties.



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vitthalbhai Patel Road, Sikkanagar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

Excessive heat input can adversely affect weld quality and dimensional stability.

FAQ 30. What is solution annealing?

Solution annealing is a heat treatment process in which the material is heated to the specified solution annealing temperature and then rapidly cooled in accordance with the applicable material specification. The process restores a uniform austenitic microstructure and helps maintain corrosion resistance after fabrication.

FAQ 31. Is solution annealing always required after fabrication?

Not necessarily. The need for solution annealing depends on the manufacturing process, applicable specification, project requirements, and intended service conditions.

FAQ 32. What is sensitization?

Sensitization occurs when chromium carbides form at grain boundaries, reducing the chromium available to maintain corrosion resistance. SS 347H is stabilized with niobium, which significantly reduces the likelihood of sensitization under appropriate service conditions.

FAQ 33. What is intergranular corrosion?

Intergranular corrosion is localized attack along grain boundaries caused by chromium depletion. The niobium stabilization in SS 347H improves resistance to this type of corrosion, particularly after welding.

FAQ 34. What types of corrosion can affect SS 347H?

Possible corrosion mechanisms include:

- General corrosion
- Pitting corrosion
- Crevice corrosion
- Intergranular corrosion
- Galvanic corrosion
- Erosion-corrosion
- Chloride stress corrosion cracking under susceptible conditions

The actual mechanism depends on the service environment.



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vithalbhair Patel Road, Sikkannagar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

FAQ 35. Is SS 347H resistant to chloride corrosion?

SS 347H performs well in many industrial environments; however, severe chloride exposure may increase the risk of localized corrosion or stress corrosion cracking under certain conditions. Material suitability should be evaluated for each application.

FAQ 36. Can SS 347H be used in seawater?

It may be used in selected applications, but continuous seawater service often requires materials with higher resistance to chloride attack, such as duplex stainless steels, super duplex stainless steels, or nickel-based alloys, depending on project requirements.

FAQ 37. What is creep resistance?

Creep resistance is the ability of a material to resist gradual deformation under constant load during prolonged exposure to elevated temperatures. SS 347H is specifically designed to provide improved creep resistance compared with many general-purpose stainless steels.

FAQ 38. What is stress rupture strength?

Stress rupture strength describes the ability of a material to withstand sustained stress at elevated temperatures before failure occurs over time. SS 347H offers enhanced stress rupture performance for high-temperature service.

FAQ 39. Why is SS 347H preferred for steam systems?

SS 347H is widely used in steam systems because it combines:

- Excellent elevated-temperature strength.
- Good oxidation resistance.
- Improved creep resistance.
- Resistance to sensitization after welding.
- Reliable long-term performance.

FAQ 40. Is SS 347H suitable for cyclic thermal loading?

Yes. When properly designed and installed, SS 347H performs well under many thermal cycling conditions. Engineers should consider expansion, supports, and fatigue during system design.



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vithalbhai Patel Road, Sikkangar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

FAQ 41. What inspections are recommended after welding?

Depending on project requirements, inspections may include:

- Visual Inspection (VT)
- Dimensional Inspection
- Liquid Penetrant Testing (PT)
- Radiographic Testing (RT)
- Ultrasonic Testing (UT)
- Positive Material Identification (PMI), where specified

Inspection methods should comply with the applicable code and inspection plan.

FAQ 42. What is Positive Material Identification (PMI)?

PMI is a verification process used to confirm that the supplied component matches the specified alloy grade. It helps prevent material mix-ups and supports complete traceability.

FAQ 43. Which methods are commonly used for PMI?

Common PMI methods include:

- X-Ray Fluorescence (XRF)
- Optical Emission Spectroscopy (OES)

The chosen method depends on the required level of chemical verification.

FAQ 44. Why is Non-Destructive Testing (NDT) important?

NDT evaluates product integrity without damaging the fitting. It helps identify surface and internal discontinuities before the product is placed into service, improving safety and reliability.

FAQ 45. Which NDT methods are commonly specified?

Typical NDT methods include:

- Visual Testing (VT)
- Liquid Penetrant Testing (PT)
- Ultrasonic Testing (UT)
- Radiographic Testing (RT)



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vithalbhai Patel Road, Sikkangar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

The required examinations depend on the governing specification, project requirements, and service conditions.

FAQ 46. Is hydrostatic testing mandatory?

Hydrostatic testing is performed when required by the applicable code, specification, or purchase order. It is not automatically required for every fitting.

FAQ 47. What documents should accompany inspection?

Typical documentation includes:

- Material Test Certificate (MTC)
- Chemical Analysis Report
- Mechanical Test Report
- Dimensional Inspection Report
- Heat Treatment Records (where applicable)
- NDT Reports
- PMI Report (if specified)

FAQ 48. How long can SS 347H Elbows remain in service?

Service life depends on:

- Operating conditions.
- Process chemistry.
- Design.
- Fabrication quality.
- Maintenance.
- Inspection program.

When properly selected and maintained, SS 347H Elbows can provide many years of reliable industrial service.

FAQ 49. How can premature failures be prevented?

Recommended practices include:

- Correct material selection.
- Qualified welding procedures.



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vitthalbhai Patel Road, Sikkanagar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

- Compliance with applicable standards.
- Proper inspection and testing.
- Routine preventive maintenance.
- Timely corrective actions.
- Complete material traceability.

FAQ 50. What is the most important factor when selecting SS 347H Elbows?

No single factor determines suitability. Engineers should evaluate:

- Operating pressure.
- Operating temperature.
- Process media.
- Corrosion environment.
- Applicable design codes.
- Inspection requirements.
- Fabrication methods.
- Lifecycle cost.
- Project specifications.

A comprehensive engineering assessment provides the best basis for safe and economical material selection.

Chapter Summary

FAQs 26–50 focus on the advanced engineering aspects of Stainless Steel 347H Elbows, including welding practices, heat treatment, corrosion mechanisms, high-temperature performance, inspection methods, and long-term service considerations. These questions and answers provide practical guidance for engineering, fabrication, quality assurance, and maintenance personnel involved in the design, manufacture, inspection, and operation of high-performance piping systems.



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vittalbhai Patel Road, Sikkangar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

Chapter 33C – Frequently Asked Questions (FAQs 51–75) About Stainless Steel 347H Elbows

Introduction

This section addresses practical questions related to industrial applications, installation, maintenance, quality assurance, procurement, certifications, documentation, export requirements, and project execution. These FAQs are intended to support engineers, EPC contractors, procurement teams, quality inspectors, maintenance personnel, and industrial buyers involved in specifying, purchasing, installing, and operating Stainless Steel 347H Elbows.

FAQ 51. Which industries most commonly use SS 347H Elbows?

SS 347H Elbows are widely used in:

- Oil & Gas
- Petrochemical
- Refineries
- Power Generation
- Chemical Processing
- LNG Plants
- Fertilizer Plants
- Marine Engineering
- Offshore Platforms
- Heat Exchanger Manufacturing
- Boiler Systems
- Process Piping

These industries value SS 347H for its elevated-temperature performance, corrosion resistance, and weldability.

FAQ 52. Are SS 347H Elbows suitable for refinery applications?

Yes. SS 347H Elbows are frequently specified for refinery piping systems because they offer excellent oxidation resistance, high-temperature strength, and resistance to sensitization after welding. Final material selection should always follow project specifications and process requirements.

FAQ 53. Can SS 347H Elbows be used in power plants?

Yes. They are commonly installed in steam systems, superheater piping, heat exchangers, and other elevated-temperature services in thermal and combined-cycle power plants.



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vithalbhair Patel Road, Sikkannagar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

FAQ 54. Are SS 347H Elbows used in petrochemical plants?

Yes. Petrochemical facilities use SS 347H Elbows in process piping, furnace systems, reactors, heat exchangers, and steam distribution where reliable elevated-temperature performance is required.

FAQ 55. Can SS 347H Elbows be used in chemical processing?

Yes. SS 347H performs well in many chemical processing environments. However, compatibility with specific chemicals, concentrations, temperatures, and operating conditions should always be verified during material selection.

FAQ 56. What should be checked before installation?

Before installation, verify:

- Material grade.
- Product dimensions.
- Heat number.
- Material Test Certificate (MTC).
- Surface condition.
- End preparation.
- Product marking.
- Compliance with the purchase specification.

Any discrepancies should be resolved before installation.

FAQ 57. How should SS 347H Elbows be handled during installation?

Recommended practices include:

- Use clean handling equipment.
- Protect machined and beveled ends.
- Avoid impact damage.
- Prevent carbon steel contamination.
- Store fittings in clean, dry conditions before installation.

Proper handling helps preserve corrosion resistance and dimensional integrity.



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vitthalbhai Patel Road, Sikkanagar Girgaon,
Mumbai – 400 004.

SINCE 2016

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net



STAINLESS INDIA
A HOUSE OF QUALITY

FAQ 58. What are common installation mistakes?

Common mistakes include:

- Misalignment.
- Excessive fit-up force.
- Incorrect welding procedures.
- Inadequate pipe supports.
- Improper storage before installation.
- Failure to verify material identification.

These issues can reduce long-term system reliability.

FAQ 59. How often should SS 347H Elbows be inspected?

Inspection intervals depend on:

- Service criticality.
- Operating pressure.
- Operating temperature.
- Corrosion environment.
- Applicable regulations.
- Plant maintenance strategy.

Inspection programs should be established through engineering evaluation and risk assessment.

FAQ 60. What maintenance is recommended?

Routine maintenance may include:

- Visual inspections.
- Corrosion monitoring.
- Leak detection.
- Support inspection.
- Surface cleaning.
- Verification of insulation condition.
- Review of maintenance records.

Preventive maintenance helps extend service life and reduce unplanned downtime.



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vitthalbhai Patel Road, Sikkanagar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

FAQ 61. What causes premature failure?

Common causes include:

- Incorrect material selection.
- Poor welding practices.
- Corrosion.
- Excessive thermal stress.
- Mechanical overload.
- Inadequate maintenance.
- Improper installation.
- Material substitution.

Root cause analysis should be performed before replacing failed components.

FAQ 62. How can failures be minimized?

Failures can be reduced by:

- Selecting the correct material.
- Following qualified welding procedures.
- Performing required inspections.
- Maintaining complete traceability.
- Conducting preventive maintenance.
- Investigating abnormal operating conditions promptly.

FAQ 63. Why is traceability important?

Material traceability links every fitting to its manufacturing records, including:

- Heat Number.
- Material Test Certificate.
- Inspection Reports.
- Manufacturing Batch.

Traceability supports quality assurance, maintenance, audits, and failure investigations.

FAQ 64. What is an EN 10204 Type 3.1 Certificate?

An EN 10204 Type 3.1 Inspection Certificate is issued by the manufacturer and confirms compliance with the specified material requirements, including chemical composition, mechanical properties, and inspection results.



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vithalbhai Patel Road, Sikkangar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

FAQ 65. When is an EN 10204 Type 3.2 Certificate required?

Type 3.2 certification may be specified for critical projects requiring independent verification by an authorized inspection body or purchaser's representative. Requirements depend on project specifications and contractual obligations.

FAQ 66. Is third-party inspection necessary?

Third-party inspection is not mandatory for every project but is commonly specified for critical applications such as refineries, offshore platforms, LNG facilities, and major EPC projects.

FAQ 67. Which documents should accompany an export shipment?

Typical documentation includes:

- Commercial Invoice.
 - Packing List.
 - Material Test Certificate.
 - Certificate of Origin (if required).
 - Inspection Certificate (if specified).
 - Transport Documents.
 - Additional export documents as required by the destination country.
-

FAQ 68. What information is marked on an SS 347H Elbow?

Typical product marking includes:

- Manufacturer's name or logo.
- Material grade.
- Nominal Pipe Size (NPS).
- Schedule.
- Heat Number.
- Applicable specification.
- Production identification.

Marking should remain legible throughout handling and installation.



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vitthalbhai Patel Road, Sikkanagar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

FAQ 69. How should SS 347H Elbows be packaged?

Common packaging methods include:

- Wooden crates.
- Wooden boxes.
- Pallet packing.
- Moisture-resistant wrapping.
- Protective end caps.
- Export-quality packaging.

The selected method depends on product size, destination, and transportation mode.

FAQ 70. How should fittings be stored before installation?

Store fittings:

- In clean, dry conditions.
- Away from standing water.
- Protected from mechanical damage.
- Separated from carbon steel where practical.
- With original markings and documentation intact.

Proper storage preserves product quality and traceability.

FAQ 71. What should buyers verify before accepting delivery?

Buyers should verify:

- Material grade.
- Product dimensions.
- Heat number.
- Material Test Certificate.
- Inspection reports.
- Product marking.
- Quantity.
- Packaging condition.

Incoming inspection helps identify issues before installation.



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vithalbhair Patel Road, Sikkannagar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

FAQ 72. How should suppliers be evaluated?

Supplier evaluation should consider:

- Manufacturing capability.
- Quality management system.
- Compliance with standards.
- Inspection facilities.
- Delivery performance.
- Technical support.
- Industry experience.
- Customer references.

Supplier qualification is an important part of procurement planning.

FAQ 73. How can lifecycle costs be reduced?

Lifecycle costs can be reduced through:

- Proper material selection.
- Quality manufacturing.
- Qualified installation.
- Preventive maintenance.
- Routine inspections.
- Timely repairs.
- Effective spare parts management.

Evaluating total ownership cost often provides greater value than considering purchase price alone.

FAQ 74. What are the key procurement considerations?

Important procurement factors include:

- Technical compliance.
- Applicable standards.
- Delivery schedule.
- Inspection requirements.
- Documentation.
- Material traceability.
- Packaging.
- Commercial terms.



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vithalbhai Patel Road, Sikkanagar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

- Warranty.

A detailed purchase specification helps reduce procurement risks.

FAQ 75. Why is SS 347H a preferred material for critical piping systems?

SS 347H is widely selected because it offers:

- Excellent elevated-temperature strength.
- Good oxidation resistance.
- Resistance to sensitization after welding.
- Reliable weldability.
- Good mechanical properties.
- Long service life.
- Compliance with internationally recognized standards.
- Proven performance in demanding industrial environments.

Its combination of mechanical performance, corrosion resistance, and thermal stability makes it a trusted choice for many high-temperature pressure piping applications.

Chapter Summary

FAQs 51–75 focus on the practical aspects of using Stainless Steel 347H Elbows in industrial projects, including installation, maintenance, inspection, procurement, documentation, export, and supplier evaluation. These answers provide practical guidance that supports successful project execution, quality assurance, and long-term operational reliability across a wide range of industries.



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vitthalbhai Patel Road, Sikkanagar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

Chapter 33D – Frequently Asked Questions (FAQs 76–100) About Stainless Steel 347H Elbows

Introduction

This final FAQ section focuses on material selection, cost considerations, comparisons with other alloys, troubleshooting, purchasing guidance, sustainability, future trends, and general customer questions. Together with the previous sections, these 100 FAQs provide a comprehensive technical reference for engineers, procurement professionals, QA/QC inspectors, EPC contractors, maintenance personnel, and industrial buyers.

FAQ 76. How do I choose the correct SS 347H Elbow?

Material selection should consider:

- Operating pressure
- Design temperature
- Process fluid
- Corrosion environment
- Applicable design code
- Pipe size and schedule
- Welding requirements
- Inspection requirements
- Lifecycle cost
- Project specifications

FAQ 77. When should SS 347H be selected instead of SS 304?

SS 347H is generally preferred when prolonged elevated-temperature service, improved creep resistance, and enhanced resistance to sensitization after welding are required.

FAQ 78. When should SS 316 or SS 316L be selected instead of SS 347H?

SS 316 and SS 316L are commonly selected when chloride resistance is a higher priority than elevated-temperature strength, such as in many marine or chemical processing applications.

FAQ 79. When should Duplex Stainless Steel be considered?

Duplex stainless steels are often considered for:

- Chloride-rich environments
- Offshore facilities



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vithalbhair Patel Road, Sikkannagar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

- Seawater systems
- High-strength applications
- Desalination plants

Material selection should always be verified through engineering evaluation.

FAQ 80. When are nickel-based alloys more suitable than SS 347H?

Nickel-based alloys such as Inconel or Hastelloy may be appropriate when the service involves highly aggressive chemical environments, severe chloride exposure, or conditions that exceed the corrosion resistance capabilities of stainless steel.

FAQ 81. Is SS 347H more expensive than carbon steel?

Yes. The initial purchase price of SS 347H is generally higher than carbon steel because of its alloy composition and manufacturing requirements. However, lower maintenance requirements and longer service life may reduce total lifecycle costs in suitable applications.

FAQ 82. Is the lowest purchase price always the best choice?

No. Material selection should consider:

- Reliability
- Maintenance
- Downtime
- Replacement costs
- Inspection requirements
- Service life
- Overall lifecycle value

The lowest purchase price does not necessarily result in the lowest total ownership cost.

FAQ 83. How can buyers avoid counterfeit or non-compliant products?

Recommended practices include:

- Purchase from qualified manufacturers.
- Verify Material Test Certificates.
- Confirm heat number traceability.
- Review inspection documentation.



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vithalbhai Patel Road, Sikkangar Girgaon,
Mumbai – 400 004.

SINCE 2016

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net



STAINLESS INDIA
A HOUSE OF QUALITY

- Specify independent inspection where required.
- Perform incoming inspection before installation.

FAQ 84. What information should be included in a purchase order?

A purchase order should clearly specify:

- Material grade
- Applicable standards
- Elbow type
- Size
- Schedule
- Quantity
- Inspection requirements
- Documentation requirements
- Packaging requirements
- Delivery schedule

FAQ 85. What certifications are commonly requested for export projects?

Depending on the project and destination, customers may request:

- EN 10204 Type 3.1 Inspection Certificate
- EN 10204 Type 3.2 Inspection Certificate
- Material Test Certificate
- Certificate of Origin
- Third-party inspection reports
- Additional documents required by the importing country

FAQ 86. Can SS 347H Elbows be customized?

Yes. Manufacturers may produce custom elbows with:

- Special sizes
- Heavy wall schedules
- Custom radii
- Non-standard angles
- Project-specific dimensions

Availability depends on manufacturing capability and project requirements.



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vithalbhair Patel Road, Sikkannagar Girgaon,
Mumbai – 400 004.

SINCE 2016

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net



STAINLESS INDIA
A HOUSE OF QUALITY

FAQ 87. How should a damaged elbow be evaluated?

A qualified engineer should determine whether the component can be repaired or should be replaced. The evaluation may include visual inspection, dimensional checks, material verification, and non-destructive testing as required.

FAQ 88. Can surface scratches affect performance?

Minor cosmetic scratches may not affect serviceability. However, deeper damage or contamination should be assessed because it may influence corrosion resistance or structural integrity, depending on the service conditions.

FAQ 89. How can carbon steel contamination be avoided?

Recommended practices include:

- Use dedicated stainless steel handling tools where practical.
- Separate stainless steel storage from carbon steel.
- Maintain clean work areas.
- Remove contamination promptly using appropriate cleaning methods.

FAQ 90. Why are regular inspections important?

Routine inspections help identify:

- Corrosion
- Leakage
- Mechanical damage
- Vibration
- Support problems
- Weld defects

Early detection reduces the likelihood of unexpected failures and costly shutdowns.

FAQ 91. Can SS 347H Elbows be recycled?

Yes. Stainless steel is recyclable, and recycled material is commonly incorporated into stainless steel production. Recycling supports resource conservation while maintaining material quality when processed appropriately.



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vitthalbhai Patel Road, Sikkanagar Girgaon,
Mumbai – 400 004.

SINCE 2016

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net



STAINLESS INDIA
A HOUSE OF QUALITY

FAQ 92. What factors influence the service life of SS 347H Elbows?

Service life depends on:

- Material selection
- Operating conditions
- Process chemistry
- Fabrication quality
- Installation practices
- Inspection program
- Preventive maintenance

FAQ 93. How does preventive maintenance improve reliability?

Preventive maintenance helps:

- Detect developing problems early.
- Reduce unplanned shutdowns.
- Extend service life.
- Improve plant safety.
- Lower maintenance costs.

FAQ 94. Are SS 347H Elbows suitable for global projects?

Yes. Products manufactured in accordance with internationally recognized standards and project specifications are widely supplied for industrial projects around the world.

FAQ 95. How can engineers select the most suitable material?

Engineers should evaluate:

- Operating conditions
- Process media
- Corrosion mechanisms
- Mechanical requirements
- Fabrication methods
- Applicable standards
- Lifecycle cost
- Project specifications

Material selection should be based on engineering analysis rather than a single property.



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vithalbhai Patel Road, Sikkangar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

FAQ 96. What trends are influencing the piping industry?

Current industry trends include:

- Increased digital quality documentation.
- Improved material traceability.
- Enhanced non-destructive testing technologies.
- Greater emphasis on lifecycle cost evaluation.
- Automation in manufacturing and inspection.
- Sustainability initiatives.

Adoption varies by industry and project requirements.

FAQ 97. How important is documentation?

Comprehensive documentation supports:

- Quality assurance
- Regulatory compliance
- Traceability
- Maintenance planning
- Project audits
- Future investigations

Maintaining complete records throughout the product lifecycle is considered a best practice.

FAQ 98. What should be done if documentation is incomplete?

Any missing or inconsistent documentation should be resolved with the manufacturer or supplier before the product is accepted or installed.

FAQ 99. What are the key reasons customers choose SS 347H Elbows?

Customers frequently select SS 347H because it offers:

- Excellent elevated-temperature performance.
- Good oxidation resistance.
- Reliable weldability.
- Resistance to sensitization.
- Long service life.



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vithalbhai Patel Road, Sikkangar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

- Compliance with recognized international standards.
- Proven industrial performance.

FAQ 100. What is the most important recommendation for successful use of SS 347H Elbows?

Successful application depends on combining:

- Correct material selection.
- Compliance with applicable standards.
- Quality-controlled manufacturing.
- Qualified welding procedures.
- Proper inspection and testing.
- Careful installation.
- Preventive maintenance.
- Complete material traceability.
- Ongoing engineering review throughout the equipment lifecycle.

No single factor guarantees reliability; long-term performance is achieved through the integration of sound engineering, quality assurance, and disciplined maintenance practices.

Chapter Summary

This chapter completes the **100 Technical FAQs** covering the full lifecycle of Stainless Steel 347H Elbows—from material selection and design through manufacturing, inspection, installation, maintenance, procurement, troubleshooting, and long-term operation. Together, these FAQs provide a practical technical reference that supports informed decision-making, promotes industry best practices, and helps ensure safe and reliable performance in critical piping systems across a wide range of industrial applications.



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vitthalbhai Patel Road, Sikkanagar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

Chapter 34 – Engineering Glossary (Part 1: Terms A–D)

Introduction

This glossary explains the technical terminology commonly used in the design, manufacture, inspection, procurement, installation, and maintenance of Stainless Steel 347H Elbows. The definitions are intended to help engineers, quality inspectors, procurement professionals, students, and end users understand important engineering concepts used throughout this book.

A

Acceptance Criteria

The specified limits used to determine whether a product, weld, material, or inspection result complies with the applicable code, standard, or project specification.

Acid Corrosion

Material deterioration caused by exposure to acidic environments. The severity depends on the acid type, concentration, temperature, and material selected.

Alloy

A metallic material composed of two or more elements to achieve improved mechanical, chemical, or physical properties.

Alloy Steel

Steel containing alloying elements such as chromium, molybdenum, nickel, or vanadium to improve strength, toughness, heat resistance, or corrosion resistance.

Annealing

A heat treatment process used to relieve internal stresses, improve ductility, and restore the desired microstructure.



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Viththalbhai Patel Road, Sikkanagar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

ASME

The **American Society of Mechanical Engineers**, an organization that publishes internationally recognized engineering codes and standards for pressure equipment and piping systems.

ASTM

ASTM International develops voluntary consensus standards covering materials, products, testing methods, and engineering practices used worldwide.

Austenite

The face-centered cubic (FCC) crystal structure found in austenitic stainless steels such as SS 347H, providing excellent toughness, ductility, and weldability.

Austenitic Stainless Steel

A family of stainless steels containing significant chromium and nickel, characterized by excellent corrosion resistance, good formability, and high toughness.

B

Batch Number

A unique identification assigned to a group of products manufactured under the same production conditions for traceability.

Bevel

The angled preparation machined on the end of a pipe or fitting to facilitate butt welding.

Bend Radius

The radius measured from the centerline of a bend or elbow. Long Radius (LR) elbows typically have a radius of 1.5 times the nominal pipe size, while Short Radius (SR) elbows have a radius equal to the nominal pipe size.



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Viththalbhai Patel Road, Sikkanagar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

Boiler

A pressure vessel used to generate steam by heating water for industrial processes or power generation.

Butt Weld

A welding joint in which two components are joined end-to-end after proper edge preparation.

Buttweld Fitting

A piping component designed to be connected to pipe by butt welding. Common examples include elbows, tees, reducers, caps, and stub ends.

C

CAPA (Corrective and Preventive Action)

A quality management process used to investigate non-conformities, implement corrective actions, and prevent recurrence.

Carbon Content

The percentage of carbon present in steel. Carbon content significantly influences strength, hardness, ductility, and weldability.

Carbon Steel

Steel primarily composed of iron and carbon, with relatively low alloy content. Carbon steel is widely used for general industrial piping applications.

Cavitation

The formation and collapse of vapor bubbles within a flowing liquid, potentially causing erosion and damage to piping components.



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vitthalbhai Patel Road, Sikkannagar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

Center-to-End Dimension

The standard distance from the centerline of an elbow to its end, as specified by dimensional standards such as ASME B16.9.

Certificate of Origin (COO)

A document confirming the country where the product was manufactured. It is commonly required for customs clearance and international trade.

Chemical Composition

The proportion of alloying elements present in a material, verified through chemical analysis to ensure compliance with applicable specifications.

Chloride Stress Corrosion Cracking (SCC)

A form of environmentally assisted cracking that can occur in susceptible materials exposed to tensile stress and chloride-containing environments.

Chromium

A primary alloying element in stainless steel responsible for forming the passive oxide layer that provides corrosion resistance.

Creep

The gradual deformation of a material under constant stress during prolonged exposure to elevated temperatures.

Creep Strength

The ability of a material to resist deformation caused by creep over time.

Corrosion

The deterioration of a material due to chemical or electrochemical reactions with its environment.



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vitthalbhai Patel Road, Sikkanagar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

Corrosion Allowance

Additional wall thickness incorporated into piping design to compensate for expected corrosion during service.

Crevice Corrosion

Localized corrosion occurring within confined spaces where stagnant fluid creates conditions favorable for accelerated attack.

D

Defect

An imperfection that exceeds the acceptance limits defined by the applicable code, specification, or inspection criteria.

Destructive Testing

Testing methods that permanently alter or destroy the test specimen to evaluate mechanical or metallurgical properties.

Dimensional Inspection

Verification that product dimensions conform to the applicable standard, drawing, or purchase specification.

Ductility

The ability of a material to deform plastically before fracture, often measured by elongation during tensile testing.

Duplex Stainless Steel

A family of stainless steels containing both austenitic and ferritic microstructures, offering high strength and improved resistance to chloride-induced corrosion.



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Viththalbhai Patel Road, Sikkangar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

Distortion

Unwanted dimensional changes resulting from welding, forming, heat treatment, or mechanical loading.

Documentation

The collection of records supporting product quality, traceability, inspection, testing, certification, and compliance with contractual requirements.

Design Pressure

The maximum pressure used for engineering design calculations in accordance with the applicable design code.

Design Temperature

The temperature used as the basis for equipment and piping design, considering normal operating conditions and potential process variations.

Differential Pressure

The difference in pressure measured between two points within a piping system.

Drawing

An engineering document containing dimensional details, tolerances, materials, specifications, and manufacturing requirements for a component.

Chapter Summary

This first section of the Engineering Glossary introduced fundamental terminology from **A through D**, covering metallurgy, piping, welding, corrosion, quality assurance, and engineering documentation. These definitions establish a consistent technical vocabulary that supports understanding of the concepts presented throughout this book.



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vitthalbhai Patel Road, Sikkanagar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

Chapter 34B – Engineering Glossary (Part 2: Terms E–H)

Introduction

This section continues the Engineering Glossary by defining technical terms beginning with the letters **E through H**. These terms are commonly encountered in piping design, metallurgy, welding, inspection, pressure equipment, manufacturing, and quality assurance related to Stainless Steel 347H Elbows.

E

Eddy Current Testing (ET)

A non-destructive testing (NDT) method that uses electromagnetic induction to detect certain surface and near-surface discontinuities in conductive materials. ET is commonly used for tubing and thin-wall components.

Elbow

A butt-weld pipe fitting used to change the direction of fluid flow in a piping system. Standard elbow angles include **45°**, **90°**, and **180°**, with long-radius (LR) and short-radius (SR) configurations available.

Elongation

The percentage increase in the length of a test specimen after tensile testing. It is an indicator of ductility and the material's ability to deform before fracture.

EN 10204

A European standard defining inspection documents supplied with metallic products, including **Type 2.1**, **2.2**, **3.1**, and **3.2** certificates.

End Preparation

The machining or forming of pipe or fitting ends to facilitate welding or joining. Common end preparations include bevels for butt welding.

Erosion-Corrosion

Material loss caused by the combined action of mechanical wear from flowing fluids and electrochemical corrosion.



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vithalbhai Patel Road, Sikkangar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

Export Packaging

Packaging designed to protect industrial products during international transportation by road, rail, sea, or air while maintaining traceability and preventing damage.

Expansion Joint

A piping component designed to absorb thermal expansion, vibration, or movement within a piping system, reducing stresses on connected equipment and fittings.

Expansion Loop

A section of piping intentionally configured to absorb thermal expansion through controlled flexibility rather than by using mechanical expansion joints.

E Fabrication

The process of manufacturing piping components through operations such as cutting, forming, welding, machining, heat treatment, inspection, and finishing.

Failure Analysis

A systematic engineering investigation conducted to determine the root cause of equipment or material failure and to recommend corrective and preventive actions.

Fatigue

Progressive structural damage resulting from repeated cyclic loading or thermal cycling that may eventually lead to cracking or fracture.

Ferrite

A body-centered cubic (BCC) phase of iron. In stainless steel welding, ferrite content in weld metal may be controlled to achieve the desired mechanical properties and resistance to hot cracking.



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vittalbhai Patel Road, Sikkanagar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

Ferrite Meter

An instrument used to measure ferrite content in stainless steel welds where project specifications require ferrite verification.

Filler Metal

The consumable metal added during welding to form the weld joint. Selection depends on the base material, welding process, service conditions, and qualified welding procedure.

Final Inspection

The last quality verification performed before shipment to confirm compliance with applicable standards, customer specifications, and purchase order requirements.

Fire Protection System

A piping system designed to detect, control, or suppress fires using water or other approved extinguishing media.

Flange

A mechanical piping component used to connect pipes, valves, fittings, and equipment, allowing assembly and maintenance through bolted joints.

Flow Rate

The quantity of fluid passing through a piping system during a specified period, typically expressed as volume or mass per unit time.

Forging

A manufacturing process in which metal is shaped using compressive forces to improve mechanical properties and structural integrity.

Fractography

The study of fracture surfaces to determine the mode and cause of material failure.



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vittalbhai Patel Road, Sikkangar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

Fracture Toughness

A measure of a material's ability to resist crack propagation under applied stress.

Furnace

An industrial heating unit used for processes such as heat treatment, solution annealing, forging, and other thermal manufacturing operations.

G

Galvanic Corrosion

Electrochemical corrosion that occurs when two dissimilar metals are electrically connected in the presence of an electrolyte.

Gasket

A sealing component placed between two mating surfaces, such as flanges, to prevent fluid leakage under operating conditions.

Grain Boundary

The interface where adjacent metal crystals (grains) meet. Grain boundaries play an important role in mechanical properties and certain corrosion mechanisms.

Grain Size

The average size of crystals within a metal's microstructure. Grain size influences strength, toughness, ductility, and creep behavior.

GTAW (Gas Tungsten Arc Welding)

Also known as TIG welding, GTAW uses a non-consumable tungsten electrode to produce high-quality welds, particularly for stainless steel and critical piping applications.



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vitthalbhai Patel Road, Sikkanagar Girgaon,
Mumbai – 400 004.

SINCE 2016

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net



STAINLESS INDIA
A HOUSE OF QUALITY

GMAW (Gas Metal Arc Welding)

Also known as MIG welding, GMAW is a welding process that uses a continuously fed consumable wire electrode and shielding gas.

Groove Weld

A weld deposited within a prepared groove between two components to achieve complete joint penetration where required.

Guide Support

A pipe support that allows controlled axial movement due to thermal expansion while restricting lateral displacement.

Gross Weight

The total shipping weight of a package, including the product, packaging materials, pallets, and protective packing.

H Hardness

The resistance of a material to indentation, scratching, or localized plastic deformation.

Hardness Test

A mechanical test used to evaluate hardness using methods such as Brinell, Rockwell, or Vickers, depending on the applicable specification and material.

Heat Affected Zone (HAZ)

The region adjacent to a weld that experiences thermal cycles during welding but does not melt. Changes in microstructure within the HAZ can influence mechanical properties and corrosion resistance.



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vitthalbhai Patel Road, Sikkangar Girgaon,
Mumbai – 400 004.

SINCE 2016

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net



STAINLESS INDIA
A HOUSE OF QUALITY

Heat Number

A unique identification assigned to each production heat of steel, providing complete traceability to manufacturing and inspection records.

Heat Treatment

Controlled heating and cooling processes used to achieve the required mechanical properties, microstructure, and performance characteristics of a material.

High-Temperature Service

Applications involving prolonged operation at elevated temperatures where creep strength, oxidation resistance, and thermal stability are important.

Hot Cracking

Cracking that occurs during the solidification of weld metal or immediately afterward because of metallurgical or welding-related factors.

Hydrostatic Test

A pressure test conducted using water or another approved test medium to verify the pressure integrity and leak tightness of a piping component or system.

Hydrogen Embrittlement

A phenomenon in which absorbed hydrogen reduces the ductility and load-bearing capacity of susceptible materials, potentially leading to cracking.

Hygroscopic Material

A material that readily absorbs moisture from the surrounding environment. Hygroscopic packaging materials should be managed carefully to avoid introducing unwanted moisture during storage or transportation.



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vitthalbhai Patel Road, Sikkanagar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

Chapter Summary

This section expanded the Engineering Glossary with essential technical terms beginning with **E through H**, covering welding processes, fabrication methods, inspection techniques, corrosion mechanisms, pressure testing, metallurgy, and quality assurance. These definitions support a clearer understanding of the engineering principles discussed throughout this book.

Prepared By: STAINLESS INDIA
Website: www.stainlessindia.net
Email: info@stainlessindia.net
Phone: +91 97680 42420
Location: Mumbai, Maharashtra, India
Edition: First Edition – 2026
Dated : 11.07.2026
© 2026 STAINLESS INDIA.
All rights reserved.



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vitthalbhai Patel Road, Sikkanagar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

Chapter 34C – Engineering Glossary (Part 3: Terms I–M)

Introduction

This section continues the Engineering Glossary by defining engineering terms beginning with the letters **I through M**. These terms are widely used in metallurgy, pressure piping, fabrication, quality assurance, inspection, maintenance, procurement, and industrial engineering related to Stainless Steel 347H Elbows.

I

Impact Strength

The ability of a material to absorb energy during sudden loading without fracturing. It is commonly evaluated through standardized impact tests.

Inclusion

A non-metallic particle or impurity trapped within the metal during manufacturing. Excessive inclusions may affect mechanical properties and product quality.

Inspection

The systematic examination of a product to verify compliance with applicable specifications, drawings, codes, standards, and purchase requirements.

Inspection Certificate

A document confirming that inspection and testing have been completed in accordance with the applicable specification or purchase order.

Inspection Plan

A documented procedure outlining the required inspections, tests, acceptance criteria, responsibilities, and hold or witness points during manufacturing.

Intergranular Corrosion

Localized corrosion occurring along grain boundaries due to chromium depletion. SS 347H is stabilized with niobium to improve resistance to this form of corrosion.



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vitthalbhai Patel Road, Sikkangar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

Internal Pressure

The pressure exerted by the process fluid on the internal surface of a pipe or fitting during operation.

ISO

The **International Organization for Standardization**, which develops globally recognized standards for quality management, environmental management, and many other industrial disciplines.

ISO 9001

An internationally recognized standard specifying requirements for a Quality Management System (QMS) focused on consistent product quality and continual improvement.

Installation

The process of positioning, aligning, joining, supporting, and commissioning piping components in accordance with engineering drawings and project specifications.

J

Joint Efficiency

A design factor representing the quality and effectiveness of a welded joint. The applicable value depends on the governing design code and inspection requirements.

Joint Preparation

The machining or shaping of pipe and fitting ends before welding to ensure proper fit-up, weld penetration, and joint quality.

Joint Penetration

The depth to which weld metal extends into the joint. Complete joint penetration may be required depending on design and code requirements.

K



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vitthalbhai Patel Road, Sikkanagar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

Kilopascal (kPa)

A metric unit of pressure equal to 1,000 pascals. It is widely used in engineering calculations and pressure measurements.

Knockout Drum

A pressure vessel designed to remove liquid droplets or solid particles from gas streams before downstream processing.

Knowledge Transfer

The process of sharing technical information, procedures, lessons learned, and best practices among engineering, operations, and maintenance personnel.



Lamination

A manufacturing defect consisting of internal layers or separations within the metal, typically detected through ultrasonic testing.

Leakage

The unintended escape of process fluid from a piping component, joint, weld, or connection.

Lifecycle Cost

The total cost of ownership throughout the service life of a product, including procurement, installation, operation, maintenance, inspection, repairs, and replacement.

Liquid Penetrant Testing (PT)

A non-destructive testing method used to detect surface-breaking discontinuities such as cracks, porosity, and laps by applying a visible or fluorescent penetrant.



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vithalbhair Patel Road, Sikkannagar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

Long Radius (LR) Elbow

A pipe elbow with a centerline radius equal to **1.5 times the nominal pipe size (1.5D)**. LR elbows generally provide smoother flow characteristics and lower pressure loss than short-radius elbows.

Lot Number

A unique identification assigned to a production lot or manufacturing batch to facilitate traceability and quality control.

Low Cycle Fatigue

Fatigue damage resulting from relatively few cycles of high stress or significant thermal expansion and contraction.

Lubrication

The application of suitable lubricants to reduce friction and wear during machining, threading, or assembly operations. Lubricants should be compatible with stainless steel and the intended service.

M Machining

Manufacturing operations such as turning, drilling, milling, boring, or threading used to achieve the required dimensions and surface finish.

Magnetic Particle Testing (MT)

A non-destructive testing method used to detect surface and near-surface discontinuities in ferromagnetic materials. Because solution-annealed austenitic stainless steels such as SS 347H are generally non-magnetic, other NDT methods are usually preferred.

Maintenance

Planned activities performed to preserve equipment reliability, safety, and operational performance throughout its service life.



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vithalbhair Patel Road, Sikkangar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

Material Grade

The standardized designation identifying a material's chemical composition, mechanical properties, and applicable specification (for example, ASTM A403 WP347H).

Material Selection

The engineering process of choosing the most appropriate material based on operating conditions, corrosion environment, mechanical requirements, fabrication needs, applicable standards, and lifecycle cost.

Material Test Certificate (MTC)

A quality document confirming compliance with the specified material requirements, including chemical composition, mechanical properties, heat number, and inspection results.

Mechanical Properties

The characteristics describing how a material behaves under applied loads, including yield strength, tensile strength, hardness, toughness, ductility, and elongation.

Metallography

The examination of a material's microstructure using polished and etched specimens to evaluate grain structure, phases, inclusions, weld quality, and heat treatment effects.

Microstructure

The internal arrangement of grains, phases, and other structural features within a metal, observable using microscopic examination.

Mill Test Certificate

A commonly used term for a Material Test Certificate (MTC) issued by the manufacturer documenting compliance with the applicable material specification.



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vitthalbhai Patel Road, Sikkanagar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

Mitre Bend

A fabricated pipe bend produced by welding together angled pipe sections. Mitre bends are generally used only where permitted by the applicable design code and project specification.

Moisture Barrier

Protective packaging material used to reduce moisture ingress during storage and transportation, particularly for export shipments.

Molybdenum

An alloying element added to certain stainless steels and nickel alloys to improve corrosion resistance and high-temperature strength. Standard SS 347H does not rely on molybdenum for its primary performance characteristics.

Monel

A family of nickel-copper alloys known for excellent resistance to seawater and selected chemical environments.

MSS

The **Manufacturers Standardization Society of the Valve and Fittings Industry**, which publishes standards such as MSS SP-43 for certain stainless steel butt-weld fittings.

Multiphase Flow

The simultaneous flow of two or more phases (such as gas and liquid) within the same piping system.

Chapter Summary

This section expanded the Engineering Glossary with technical terms beginning with **I through M**, covering inspection, installation, lifecycle management, metallurgy, fabrication, maintenance, and material selection. These definitions provide practical reference material for engineers, inspectors, procurement professionals, manufacturers, and students working with Stainless Steel 347H Elbows and industrial piping systems.



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vithalbhair Patel Road, Sikkandargirgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

Chapter 34D – Engineering Glossary (Part 4: Terms N–R)

Introduction

This section continues the Engineering Glossary with engineering terms beginning with the letters **N through R**. These terms are frequently used in metallurgy, piping engineering, welding, inspection, quality assurance, procurement, maintenance, pressure equipment, and project management related to Stainless Steel 347H Elbows.

N

NACE

Formerly known as the **National Association of Corrosion Engineers**, NACE developed internationally recognized standards and guidance for corrosion prevention, materials selection, coatings, and cathodic protection. Its standards are now maintained by **AMPP (Association for Materials Protection and Performance)**.

NDT (Non-Destructive Testing)

A group of inspection methods used to evaluate the condition and integrity of a material or component without causing permanent damage.

Common NDT methods include:

- Visual Testing (VT)
- Liquid Penetrant Testing (PT)
- Ultrasonic Testing (UT)
- Radiographic Testing (RT)
- Eddy Current Testing (ET)

Nominal Pipe Size (NPS)

A standardized pipe size designation used throughout North America and many international industries. NPS identifies the pipe size rather than its exact outside diameter for most sizes.

Nominal Diameter (DN)

A metric designation approximately equivalent to Nominal Pipe Size (NPS), widely used in international piping standards.



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vithalbhair Patel Road, Sikkannagar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

Non-Conformance

Failure to comply with specified requirements contained in applicable standards, project specifications, purchase orders, or inspection criteria.

Normalizing

A heat treatment process in which steel is heated above its transformation temperature and then air cooled to refine the grain structure and improve mechanical properties. This process is commonly associated with carbon and alloy steels rather than austenitic stainless steels such as SS 347H.

Notch Toughness

The ability of a material to resist fracture when subjected to stress concentrations or impact loading.

Nuclear Grade Material

Material manufactured, inspected, tested, and documented in accordance with the additional quality assurance and regulatory requirements applicable to nuclear industry applications.



Offshore Platform

A marine structure used for offshore oil and gas exploration, production, or processing.

Oxidation

The chemical reaction between a material and oxygen, particularly at elevated temperatures. Stainless steels resist oxidation through the formation of a protective chromium-rich oxide layer.

Oxidation Resistance

The ability of a material to resist degradation caused by high-temperature exposure to oxygen-containing environments.



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vitthalbhai Patel Road, Sikkangar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

Outside Diameter (OD)

The external diameter of a pipe or fitting, measured across its outer surface.

Ovality

The deviation of a circular component from a true round shape, typically measured during dimensional inspection.

Operating Pressure

The pressure normally experienced by a piping system during routine service.

Operating Temperature

The temperature at which a piping system normally operates during service.

Optical Emission Spectroscopy (OES)

An analytical method used to determine the chemical composition of metallic materials. OES is commonly used for Positive Material Identification (PMI) and laboratory chemical verification.

P

Packing List

A shipping document describing the contents of each package, including product description, quantity, package identification, dimensions, and weight.

Passivation

A chemical treatment that enhances the naturally occurring chromium-rich oxide layer on stainless steel, improving corrosion resistance by removing free iron and surface contaminants.

Passive Layer

The thin chromium-rich oxide film that forms naturally on stainless steel surfaces and provides corrosion resistance.



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vithalbhair Patel Road, Sikkannagar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

PED (Pressure Equipment Directive)

The **Pressure Equipment Directive (PED) 2014/68/EU** establishes essential safety requirements for certain categories of pressure equipment placed on the European market.

Penetration

The depth to which weld metal extends into the joint during welding.

Petrochemical Plant

An industrial facility where petroleum and natural gas are converted into chemicals, fuels, and related products through refining and chemical processing.

Pickling

A chemical cleaning process used to remove oxide scale, heat tint, and surface contamination from stainless steel after fabrication or welding.

Pipe Fitting

A component used to connect, redirect, branch, reduce, or terminate piping systems. Common fittings include elbows, tees, reducers, caps, and stub ends.

Piping System

An interconnected network of pipes, fittings, valves, flanges, supports, and associated equipment used to transport fluids or gases.

Pitting Corrosion

Localized corrosion resulting in small cavities or pits on the metal surface. Pitting may occur when the passive layer is damaged under susceptible environmental conditions.



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vithalbhair Patel Road, Sikkannagar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

PMI (Positive Material Identification)

A verification process used to confirm the chemical identity of metallic materials, helping prevent material mix-ups during manufacturing, installation, or maintenance.

Porosity

Small gas-filled cavities within weld metal that may reduce weld quality if they exceed the applicable acceptance criteria.

Pressure Rating

The maximum allowable pressure for a component under specified conditions, as determined by the applicable design code, material, dimensions, and operating temperature.

Pressure Vessel

A closed container designed to hold fluids or gases at pressures different from atmospheric pressure and constructed in accordance with recognized design codes.

Preventive Maintenance

Planned maintenance activities intended to detect deterioration early, reduce the risk of equipment failure, and extend service life.

Procedure Qualification Record (PQR)

A document demonstrating that a welding procedure has been successfully qualified through testing in accordance with the applicable welding code.

Procurement

The process of specifying, purchasing, inspecting, receiving, and managing materials or equipment required for industrial projects.



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vithalbai Patel Road, Sikkangar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

Project Specification

A project-specific technical document that defines material requirements, inspection criteria, testing, documentation, fabrication, and acceptance requirements in addition to applicable codes and standards.

Q

QA (Quality Assurance)

The systematic activities implemented to ensure that products and processes consistently satisfy specified quality requirements.

QC (Quality Control)

The operational techniques and inspections used to verify that products conform to specified requirements before acceptance or shipment.

Quality Management System (QMS)

A structured management framework that governs quality planning, document control, inspections, corrective actions, audits, and continual improvement. Many manufacturers operate under **ISO 9001** certification.

Qualification

The documented process of demonstrating that personnel, procedures, equipment, or processes meet specified technical requirements.

Quenching

A heat treatment process involving rapid cooling from elevated temperatures. While common for many steels, quenching is generally not used as the primary strengthening mechanism for austenitic stainless steels such as SS 347H.

R

Radiographic Testing (RT)

A non-destructive testing method that uses X-rays or gamma rays to detect internal weld discontinuities such as porosity, slag inclusions, lack of fusion, and incomplete penetration.



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vithalbhai Patel Road, Sikkanagar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

Radius

The distance from the centerline of an elbow or bend to the center of curvature. Standard elbows are commonly manufactured in Long Radius (1.5D) and Short Radius (1D) configurations.

Reducer

A butt-weld fitting used to connect pipes of different diameters while maintaining controlled fluid flow.

Refinery

An industrial facility where crude oil or other feedstocks are processed into fuels, lubricants, petrochemical feedstocks, and related products.

Residual Stress

Internal stresses remaining within a material after manufacturing, welding, forming, machining, or heat treatment, even when no external load is applied.

Root Cause Analysis (RCA)

A systematic engineering method used to identify the underlying cause of equipment failure or non-conformance and develop effective corrective and preventive actions.

Roughness

A measure of the microscopic irregularities present on a surface, commonly used to evaluate surface finish quality.

Routine Inspection

Scheduled inspections performed during normal plant operation to identify corrosion, leakage, mechanical damage, or other developing issues before they lead to failure.



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vithalbhair Patel Road, Sikkannagar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

Run Pipe

The main straight section of piping into which branches, fittings, or other components are connected.

Chapter Summary

This section expanded the Engineering Glossary with essential technical terms beginning with **N through R**, covering non-destructive testing, pressure equipment, corrosion, procurement, quality assurance, welding documentation, and refinery applications. These definitions provide practical support for understanding the engineering, manufacturing, inspection, and maintenance concepts presented throughout this book.

Prepared By: STAINLESS INDIA
Website: www.stainlessindia.net
Email: info@stainlessindia.net
Phone: +91 97680 42420
Location: Mumbai, Maharashtra, India
Edition: First Edition – 2026
Dated : 11.07.2026
© 2026 STAINLESS INDIA.
All rights reserved.



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vithalbhair Patel Road, Sikkannagar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

Chapter 34E – Engineering Glossary (Part 5: Terms S–Z)

Introduction

This final section completes the Engineering Glossary by defining technical terms beginning with the letters **S through Z**. Together with Chapters 34A–34D, this glossary provides a comprehensive reference covering metallurgy, pressure piping, welding, inspection, testing, quality assurance, maintenance, procurement, and industrial applications related to Stainless Steel 347H Elbows.

S

Scale

Oxide layers that form on metal surfaces during exposure to elevated temperatures. Scale is commonly removed by pickling or other approved surface treatment methods.

Schedule (SCH)

The standardized designation for pipe wall thickness. Common schedules include SCH 5S, SCH 10S, SCH 40S, SCH 80S, SCH 160, and XXS.

Seamless Pipe Fitting

A fitting manufactured from seamless pipe or seamless hollow stock without a longitudinal weld seam.

Sensitization

A metallurgical condition in which chromium carbides form at grain boundaries, reducing corrosion resistance. SS 347H is stabilized with niobium to improve resistance to sensitization.

Service Life

The expected operating period during which a component performs its intended function under specified service conditions.

Shielded Metal Arc Welding (SMAW)

A manual arc welding process using a consumable coated electrode. SMAW is widely used for field fabrication and maintenance.



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vithalbhair Patel Road, Sikkannagar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

Short Radius (SR) Elbow

An elbow having a centerline radius equal to one times the nominal pipe size (1D). SR elbows are commonly selected where installation space is limited.

Shrink Wrapping

A protective packaging method in which plastic film is heated to form a tight protective covering around products or packages.

Solution Annealing

A heat treatment process in which stainless steel is heated to the appropriate solution annealing temperature and rapidly cooled to restore a uniform austenitic structure and maintain corrosion resistance.

Specification

A document defining technical requirements, material standards, manufacturing methods, inspection criteria, testing, and acceptance requirements.

Stainless Steel

An iron-based alloy containing sufficient chromium to form a passive oxide layer that provides corrosion resistance.

Stress Corrosion Cracking (SCC)

Cracking caused by the combined effects of tensile stress and a specific corrosive environment. Certain chloride-containing environments may increase the risk for susceptible materials.

Stress Rupture

Failure occurring after prolonged exposure to elevated temperatures under constant stress.



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Viththalbhai Patel Road, Sikkanagar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

Stub End

A butt weld fitting used with a lap joint flange to facilitate piping assembly and maintenance.

Surface Finish

The texture and condition of a component's surface after manufacturing, machining, or finishing operations.

Surface Roughness

A quantitative measurement of the microscopic irregularities on a surface, often specified to meet functional or cleanliness requirements.

Supplier Qualification

The process of evaluating and approving suppliers based on quality systems, technical capability, manufacturing capacity, inspection facilities, and delivery performance.

Superheater

A boiler component that raises steam temperature above its saturation point before delivery to turbines or process systems.

Super Duplex Stainless Steel

A family of duplex stainless steels with enhanced corrosion resistance and higher mechanical strength than standard duplex grades, particularly in chloride-rich environments.

Tee

A pipe fitting used to create a branch connection in a piping system. Tees may be equal or reducing.

Tempering

A heat treatment process commonly applied to hardened carbon and alloy steels to improve toughness. It is generally not the primary heat treatment used for austenitic stainless steels such as SS 347H.



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vithalbhair Patel Road, Sikkannagar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

Tensile Strength

The maximum tensile stress a material can withstand before fracture during a tensile test.

Thermal Expansion

The increase in material dimensions caused by temperature rise. Proper piping design accommodates thermal expansion to reduce stress.

Thermal Fatigue

Progressive damage caused by repeated heating and cooling cycles that generate cyclic thermal stresses.

Third-Party Inspection

Inspection performed by an independent organization to verify compliance with contractual, technical, and regulatory requirements.

Threaded Connection

A piping connection using screw threads rather than welding or flanges. Threaded joints are generally limited to certain pressure and service conditions.

Tolerance

The permissible variation from a specified dimension or property as defined by the applicable standard or drawing.

Traceability

The ability to trace a product from the finished component back to its original raw material, manufacturing records, inspections, and certifications.



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vithalbai Patel Road, Sikkanagar Girgaon,
Mumbai – 400 004.

SINCE 2016

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net



STAINLESS INDIA
A HOUSE OF QUALITY

Transition Piece

A fitting or fabricated component used to connect piping systems with different sizes, wall thicknesses, or configurations.

U

Ultrasonic Testing (UT)

A non-destructive testing method that uses high-frequency sound waves to detect internal discontinuities, measure thickness, and evaluate material integrity.

Ultimate Tensile Strength (UTS)

The maximum stress a material can withstand before failure during tensile testing.

Undercut

A groove melted into the base metal adjacent to the weld that is left unfilled by weld metal. Excessive undercut may reduce fatigue strength and is evaluated against applicable acceptance criteria.

Utility Piping

Piping systems carrying services such as water, air, steam, condensate, or inert gases that support plant operations.

V

Valve

A mechanical device used to start, stop, regulate, or direct the flow of fluids within a piping system.

Vapor Pressure

The pressure exerted by a vapor in equilibrium with its liquid at a specified temperature.

Vent

A connection provided to release trapped air or gases from piping systems or pressure equipment.



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vitthalbhai Patel Road, Sikkanagar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

Verification

Confirmation through examination, inspection, or testing that specified requirements have been satisfied.

Visual Testing (VT)

The most fundamental non-destructive testing method, involving direct or indirect visual examination to identify surface defects, damage, or non-conformities.

Vickers Hardness Test

A hardness testing method using a diamond pyramid indenter to measure material hardness.

W

Wall Thickness

The distance between the inside and outside surfaces of a pipe or fitting wall.

Warranty

A contractual commitment by the supplier regarding product quality or performance, subject to the agreed terms and conditions.

Water Hammer

A pressure surge caused by a sudden change in fluid velocity, such as rapid valve closure. Proper piping design helps reduce water hammer effects.

Weld

The metallurgical bond formed between materials during a welding process.

Weld Bead

The deposited weld metal visible on the surface of a welded joint.



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vitthalbhai Patel Road, Sikkanagar Girgaon,
Mumbai – 400 004.

SINCE 2016

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net



STAINLESS INDIA
A HOUSE OF QUALITY

Weld Defect

A discontinuity or imperfection in a weld that exceeds the acceptance limits specified by the applicable code or specification.

Weld Procedure Specification (WPS)

A qualified document describing the welding variables, processes, filler metals, parameters, and techniques required to produce acceptable welds.

Welder Qualification

The documented demonstration that a welder possesses the skills required to produce welds meeting applicable code requirements.

Working Pressure

The pressure under which a piping system normally operates during routine service.

Wrought Stainless Steel

Stainless steel that has been mechanically worked by rolling, forging, extruding, or forming rather than produced as a casting.

X

X-Ray Fluorescence (XRF)

A non-destructive analytical method commonly used for Positive Material Identification (PMI) by determining the elemental composition of metallic materials.

X-Ray Inspection

A radiographic examination method using X-rays to evaluate the internal quality of welded joints and components.



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vithalbhair Patel Road, Sikkannagar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

Y

Yield Strength

The stress at which a material begins to deform permanently during tensile loading.

Yield Point

The point on a stress-strain curve where plastic deformation begins.

Z

Zero Defect Philosophy

A quality management principle emphasizing defect prevention through robust planning, process control, inspection, and continual improvement rather than relying solely on final inspection.

Zinc Contamination

Surface contamination caused by contact with zinc or galvanized materials during fabrication or handling. Such contamination should be avoided because it may adversely affect stainless steel during certain fabrication or service conditions.

Zone of Influence

The area surrounding a weld or heated region where thermal cycles may influence material properties and residual stresses.

Abbreviations Frequently Used in This Book

Abbreviation	Meaning
ASTM	ASTM International
ASME	American Society of Mechanical Engineers
NPS	Nominal Pipe Size
DN	Nominal Diameter
LR	Long Radius
SR	Short Radius
PMI	Positive Material Identification
MTC	Material Test Certificate



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vitthalbhai Patel Road, Sikkanagar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

Abbreviation	Meaning
NDT	Non-Destructive Testing
VT	Visual Testing
PT	Liquid Penetrant Testing
UT	Ultrasonic Testing
RT	Radiographic Testing
ET	Eddy Current Testing
GTAW	Gas Tungsten Arc Welding
GMAW	Gas Metal Arc Welding
SMAW	Shielded Metal Arc Welding
WPS	Welding Procedure Specification
PQR	Procedure Qualification Record
QA	Quality Assurance
QC	Quality Control
QMS	Quality Management System
HAZ	Heat Affected Zone
PWHT	Post-Weld Heat Treatment
PED	Pressure Equipment Directive
COO	Certificate of Origin
RCCA	Root Cause and Corrective Action (if used in project documentation)



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vithalbhair Patel Road, Sikkannagar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

Complete Glossary Summary

- Stainless Steel Metallurgy
- ASTM & ASME Standards
- Pipe Fittings
- Welding Technology
- Heat Treatment
- Corrosion Science
- Mechanical Properties
- Quality Assurance
- Non-Destructive Testing
- Manufacturing
- Inspection
- Material Traceability
- Procurement
- Export Documentation
- Maintenance
- Failure Analysis
- Industrial Applications

This glossary serves as a quick-reference guide for engineers, inspectors, procurement professionals, EPC contractors, students, and industrial buyers working with Stainless Steel 347H Elbows and other high-performance piping components.



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vitthalbhai Patel Road, Sikkanagar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

Chapter 35 – Complete Technical Data Tables & Engineering Reference Charts for Stainless Steel 347H Elbows

35.1 Introduction

Engineering data tables are essential references for the design, procurement, inspection, fabrication, installation, and maintenance of Stainless Steel 347H Elbows. They provide standardized technical information that supports material selection, dimensional verification, pressure piping design, quality assurance, and compliance with international standards.

The data presented in this chapter should be used together with the applicable ASTM, ASME, MSS, and project specifications. Where project-specific or code requirements differ, the governing code or specification shall take precedence.

35.2 Material Specification Reference Table

Property	Specification
Material Grade	ASTM A403 WP347H
ASME Equivalent	ASME SA403 WP347H
Material Family	Austenitic Stainless Steel
Product Type	Wrought Buttweld Pipe Fittings
Manufacturing Standard	ASTM A403 / ASME SA403
Dimensional Standard	ASME B16.9
Short Radius Standard	ASME B16.28 (where applicable)
Inspection Documents	EN 10204 Type 3.1 / 3.2 (when specified)

35.3 Typical Chemical Composition Requirements

Element	Symbol
Carbon	C
Manganese	Mn
Silicon	Si
Chromium	Cr
Nickel	Ni
Phosphorus	P
Sulfur	S
Niobium (Columbium)	Nb (Cb)
Iron	Fe (Balance)

Note: The applicable ASTM A403 material specification defines the required chemical composition limits.



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vitthalbhai Patel Road, Sikkanagar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

35.4 Mechanical Property Reference

Property	Typical Evaluation
Yield Strength	Tensile Test
Tensile Strength	Tensile Test
Elongation	Tensile Test
Hardness	Brinell, Rockwell, or Vickers
Toughness	Impact Testing (when specified)
Creep Strength	Elevated Temperature Evaluation
Stress Rupture	Long-Term High-Temperature Testing

35.5 Physical Properties

Property	Engineering Importance
Density	Weight Calculations
Melting Range	Manufacturing
Thermal Conductivity	Heat Transfer
Electrical Resistivity	Electrical Design
Coefficient of Thermal Expansion	Piping Stress Analysis
Specific Heat	Thermal Design
Elastic Modulus	Mechanical Design

35.6 Standard Elbow Types

Elbow Type	Standard
45° Long Radius	ASME B16.9
90° Long Radius	ASME B16.9
180° Long Radius	ASME B16.9
90° Short Radius	ASME B16.28
180° Short Radius	ASME B16.28

35.7 Standard Pipe Schedules

Schedule
SCH 5S
SCH 10S
SCH 20
SCH 30
SCH 40S
SCH 60



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vithalbhair Patel Road, Sikkannagar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

Schedule

SCH 80S
SCH 100
SCH 120
SCH 140
SCH 160
XXS

35.8 Nominal Pipe Size (NPS) Reference

Nominal Pipe Size

1/2"
3/4"
1"
1 1/4"
1 1/2"
2"
2 1/2"
3"
4"
5"
6"
8"
10"
12"
14"
16"
18"
20"
24"
30"
36"
42"
48"

Larger sizes may be available depending on manufacturer capability and project requirements.

35.9 Long Radius vs Short Radius



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vithalbhai Patel Road, Sikkanagar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

Feature	Long Radius	Short Radius
Radius	1.5D	1D
Flow Characteristics	Better	Moderate
Pressure Loss	Lower	Higher
Space Requirement	More	Less
Typical Use	Process Plants	Compact Installations

35.10 Manufacturing Methods

Method	Typical Application
Hot Forming	Large Elbows
Cold Forming	Small Sizes
Induction Bending	Special Applications
Forging	Heavy Sections
Welding	Fabricated Components
Machining	End Preparation

35.11 Heat Treatment Reference

Heat Treatment	Purpose
Solution Annealing	Restore Corrosion Resistance
Rapid Cooling	Maintain Austenitic Structure
Heat Treatment Verification	Quality Assurance

Heat treatment requirements depend on the applicable material specification and manufacturing process.

35.12 Welding Process Selection

Process	Typical Application
GTAW (TIG)	Root Pass & High-Quality Welding
GMAW (MIG)	Production Welding
SMAW	Site Installation
SAW	Heavy Industrial Fabrication

35.13 Non-Destructive Testing Reference

Test Method	Purpose
VT	Surface Examination
PT	Surface Crack Detection
UT	Internal Defect Detection



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vithalbhai Patel Road, Sikkanagar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

Test Method	Purpose
RT	Weld Examination
ET	Surface/Near-Surface Inspection (where applicable)
PMI	Material Verification

35.14 Inspection Checklist

Inspection Activity	Typical Requirement
Visual Inspection	✓
Dimensional Inspection	✓
Chemical Analysis	✓
Mechanical Testing	✓
Heat Number Verification	✓
Product Marking	✓
Material Test Certificate	✓
NDT (When Specified)	✓

35.15 Documentation Matrix

Document	Purpose
Material Test Certificate	Material Verification
Chemical Analysis Report	Composition Verification
Mechanical Test Report	Mechanical Properties
Inspection Report	Quality Verification
PMI Report	Alloy Confirmation
NDT Report	Defect Evaluation
Packing List	Shipping Documentation
Commercial Invoice	Commercial Documentation
Certificate of Origin	Export Documentation

35.16 Typical Industrial Applications

Industry	Typical Service
Oil & Gas	Process Piping
Refineries	High-Temperature Service
Petrochemical	Chemical Processing
Power Plants	Steam Systems
LNG	Cryogenic & Process Systems



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vithalbhair Patel Road, Sikkannagar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

Industry	Typical Service
Marine	Process Equipment
Offshore	Production Facilities
Chemical Plants	Corrosion-Resistant Piping

35.17 Material Comparison Reference

Material	Primary Advantage
Carbon Steel WPB	Economical
Alloy Steel WP11	Elevated Temperature
Alloy Steel WP22	High-Temperature Steam
SS 304	General Corrosion Resistance
SS 316	Improved Chloride Resistance
SS 347H	Elevated-Temperature Strength
Duplex 2205	High Strength & Chloride Resistance
Super Duplex 2507	Severe Chloride Service
Inconel 625	Marine & High Corrosion Resistance
Hastelloy C276	Aggressive Chemical Service

35.18 Typical Quality Documents

- ✓ Material Test Certificate
- ✓ Heat Number Traceability
- ✓ Chemical Analysis Report
- ✓ Mechanical Test Report
- ✓ Dimensional Inspection Report
- ✓ PMI Report (when specified)
- ✓ NDT Reports (where required)
- ✓ Inspection Certificate
- ✓ Packing List
- ✓ Commercial Invoice

35.19 Procurement Checklist

Before placing an order, verify:

- Material Grade
- ASTM / ASME Standard
- Pipe Size



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Viththalbhai Patel Road, Sikkanagar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

- Schedule
- Elbow Type
- Radius
- Quantity
- Inspection Requirements
- Documentation
- Delivery Schedule
- Packaging
- Third-Party Inspection (if required)

35.20 Storage Recommendations

Store SS 347H Elbows:

- In dry environments.
- Away from standing water.
- Protected from carbon steel contamination.
- On pallets or racks.
- With original markings preserved.
- With certificates retained for traceability.

35.21 Preventive Maintenance Reference

Routine inspections should verify:

- Corrosion
- Leakage
- Pipe Supports
- Weld Integrity
- Thermal Expansion Components
- Vibration
- Surface Condition
- Documentation

35.22 Troubleshooting Guide

Problem	Possible Cause	Recommended Action
Leakage	Weld Defect	Inspect and Repair
Corrosion	Aggressive Environment	Review Material Selection
Vibration	Poor Pipe Support	Improve Support System



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vithalbhai Patel Road, Sikkanagar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

Problem	Possible Cause	Recommended Action
Distortion	Thermal Stress	Review Expansion Design
Surface Contamination	Improper Handling	Clean and Restore Surface

35.23 Material Selection Quick Guide

Requirement	Recommended Material
General Industrial Service	Carbon Steel WPB
High-Temperature Steam	SS 347H / WP22
Refinery Service	SS 347H
Petrochemical Plant	SS 347H
Marine Environment	Duplex / Super Duplex
Severe Chemical Service	Hastelloy C276
Offshore Platform	Inconel 625

35.24 Engineering Design Checklist

Before approving a piping system design, verify:

- ✓ Applicable Design Code
- ✓ Material Compatibility
- ✓ Design Pressure
- ✓ Design Temperature
- ✓ Pipe Schedule
- ✓ Corrosion Allowance
- ✓ Welding Requirements
- ✓ Inspection Requirements
- ✓ Material Traceability
- ✓ Quality Documentation
- ✓ Thermal Expansion Analysis
- ✓ Pipe Support Design



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vitthalbhai Patel Road, Sikkannagar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

35.25 Chapter Summary

This chapter provides a consolidated engineering reference for Stainless Steel 347H Elbows, bringing together essential technical tables, material data, manufacturing references, inspection checklists, procurement guidance, maintenance practices, and material selection criteria. These reference charts are intended to support engineers, designers, procurement specialists, inspectors, manufacturers, and end users throughout the complete lifecycle of industrial piping systems.

Used in conjunction with applicable ASTM, ASME, and project specifications, these engineering tables promote consistent decision-making, improve quality assurance, simplify procurement, and support the safe, reliable, and efficient application of Stainless Steel 347H Elbows in critical industrial environments.

Prepared By: STAINLESS INDIA
Website: www.stainlessindia.net
Email: info@stainlessindia.net
Phone: +91 97680 42420
Location: Mumbai, Maharashtra, India
Edition: First Edition – 2026
Dated : 11.07.2026
© 2026 STAINLESS INDIA.
All rights reserved.



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vitthalbhai Patel Road, Sikkanagar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

Chapter 36 – References, Codes & Technical Bibliography for Stainless Steel 347H Elbows

36.1 Introduction

The design, manufacture, inspection, testing, installation, and maintenance of Stainless Steel 347H Elbows rely on internationally recognized engineering codes, material specifications, technical standards, and industry publications. These references provide the technical framework that ensures product quality, safety, reliability, and consistency across industrial projects.

This chapter summarizes the most important standards and reference publications applicable to Stainless Steel 347H Elbows. Engineers should always use the latest applicable editions of the referenced standards together with project specifications and local regulatory requirements.

36.2 ASTM Material Standards

ASTM A403 / A403M

Standard Specification for Wrought Austenitic Stainless Steel Piping Fittings

This is the primary material specification for Stainless Steel 347H Buttweld Pipe Fittings.

It covers:

- Chemical composition
- Mechanical properties
- Manufacturing requirements
- Heat treatment
- Inspection
- Testing
- Product marking
- Certification

ASTM A312

Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes

Frequently referenced when selecting compatible stainless steel piping for WP347H fittings.

ASTM A182

Standard Specification for Forged or Rolled Alloy and Stainless Steel Pipe Flanges, Forged Fittings, Valves, and Parts

Applicable to forged stainless steel components used with piping systems.

ASTM A240

Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vithalbhair Patel Road, Sikkangar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

Widely used for stainless steel raw materials employed in fabrication.

ASTM A262

Standard Practices for Detecting Susceptibility to Intergranular Attack in Austenitic Stainless Steels

Provides test methods for evaluating resistance to intergranular corrosion.

36.3 ASME Standards

ASME B16.9

Factory-Made Wrought Buttwelding Fittings.

Defines:

- Dimensions
 - Tolerances
 - End preparation
 - Manufacturing requirements
-

ASME B16.28

Wrought Steel Short Radius Elbows and Return Bends.

Applicable to:

- Short Radius 90° Elbows
 - Short Radius 180° Return Bends
-

ASME B31.3

Process Piping Code

One of the most widely used design codes for industrial piping systems.

Covers:

- Design
 - Materials
 - Fabrication
 - Welding
 - Examination
 - Testing
 - Inspection
-

ASME Boiler and Pressure Vessel Code (BPVC)

Provides comprehensive engineering requirements for:



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vithalbhai Patel Road, Sikkanagar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

- Boilers
- Pressure vessels
- Pressure-retaining components

Widely referenced throughout the power generation and process industries.

36.4 MSS Standards

MSS SP-43

Lightweight Corrosion Resistant Buttwelding Fittings.

Applies primarily to certain stainless steel buttweld fittings where lightweight wall thicknesses are specified.

36.5 ISO Standards

ISO 9001

Quality Management Systems.

Provides internationally recognized requirements for maintaining consistent product quality and continual improvement.

ISO 14001

Environmental Management Systems.

Supports environmental responsibility during manufacturing operations.

ISO 45001

Occupational Health and Safety Management Systems.

Focuses on workplace health, safety, and risk management.

36.6 European Standards

EN 10204

Metallic Products – Types of Inspection Documents.

Defines:

- Type 2.1
 - Type 2.2
 - Type 3.1
 - Type 3.2 Inspection Certificates
-



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vithalbhair Patel Road, Sikkannagar Girgaon,
Mumbai – 400 004.

SINCE 2016

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net



STAINLESS INDIA
A HOUSE OF QUALITY

Pressure Equipment Directive (PED) 2014/68/EU

Establishes essential safety requirements for certain categories of pressure equipment placed on the European market.

36.7 Welding Standards

Common welding qualification standards include:

- ASME Section IX
- ISO 9606 (Welder Qualification)
- ISO 15614 (Welding Procedure Qualification)

These standards define requirements for:

- Welder qualification
- Welding Procedure Specifications (WPS)
- Procedure Qualification Records (PQR)
- Welding variables
- Qualification testing

36.8 Non-Destructive Testing Standards

Inspection activities may be performed in accordance with applicable standards covering:

- Visual Testing (VT)
- Liquid Penetrant Testing (PT)
- Ultrasonic Testing (UT)
- Radiographic Testing (RT)
- Eddy Current Testing (ET)

The governing code or project specification determines the required examination methods and acceptance criteria.

36.9 Corrosion References

Important industry organizations and references include:

- AMPP (Association for Materials Protection and Performance)
- Corrosion engineering publications
- Industrial corrosion books
- Material compatibility guides

These references support appropriate material selection and corrosion control.



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vithalbhair Patel Road, Sikkannagar Girgaon,
Mumbai – 400 004.

SINCE 2016

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net



STAINLESS INDIA
A HOUSE OF QUALITY

36.10 Metallurgical References

Useful metallurgical resources include:

- Stainless steel engineering books
- Materials science textbooks
- Phase diagram references
- Heat treatment guides
- Welding metallurgy references

These publications help engineers understand microstructure, mechanical properties, corrosion behavior, and fabrication considerations.

36.11 Pressure Piping Design References

Common engineering references include:

- Pressure piping design manuals
- Process engineering books
- Mechanical engineering design texts
- Industrial piping guides
- Stress analysis references

These resources assist engineers with piping layout, thermal expansion, support design, and system integrity.

36.12 Inspection & Quality References

Quality assurance documentation commonly references:

- Inspection and Test Plans (ITPs)
- Quality Management Manuals
- Calibration Procedures
- Internal Audit Procedures
- Material Traceability Systems
- Corrective and Preventive Action (CAPA) Procedures

These documents help ensure compliance throughout manufacturing and inspection.

36.13 Procurement References

Procurement teams typically refer to:

- Project specifications
- Approved vendor lists
- Technical data sheets



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vithalbhai Patel Road, Sikkanagar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

- Purchase requisitions
- Material requisitions
- Vendor qualification records
- Inspection requirements
- Contract documentation

36.14 Export & Shipping References

International shipments may require compliance with:

- International commercial trade practices
- Customs documentation requirements
- Country-specific import regulations
- Packaging specifications
- Transportation requirements

Documentation requirements vary depending on the destination country and contractual obligations.

36.15 Engineering Books

Frequently consulted engineering references include publications covering:

- Stainless steel metallurgy
- Welding technology
- Pressure vessel engineering
- Corrosion engineering
- Heat treatment
- Process piping
- Mechanical design
- Materials selection

These books provide practical engineering guidance that complements formal codes and standards.

36.16 Academic & Research Publications

Technical research may be supported by:

- Peer-reviewed engineering journals
- Materials science publications
- Corrosion research papers
- Welding research
- Mechanical engineering journals
- Metallurgical conference proceedings



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vithalbhai Patel Road, Sikkanagar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

Peer-reviewed literature contributes to the continued development of engineering knowledge and best practices.

36.17 Manufacturer Documentation

Manufacturers commonly provide:

- Technical Data Sheets
- Product Catalogues
- Material Test Certificates
- Installation Guides
- Maintenance Recommendations
- Product Drawings
- Inspection Reports

These documents should always be reviewed together with applicable codes and project specifications.

36.18 Recommended Reference Categories

For engineering projects involving Stainless Steel 347H Elbows, consult references related to:

- Material Specifications
- Piping Design
- Welding Engineering
- Corrosion Engineering
- Metallurgy
- Mechanical Engineering
- Pressure Equipment
- Non-Destructive Testing
- Quality Assurance
- Procurement
- Industrial Safety

Using multiple authoritative sources supports sound engineering decisions.

36.19 Best Practices for Using Technical References

Engineers and quality professionals should:

- Use the latest applicable editions of standards.
- Verify project-specific requirements.
- Maintain controlled copies of critical documents.
- Review revisions before design or procurement.
- Confirm material compatibility.



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vithalbhai Patel Road, Sikkangar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

- Document all applicable references within project records.
- Train personnel on the relevant standards.

Consistent use of current technical references promotes quality, safety, and regulatory compliance.

36.20 Chapter Summary

International standards, engineering codes, and technical literature form the foundation for the safe and reliable application of Stainless Steel 347H Elbows. Standards such as ASTM A403, ASME B16.9, ASME B31.3, EN 10204, ISO 9001, and related publications provide guidance for material selection, manufacturing, inspection, testing, documentation, and installation. By applying current editions of recognized standards together with project specifications and sound engineering judgment, manufacturers, engineers, inspectors, and procurement professionals can achieve consistent product quality and long-term operational reliability.

Prepared By: STAINLESS INDIA
Website: www.stainlessindia.net
Email: info@stainlessindia.net
Phone: +91 97680 42420
Location: Mumbai, Maharashtra, India
Edition: First Edition – 2026
Dated : 11.07.2026
© 2026 STAINLESS INDIA.
All rights reserved.



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vithalbhair Patel Road, Sikkannagar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

Chapter 37 – About STAINLESS INDIA, Company Profile, Manufacturing Capability, Global Supply Network, Industries Served, Quality Policy, Contact Information & Call to Action

37.1 About STAINLESS INDIA

STAINLESS INDIA is a trusted manufacturer, stockist, supplier, and exporter of high-performance ferrous and non-ferrous metal products for critical industrial applications. With more than 25 years of industry experience, the company supplies premium-quality piping products, flanges, fittings, fasteners, pipes, tubes, plates, bars, and special alloys to customers across domestic and international markets.

Our focus is to provide technically compliant products that meet internationally recognized engineering standards while delivering dependable service, competitive pricing, and timely project execution.

37.2 Our Vision

To become one of the world's most trusted industrial metal solution providers by delivering superior quality products, technical excellence, continuous innovation, and exceptional customer satisfaction.

37.3 Our Mission

Our mission is to:

- Supply high-quality industrial metal products.
- Deliver technically compliant engineering solutions.
- Maintain complete material traceability.
- Ensure customer satisfaction through quality and service.
- Support global infrastructure with reliable products.
- Build long-term relationships based on trust and integrity.

37.4 Our Core Values

Our business is guided by the following principles:

- Quality
- Integrity
- Technical Excellence
- Customer Satisfaction
- Innovation
- Transparency
- Reliability
- Continuous Improvement
- Ethical Business Practices



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vitthalbhai Patel Road, Sikkanagar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

- Long-Term Partnerships

37.5 Company Profile

STAINLESS INDIA specializes in supplying a comprehensive range of industrial piping products manufactured in accordance with internationally recognized specifications.

Product Portfolio

Stainless Steel Products

- Pipes
- Tubes
- Buttweld Pipe Fittings
- Forged Pipe Fittings
- Flanges
- Fasteners
- Sheets
- Plates
- Coils
- Round Bars

Carbon Steel Products

- Pipes
- Pipe Fittings
- Flanges
- Plates
- Fasteners
- Round Bars

Alloy Steel Products

- Pipes
- Tubes
- Pipe Fittings
- Flanges
- Forged Components

High Nickel Alloys

- Inconel



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vitthalbhai Patel Road, Sikkanagar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

- Monel
- Hastelloy
- Nickel Alloys
- Duplex Stainless Steel
- Super Duplex Stainless Steel

The company serves diverse engineering and process industries requiring reliable metallic products for critical applications.

37.6 Manufacturing & Supply Capability

Our capabilities include:

- Precision manufacturing
- Large inventory management
- Project-based supply
- Custom product sourcing
- Technical material selection
- Material traceability
- Export packaging
- Global logistics coordination
- Third-party inspection coordination

We support both standard and project-specific requirements for industrial piping systems.

37.7 Quality Assurance

Quality is integrated throughout every stage of our supply process.

Our quality practices include:

- Incoming material verification
- Positive Material Identification (PMI), where specified
- Chemical analysis review
- Mechanical property verification
- Dimensional inspection
- Non-destructive testing, when required
- Heat number traceability
- Final inspection before dispatch
- Documentation review



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vitthalbhai Patel Road, Sikkanagar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

Every shipment is supported by applicable inspection and quality documentation as specified by customer or project requirements.

37.8 Quality Policy

Our quality policy is based on four key commitments:

Customer Satisfaction

Deliver products that consistently meet customer expectations.

Technical Compliance

Supply materials conforming to applicable ASTM, ASME, EN, ISO, and customer specifications.

Continuous Improvement

Improve processes, quality systems, and customer service through ongoing evaluation and improvement.

Reliable Delivery

Deliver products safely, accurately, and on schedule.

37.9 Standards We Support

Products can be supplied in accordance with internationally recognized standards, including:

- ASTM
- ASME
- ANSI
- MSS
- ISO
- EN
- PED (where applicable)
- Customer project specifications

The applicable standards depend on the product and purchase requirements.

37.10 Inspection & Certification

Depending on customer requirements, documentation may include:

- EN 10204 Type 3.1 Inspection Certificate
- EN 10204 Type 3.2 Inspection Certificate (where specified)



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vithalbhai Patel Road, Sikkangar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

- Material Test Certificate (MTC)
- Chemical Analysis Report
- Mechanical Test Report
- Positive Material Identification (PMI) Report
- Dimensional Inspection Report
- Non-Destructive Testing (NDT) Reports
- Third-Party Inspection Reports

37.11 Industries We Serve

Our products are supplied to a wide range of industries, including:

- Oil & Gas
- Petrochemical
- Refineries
- Power Generation
- Chemical Processing
- LNG & Gas Processing
- Offshore Platforms
- Marine Engineering
- Shipbuilding
- Fertilizer Plants
- Water Treatment
- Pharmaceutical Manufacturing
- Food Processing
- Sugar Plants
- Cement Plants
- Infrastructure Projects
- EPC Contractors

37.12 Global Supply Network

STAINLESS INDIA supports customers in domestic and international markets through efficient logistics and export coordination.

Our supply network includes:

- Industrial manufacturers
- EPC contractors
- Process industries
- Engineering consultants



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vitthalbhai Patel Road, Sikkanagar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

- OEMs
- Government organizations
- Infrastructure developers
- International distributors

The company serves customers across multiple regions while providing export-quality packaging and documentation.

37.13 Why Choose STAINLESS INDIA?

Customers choose STAINLESS INDIA because of:

- Extensive industry experience
- High-quality products
- International standards compliance
- Competitive pricing
- Technical assistance
- Reliable delivery
- Complete material traceability
- Quality documentation
- Professional customer support
- Long-term business relationships

37.14 Commitment to Sustainability

We support responsible business practices by:

- Promoting efficient material utilization.
- Encouraging recycling of stainless steel products.
- Reducing unnecessary packaging waste where practical.
- Supporting environmentally responsible manufacturing practices.
- Continuously improving operational efficiency.

37.15 Customer Support

Our technical team assists customers with:

- Material selection
- Product identification
- Standards interpretation
- Technical documentation



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vittalbhai Patel Road, Sikkanagar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

- Inspection requirements
- Export documentation
- Procurement support
- Project coordination

37.16 Contact Information

Head Office

STAINLESS INDIA

Office No. 301, 3rd Floor, Praman Heritage,
V. P. Road, Sikka Nagar, Girgaon,
Mumbai – 400004, Maharashtra, India.

Branch Office

Gandhinagar – 372024, Gujarat, India.

Contact

Phone: +91 22 6666 8751

Mobile / WhatsApp: +91 97680 42420

Email: info@stainlessindia.net

Website: urlwww.stainlessindia.netturn0search3

37.17 Request for Quotation (RFQ)

To help us prepare an accurate quotation, please provide:

- Product Name
 - Material Grade
 - Standard
 - Size
 - Schedule
 - Quantity
 - Drawing (if applicable)
 - Inspection Requirements
 - Delivery Location
 - Project Name
 - Required Delivery Date
-



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Viththalbhai Patel Road, Sikkanagar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016



STAINLESS INDIA
A HOUSE OF QUALITY

37.18 Our Commitment

At STAINLESS INDIA, we believe that every industrial project deserves products that combine quality, reliability, and engineering excellence. We are committed to delivering technically compliant piping solutions backed by responsive service, complete documentation, and a customer-focused approach. Whether supporting a single replacement requirement or a large EPC project, our goal is to build long-term partnerships through consistent performance and dependable supply.

37.19 Final Conclusion

Stainless Steel 347H Elbows are among the most reliable piping components for elevated-temperature and pressure applications. Their combination of high-temperature strength, weldability, resistance to sensitization, and long-term durability makes them an excellent choice for refineries, petrochemical plants, power stations, chemical processing facilities, and other demanding industrial environments.

This book has covered the complete engineering lifecycle of Stainless Steel 347H Elbows—from metallurgy and manufacturing to inspection, procurement, maintenance, failure analysis, technical references, SEO strategy, and practical guidance. By following recognized engineering standards and industry best practices, organizations can improve safety, reliability, and operational efficiency while maximizing the service life of their piping systems.



STAINLESS INDIA

Office No: 301, 3rd Floor, Plot No.
CS No.9/639 N Block 134L, Praman Heritage,
Vitthalbhai Patel Road, Sikkanagar Girgaon,
Mumbai – 400 004.

+91-9768042420
+91-22-66668750 / 8751
shah@stainlessindia.net
www.stainlessindia.net

SINCE 2016