

Thermowells - Fabricated

- **Wide Range of Materials**
 - Stainless Steels
 - Exotic Materials
- **Choice of Process Connections**
 - Flanged
 - Screwed
 - Weld-In
- **Pipe or Tube**
- **ASME IX Coded Welding**
- **Special Coatings**
- **Non Destructive Testing**

General Description

Fabricated Pockets are precision components manufactured to the highest standard from pipe, tube and bar, to serve as protective devices for primary sensing elements of all types.

A wide range of possible products are available. Conditions of pressure, temperature, velocity and corrosion resistance govern the size, shape and selection of materials to ensure optimum dependability, response time and accuracy.

Specification

Materials

We are experienced in the manufacture of fabricated pockets in a wide range of materials, including 304, 310, 316 and 321 Stainless Steels, 446 Cr-Fe, 6% Mo, Haynes Alloys 214, 230, 556 and HR-160, Carbon Steels, Chromium Steels, Duplex and Super Duplex Stainless Steels, Hastelloy B3, C22, C276 and X, Incoloy 800, 825, Inconel 600 and 625, Monel 400 and Titanium.

For recommendations on the use of these materials, please refer to later in this data sheet.

Pocket Size

We can fabricate pockets from a wide variety of tube or pipe sizes including 11 mm x 7 mm, ¼" NB, ½" NB, ¾" NB, 1" NB and larger, in a variety of schedules subject to requirements and process conditions.

Instrument Connection

Instrument connections may be male or female, in API, NPT, BSP or other thread forms.

Process Connection

Connection to the pipe or vessel may be by means of thread, flange or weld.

Threaded

Using standard tapered or parallel pipe threads for simplicity and low cost is popular, generally for low pressure applications.

Standard threads are NPT, BSP(PI), BSP(Tr) and API. The thread size is dependent on the application. Standard sizes range from ½" to 2".



Fabricated Thermowells

Flanged

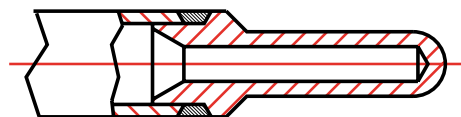
All sizes and pressure ratings are available to DIN, BS, ANSI/ASME and JIS or other standards. Flanged connections are now the petrochemical standard for all applications.

Weld-In

Weld in pockets are normally used where process pressure and velocities are too great for flanged and threaded, or where long term inexpensive connections are required.

Reduced Tip

For applications where a quick response to changes in temperature is required, fabricated pockets may be fitted with a reduced tip. The tip is machined from bar-stock, with a bore suited to the primary element, minimising the amount of free air space around the sensor.



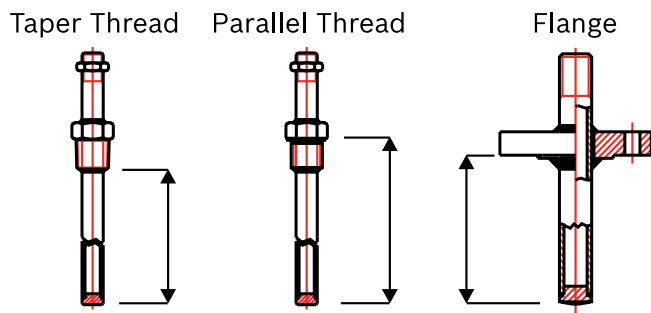
Immersion Length

The immersion length should be calculated to ensure that the sensing element has sufficient immersion into the process medium to give accurate measurement. To ensure optimum results and freedom from outside influences, thermowell tip should be located at a point which equates with the lower portion of the centre third of the pipe line.

For tanks, the depth of immersion obviously varies considerably but, as a rule of thumb, 300 mm from outer wall will give ideal results.

In high velocity applications, wake frequency effects must also be considered.

Immersion length is defined as shown.



Surface Finish

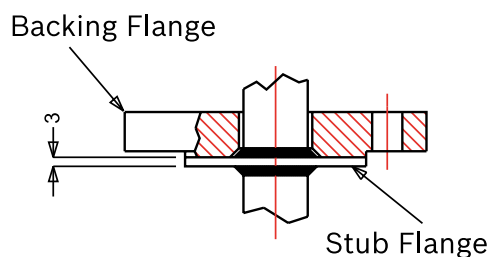
Thermowells are supplied as standard with a fine machined surface finish. Other finishes may be supplied on request.

Special Coatings

We have specialist in-house facilities for coating thermowells to increase corrosion and abrasion resistance. Options include Stellite®, Tungsten Carbide, Tantalum, Zirconium and PTFE.

Stub Flange Arrangement

When a fabricated pocket is manufactured from exotic materials, for example Inconel®, Monel®, Hastelloy® or Titanium, it is not necessary for the whole flange to be of the same material. For economic reasons, we offer a stub flange typically 3mm thick with a diameter equal to the raised face. This is welded to the Thermowell stem and is supplied fitted with a loose backing flange normally manufactured in 316 stainless steel or carbon steel.



Weld Procedures

We employ ASME IX coded welders, experienced in stainless steels, Carbon Steels and exotic materials. Welding procedures, qualification records and welder approval certificates can be supplied on request.

Heat Treatment

Thermowells may be heat treated to customers' requirements. The requirements of NACE MR 01-75 can be met.

Quality Control / Inspection

Our thermowells are manufactured under a strict ISO 9001-2000 quality control system. A wide range of documentation and Non Destructive Testing can be provided on request, including:

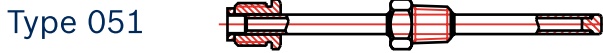
- Material Certification (EN 10049 3.1b)
- Certificate of Conformity
- Hydrostatic Pressure Test
- Dye Penetrant Inspection
- Radiography
- Ultrasonic Bore Concentricity Test
- Positive Material Identification
- Intergranular Corrosion Test
- Hardness Testing

Third party inspection may be arranged, and material certification to EN 10204 3.1c and IBR can be provided.

Standard Thermowells

The following are the most common fabricated pockets available. Other designs are available to customers' standards, as the application requires.

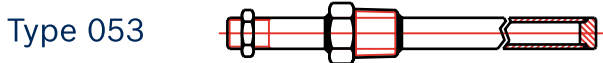
It is not to be implied that all pockets shown below are available in all sizes, ratings and materials. Please refer to the sales department with specific enquiries.



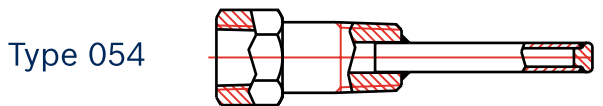
Type 051
11 mm OD or 1/4" NB, Parallel or Tapered Thread
M24 or 1/2" BSP(PI) Gland and Ring



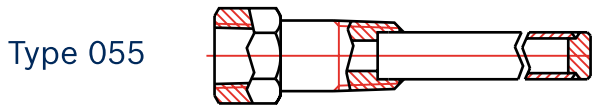
Type 052
11 mm OD or 1/4" NB, Parallel or Tapered Thread
1/2" BSP(PI) Running Nipple



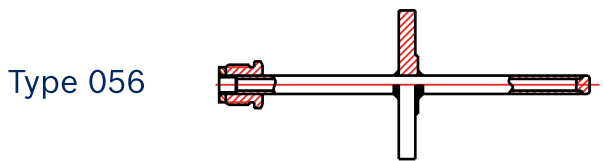
Type 053
1/2" NB, Parallel or Tapered Thread
Available with Reduced Tip



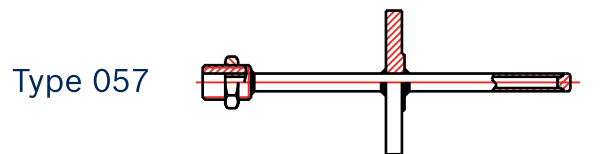
Type 054
11 mm OD or 1/4" NB, Parallel or Tapered Thread



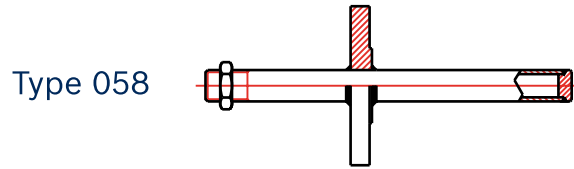
Type 055
1/2" NB, Parallel or Tapered Thread
Available with Reduced Tip



Type 056
11 mm OD or 1/4" NB, Flanged Process Connection
M24 or 1/2" BSP(PI) Gland and Ring

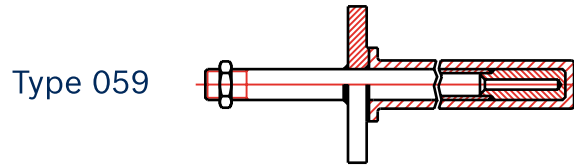


Type 057
11 mm OD or 1/4" NB, Flanged
1/2" BSP(PI) Running Nipple



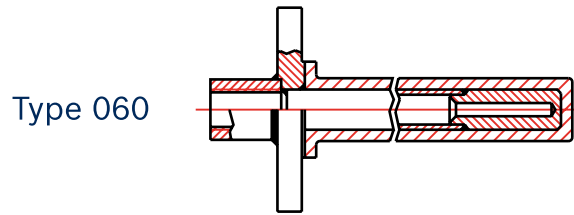
Type 058

1/2" NB, Flanged, 1/2" BSP(PI) Male Top Connection
Available with reduced tip



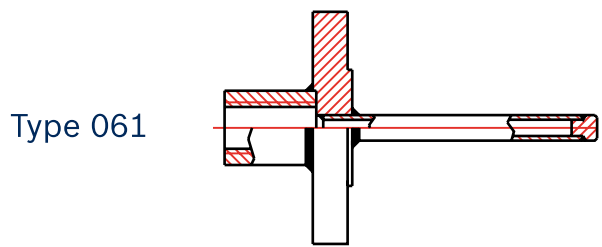
Type 059

1/2" NB, Flanged, 1/2" BSP(PI) Male Top Connection
With Protective Sheath



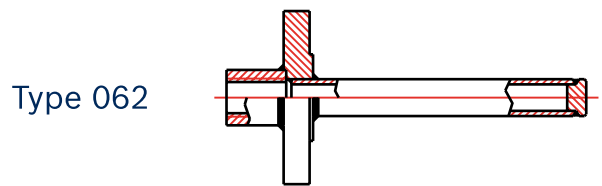
Type 060

1/2" NB, Flanged, Female Top Connection
With Protective Sheath



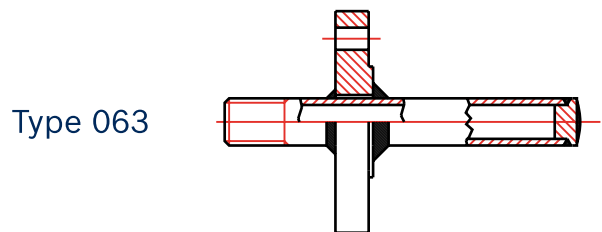
Type 061

11 mm OD or 1/4" NB, Flanged, Female Top Connection



Type 062

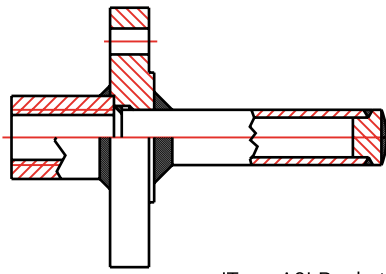
1/2" NB, Flanged, Female Top Connection
Available with reduced tip



Type 063

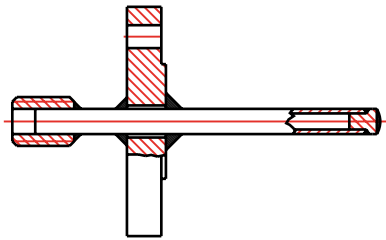
'Type A' Pocket
1/2" NB, Flanged, 1/2" BSP(PI) Male Top Connection
Available with Stub Flange and Backing Flange

Type 064



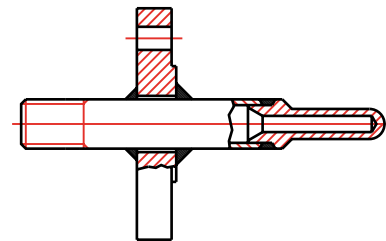
'Type A2' Pocket
 1/2" NB, Flanged, 3/4" BSP(PI) Female Top Connection
 Available with Stub Flange and Backing Flange

Type 065



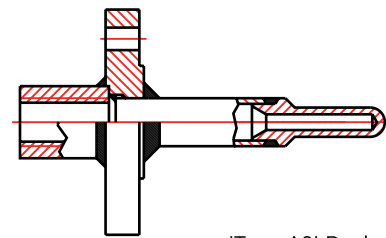
'Type B' Pocket
 11 mm OD, Flanged, 1/2" BSP(PI) Male Top Connection
 Available with Stub Flange and Backing Flange

Type 066



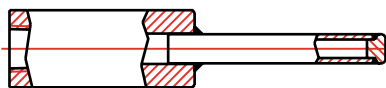
'Type C' Pocket
 1/2" NB, Flanged, 1/2" BSP(PI) Male Top Connection
 With Reduced Tip
 Available with Stub Flange and Backing Flange

Type 067



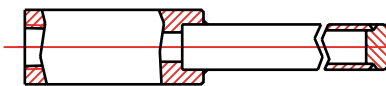
'Type A2' Pocket
 1/2" NB, Flanged, 3/4" BSP(PI) Female Top Connection
 With Reduced Tip
 Available with Stub Flange and Backing Flange

Type 068



Weld-In Pocket
 11 mm OD or 1/4" NB
 Female Top Connection

Type 069



Weld-In Pocket
 1/2" NB
 Female Top Connection
 Available with reduced tip

Thermowells - Solid Drilled

- **Wide Range of Materials**
 - Stainless Steels
 - Exotic Materials
- **Choice of Process Connections**
 - Flanged
 - Screwed
 - Weld-In
- **One Piece Forgings**
- **ASME IX Coded Welding**
- **Special Coatings**
- **Non Destructive Testing**

General Description

Solid Drilled Thermowells are precision components manufactured to the highest standard from bar or forgings, to serve as protective devices for primary sensing elements of all types.

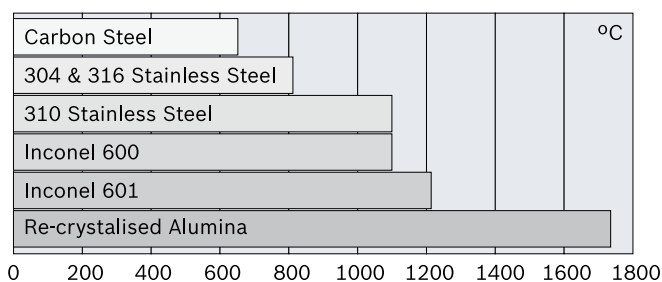
A wide range of possible products are available. Conditions of pressure, temperature and corrosion resistance govern the size, shape and selection of materials to ensure optimum dependability system response and accuracy.

Specification

Materials

We are experienced in the manufacture of solid drilled thermowells in a wide range of materials, including 304, 310, 316 and 321 Stainless Steels, 446 Cr-Fe, 6% Mo, Haynes Alloys 214, 230, 556 and HR-160, Carbon Steels, Chromium Steels, Duplex and Super Duplex Stainless Steels, Hastelloy B3, C22, C276 and X, Incoloy 800, 825 and MA-956, Inconel 600 and 625, Monel 400 and Titanium.

Some suggested materials for various temperatures are shown in the chart below.



For recommendations on the use of these materials, please refer to page 38.

Instrument Connection

Instrument connections may be male or female, with API, NPT, BSP, or other thread forms.

Process Connection

Connection to the pipe or vessel may be by means of thread, flange or weld.

Threaded Connection

Using standard tapered or parallel pipe threads for simplicity and low cost is popular, generally for low pressure applications.

Standard threads are NPT, BSP(PI), BSP(Tr) and API. The thread size is dependent on the application, but $\frac{3}{4}$ " and 1" are common.



Solid Drilled Thermowells

Flanged Connection

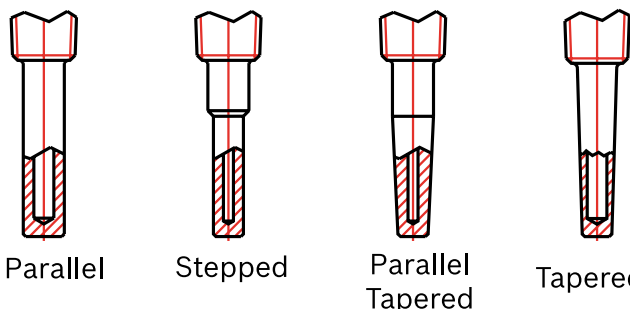
All sizes and pressure ratings are available to DIN, BS, ANSI/ASME and JIS or other standards. Flanged connections are now the petrochemical standard for all applications.

Weld-In Connection

Weld in thermowells are normally used where process pressure and velocities are too great for flanged and threaded, or where long term inexpensive connections are required.

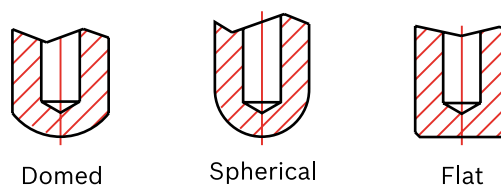
Immersion Profile

The profile should take account of fluid flow characteristics, strength of thermowell and immersion length.



Tip Profile

Consideration should be given to tip profiles when designing the thermowell for a specific application. As a rough guide, flat tip should be used for lower pressure applications, where flow characteristics around thermowell are not important. Domed and spherical profiles should be used in medium and high pressure applications respectively where flow characteristics around thermowell are important.



Bore

Selected to suit primary sensing element, ensure ease of removal and minimise the amount of free air space around sensor, thus providing optimum response time. In general the outside diameter and bore of the thermowell should be such that the minimum wall thickness is 3 mm.

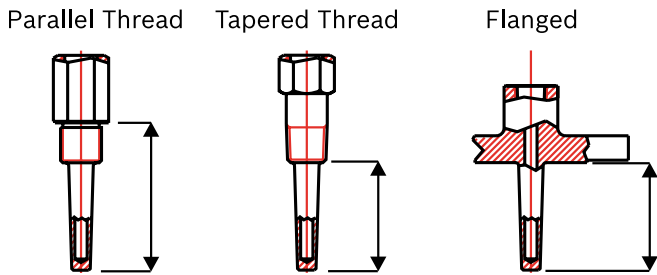
We operate specialised deep bore gun-drilling machines to ensure the concentricity and finish of the thermowell bore.

Immersion Length

The immersion length should be calculated to ensure that the sensing element has sufficient immersion into the process medium to give accurate measurement. To ensure optimum results and freedom from outside influences, thermowell tip should be located at a point which equates with the lower portion of the centre third of the pipe line.

For tanks, the depth of immersion obviously varies considerably but, as a rule of thumb, 300 mm from outer wall will give ideal results.

In high velocity applications, wake frequency effects must also be considered. Refer to page 49 for more information. Immersion length is defined as shown.



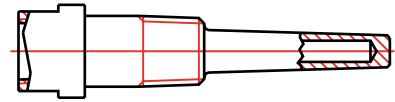
Please refer to page 41 for further details of Surface Finishes, Special Coatings, Weld Procedures and Heat Treatment.

Standard Thermowells

The following are the most common thermowell types available. Other designs are available to customers' standards, as the application requires.

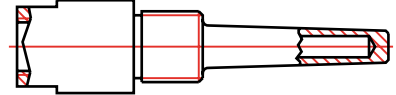
It is not to be implied that all thermowells shown below are available in all sizes, ratings and materials. Please refer to the sales department with specific enquiries.

Type 003



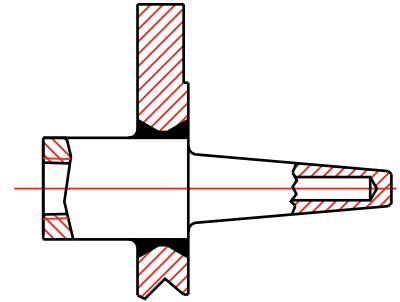
Round Thermowell With Tapered Thread

Type 004



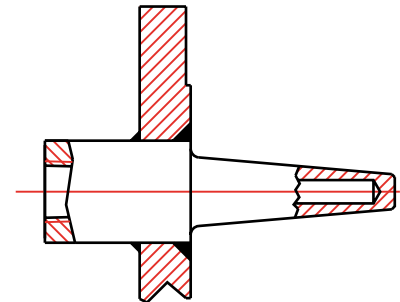
Round Thermowell With Parallel Thread

Type 005



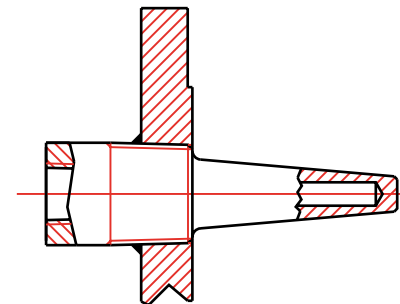
Flanged Thermowell, Full Penetration Weld

Type 006



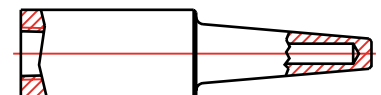
Flanged Thermowell, Fillet Weld

Type 007



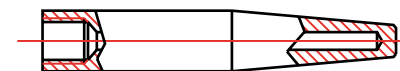
Flanged Thermowell, Thread and Weld

Type 008



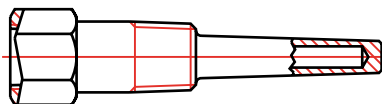
Weld-In Thermowell

Type 009



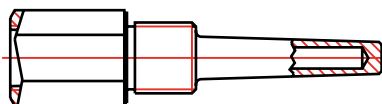
DIN Standard Weld-In Thermowell

Type 001



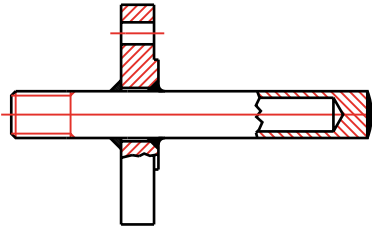
Hex Thermowell With Tapered Thread

Type 002



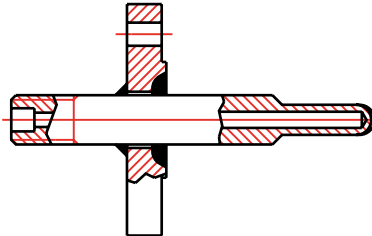
Hex Thermowell With Parallel Thread

Type 010



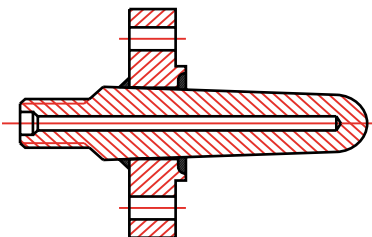
Type A Flanged Thermowell

Type 011



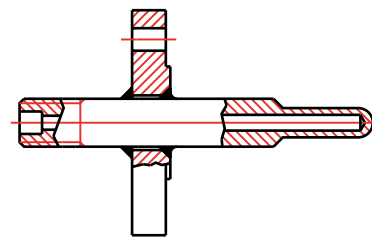
Type E Flanged Thermowell

Type 012



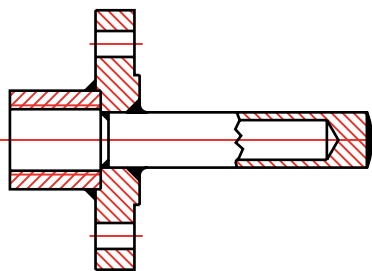
Type D Flanged Thermowell

Type 013



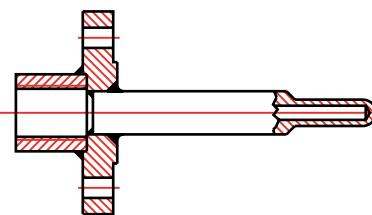
Type C Flanged Thermowell

Type 014



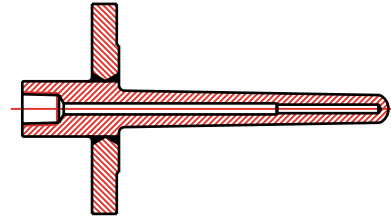
Type A2 Flanged Thermowell

Type 015



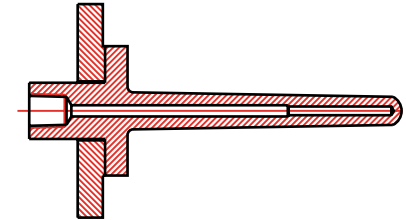
Type A2 Flanged Thermowell, Reduced Tip

Type 016



S-2006-4 Thermowell

Type 017



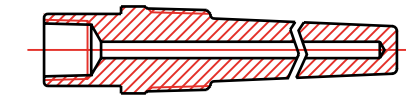
S-2007-4 Thermowell

Type 018



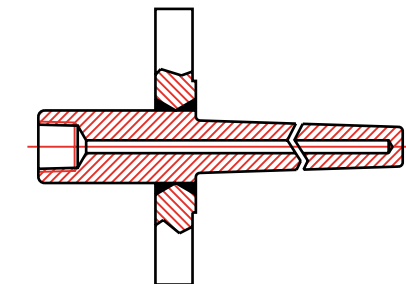
S-0984-9 Thermowell

Type 019



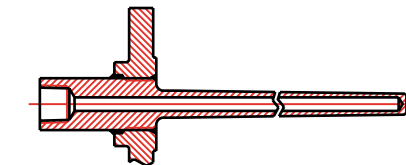
FSI-776 Screwed Thermowell

Type 020



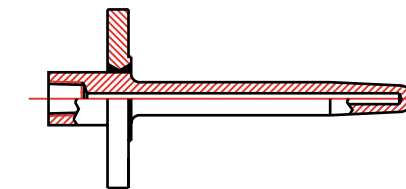
FSI-776 Flanged Thermowell

Type 021



6-105-3 Flanged Thermowell

Type 022



SP.BL.2291-K14 Flanged Thermowell

Type 023

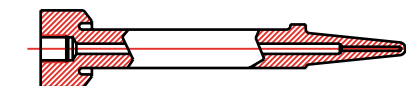


Fig 1 Weld-In Thermowell

Type 024

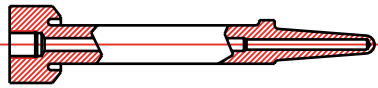


Fig 2 Weld-In Thermowell

Type 025

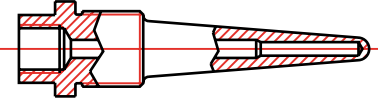


Fig 3 Screwed Thermowell

Type 026

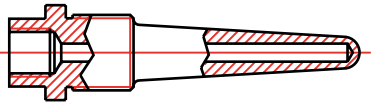
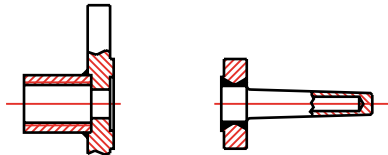


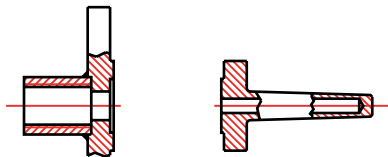
Fig 4 Screwed Thermowell

Type 027



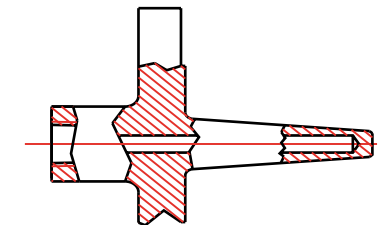
Welded Thermowell and Backing Flange

Type 028



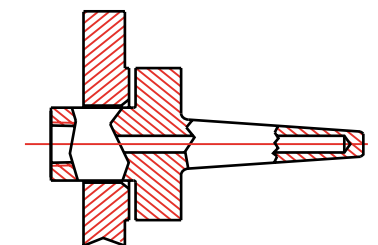
Forged Thermowell and Backing Flange

Type 029



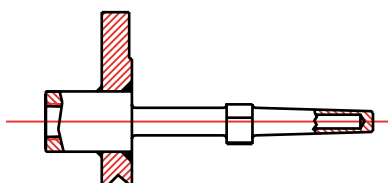
Forged Flanged Thermowell

Type 030



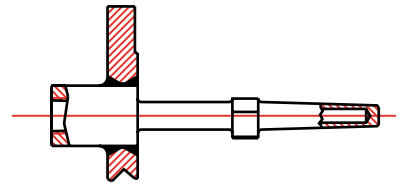
Forged Thermowell with Backing Flange

Type 031



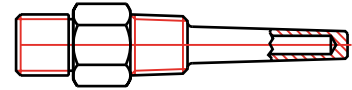
High Velocity Thermowell, Fillet Weld

Type 032



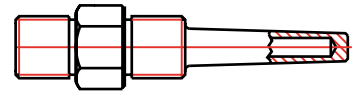
High Velocity Thermowell, Full Penetration Weld

Type 033



Hex Thermowell with Tapered Thread

Type 034



Hex Thermowell with Parallel Thread

Thermowell Materials

Carbon Steel

Low cost materials with little corrosion resistance. Used in low temperature and stress applications where the measured medium protects it from corrosion, oils, petroleum, tars etc.

Maximum temperature: 530°C.

Chrome/Moly Steels

High strength steels used in pressure vessels and industrial boiler plant. Resistant to chloroform, cleaning agents, food products and carbon disulphide.

Maximum temperature: 600°C.

304 Stainless Steel

Low cost corrosion resistant material, used extensively in food, beverage and chemical processing where good corrosion resistance is required. A low carbon grade, 304L is available which can be welded without impairing its corrosion resistance.

Maximum temperature: 900°C.

321 Stainless Steel

Similar properties to 304SS above, except that this grade is titanium stabilized to prevent intergranular corrosion when welded.

316 Stainless Steel

Best corrosion resistance of the austenitic stainless steels due to the addition of molybdenum, widely used in chemical processing, offers useful resistance to H₂S. As with 304, a low carbon grade, 316L is available for welded applications.

Maximum temperature: 900°C.

310 Stainless Steel

Heat resistant material, which can be used up to 1150°C with useful resistance in sulphur bearing atmospheres. Corrosion resistance is slightly better than 304SS, but not as good as 316SS. Can be welded with caution.

446 Stainless Steel

Ferritic stainless steel with excellent resistance to sulphurous atmospheres at high temperature, however due to its low strength at high temperature, thermowells made from this material should be mounted vertically.

Used in heat treatment processes, iron and steel furnaces, gas production plant and it has some useful resistance to molten lead. Good corrosion resistance to nitric acid, sulphuric acid and most alkalis gives it some limited use in chemical plant. Maximum temperature: 1150°C.

Duplex Stainless Steel

These grades combine high strength with excellent corrosion resistance, especially to chloride stress corrosion cracking, however a tendency to brittleness limits their use to approx 300° to 315°C maximum, sub-zero use is also restricted to approx 50°C because of brittleness due to the ferrite content. Main uses include offshore piping, chemical tanks, flue gas scrubbers and chimneys.

Super Duplex Stainless Steel

Similar qualities and limitations to duplex grades above. These grades are widely used to handle seawater and other brackish waters, marine pumps, oil and gas production and desalination plants are typical applications.

Inconel® 600

A very widely used nickel-chromium-ion alloy with excellent high temperature strength and oxidation resistance, however it is very vulnerable to attack in sulphurous atmospheres above 500°C. Good resistance to chloride-ion stress corrosion cracking and nitriding environments. Used extensively in chemical industries for its strength and corrosion resistance. Easily welded, can normally be used without post weld heat treatment.

Maximum temperature: 1212°C.

Inconel® 625

A nickel-chromium alloy with excellent resistance to pitting and crevice corrosion, unaffected by radiation embrittlement, widely used in aerospace applications and in marine environments. Good weldability, can be used in the as-welded condition.

Maximum temperature: 1093°C.

Incoloy® 800

Superior to alloy 600 in sulphur, cyanide salts and neutral salts. Extensively used in steam/hydrocarbon reforming plants for pigtail piping, manifolds and waste heat boilers and in the internal components of secondary reformers. Widely used in heat treatment equipment and as a heater sheath material.

Maximum temperature: 1093°C.

Incoloy® 825

A nickel-iron-chromium alloy with exceptional resistance to many corrosive environments, it is superior to almost all metallic materials for handling sulphuric acid and shows excellent resistance to phosphoric acid. It is widely used in chemical processing, oil and gas recovery, acid production, pickling operations, nuclear fuel reprocessing and handling of radioactive wastes.

Maximum temperature: 540°C.

Incoloy® MA 956

An iron-chromium-aluminium alloy produced by mechanical alloying, it features great strength at high temperatures with excellent resistance to oxidation, carburization, and hot corrosion. These properties make it especially suitable for gas-turbine combustion chambers and other aggressive environments containing sulphur and chloride salts.

Maximum temperature: 1350°C.

Monel® 400

Nickel-copper alloy with very good corrosion resistance, commonly used to handle sea water, hydrofluoric acid, sulphuric acid, hydrochloric acid and most alkalis. Typical applications include marine fixtures, chemical processing equipment, gasoline and water tanks, process vessels and piping and boiler feedwater heaters.

Maximum temperature: 538°C.

Hastelloy® C276

Nickel-molybdenum-chromium alloy with excellent corrosion resistance, especially in chlorinated environments. Widely used in chemical plant where it tolerates ferric and cupric chlorides, solvents, chlorine, formic acid, acetic acid, brine, wet chlorine gas and hypochlorite. Can be easily welded and maintains its properties in the as-welded condition.

Maximum temperature: 1093°C.

Hastelloy® B3

A development of the well-established B2 alloy with improved thermal stability, fabricability and stress corrosion cracking resistance. It is the alloy of choice for handling hydrochloric acid in all concentrations and temperatures; it also withstands hydrogen chloride, sulphuric, acetic, hydrofluoric and phosphoric acids.

Maximum temperature: 538°C, up to 816°C in reducing or vacuum environment.

Hastelloy® C22

A nickel-chromium-molybdenum-tungsten alloy with outstanding resistance to pitting, crevice corrosion and stress corrosion cracking. It shows exceptional resistance to a wide range of chemical process environments, such as ferric and cupric chlorides, chlorine, hot contaminated solutions, formic and acetic acids and seawater or brine solutions. The material has superior weldability, and retains its properties in the as-welded state.

Hastelloy® X

A high temperature alloy with excellent resistance to oxidizing, reducing and neutral atmospheric conditions, widely used in aircraft jet engine components. Very good high temperature strength makes it ideal for furnace applications. Resistant to stress corrosion cracking in petrochemical applications.

Maximum Temperature: 1204°C.

Haynes Alloy 214

Excellent high temperature material, with the highest resistance to oxidation and carburization of almost any alloy, it is recommended for temperatures of 950°C and above, it shows useful resistance up to 1315°C but its strength is severely reduced. Applications include ceramic firing furnace parts, automotive catalytic converter internals and in the industrial heating industry furnace flame hoods and rotary calciners. Has good resistance to chlorine contaminated environments, which allows its use in hospital waste incinerators.

Maximum temperature: 1204°C.

Haynes Alloy 230

Excellent high temperature strength, oxidation resistance and long term thermal stability. Used in aerospace, chemical processing and high temperature heating applications. Recommended for use in nitriding environments.

Maximum temperature: 1149°C.

Haynes Alloy 556

A multipurpose alloy which offers good resistance to sulphidising, carburising and chlorine bearing atmospheres. Common applications include waste incinerators, petroleum processes where sulphur is present, chloride salt baths, exhaust gas probes, the alloy is one of very few that can survive in molten zinc, making it ideal for galvanizing processes.

Maximum temperature: 1093°C.

Haynes Alloy HR160

A high temperature alloy with outstanding resistance to high temperature corrosion, it has excellent resistance to sulphidation, and chloride attack in both reducing and oxidizing atmospheres. Its resistance to attack by the products of combustion of low-grade fuels make it particularly useful in municipal, industrial, hazardous and nuclear waste incinerators.

Maximum temperature: 1204°C.

Titanium

A lightweight material with good strength in the 150° to 470°C range. Excellent resistance to oxidizing acids such as nitric or chromic, it is also resistant to inorganic chloride solutions, chlorinated organic compounds and moist chlorine gas. Its good resistance to seawater and salt spray, allows it to be used in off-shore installations. Can be welded with special precautions to protect from atmospheric contamination.

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