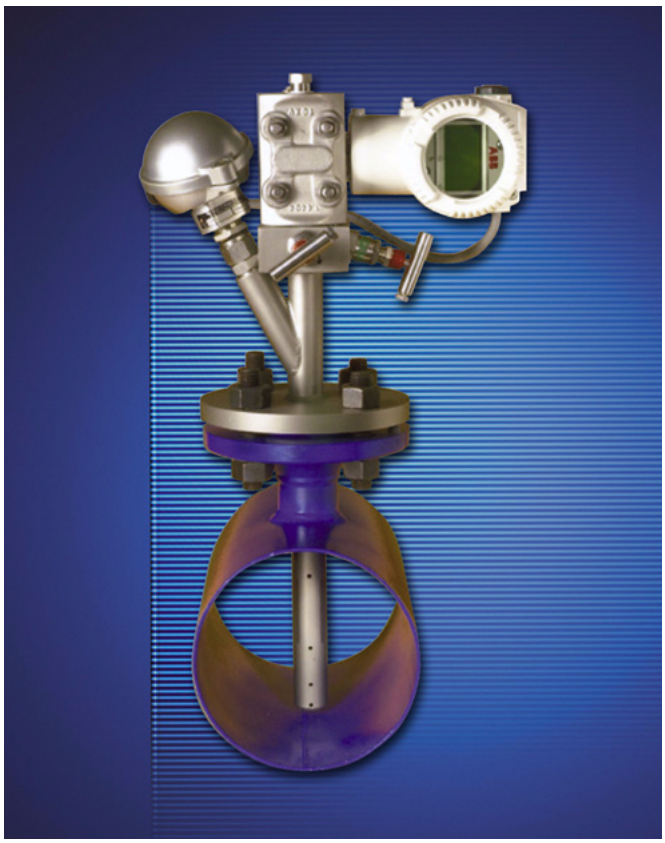
User Guide

IM/TORBAR–EN Issue 1

Averaging Pitot Tubes

TORBAR



ABB

The Company

We are an established world force in the design and manufacture of instrumentation for industrial process control, flow measurement, gas and liquid analysis and environmental applications.

As a part of ABB, a world leader in process automation technology, we offer customers application expertise, service and support worldwide.

We are committed to teamwork, high quality manufacturing, advanced technology and unrivalled service and support.

The quality, accuracy and performance of the Company's products result from over 100 years experience, combined with a continuous program of innovative design and development to incorporate the latest technology.

The UKAS Calibration Laboratory No. 0255 is just one of the ten flow calibration plants operated by the Company and is indicative of our dedication to quality and accuracy.

EN ISO 9001:2000

Cert. No. Q 05907

EN 29001 (ISO 9001)

Lenno, Italy – Cert. No. 9/90A

Stonehouse, U.K.

0255

Health and Safety

To ensure that our products are safe and without risk to health, the following points must be noted:

1. The relevant sections of these instructions must be read carefully before proceeding.
2. Warning labels on containers and packages must be observed.
3. Installation, operation, maintenance and servicing must only be carried out by suitably trained personnel and in accordance with the information given.
4. Normal safety precautions must be taken to avoid the possibility of an accident occurring when operating in conditions of high pressure and/or temperature.
5. Chemicals must be stored away from heat, protected from temperature extremes and powders kept dry. Normal safe handling procedures must be used.
6. When disposing of chemicals ensure that no two chemicals are mixed.

Safety advice concerning the use of the equipment described in this manual or any relevant hazard data sheets (where applicable) may be obtained from the Company address on the back cover, together with servicing and spares information.

Contents

1 General Information

1.1 Description

TORBAR is a multi-port, self-averaging primary flow element, based on the 'Pitot Tube' principle of fluid flow measurement. TORBAR produces an averaged differential pressure (DP) signal proportional to the square of the flow rate. This DP output is normally connected via small-bore piping to a Differential Pressure Transmitter that produces an electrical signal in proportion to the flow rate.

There are six main versions:

1. For insertion through a threaded fitting with a compression coupling.
2. For insertion through a flange.
3. 'Hot-tap' versions, to enable insertion and withdrawal under pressure.
4. Small pipe size versions equipped with 15 to 50 mm (0.5 to 2 in) in-line fittings and butt-welded, screwed or flanged ends.
5. TRIBAR – a single-insertion flowmeter comprising an integral 3-valve manifold and a DP transmitter connected to a TORBAR element. The TRIBAR can be supplied with an RTD element with or without a temperature transmitter.
6. MASS TRIBAR – a single-insertion flowmeter comprising an integral valve manifold, an RTD temperature sensor and a Smart, Multivariable Transmitter attached to a TORBAR element. It computes the mass flow of liquids and gases with automatic compensation for changes in pressure and temperature.

1.2 Health and Safety Information

TORBAR is supplied specifically for the application detailed on the tag-plate attached by a ring to the head of the device. Before installing TORBAR, ensure that the tag-plate information is correct for that application and matches the required specification. DO NOT use TORBAR for any other application without consulting ABB Limited or an accredited agent.

The instructions in this document detail the important basic information to ensure correct installation. However, it is the user's responsibility to ensure that suitably qualified personnel carry out the installation to established and recognized engineering codes of practice.

Warning.

- Before drilling into a process pipe, or before carrying out any maintenance activity or component replacement, reduce the pipe pressure to a safe level and remove all potentially injurious process material.

  Note that this warning does not necessarily apply when installing 'Hot-Tap' versions of TORBAR (except models L702, H702, H712, H812). However, ensure that the process material does not exceed the pressure and temperature limits of the TORBAR as specified.

- The part of the TORBAR external to the process pipe may present a a burn hazard, especially if the maximum temperature of the process material exceeds 100 ºC (212 °F). Either lag or shield the exposed parts of the TORBAR to protect personnel or display clear warning signs to alert personnel to the possible hazard. Refer to Standard EN563: 1904 'Safety of Machinery – Temperatures of Touchable Surfaces'.

It is the customer's responsibility to ensure that the products detailed in this publication are not used for purposes other than those for which they are designed.

It is the user's responsibility to ensure that adequate protection exists to prevent pressurization in excess of the maximum specified pressure for the product, even in the event of a fire.

If there are any queries regarding the instructions in this publication, contact either ABB Limited or their accredited agent before installing TORBAR.

2 Installation

2.1 General

The differential pressure generated by the TORBAR exits at the high- and low-pressure connections on the head of the device. The connections are identified by the letters L (low pressure) and H (high pressure).

The direction of flow is indicated by the small indentations on the head – see Fig. 2.1. The indentations must be positioned on the downstream side of the flow and are clearly visible from various directions and distances. Exceptions to this are Models 121, 122, 123, 511 and 512, and Direct Mount Head (DM) options, – refer to the relevant drawing for indication of alignment with direction of flow.

In addition, an arrow is stamped on the head of all TORBAR models to indicate direction of flow.

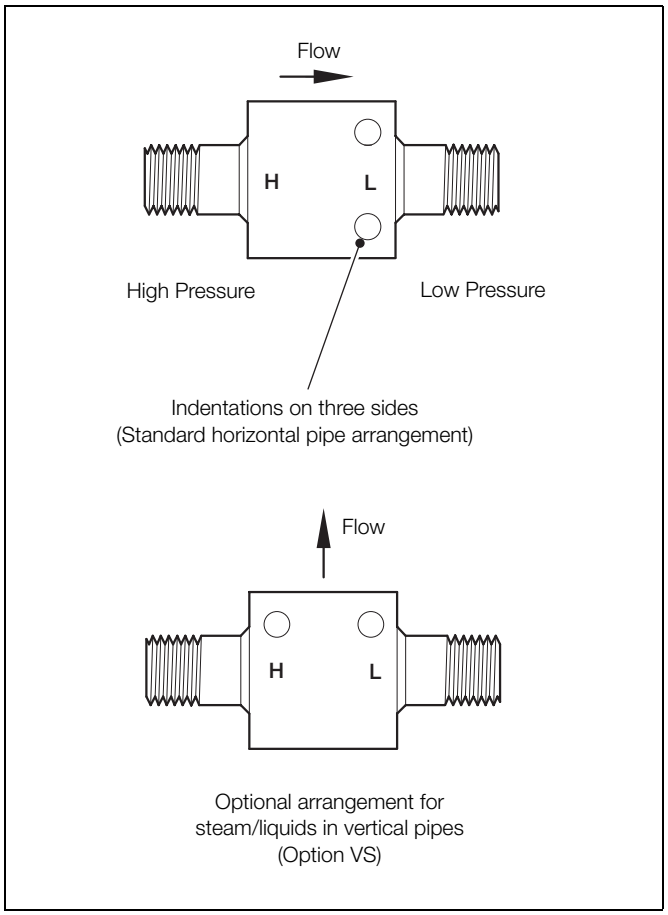


Fig. 2.1 TORBAR Head Flow Alignment Marks

To prevent noisy signal outputs, do not install TORBAR in a pulsating flow. Vibration also distorts the output signal and affects the structural limits of TORBAR.

2.2 Mounting

2.2.1 General

Select a location with sufficient clearance to install and remove TORBAR.

Referring to Fig. 2.1, install TORBAR:

- at right angles to the pipe run
- across the pipe diameter
- aligned with the pipe axis

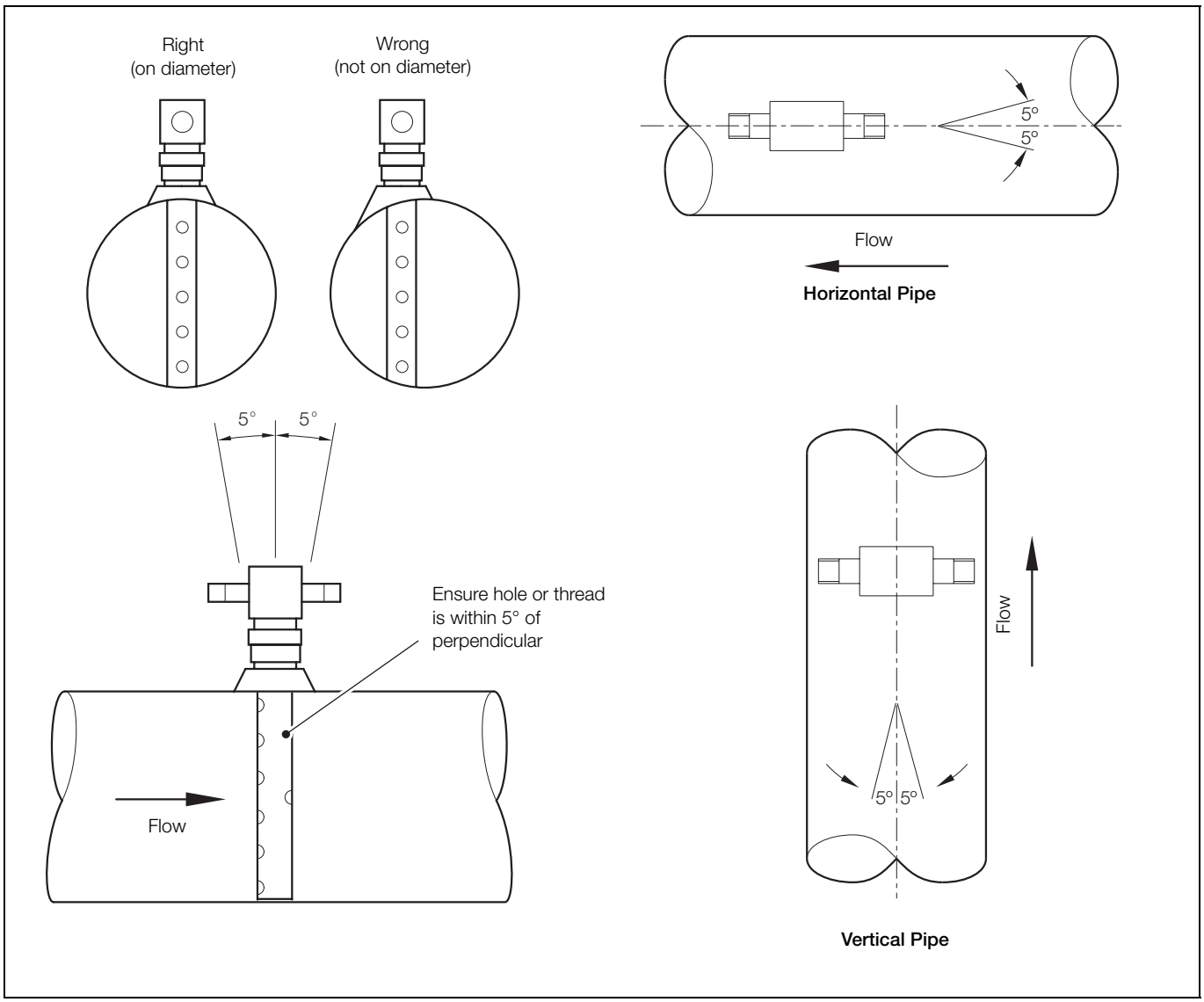


Fig. 2.2 TORBAR Alignment

2.2.2 Horizontal Pipe Mounting – Gas

To ensure that the instrument lines contain only gas, install TORBAR with the instrument connections **above** the centre line of the pipe, at least 5 degrees above the horizontal – see Fig. 2.3.

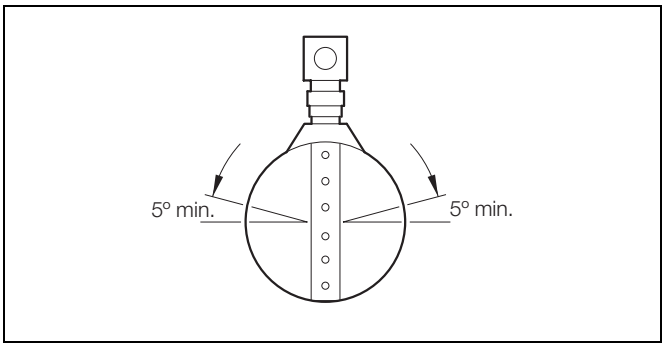


Fig. 2.3 Horizontal Pipe Mounting – Gas

2.2.3 Horizontal Pipe Mounting – Liquids

To ensure that the instrument lines contain only the process liquid, install TORBAR with the instrument connections **below** the centre line of the pipe, at least 5 degrees below the horizontal – see Fig. 2.4.

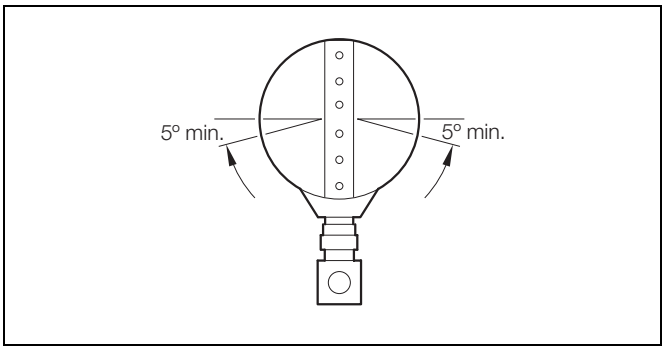


Fig. 2.4 Horizontal Pipe Mounting – Liquids

2.2.4 Horizontal Pipe Mounting – Steam

To ensure that the instrument lines contain only steam, install TORBAR with the instrument connections **at or below** the centre line of the pipe – see Fig. 2.4.

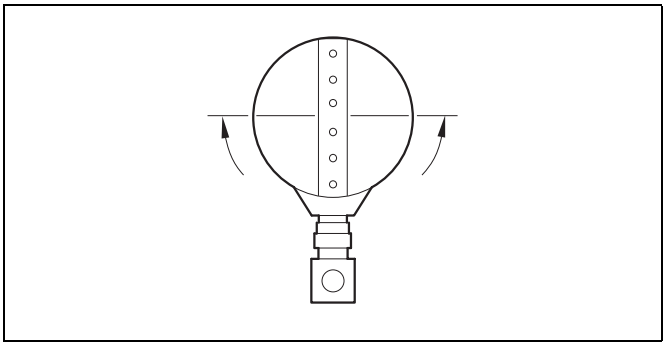


Fig. 2.5 Horizontal Pipe Mounting – Steam

2.2.5 Vertical Pipe Mounting – All Applications

Install only TORBAR option VS in vertical pipelines.

To ensure an equal head of gas, liquid or steam in both instrument lines, TORBAR option VS is designed so that the instrument lines are in the horizontal plane when the instrument is installed (see Fig. 2.1).

Any lateral-mounting angle is suitable – see Fig. 2.6.

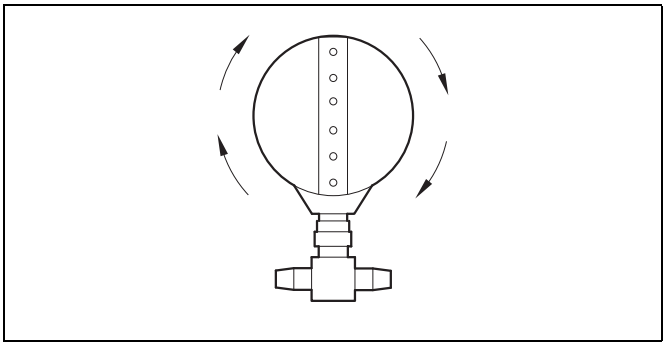


Fig. 2.6 Vertical Pipe Mounting – All Applications

2.2.6 Straight Pipe Requirements

To meet specified accuracy figures, install TORBAR at distances of **no less** than those shown in Fig. 2.7 from flow disturbances in the pipe. If TORBAR is installed within distances less than those shown, absolute accuracy will decrease BUT repeatability of measurement will continue to be excellent due to the inherent averaging characteristics. If it is not possible to comply with this instruction and maximum accuracy is required, consult ABB.

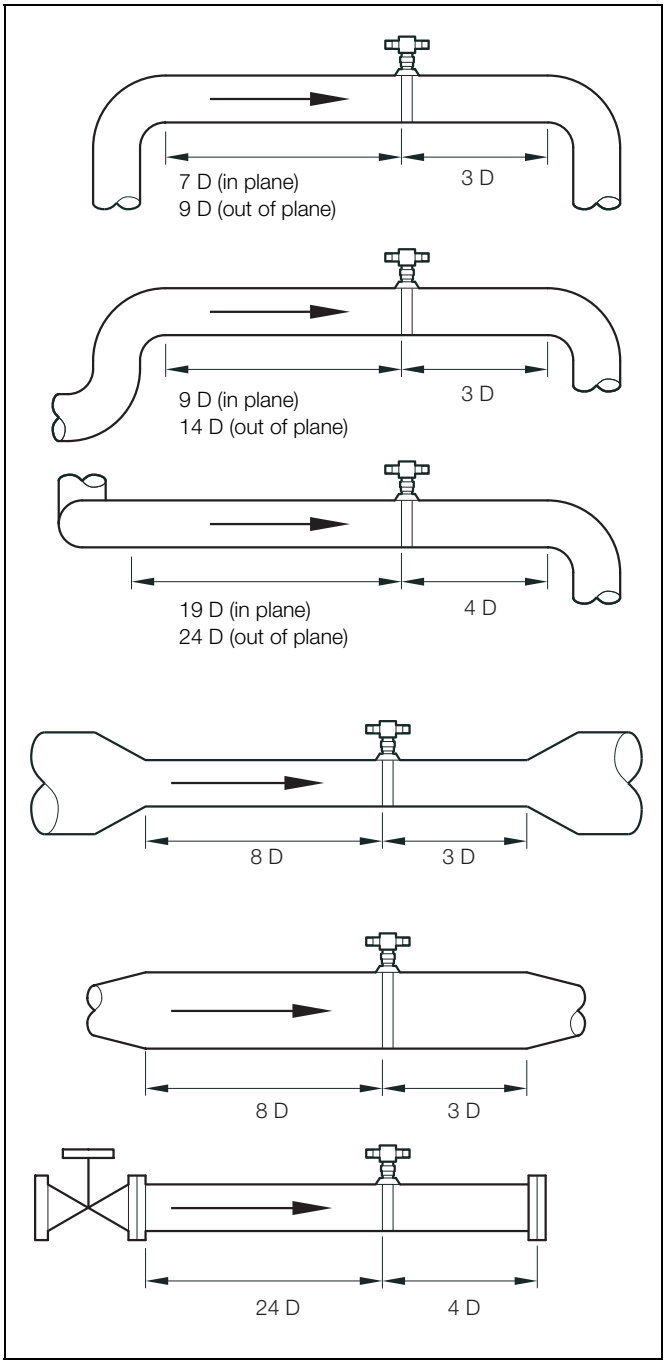


Fig. 2.7 Straight Pipe Requirements

2.2.7 Lagging (steam applications only)

The following instructions apply to both horizontal and vertical pipe installations:

1. Lag the entire TORBAR head and fitting assembly extending to the process pipe to prevent the formation of condensate. Excessive amounts of condensate forming in the head or fitting assembly has a detrimental effect on the correct functioning of TORBAR. Extend the lagging to (but do not lag) the filling tees, condensate pots (if fitted) and isolation valve handles.
2. In retractable TORBAR installations, ensure the lagging is easily removable.
3. Ensure that the tag plate is positioned outside the lagging for ease of identification.

2.3 Models 121, 122 and 123

Models 121, 122 and 123 are supplied with the TORBAR element installed in a pipe section. Table 2.1 details the type of fitting supplied with each model. The pipe length and relevant thread or flange sizes are shown on the drawing supplied with the TORBAR.

Model	Fitting
121	Butt weld
122	Threaded
123	Flanged

Table 2.1 Models 121, 122 and 123

2.4 Models 301, 401 and 402

Note. For models with a Duct-Mounting Plate, see Section 2.5, page 8.

Install the TORBAR as follow:

1. Select the required insertion position and mark the pipe.
2. Drill a 6 mm (0.24 in) pilot hole at the marked position, then drill to the appropriate size – see Table 2.2.

   Note. If a full penetration weld is required, measure the inside diameter of the fittings supplied with the TORBAR.

TORBAR Model	301	401 and 402
Hole Size in mm (in)	16 (0.63)	28 (1.1)

Table 2.2 Hole Size

3. Align the threaded fitting concentrically over the hole and tack-weld in place.
4. Using a suitably sized and threaded length of pipe, check the threaded fitting is concentric and aligned correctly – see Fig. 2.2 on page 4.
5. Completely weld the threaded fitting to the pipe.
6. **TORBAR Model 402 only**
   a. Measure exactly 180° around the pipe circumference and mark the pipe.
   b. Repeat steps 2 to 5.
7. Slide the compression-fitting assembly onto the TORBAR.
8. **TORBAR Models 301 and 401 only** – insert the TORBAR through the threaded fitting into the pipe until it touches the opposite internal wall.
9. **TORBAR Model 402 only**
   a. Insert the TORBAR through the threaded fitting into the pipe until it enters the opposite fitting.
   b. Apply appropriate sealant to the threads of the support plug.
   c. Referring to Fig. 2.9, screw support plug (A) into threaded fitting (B) and tighten, ensuring that:

      support plug (A) contacts the TORBAR (C)

      the distance between the head of support plug (A) and the pipe wall does not exceed 60 mm (2.4 in).

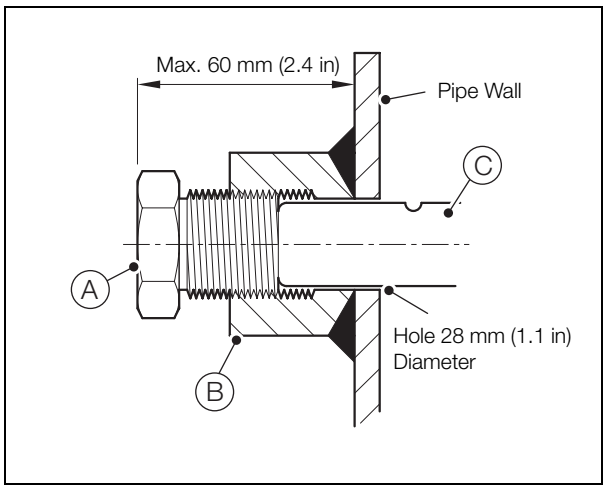


Fig. 2.8 Model 402 Support Plug

10. Apply appropriate sealant to the threads of the compression fitting.
11. Screw the compression fitting into the threaded fitting until hand-tight.
12. Turn the TORBAR until the indentation marks on the head are positioned downstream of the flow – see Fig. 2.1.
13. Holding the head of the TORBAR with a wrench to maintain correct orientation, use a long wrench to tighten the compression fitting until approximately one thread is left exposed under the nut, ensuring that the TORBAR does not turn.
14. Check the TORBAR is correctly installed and aligned.

2.5 Models 301, 401 and 402 with Duct Mounting Plates (Option Df)

1. Select the required insertion position and mark the pipe.
2. Drill a 6 mm (0.24 in) pilot hole at the marked position, then drill to the appropriate size – see Table 2.3.

TORBAR Model	301	401 and 402
Hole Size in mm (in)	16 (0.63)	28 (1.1)

Table 2.3 Hole Size

3. Align the duct mounting plate and gasket concentrically with the hole, ensuring that the TORBAR can pass cleanly through the duct mounting plate threaded fitting and into the pipe.
4. Drill through the duct mounting plate fixing holes and gasket into the pipe. **Do not** separate the gasket from the mounting plate.
5. Secure the duct mounting plate and gasket to the pipe with rivets.
6. **TORBAR Model 402 only**
   a. Measure exactly 180° around the pipe circumference and mark the pipe.
   b. Repeat steps 2 to 5.
7. Slide the compression-fitting assembly onto the TORBAR.
8. **TORBAR Models 301 and 401 only** – insert the TORBAR through the threaded fitting into the pipe until it touches the opposite internal wall.
9. **TORBAR Model 402 only**
   a. Insert the TORBAR through the threaded fitting into the pipe until it enters the opposite fitting.
   b. Apply appropriate sealant to the threads of the support plug.
   c. Referring to Fig. 2.9, screw support plug (A) into threaded fitting (B) and tighten, ensuring that:
      support plug (A) contacts the TORBAR (C)
      the distance between the head of support plug (A) and the pipe wall does not exceed 60 mm (2.4 in).

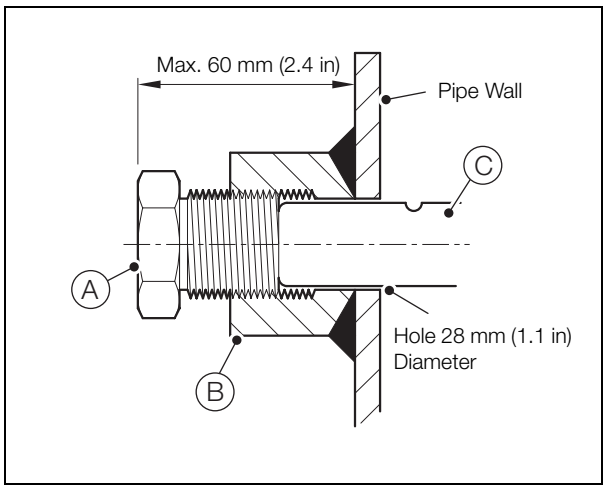


Fig. 2.9 Model 402 Support Plug

10. Apply appropriate sealant to the threads of the compression fitting.
11. Screw the compression fitting into the threaded fitting until hand-tight.
12. Turn the TORBAR until the indentation marks on the head are positioned downstream of the flow – see Fig. 2.1 on page 3.
13. Holding the head of the TORBAR with a wrench to maintain correct orientation, use a long wrench to tighten the compression fitting until approximately one thread is left exposed under the nut, ensuring that the TORBAR does not turn.
14. Check that the TORBAR is correctly installed and aligned.

2.6 Models 311, 411, 412, 511 and 512

Note. If the pipe flange and stub are already installed then proceed from (6). If the stud and flange are to be welded to pipe then proceed from (2).

1. Select the required insertion position and mark the pipe.
2. Drill a 6 mm (0.24 in) pilot hole at the marked position, then drill to the appropriate size – see Table 2.4.

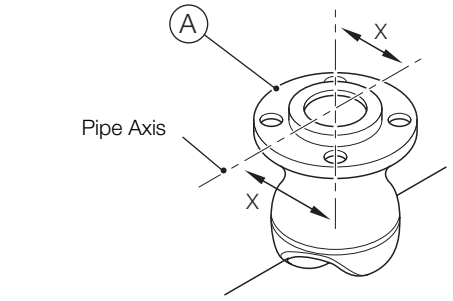
TORBAR Model	311	411 412	511 512
Hole Size in mm (in)	16 (0.63)	28 (1.1)	65 (2.56)

Table 2.4 Hole Size

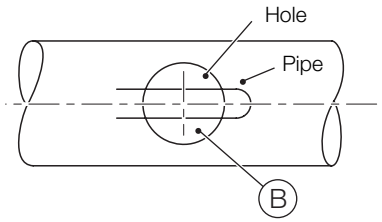
Note. Every pipe flange and stub fitting is shaped to fit the pipe and is self-aligning on two bolt holes as standard.

3. Referring to Fig. 2.10:
   a. Place the pipe flange and stub fitting (A) centrally over the drilled hole and align it correctly to the axis of the pipe (angle X) according to the number of bolt holes in the flange. Ensure it is perpendicular to the pipe axis and square to the pipe plane.
   b. Use suitable spacers (B) to raise the pipe flange and stub fitting off the pipe to establish the necessary gap for full-penetration welding.
   c. Tack-weld at four points (C) midway between the crotch and the skirt sections of the fitting.
   d. Using a suitable piece of pipe, ensure the pipe flange and stub fitting is correctly aligned with the pipe (see Fig. 2.2 on page 4) and concentric with the hole.
   e. Remove the spacers (B).
   f. Apply a full penetration root run completely around the base of the pipe flange and stub fitting at the clearly defined weld preparation line (D).
   g. Make reinforcing welds at the crotch bevelled areas (E) of the pipe flange and stub fitting to provide maximum weld at the crotch tapering to a minimum at the skirt (F).

Caution. Weld only the bevelled portion of the pipe flange and stub fitting to prevent the integrity of the weld being compromised by any notch effect.



Number of Holes in Flange	Angle X in Degrees
4 hole	45°
6 hole	30°
8 hole	22.5°



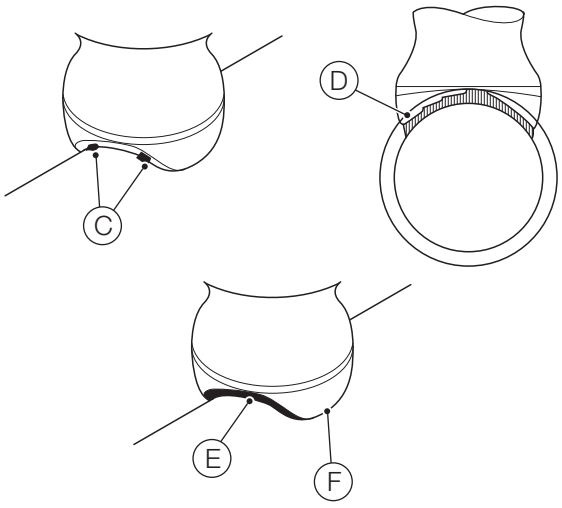


Fig. 2.10 Pipe Flange and Stub Installation

4. **TORBAR Models 412 and 512 only**

   a. Measure exactly 180° around the pipe circumference and mark the pipe.

   b. Drill a 6 mm (0.24 in) pilot hole at the marked position, then drill to the appropriate size – see Table 2.5.

TORBAR Model	412	512
Hole Size in mm (in)	33 (1.3)	70 (2.75)

Table 2.5 Hole Size

   c. Insert the TORBAR through the pipe flange and stub fitting into the pipe and check that the tip protrudes through the hole in the opposite pipe wall when the two flanges mate squarely.

   d. Position the end-support cup over the tip of the TORBAR, ensuring it is concentric with the hole, and tack-weld it in place.

   e. Remove the TORBAR and complete the support cup full-penetration weld.

5. Position the gasket onto the TORBAR flange and carefully insert the TORBAR through the pipe flange and stub fitting until the two flanges mate squarely. (**Models 412 and 512 only** – ensure that the tip of the TORBAR enters the support cup).
6. Turn the upper flange until the indentation marks on the head are positioned downstream of the flow – see Fig. 2.1 on page 3. (**Models 511 and 512 only** – the flow direction is indicated by an arrow on the top face of the TORBAR flange).
7. Fit the flange securing bolts and tighten equally and evenly, observing correct procedures appropriate to the flange.
8. Check the TORBAR is correctly installed and aligned.

2.7 Models L601 and L701

Warning. Models L601 and L701 are designed for 'Hot-Tap' installation. Observe all relevant safety precautions for drilling into pressurized pipelines, and ensure that the process material does not exceed the pressure and temperature limits of the TORBAR as specified.

1. Select the required insertion position and mark the pipe.
2. Align the threaded fitting over the mark and tack-weld it in place.
3. Using a suitably sized and threaded length of pipe, check the threaded fitting is aligned correctly – see Fig. 2.2 on page 4.
4. Completely weld the threaded fitting to the pipe.
5. Referring to Fig. 2.11:
   a. Apply suitable sealant to the close nipple (A) and isolation valve (B) and fit them to the threaded fitting (C). Tighten securely.
   b. Attach hot-tap drilling equipment to isolation valve (B) in accordance with the manufacturer's instructions.
   c. Drill a 6 mm (0.24 in) pilot hole in the process pipe at the marked position, then drill to the appropriate size – see Table 2.6.

TORBAR Model	L601	L701
Hole Size in mm (in)	16 (0.63)	28 (1.1)

Table 2.6 Hole Size

   d. Withdraw the drill and close isolation valve (B) fully.
   e. Ensure packing material is in place in packing gland (D).
   f. Fit pressure chamber (E), complete with packing gland (D), to isolation valve (B), using appropriate sealants where necessary.
   g. Insert the TORBAR into packing gland (D) and tighten the packing gland until it is fully sealed, ensuring the TORBAR is able to slide through it.
   h. Ensure safety chain (F) is securely attached to pressure chamber (E)
   i. Attach chain link (G) to safety chain (F), ensuring the safety chain is tight.
   j. Carefully open isolation valve (B) and check for leaks around packing gland (D).
   k. Insert the TORBAR through isolation valve (B) until it touches the opposite internal wall of the process pipe.

      Warning. During step l, maintain continuous pressure on the TORBAR to ensure that it remians in conatct with the opposite internal wall of the process pipe.

   l. Reposition chain link (G) to tighten safety chain (F).
   m. Turn the TORBAR until the indentation marks on the head are positioned downstream of the flow – see Fig. 2.1 on page 3.
   n. Fully tighten packing gland (D), ensuring that the TORBAR does not turn. Check for leaks.
   o. Ensure that safety chain (F) is fully tightened and secure.

Continued…

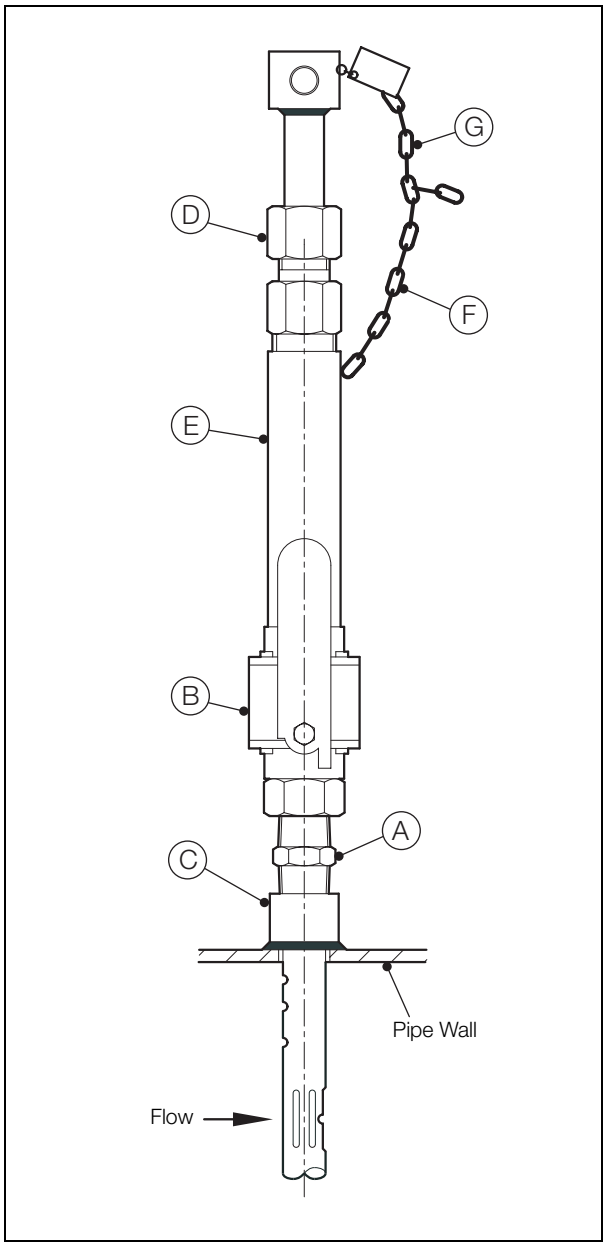


Fig. 2.11 Models L601 and L701 Installation

6. Check the TORBAR is correctly installed and aligned.

2.8 Model L702

Warning. Model L702 is supported in the process pipe at the TORBAR tip as well as at the entry point into the pipe, therefore it cannot be 'Hot-Tap' installed. Before drilling into the pipe, reduce the pipe pressure to a safe level and remove all hazardous material.

1. Select the required insertion position and mark the pipe.
2. Drill a 6 mm (0.24 in) pilot hole at the marked position, then drill to 28 mm (1.1 in).
3. Align the threaded fitting concentrically over the hole and tack-weld in place.
4. Using a suitably sized and threaded length of pipe, check the threaded fitting is concentric and aligned correctly – see Fig. 2.2 on page 4.
5. Completely weld the threaded fitting to the pipe.
6. Measure exactly 180° around the pipe circumference and mark the pipe.
7. Repeat steps 2 to 5.
8. Referring to Fig. 2.12:
   a. Apply suitable sealant to the close nipple (A) and isolation valve (B) and fit them to the threaded fitting (C). Tighten securely.
   b. Ensure packing material is in place in packing gland (D).
   c. Fit pressure chamber (E), complete with packing gland (D), to isolation valve (B), using appropriate sealants where necessary.
   d. Fully open isolation valve (B) and insert the TORBAR through the packing gland, isolation valve and process pipe until the tip exits at the opposite fitting.
   e. Apply appropriate sealant to the threads of support plug (F).
   f. Screw support plug (F) into threaded fitting (G) and tighten, ensuring that it contacts the TORBAR.
   g. Turn the TORBAR until the indentation marks on the head are positioned downstream of the flow – see Fig. 2.1 on page 3.
   h. Fully tighten packing gland (D), ensuring that the TORBAR does not turn.
   i. Ensure safety chain (H) is securely attached to pressure chamber (E) and that chain link (J) is fitted.
   j. Attach chain link (J) to safety chain (H) ensuring the safety chain is tight.

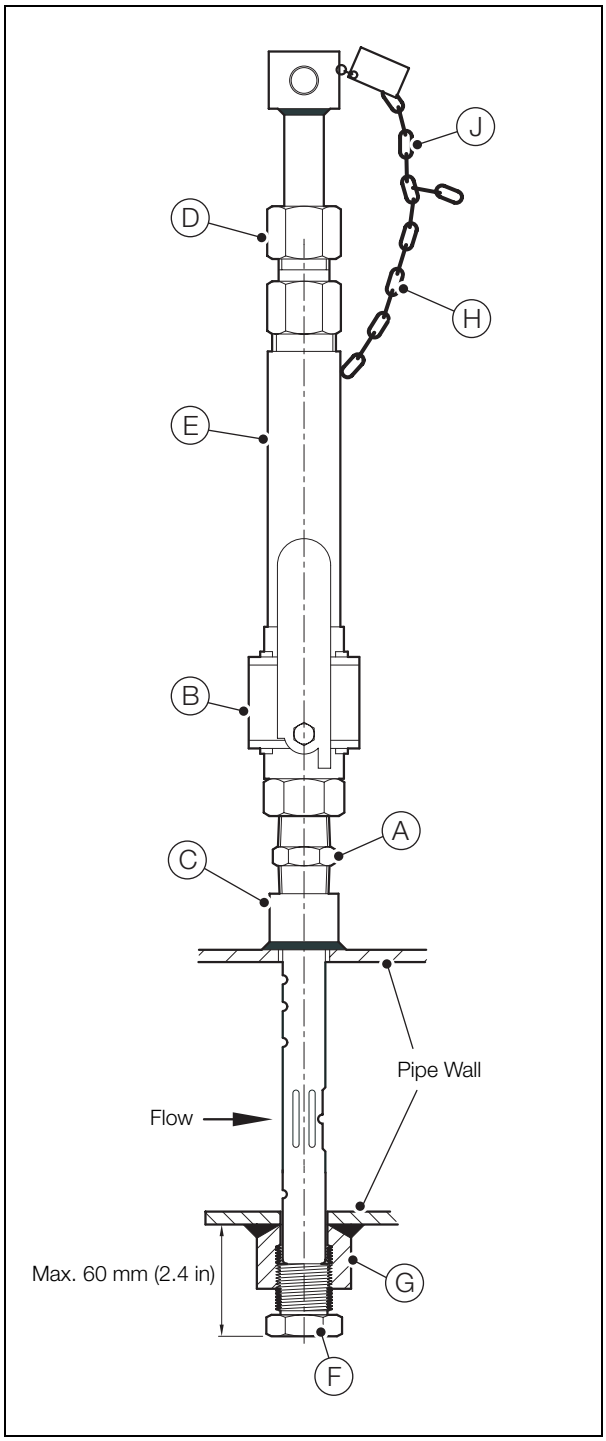


Fig. 2.12 Model L702 Installation

9. Check the TORBAR is correctly installed and aligned.
10. Pressurize the process pipe and check for leaks.

2.9 Models H601 and H701

Warning. Models H601 and H701 are designed for 'Hot-Tap' installation. Observe all relevant safety precautions for drilling into pressurized pipelines, and ensure that the process material does not exceed the pressure and temperature limits of the TORBAR as specified.

1. Select the required insertion position and mark the pipe.
2. Align the threaded fitting over the mark and tack-weld it in place.
3. Using a suitably sized and threaded length of pipe, check the threaded fitting is aligned correctly – see Fig. 2.2 on page 4.
4. Completely weld the threaded fitting to the pipe.
5. Referring to Fig. 2.13:
   a. Apply suitable sealant to the close nipple (A) and isolation valve (B) and fit them to the threaded fitting (C). Tighten securely.
   b. Attach hot-tap drilling equipment to isolation valve (B) in accordance with the manufacturer's instructions.
   c. Drill a 6 mm (0.24 in) pilot hole in the process pipe at the marked position, then drill to the appropriate size – see Table 2.7.

TORBAR Model	H601	H701
Hole Size in mm (in)	16 (0.63)	28 (1.1)

Table 2.7 Hole Size

   d. Withdraw the drill and close isolation valve (B) fully.
   e. Ensure six packing rings are correctly located inside packing gland (D).
   f. Ensure the drawbolt (or optional geared) retraction assembly (E) is in the fully retracted position.
   g. Fit pressure chamber (F), complete with packing gland (D) and retraction assembly (E), to isolation valve (B), using appropriate sealants where necessary.
   h. Insert the TORBAR into packing gland (D).
   i. Turn the TORBAR until the indentation marks on the head are positioned downstream of the flow – see Fig. 2.1 on page 3.
   j. Tighten the packing gland bolts (G) equally and evenly until the packing gland is fully sealed, ensuring the TORBAR is able to slide through it.
   k. Carefully open isolation valve (B) and check for leaks around packing gland (D).

   Note. During step l, turn drive nuts (H) equally and evenly to prevent binding.

   l. **Drawbolt retraction assembly only** – turn each drive-nut (H) clockwise alternately until the TORBAR passes through isolation valve (B) and contacts the opposite side of the process pipe. When the TORBAR is fully inserted, ensure the drawbolts (J) and stop nuts (K) are in the positions shown.
   m. **Drawbolt retraction assembly only** – tighten lock nuts (L).
   n. **Optional geared retraction assembly only** – turn the integral handle clockwise until the TORBAR contacts the opposite side of the process pipe.
   o. Fully tighten packing gland bolts (G), ensuring that the TORBAR does not turn. Check for leaks.

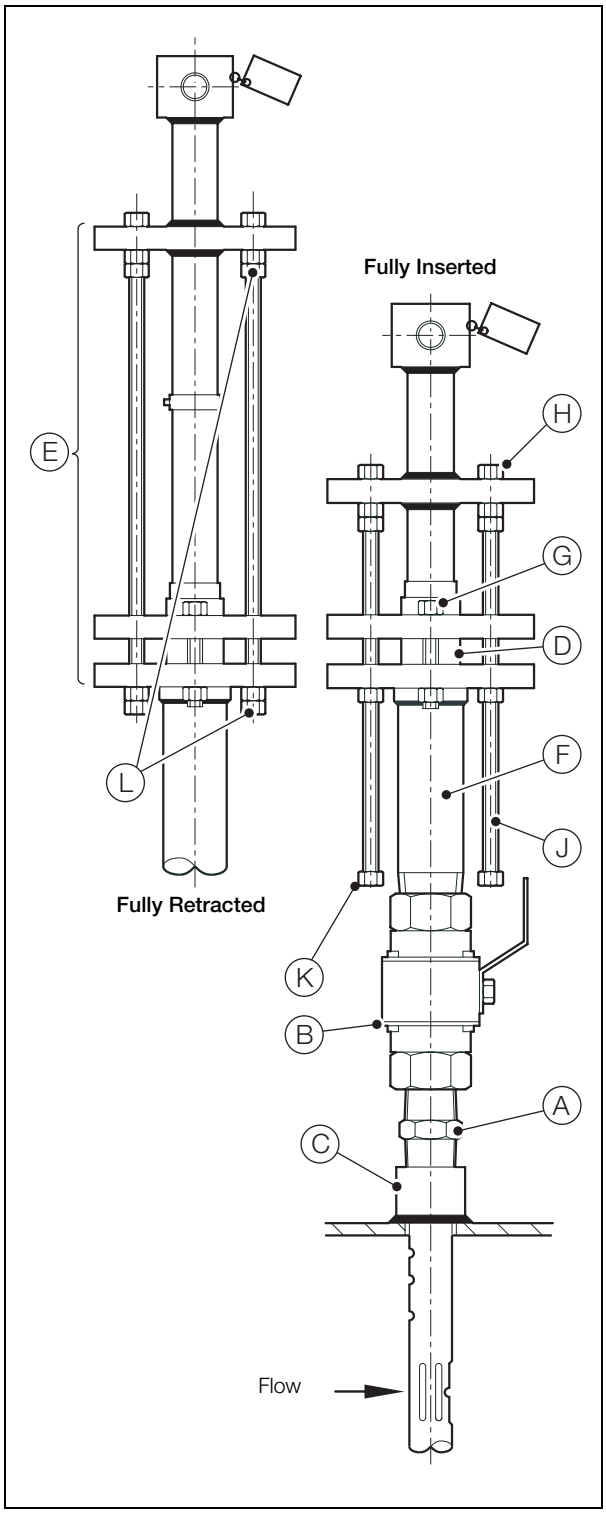


Fig. 2.13 Models H601 and H701 Installation

6. Check that the TORBAR is correctly installed and aligned.

2.10 Model H702

Warning. Model H702 is supported in the process pipe at the TORBAR tip as well as at the entry point into the pipe, therefore it cannot be 'Hot-Tap' installed. Before drilling into the pipe, reduce the pipe pressure to a safe level and remove all hazardous material.

1. Select the required insertion position and mark the pipe.
2. Drill a 6 mm (0.24 in) pilot hole at the marked position, then drill to 28 mm (1.1 in).
3. Align the threaded fitting concentrically over the hole and tack-weld in place.
4. Using a suitably sized and threaded length of pipe, check the threaded fitting is concentric and aligned correctly – see Fig. 2.2 on page 4.
5. Completely weld the threaded fitting to the pipe.
6. Measure exactly 180° around the pipe circumference and mark the pipe.
7. Repeat steps 2 to 5.
8. Referring to Fig. 2.14:
   a. Apply suitable sealant to the close nipple (A) and isolation valve (B) and fit them to the threaded fitting (C). Tighten securely.
   b. Ensure six packing rings are correctly located inside packing gland (D).
   c. Ensure the drawbolt (or optional geared) retraction assembly (E) is in the fully retracted position.
   d. Fit pressure chamber (F), complete with packing gland (D) and retraction assembly (E), to isolation valve (B), using appropriate sealants where necessary.
   e. Insert the TORBAR into packing gland (D).
   f. Turn the TORBAR until the indentation marks on the head are positioned downstream of the flow – see Fig. 2.1 on page 3.
   g. Tighten the packing gland bolts (G) equally and evenly until the packing gland is fully sealed, ensuring the TORBAR is able to slide through it.
   h. Open isolation valve (B).

   Note. During step I, turn drive nuts (H) equally and evenly to prevent binding.

   i. **Drawbolt retraction assembly only** – turn each drive-nut (H) clockwise alternately until the TORBAR passes through isolation valve (B) and protrudes from the threaded fitting on the opposite side of the process pipe by 25 mm (1.0 in). When the TORBAR is fully inserted, ensure the drawbolts (J) and stop nuts (K) are in the positions shown.
   j. **Drawbolt retraction assembly only** – tighten lock nuts (L).
   k. **Optional geared retraction assembly only** – turn the integral handle clockwise until the TORBAR protrudes from the threaded fitting on the opposite side of the process pipe by 25 mm (1.0 in).
   l. Apply appropriate sealant to the threads of support plug (M).
   m. Screw support plug (M) into threaded fitting (N) and tighten, ensuring that it contacts the TORBAR.
   n. Fully tighten packing gland bolts (G), ensuring that the TORBAR does not turn. Check for leaks.

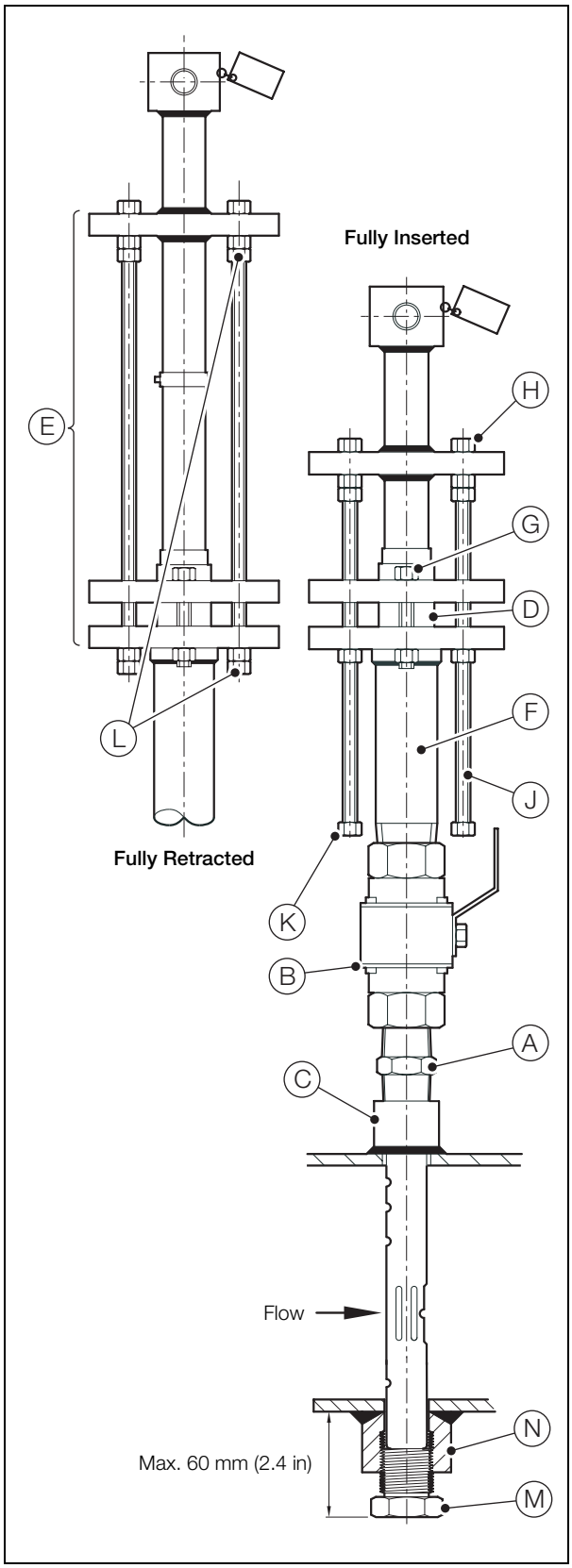


Fig. 2.14 Model H702 Installation

9. Check the TORBAR is correctly installed and aligned.
10. Pressurize the process pipe and check for leaks.

2.11 Models H611, H711 and H811

Warning. Models H611, H711 and H811 are designed for 'Hot-Tap' installation. Observe all relevant safety precautions for drilling into pressurized pipelines, and ensure that the process material does not exceed the pressure and temperature limits of the TORBAR as specified.

1. Select the required insertion position and mark the pipe.
2. Referring to Fig. 2.15:
   a. Position the flanged coupling (A) over the mark, ensuring the coupling is aligned perpendicular to the pipe axis and square to its plane with the flange bolt holes aligned according to standard practice.
   b. Tack-weld the flanged coupling in place.
   c. Using a suitably sized and threaded length of pipe, check the flanged coupling is aligned correctly – see Fig. 2.2 on page 4.
   d. Completely weld the flanged coupling to the pipe.
   e. Fit isolation valve (B) to flanged coupling (A).
   f. Attach hot-tap drilling equipment to isolation valve (B) in accordance with the manufacturer's instructions.
   g. Drill a 6 mm (0.24 in) pilot hole in the process pipe at the marked position, then drill to the appropriate size – see Table 2.8.

TORBAR Model	H611	H711	H811
Hole Size in mm (in)	16 (0.5)	28 (1.0)	65 (2.4)

Table 2.8 Hole Size

   h. Withdraw the drill and close isolation valve (B) fully.
   i. Ensure six packing rings are correctly located inside packing gland (C).
   j. Ensure the drawbolt (or optional geared) retraction assembly (D) is in the fully retracted position.
   k. Fit flanged pressure chamber (E), complete with packing gland (C) and retraction assembly (D), to isolation valve (B).
   l. Insert the TORBAR into packing gland (C).
   m. Turn the TORBAR until the indentation marks on the head are positioned downstream of the flow – see Fig. 2.1 on page 3.
   n. Tighten the packing gland bolts (F) equally and evenly until the packing gland is fully sealed, ensuring the TORBAR is able to slide through it.
   o. Carefully open isolation valve (B) and check for leaks around packing gland (C).

Note. During step p, turn drive nuts (G) equally and evenly to prevent binding.

   p. **Drawbolt retraction assembly only** – turn each drive-nut (G) clockwise alternately until the TORBAR passes through isolation valve (B) and contacts the opposite side of the process pipe. When the TORBAR is fully inserted, ensure the drawbolts (H) and stop nuts (J) are in the positions shown.
   q. **Drawbolt retraction assembly only** – tighten lock nuts (K).
   r. **Optional geared retraction assembly only** – turn the integral handle clockwise until the TORBAR contacts the opposite side of the process pipe.
   s. Fully tighten packing gland bolts (F), ensuring that the TORBAR does not turn. Check for leaks.

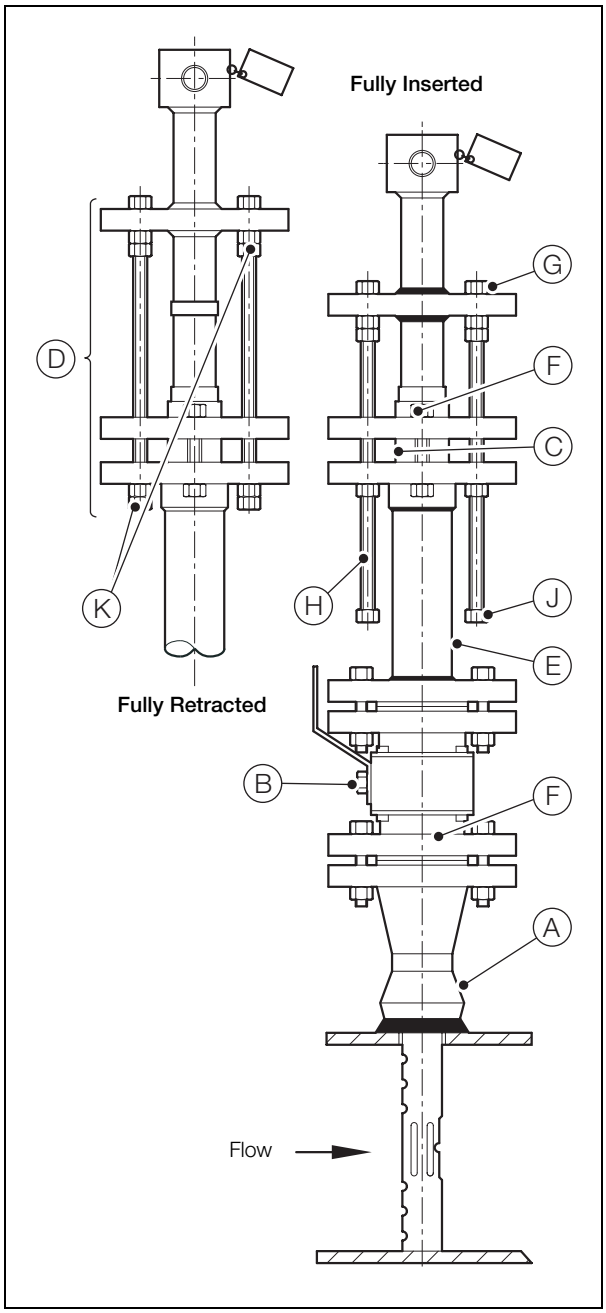


Fig. 2.15 Models H611, H711 and H811 Installation

3. Check the TORBAR is correctly installed and aligned.

2.12 Model H712 and H812

Warning. Models H712 and H812 are supported in the process pipe at the TORBAR tip as well as at the entry point into the pipe, therefore they cannot be 'Hot-Tap' installed. Before drilling into the pipe, reduce the pipe pressure to a safe level and remove all hazardous material.

1. Select the required insertion position and mark the pipe.
2. Drill a 6 mm (0.24 in) pilot hole in the process pipe at the marked position, then drill to the appropriate size – see Table 2.9.

TORBAR Model	H712	H812
Hole Size in mm (in)	28 (1.0)	65 (2.4)

Table 2.9 Hole Size

3. Position the flanged coupling concentrically over the hole, ensuring the coupling is aligned perpendicular to the pipe axis and square to its plane with the flange bolt holes aligned according to standard practice.
4. Tack-weld the flanged coupling in place.
5. Using a suitably sized and threaded length of pipe, check the flanged coupling is concentric and aligned correctly – see Fig. 2.2 on page 4.
6. Completely weld the flanged coupling to the pipe.
7. Measure exactly 180° around the pipe circumference and mark the pipe.
8. Repeat step 2.
9. Referring to Fig. 2.16:
   a. Fit isolation valve (A) to flanged coupling (B).
   b. Ensure six packing rings are correctly located inside packing gland (C).
   c. Ensure the drawbolt (or optional geared) retraction assembly (D) is in the fully retracted position.
   d. Fit flanged pressure chamber (E), complete with packing gland (C) and retraction assembly (D), to isolation valve (A).
   e. Insert the TORBAR into packing gland (C).
   f. Turn the TORBAR until the indentation marks on the head are positioned downstream of the flow – see Fig. 2.1 on page 3.
   g. Tighten the packing gland bolts (F) equally and evenly until the packing gland is fully sealed, ensuring the TORBAR is able to slide through it.
   h. Open isolation valve (A).

   Note. During step I, turn drive nuts (G) equally and evenly to prevent binding.

   i. **Drawbolt retraction assembly only** – turn each drive-nut (H) clockwise alternately until the TORBAR passes through isolation valve (A) and protrudes from the hole on the opposite side of the process pipe by 40 mm (1.6 in). When the TORBAR is fully inserted, ensure the drawbolts (H) and stop nuts (J) are in the positions shown.
   j. **Geared retraction assembly only** – turn the integral handle clockwise until the TORBAR protrudes from the threaded fitting on the opposite side of the process pipe by 40 mm (1.6 in).
   k. Place end support cup (L) over the tip of the TORBAR and tack-weld it to the process pipe.
   l. Reverse step i (drawbolt retraction assembly) or step j (geared retraction assembly) and retract the TORBAR by 100 mm (4.0 in).
   m. Completely weld end support cup (L) to the pipe.
   n. Repeat step i (drawbolt retraction assembly) or step j (geared retraction assembly) to re-insert the TORBAR by 100 mm (4.0 in), ensuring it enters the support cup (L).
   o. **Drawbolt retraction assembly only** – tighten lock nuts (K).
   p. Fully tighten packing gland bolts (F), ensuring that the TORBAR does not turn. Check for leaks.

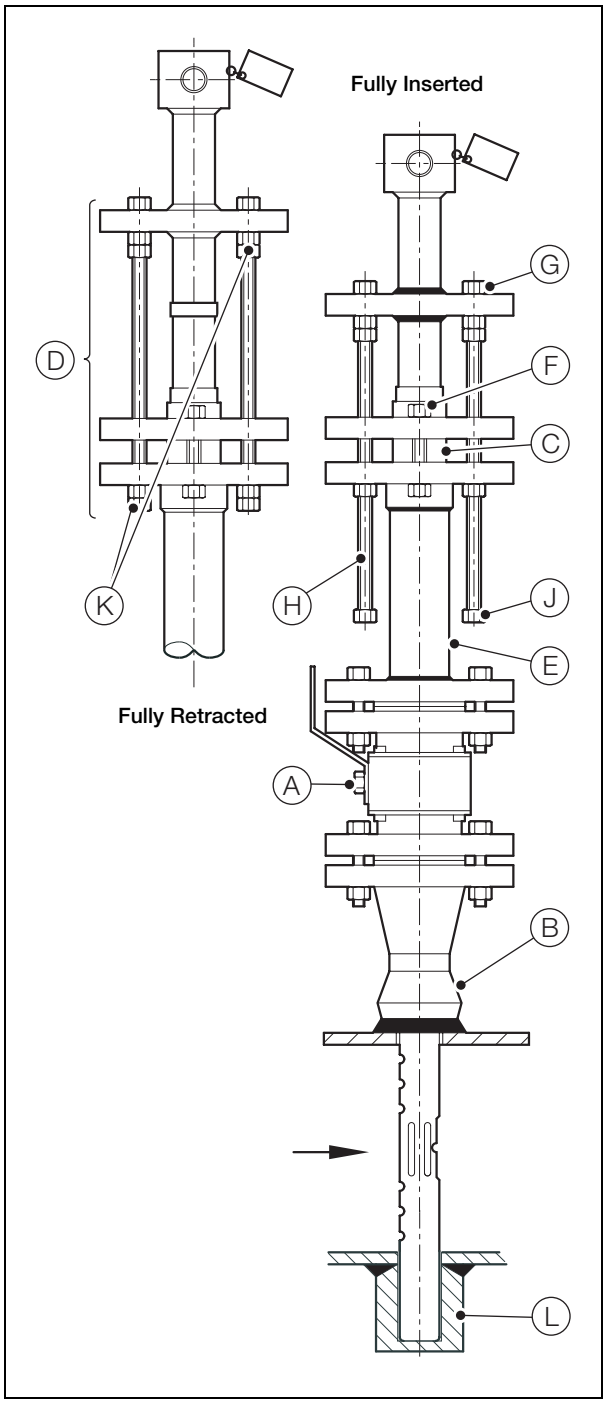


Fig. 2.16 Models H712 and H812 Installation

10. Check the TORBAR is correctly installed and aligned.
11. Pressurize the process pipe and check for leaks.

3 Removal

3.1 Models 301, 401 and 402

Warning. Failure to reduce the pipe pressure to a safe level and remove all hazardous material prior to removing the TORBAR could result in serious injury to personnel.

1. Reduce pipe pressure to a safe level and remove all hazardous material.
2. Remove the compression fitting.
3. Remove the TORBAR.

3.2 Models 311, 411, 412, 511 and 512

Warning. Failure to reduce the pipe pressure to a safe level and remove all hazardous material prior to removing the TORBAR could result in serious injury to personnel.

1. Reduce pipe pressure to a safe level and remove all hazardous material.
2. Remove the flange securing bolts.
3. Remove the TORBAR.

3.3 Models L601, L701 and L702

Warning. Do not position any part of the body in the TORBAR's exit path when removing the TORBAR.

Referring to Fig. 3.1:

1. Reposition chain link (A) to lengthen safety chain (B) to its maximum. Take care if the TORBAR begins to exit from packing gland (C).
2. Slacken packing gland (C) slowly and just sufficiently to enable the slow, controlled exit of the TORBAR.
3. When the TORBAR is clear of isolation valve (D), fully close the valve.
4. Slacken packing gland (C) slowly to release the pressure in pressure chamber (E).
5. Remove the TORBAR completely if required.

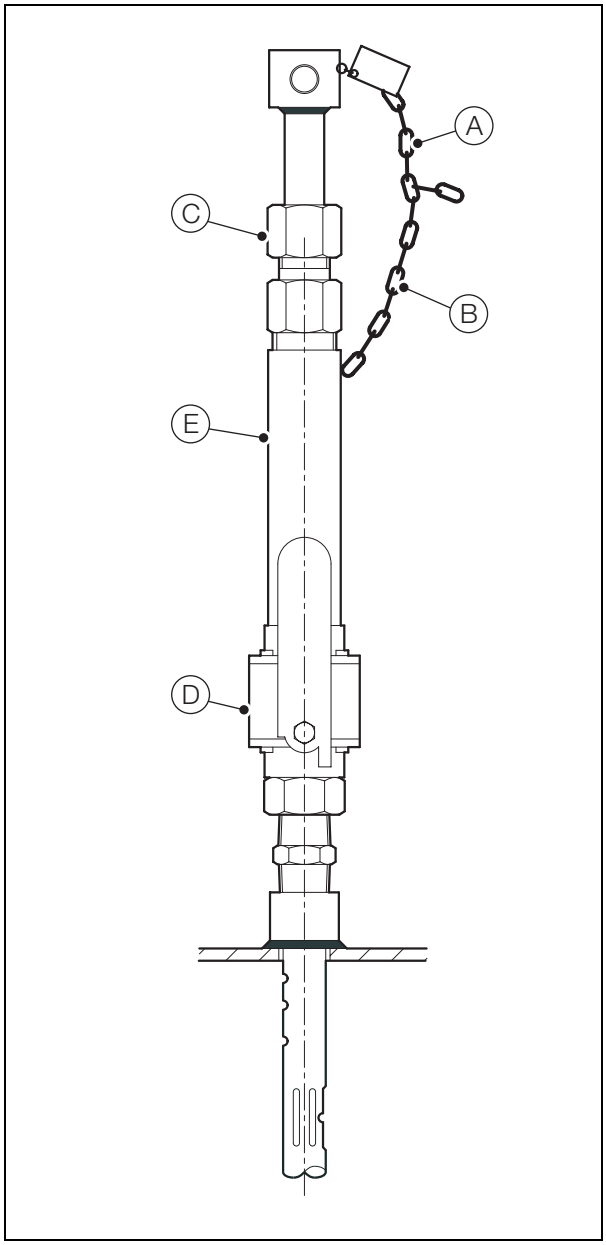


Fig. 3.1 Models L601, L701 and L702 Removal

3.4 Models H601, H701 and H702

Warning. Do not position any part of the body in the TORBAR's exit path when removing the TORBAR

Referring to Fig. 3.2:

1. Slacken packing gland bolts (A) evenly and just sufficiently to enable the slow, controlled exit of the TORBAR.

   Note. During step 2, turn drive nuts (C) equally and evenly to prevent binding.

2. **Drawbolt retraction assembly only** – Loosen lock nuts (B) and turn drive-nuts (C) counter-clockwise alternately until the TORBAR passes through isolation valve (D). Ensure the retraction assembly is in the fully retracted position (E).
3. **Geared retraction assembly only** – turn the integral handle counter-clockwise until the TORBAR passes through isolation valve (D)).
4. Close isolation valve (D).
5. Slacken packing gland bolts (A) slowly to release the pressure in pressure chamber (F).
6. Remove the TORBAR completely if required.

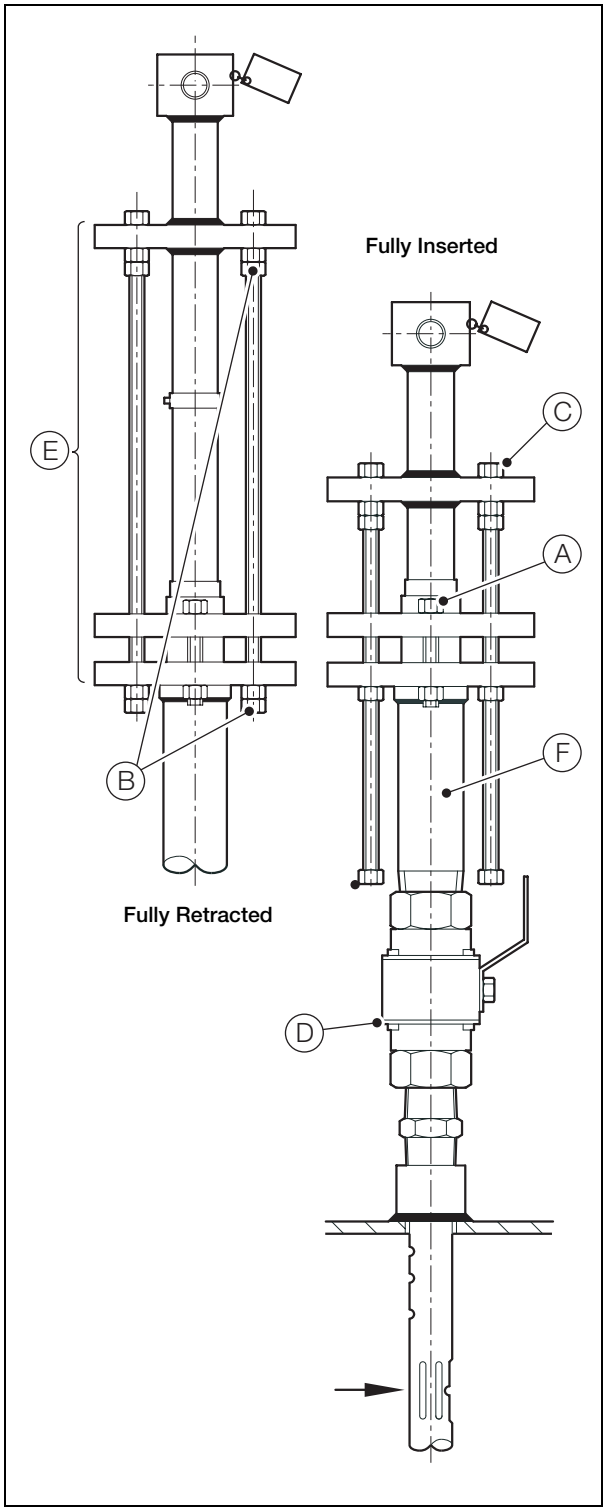


Fig. 3.2 Models H601, H701 and H702 Removal

3.5 Models H611, H711, H712, H811 and H812

Warning. Do not position any part of the body in the TORBAR's exit path when removing the TORBAR

Referring to Fig. 3.2:

1. Slacken packing gland bolts (A) evenly and just sufficiently to enable the slow, controlled exit of the TORBAR.

   Note. During step 2, turn drive nuts (C) equally and evenly to prevent binding.

2. **Drawbolt retraction assembly only** – Loosen lock nuts (B) and turn drive-nuts (C) counter-clockwise alternately until the TORBAR passes through isolation valve (D). Ensure the retraction assembly is in the fully retracted position (E).
3. **Geared retraction assembly only** – turn the integral handle counter-clockwise until the TORBAR passes through isolation valve (D)).
4. Close isolation valve (D).
5. Slacken packing gland bolts (A) slowly to release the pressure in pressure chamber (F).
6. Remove the TORBAR completely if required.

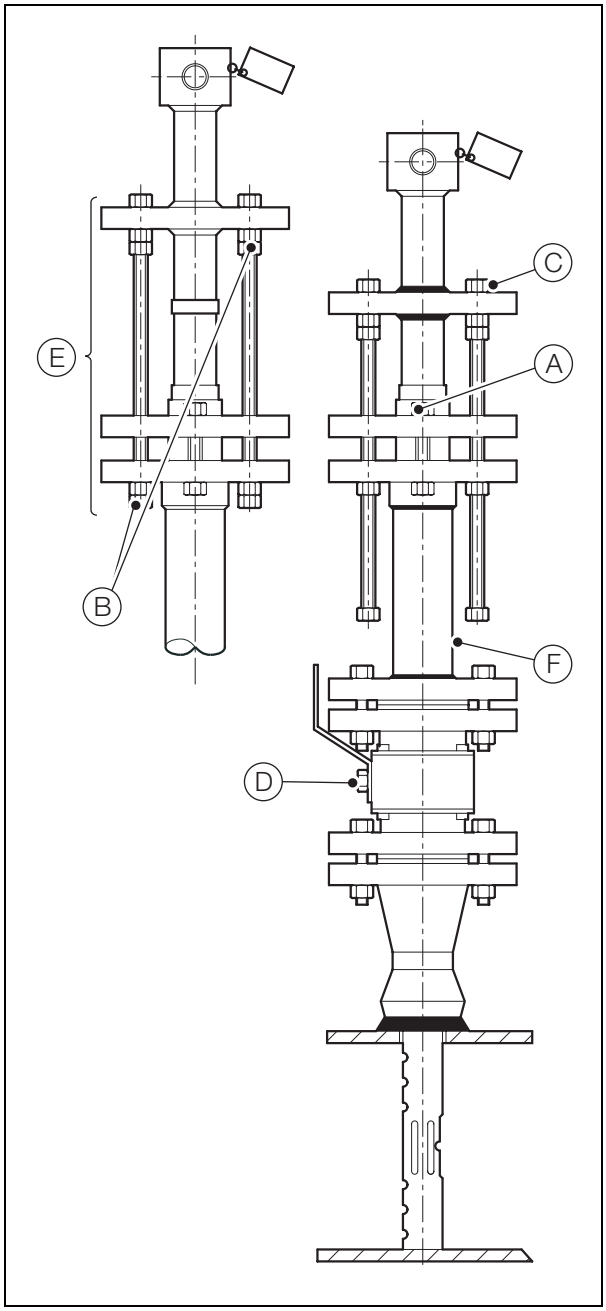


Fig. 3.3 Models H611, H711, H712, H811 and H812 Removal

4 Connecting a Differential Pressure Measuring Instrument

4.1 General

Before connecting a differential pressure measuring instrument, read the manufacturers's installation instructions.

The TORBAR may or may not be supplied with isolating valves fitted to the two output connections. Check whether or not they are required.

Connect the TORBAR's high-pressure connection (marked H) of the TORBAR (see Fig. 2.1 on page 3) to the high pressure side of the differential pressure instrument and the low pressure connection (marked L) to the low pressure side of the differential pressure instrument.

4.2 Impulse Tubing

- Use minimum 6 mm (0.25 in) ID piping. For steam flow measurement, use 13 mm (0.5 in) ID tubing.
- Keep tubing as short as possible but ensure that the differential pressure measuring instrument can operate within its specified temperature limits.
- Support tubing over its entire length and isolate it from sources of vibration or damage.
- Route the tubing from the high and low pressure connections as close together as possible to maintain equal temperatures.
- Do not route the tubing in areas where the ambient temperature may fluctuate.
- **Liquid and steam applications** – mount the differential pressure measuring instrument **below** the level of the TORBAR head, ensuring that the tubing slopes **up** toward the TORBAR connections at an incline of at least 25 mm per 300 mm (1 in per 12 in).
- **Gas applications** – mount the differential pressure measuring instrument **above** the level of the TORBAR head, ensuring that the tubing slopes **down** toward the TORBAR connections at an incline of at least 25 mm per 300 mm (1 in per 12 in).
- **Liquid applications** – ensure the tubing from the high and low pressure connections are mounted at the same level in order to balance the head of liquid in both tubes and vent any gas build-up.

4.3 Purging

TORBARs can be used successfully for measuring the flow of dirty fluids without purging.

If purging is necessary, periodic purging is the simplest method.

To purge the TORBAR, refer to the specific operating instructions and drawings supplied with the purge unit and:

1. Isolate the measuring instrument from the purge lines.
2. Connect a compatible pressurized medium to the TORBAR output and blow it through the TORBAR to force out contamination.

TORBAR Purge Systems are available for continuous or intermittent air purging.

4.4 Steam Applications

Ensure both high- and low-pressure TORBAR connections are at the same vertical height to maintain equal condensate levels above the secondary instrumentation – see Fig. 4.1 on page 26. Mount the filling tees or condensate pots at the same level and as close as possible to the TORBAR head to ensure no condensate forms in the lagged sections.

Mount the secondary instrumentation below the level of the TORBAR and connect 13 mm (0.5 in) ID tubing (rated for continuous use at the steam pressure) to the bottom of the filling tee or condensate pot. Ensure the tubing has a minimum slope of 25 mm per 300 mm (1 in per 12 in) and ensure the two lines are close together to maintain equal temperature. Use a 3- or 5-valve manifold to interface the connections between the secondary instrumentation and the TORBAR fitting. Take care to ensure that the condensate temperature does not exceed the temperature limit of the secondary instrumentation.

For information on start-up and operation procedures, refer to the manufacturer's instructions for the secondary instrumentation.

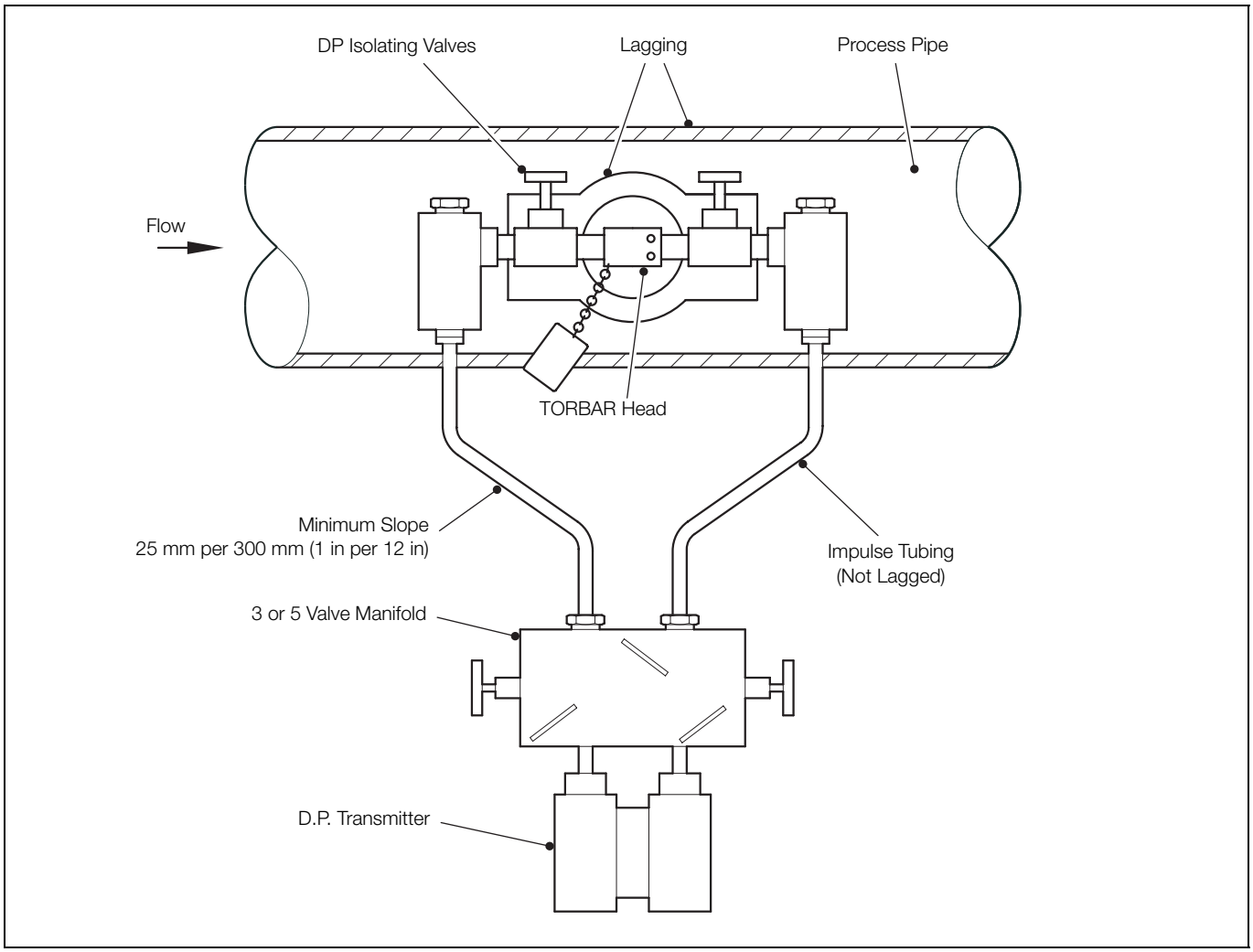


Fig. 4.1 Connection (steam applications only)

5 Maintenance

TORBAR Averaging Pitot Tube elements have no moving parts, and do not normally require routine maintenance.

However, depending on process conditions, check TORBAR periodically for signs of blockage, erosion or corrosion. If withdrawal is necessary, it must be carried out in accordance with the relevant procedure – see Section 3, page 22.

6 Troubleshooting

If a malfunction is suspected:

1. Check for leakage between the head of the TORBAR and the transmitter or indicator.

   Note. Compared to orifice plates and other primary flow elements, Averaging Pitot Tubes create small differential pressures. Therefore test all potential leak points carefully for leaks.

2. Check for partial or total blockages by testing that pressure is present at both outlets.
3. Using a reliable differential pressure source such as a manometer or a calibrated differential pressure cell, check the actual differential pressure while flow is present.

7 TRIBAR / MASS TRIBAR

7.1 Description

TRIBAR comprises an integral 3-valve manifold and industry standard transmitter connected to the TORBAR.

MASS TRIBAR comprises an integral valve manifold, a PT100 temperature element and a Smart, Multivariable Transmitter connected to the TORBAR.

The integral, direct-mount head (or valve manifold direct-mount head) of the TRIBAR assemblies have pressure connections at 54 mm (2.125 in) centres, with O-ring seals and standard-dimensioned bolt clearance holes suitable for mounting all process-type DP transmitters. Bolts appropriate to each individual make of DP transmitter must be used. If the transmitter is supplied with oval flanges these must be discarded. Ensure that the sealing rings are fitted to the recesses of the direct mount head, then bolt the transmitter onto the head, and pressure test the assembly.

Caution.

- TRIBAR / MASS TRIBAR is normally supplied with transmitters specified by ABB. However, it can also be supplied with a transmitter specified by the customer. In each case, the manufacturer's instructions for the transmitter is included in the documentation pack.
- If a TRIBAR /MASS TRIBAR is to be fitted with a transmitter **not** supplied by ABB, it is the customer's responsibility to ensure that:
  - the transmitter is fitted in strict accordance with the manufacturer's instructions
  - there are no leaks between the manifold and the fitted transmitter
  - all relevant intrinsic safety requirements are fully complied with in terms of the device housing and installation

7.2 Installation – General

Note. Do not remove the transmitter during installation, unless this is unavoidable because of space restrictions.

- Install the TRIBAR in the process pipe in accordance with the installation instructions for the corresponding TORBAR; for example, for TRIBAR Model T412, install as TORBAR Model 412 – see Section 2.6, page 9.
- Ensure that the manifold valves are set as follows:
  - Equalize – OPEN
  - Isolate – CLOSED
- Once the TRIBAR has been correctly installed in the process pipe, make the electrical connections in accordance with the transmitter manufacturer's instructions.

7.2.1 Operation

Warning. Do not open the equalizing valve under flowing process conditions if the process fluid temperature exceeds 80 °C (176 °F).

- To check zero calibration, open the isolation valves fully. For details, refer to the transmitter set-up instructions.
- To begin flow measurement, close the equalizing valve.

PRODUCTS & CUSTOMER SUPPORT

Products

Automation Systems
- for the following industries:
  - Chemical & Pharmaceutical
  - Food & Beverage
  - Manufacturing
  - Metals and Minerals
  - Oil, Gas & Petrochemical
  - Pulp and Paper

Drives and Motors
- AC and DC Drives, AC and DC Machines, AC Motors to 1kV
- Drive Systems
- Force Measurement
- Servo Drives

Controllers & Recorders
- Single and Multi-loop Controllers
- Circular Chart and Strip Chart Recorders
- Paperless Recorders
- Process Indicators

Flexible Automation
- Industrial Robots and Robot Systems

Flow Measurement
- Electromagnetic Flowmeters
- Mass Flowmeters
- Turbine Flowmeters
- Wedge Flow Elements

Marine Systems & Turbochargers
- Electrical Systems
- Marine Equipment
- Offshore Retrofit and Refurbishment

Process Analytics
- Process Gas Analysis
- Systems Integration

Transmitters
- Pressure
- Temperature
- Level
- Interface Modules

Valves, Actuators and Positioners
- Control Valves
- Actuators
- Positioners

Water, Gas & Industrial Analytics Instrumentation
- pH, Conductivity and Dissolved Oxygen Transmitters and Sensors
- Ammonia, Nitrate, Phosphate, Silica, Sodium, Chloride, Fluoride, Dissolved Oxygen and Hydrazine Analyzers
- Zirconia Oxygen Analyzers, Katharometers, Hydrogen Purity and Purge-gas Monitors, Thermal Conductivity

Customer Support

We provide a comprehensive after sales service via a Worldwide Service Organization. Contact one of the following offices for details on your nearest Service and Repair Centre.

UK
ABB Limited
Tel: +44 (0)1453 826661
Fax: +44 (0)1453 829671

USA
ABB Inc.
Tel: +1 215 674 6000
Fax: +1 215 674 7183

Client Warranty

Prior to installation, the equipment referred to in this manual must be stored in a clean, dry environment, in accordance with the Company's published specification.

Periodic checks must be made on the equipment's condition. In the event of a failure under warranty, the following documentation must be provided as substantiation:

1. A listing evidencing process operation and alarm logs at time of failure.
2. Copies of all storage, installation, operating and maintenance records relating to the alleged faulty unit.

ABB has Sales & Customer Support expertise
in over 100 countries worldwide

www.abb.com

The Company's policy is one of continuous product
improvement and the right is reserved to modify the
information contained herein without notice.

Printed in UK (01.10)

IM/TORBAR–EN Issue 1

ABB Limited
Oldends Lane, Stonehouse
Gloucestershire
GL10 3TA
UK
Tel: +44 (0)1453 826661
Fax: +44 (0)1453 829671

ABB Inc.
125 E. County Line Road
Warminster
PA 18974
USA
Tel: +1 215 674 6000
Fax: +1 215 674 7183