

# Easy-Brace®

Universal Small Bore Connection (SBC)  
Anti-Vibration Bracing System



## Reducing the risk of piping failures

- **Saves time** - No need to design a bespoke solution
- **Easy to specify and order** - Requires just 2 or 3 basic dimensions
- **Easy to install** - Can be installed by non-specialist fitters
- **Guaranteed to fit any SBC** - Eliminates static offset stresses caused by misalignment which can occur with fabricated fixed braces
- **Guaranteed to perform** - Will increase the stiffness of any SBC
  - **No welding or hot work permit required** - Uses high stiffness clamping system constructed from marine grade 316 stainless steel
  - **Energy Institute compliant** - Incorporates EI recommendations for SBC bracing

## Universal Small Bore Connection (SBC) Bracing System

Easy-Brace® is a universal SBC bracing system designed to provide an effective and economical permanent solution for reducing vibration and the risk of fatigue failures in process pipework.

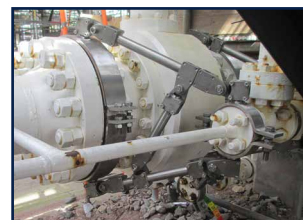
Vibration induced fatigue is a major cause of pipework failure, in particular welded connections between 'Small Bore Connections' (SBCs) and 'main lines', which account for around 80% of all piping failures.

- Offshore: 21% of all hydrocarbon releases are caused by vibration and fatigue (source: HSE Statistics for Offshore Industry).
- Onshore: 10% to 15% of all pipework failures are caused by vibration induced fatigue (estimated by Western Europe Onshore Industry).

The likelihood of failure increases if the main line pipe experiences high operational vibration, transient vibration events, or if the natural frequency of vibration of the SBC matches any of the operational frequencies. The likelihood of failure is highest in the case of large unsupported valves on long small diameter SBCs.

The most common retrofit solution is to fit bracing in accordance with the Energy Institute guidelines. This commonly requires the SBC to be braced back to the parent pipe with high stiffness supports to provide restraint against movement in all planes.

Typically, SBC bracing designs are bespoke to each application. AVT Reliability® is the first company to offer an 'off the shelf' universal product which can be configured on-site for each application and is guaranteed to fit all standard SBC geometries.



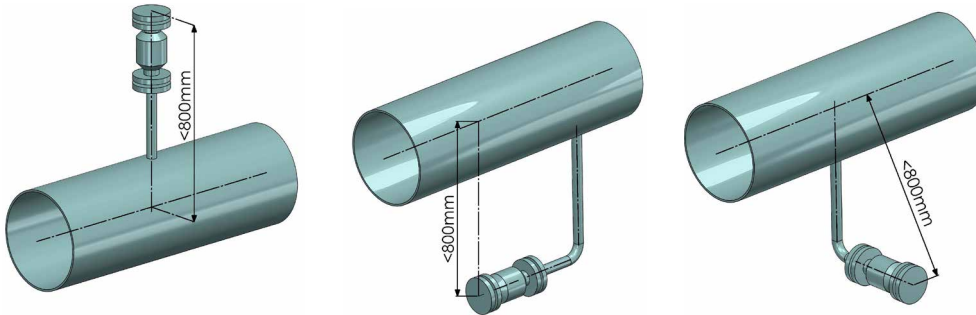
Features	Benefits
<b>Guaranteed to fit any standard SBC geometric configuration</b>	No need for site visit to design bespoke brace. Easy-Brace® has full angular and linear adjustment, enabling it to fit any standard SBC geometric configuration without stressing the SBC.
<b>Clamp-on retrofit design</b>	No welding or 'hot working' permit is required. Uses bolted split clamps onto main line pipe and SBC.
<b>Guaranteed to work</b>	Increases stiffness of the SBC.
<b>Easy to install</b>	Can be installed by non-specialist fitters. Supplied in kit form.
<b>Permanent</b>	Clamp on solution uses Nord-Lock® anti-vibration washers and manufactured from marine grade 316 stainless steel.
<b>Saves time</b>	Reduces engineering time to design and manufacture a bespoke solution.
<b>Low maintenance</b>	Requires no routine maintenance and easily removed for valve maintenance.
<b>Simple to specify and order</b>	Just 2 or 3 dimensions required to order a standard Easy-Brace®.

## Specification

The standard Easy-Brace® product comprises:

- 2 (or 3) x standard split clamps (i.e. SBC flange and main line pipe)
- Split clamps of standard diameters between 60mm and 1000mm
- Optional U-Bolt adaptor to clamp pipes from ½" to 1½" NPS.
- Optional cross-bracing for increased stiffness
- Max SBC length L = 800mm
- Minimum arm length = 200mm
- Maximum pipe temperature 100°C (with standard Tico-S liner material)
- Most effective vibration frequency range 1-50Hz

Other sizes or versions are available, please contact AVT Reliability® for further information.



## Ordering Information

Product Code	Geometry	Number of Arms	Cross-Bracing	SBC Diameter / mm	Mainline 1 Diameter / mm	Mainline 2 Diameter / mm
EB	A, B, C	2, 3, 4	X = yes, O = No	Dxxx	Dxxx	Dxxx

Example:

2-arm version with cross-brace, 90mm SBC and 450mm diameter main line = EB-B-2-X-D090-D450

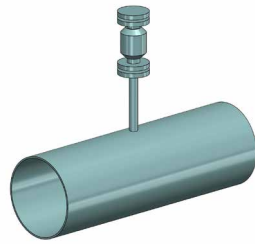
3-arm version, no cross-brace, 90mm SBC and 450mm diameter main line = EB-C-3-O-D090-D450-D500

See notes for definition of the options.

**Easy-Brace® is covered by US and UK patents GB2517297.**

## Ordering Notes

### Standard SBC Geometry Configuration Options



**Configuration A**  
Perpendicular



**Configuration B**  
In-plane bend



**Configuration C**  
Out-of-plane bend

### Protection Rating Options

Easy-Brace® can be configured to provide different levels of protection to match the application. The standard 2-arm configuration meets the requirements of the Energy Institute (EI) guidelines for bolted clamps/braces. If required, additional protection can be obtained from the use of 3-arm or 4-arm configurations and will offer increased levels of protection against vibration induced fatigue failures, as summarised below:

- 2-arm. Low Risk (precautionary) – Standard 2-arm Easy-Brace®.
- 3-arm. Medium Risk – 3-arm version – Standard 2-arm Easy-Brace® plus an additional arm.
- 4-arm. High Risk – 4-arm version – Standard 2-arm Easy-Brace® plus two additional arms.

#### 2-arm Easy-Brace®

The standard 2-arm Easy-Brace® meets the requirements of the Energy Institute guidelines for bolted clamps/braces Ref. Sections T11.1.1.3 and Figures T11-2, T11-3 and T11-4 of the EI guidelines. The 2-arm version will predominantly increase stiffness of SBC in two primary planes. In the third plane, the stiffness will also utilise the structural stiffness of the small bore branch line, which will participate in resisting any vibration. Finite element analysis (FEA) for a typical 1" SBC indicates that a 2-arm brace will typically reduce stress by up to 90% with respect to an unbraced SBC.

#### 3-arm version Easy-Brace®

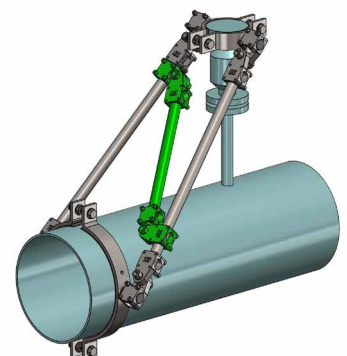
The 3-arm version will provide additional dynamic support in the third plane, reducing any participation by the small bore branch line, and thereby reducing dynamic stresses at the critical SBC welded connection to the main line. Finite element analysis (FEA) has indicated an increase of stiffness (over the 2-arm brace) of up to 50% (typical) in the third plane for a typical 1" SBC, being most beneficial for SBC configurations B & C.

#### The 4-arm version Easy-Brace®

The 4-arm version will provide greater dynamic support in all three planes, further reducing any participation by the small bore branch line and further reducing dynamic stresses at the critical SBC welded connection to the main line. FEA has indicated an increase of stiffness (over the 3-arm brace) of up to 40% (typical) in key planes for a typical 1" SBC. More importantly, the 4-arm brace helps to equalise the effectiveness of the brace in all three directions.

### Cross-Bracing Option

As a further option, for additional lateral support, a cross-brace option is available for stiffening configurations where pairs of arms are near-parallel or excessively long. FEA indicates that the cross brace can significantly increase structural stiffness and reduce stress by up to 30% compared to the equivalent brace without cross-bracing.



## Easy-Brace® Protection Rating

### Selection Guidance

AVT Reliability® offers the following guidance to aid selection; however, the ultimate responsibility for the assessment and mitigation of the risk will be with the buyer:

Number of Arms	Perceived Risk	Description of Risk	Consequences of Failure
2-arm	Low	Precautionary bracing of SBCs on safety or business critical lines, where: Calculated LOF <sup>1</sup> is <0.4 or where measured vibration $CF^2 < 1$	Low risk of major incident Low risk of serious injury to personnel Low risk of fire, explosion or pollution Low cost due to disruption of production
3-arm	Medium	Advisory bracing of SBCs on safety or business critical lines, where: Calculated LOF <sup>1</sup> is $0.4 < LOF < 0.7$ or where measured vibration $1 < CF^2 < 3$	Possibility of major incident Possibility of serious injury to personnel Possibility of fire, explosion or pollution Medium cost due to disruption of production
4-arm	High	Essential bracing of SBCs on safety or business critical lines, where: Calculated LOF <sup>1</sup> is $> 0.7$ or where measured vibration $CF^2 > 3$	High risk of major incident High risk of serious injury to personnel High risk of fire, explosion or pollution High cost due to disruption of production.

Note<sup>1</sup> LOF = Likelihood of Failure (Ref Section 3.2.1 of EI guidelines)

Note<sup>2</sup> CF = AVT Concern factor showing ratio of vibration severity compared to EI Concern and Problem limits (Ref Table T7-2 of EI guidelines). Where  $CF < 1$  is Acceptable,  $CF > 1$  is Concern,  $CF > 5$  is Problem

**NOTE:** The purchaser is responsible for selection of the required level of protection required. If required, AVT Reliability® can provide consultation as part of a service or contract.

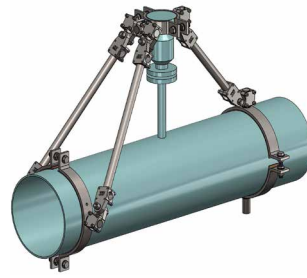


# CONFIGURATION EXAMPLES

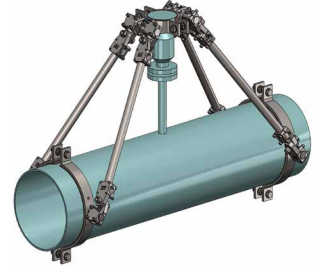
## Configuration A Protection Ratings



2-arm



3-arm

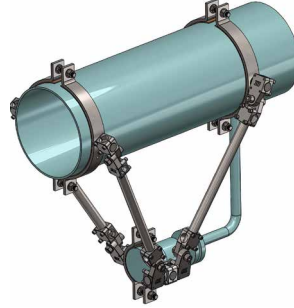


4-arm

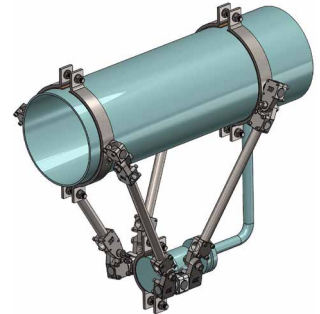
## Configuration B Protection Ratings



2-arm



3-arm

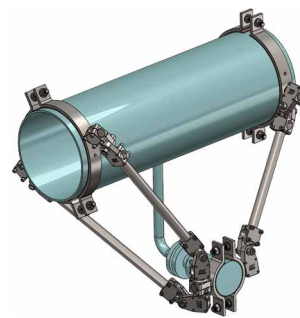


4-arm

## Configuration C Protection Ratings



2-arm



3-arm



4-arm

## Performance Statement

AVT Reliability® believe that, if fitted correctly and properly maintained, the installation of Easy-Brace® will be beneficial in reducing relative vibration levels between a Small Bore Connection (SBC) and main line, significantly reducing the risk of fatigue damage. AVT Reliability® is unable to guarantee that a failure could never occur.

However, the actual performance cannot be guaranteed and can only be assessed once the brace assembly has been installed and tested with plant in operation. This is also to ensure the modification has not resulted in any unexpected detrimental effects. AVT Reliability® recommends that during the installation, before and after vibration measurements are taken on both main line and SBC pipework to quantify amplitude and frequency. Also, natural frequency 'bump' testing is required to identify the natural frequency change to ensure this does not closely match any of the expected excitation frequencies.

The Easy-Brace® will not reduce main line vibration, which may require further remedial work, such as the installation of additional fixed supports or visco-elastic dampers, or dynamic vibration absorbers, or process changes to remove the excitation energy at source.

## Services and Training

Benefiting from over 40 years' professional experience in on-site measurements, assessment and problem solving, AVT Reliability® provides a full range of pipework vibration assessment, solutions and training.

### Pipework Vibration Risk Assessment Services

Identify which sections of pipework are most at risk of vibration induced fatigue. AVT Reliability® offers a full range of predictive and on-site measurement services, including:

- Calculate Likelihood of Failure (LOF)
- On-site visual surveys which identify potential problem areas
- On-site vibration surveys and screening against EI guidelines
- On-site strain measurement and fatigue assessment
- Specialist techniques including Finite Element Analysis, Operating Deflection Shape (ODS) and Motion Amplification

### Pipework Vibration Training

AVT Reliability® offers a range of practical on-site training courses to provide a detailed understanding of the subject of pipework vibration and to help clients to learn about best practice and develop the necessary in-house expertise to be able to identify, assess and rectify many basic pipework vibration problems.

## Additional Pipework Vibration Solutions

Main line pipework vibration is a serious threat to the integrity of main line welded connections and also at Small Bore Connections (SBC).

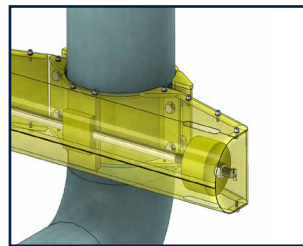
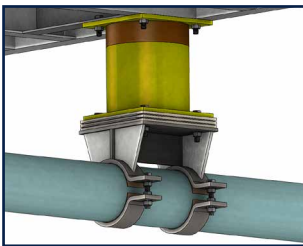
The likelihood of fatigue failure increases if the main line pipe experiences high operational vibration, transient vibration events, or if the operational frequencies of vibration match any natural frequencies of the main line vibration.

Main line vibration also significantly increases the risk of failure of Small Bore Connections (SBC) and branches, especially if they are unsupported and include heavy valves on long, small diameter pipework.

Vibration is often first observed on the SBCs because of the amplification effect but main line vibration should always be addressed as a first priority.

AVT Reliability® offers a comprehensive range of recommendations and solutions for most common pipework vibration problems, including:

- Visco-elastic dampers – selection, supply, and integration
- Dynamic Vibration Absorbers (DVA) – (aka Tuned Mass Dampers)
- Easy-Shim™ – unique main line pipe fretting eliminator by AVT Reliability®



## Warranty Statement

All parts of the system supplied by AVT Reliability® will be covered by a 12 month return to base warranty, commencing on the despatch date of the parts from AVT Reliability®. This will cover all parts found to be defective upon receipt, or which become defective within the warranty period, subject to proof of correct handling, storage, installation, post installation performance validation and proper maintenance. The warranty does not cover natural disasters, fire, explosion or cosmetic effects such as surface corrosion which is possible in certain environmental conditions, but which does not affect the performance of the parts.



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