Paragon Inspection Solutions Ltd.

Creating visibility through innovation

Presentation to the TLB's - Technology Managers Network meeting
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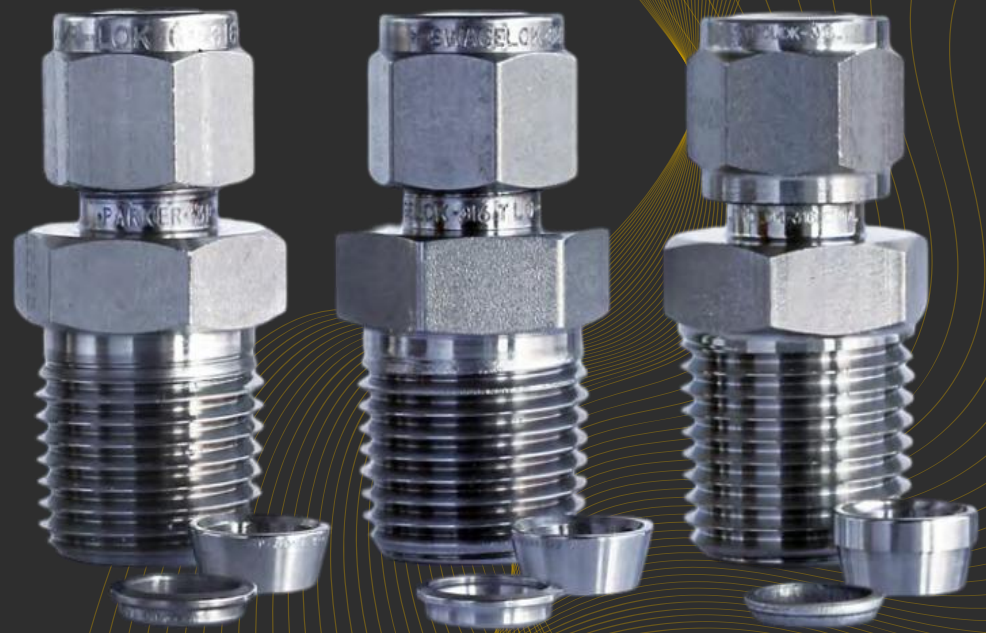
Small Bore Tubing Connectors (SBT)

SBT are mechanical connectors used extensively in industry, including onshore and offshore oil and gas installations, refineries, power generation equipment, hydrogen facilities and in utility plant such as air, chemical injection, and hydraulic fluid.

One of their main uses is for the connection of instruments to the process plant for monitoring, control and safeguarding purposes.

SBT contain fluids or gases under pressure.
90% are ½” (12mm) diameter or under.
130 million are manufactured annually.

Small bore tubing connectors

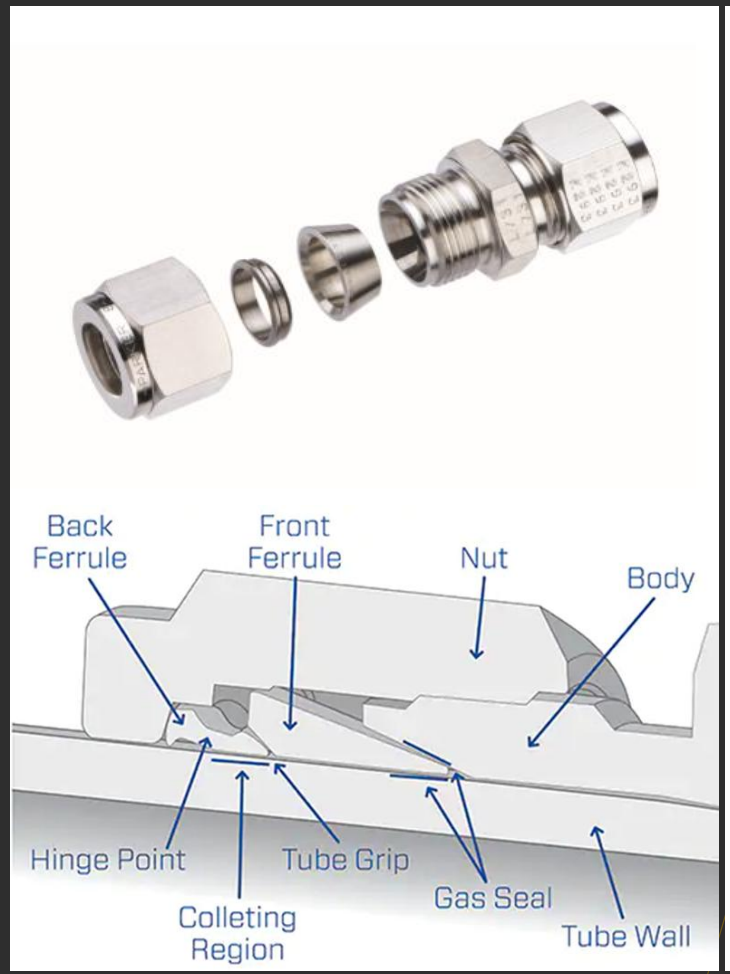


Parker Swagelok Gyrolok

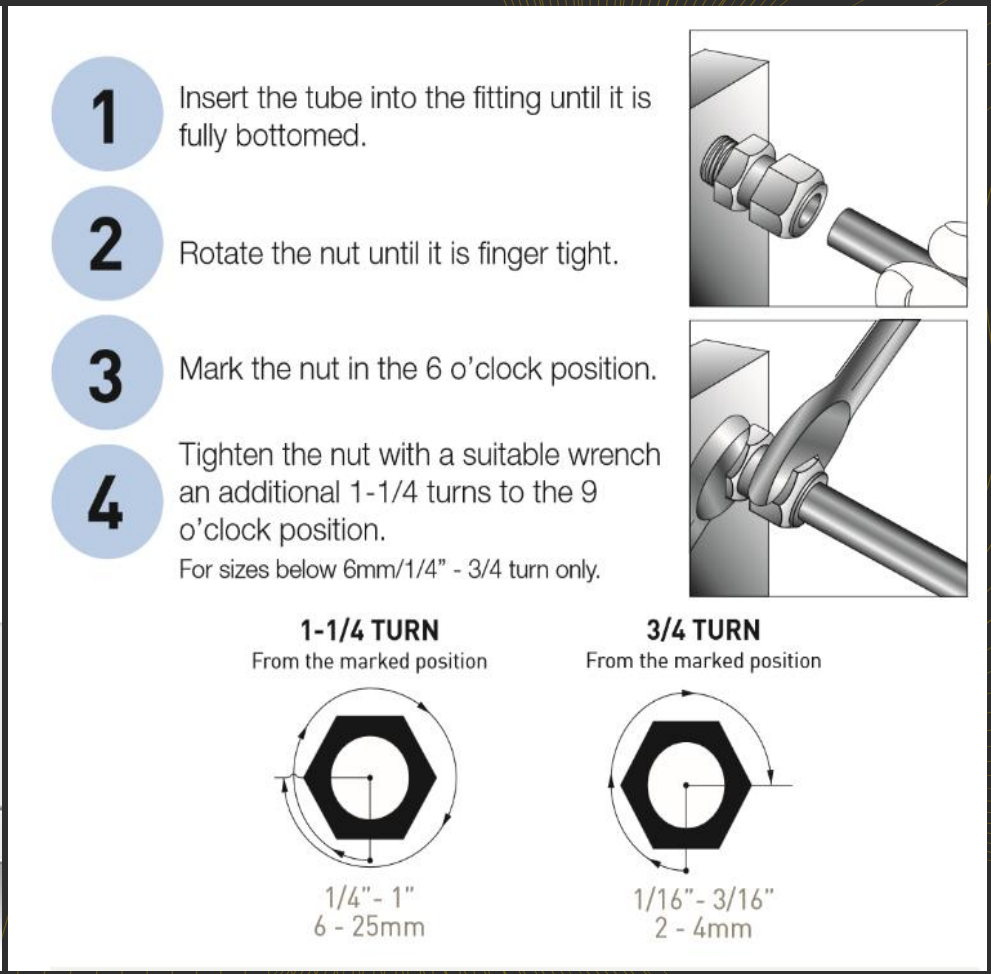
Small Bore Tubing - assembly

Assembled by hand and easy to install simple mechanical assembly makes them economically attractive.

By design, they should provide the required integrity over the entire installation life cycle.[1]



Typical SBT assembly



Typical manufacturer assembly instructions

1. Energy Institute Guidelines for SBT Management 3rd Edition April 2024

Industry SBT Challenges

Modern plant feature large numbers of SBT assemblies. Each offshore asset typically has around 15,000 connectors with 45 million in the UKCS.[2]

The large number of SBT any of which could be classed as safety critical presents a challenge for managing integrity.

The Energy Institute provides guidelines for SBT management to help manage SBT risk.

2. Parker Hannifin Corporation

Image courtesy ECITB

Vulnerability and consequences of releases - HSE

SBT are vulnerable to failure due to poor installation practice or the lack of effective inspection and maintenance programmes. If good practice is not being applied throughout the whole assembly life-cycle, there is a relatively high probability that an integrity failure event will occur at some time during service.[1]

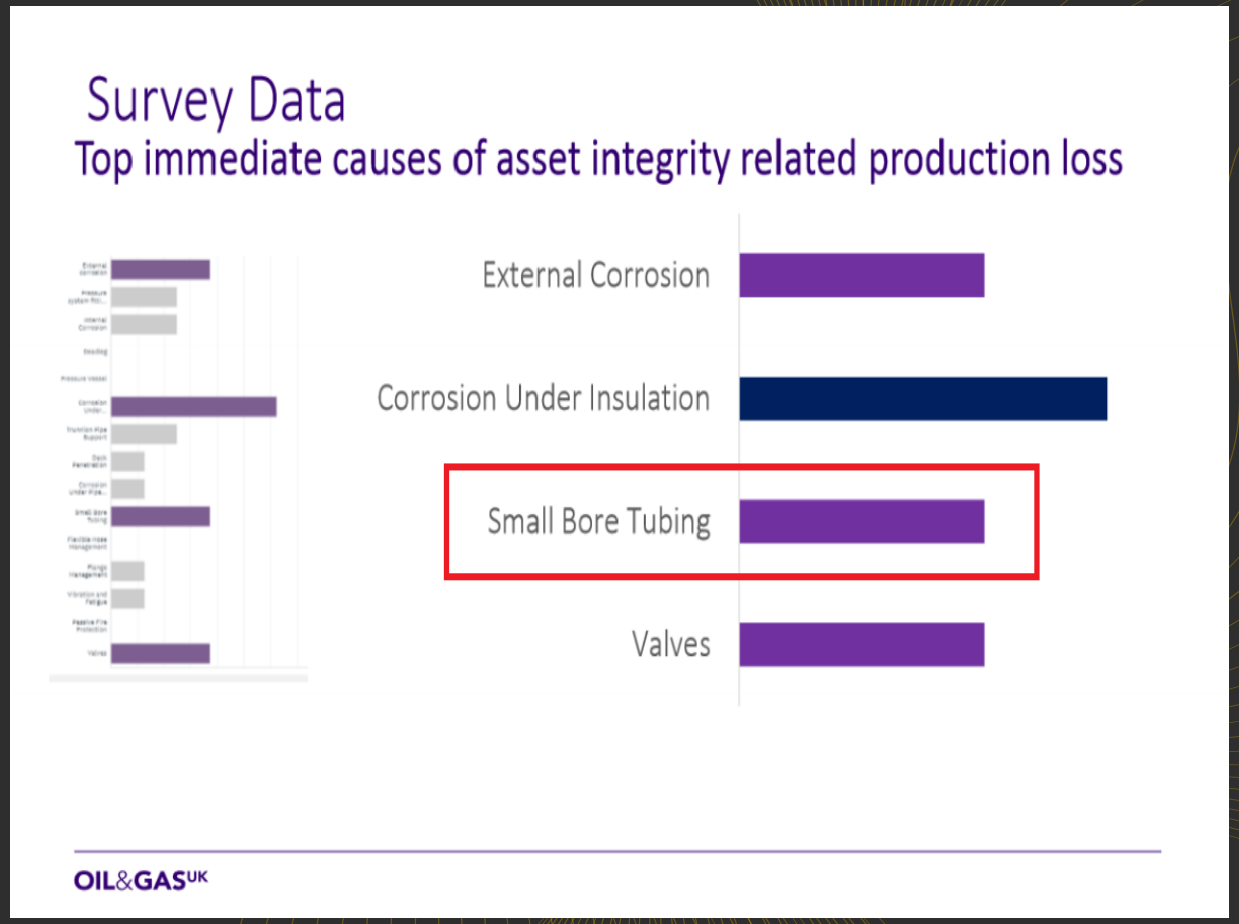
Statistics for the UKCS by the Health and Safety Executive (HSE) indicate that SBT assemblies are one of the largest contributors to loss of process containment in hazardous plant and that there was considerable room for improvement in terms of installation, inspection and maintenance practices.[1]

The integrity of SBT is a major concern for oil & gas operators with SBT being a major source of unplanned releases within the industry. Operators also identified a key contributing factor to SBT integrity issues was a lack of competency surrounding make-up and installation. [5]

1. Energy Institute Guidelines for SBT Management 3rd Edition April 2024

5. Hydrasun – BP Clair Ridge Case Study

SBT – One of the major causes of production loss



SBT - one of the top causes of production loss with £500 million lost annually in the UKCS [3]

3. Oil & Gas UK

SBT Problem Summary

- £500 million is lost in UKCS production.[3]
- 250,000 tons CO2e released annually in the UKCS.[5]
- SBT are the second largest single source of hydrocarbon leaks.[4]
- 23% of major releases SBT related.[4]
- 26% of SBT were found to contain faults[1,4] - with 13 ways to incorrectly assemble.[6]
- Hidden internal defects.[1]
- Assembly issues are the root cause of the majority of SBT industry safety alerts.

1. Energy Institute Guidelines for SBT Management 3rd Edition April 2024 3. Oil & Gas UK 4. HSE 5. Mabbett Independent study 6. Swagelok

Risk management

Inspection is required by HSE and Energy Institute Guidelines to help manage risk, avoid lost revenue, leaks and emissions and comply with regulation. Current inspection methods have been used since 1950's.

Visual inspection - the inspector visually examines the connector and determines by experience if a fault is suspected.

Gauging inspection – a metal gauge is inserted into the connector gap and if it enters a fault may be present.

Both inspection methods require the connector to be opened to further evaluate, breaking into a hydrocarbon joint, depressurising, cleaning, inspecting, re-assembly and pressure testing – invasive inspection.
75% of connectors identified by visual and gauging are opened unnecessarily increasing cost and risk.[1]
Connector manufacturers recommend unnecessary system opening is avoided.[4]

1. Energy Institute Guidelines for SBT Management 3rd Edition April 2024 4. Swagelok

Industry Challenge

Develop a fast, accurate, simple to use, non-invasive inspection method that meets HSE and Energy Institute requirements whilst helping to reduce risk and production losses.

The Solution - Tru-Fit®

Tru-Fit® is a non-invasive inspection system that uses tool sensors and software to determine if a connector has been assembled correctly.

The software automatically grades the assembly from 1-5 with 5 being the most severe.

Tru-Fit inspection video link

SBT connection testing with standard manufacturer connector

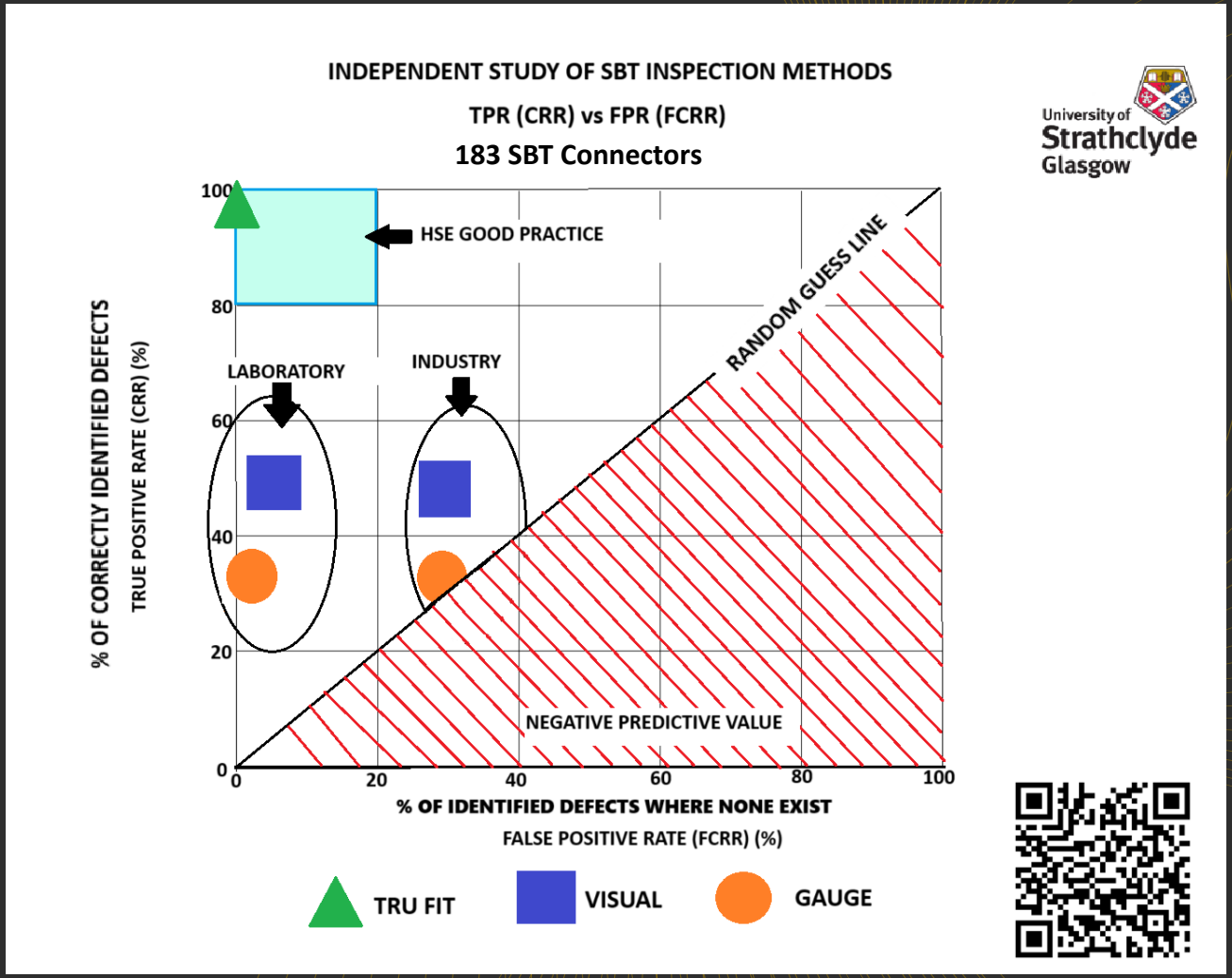
Tru-Fit® HSE & EI compliance capability tests

Performance verification by TUV:SUD National Engineering Laboratory
160 connectors 100% success rate

The University of Strathclyde recently performed an independent capability assessment of SBT inspection methods for defects causing failures in-service.

Tru-Fit ▲ was the only inspection method found to comply with HSE and Energy Institute ALARP good practice for SBT risk management with a 99% detection rate.

Both Visual ■ 46% and Gauging ● 30% were found to be slightly better than a random guess.



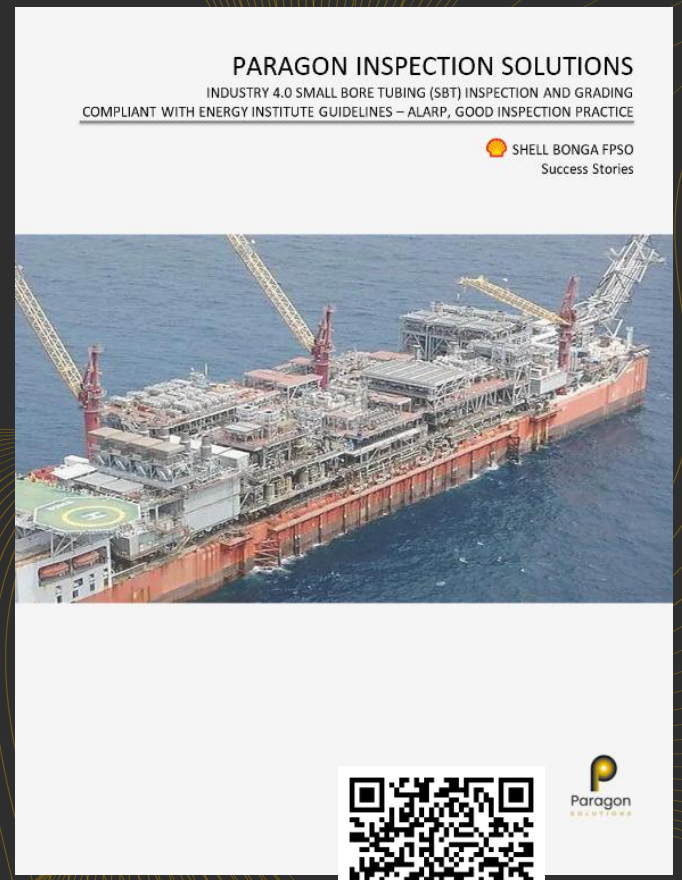
https://strathprints.strath.ac.uk/92526/

Tru-Fit® - Data-Driven Decision Making

Tru-Fit allows industry to move forward with the benefits of accurate risk-based inspection data.

Tru-Fit® data can be used to review historical failure patterns and current condition to predict future leaks allowing specific targeted maintenance.

New construction can also be monitored.



Tru-Fit use on the Shell Bonga FPSO - currently in the process of changing their maintenance management system to include Tru-Fit® grading.

Tru-Fit® Data Shell Case Study Link

Top Benefits

1. Ensure Compliance Efficiently
Achieve top-quality inspection using a non-invasive method while meeting regulatory requirements

- 4X faster
- 4X safer
- 6X lower cost

2. Prevent Losses and Reduce Risk
Avoid SBT-related production losses, leaks, and fugitive emissions. Cut maintenance backlogs while reducing the need for onboard personnel.

3. Drive Smarter Decisions
Use accurate, real-time unique inspection data to guide actions and improve operational outcomes.

Tru-Fit® System lease

Flexible Leasing Options

Paragon offers the Tru-Fit® system for short or long-term lease. Each lease includes the Tru-Fit® tool, software, and access to online inspection data and downloads.

Comprehensive Training

One-day certification training is available online or onsite to ensure your team is fully equipped to operate the system.

Support

We offer support for all aspects of the system lease, sales, technical, or service we're here to ensure you have a successful outcome using our system.

Paragon
SOLUTIONS

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Tru-Fit® - setting the standard for Small Bore Tubing Inspection

Any Questions?

Find us at the Innovation Zone
Energy Exports Conference
3rd & 4th June, P&J Live, Aberdeen.

Scottish Enterprise

RSE The Royal Society of Edinburgh ENTERPRISE FELLOWSHIPS

SCOTTISH EDGE HIGGS WINNER Round 15 | 2019

ELEVATOR

TechX Pioneers

Paragon thanks the organisations above for the innovation support and awards