MECHANICAL JOINT INTEGRITY
ROUTE TO COMPETENCE GUIDANCE

Preventing Hydrocarbon releases through safety critical competence
Mechanical joints have the potential to cause serious injury and hydrocarbon releases. This has been seen in the last few years where a number of serious incidents and accidents have occurred during construction, maintenance, disassembly and steady-state operations.

Competence related failures are one of the main causes of loss-of-containment incidents, and may lead to major accidents.

As a result of this, there is a strong desire within the oil and gas industry to improve the safety performance of such operations. To achieve this aim, a work group was established to produce this Mechanical Joint Integrity Competence guidance.

This guidance reflects current industry practice guidance as well as a definition of minimum standards of competency for carrying out such work. It has been developed by a joint working group including members from industry and standard setting bodies. In compiling this document, it was recognised that organisations already have processes and procedures. With this in mind, they are designed to provide guidance in two ways:

- To enable you to assess your current working methods against the principles put forward here and so help you identify improvements to those methods in line with current best practice.

- To allow companies to adopt improved methods for demonstrating specialist critical bolting and small bore tubing competence, based on current good practice.

We recommend the review of company procedures against the principles and practical guidance contained in this publication. An action plan should then be prepared for the implementation of any necessary improvements.

Effective and lasting improvement can be achieved where all concerned, from senior management to those carrying out work on the plant, share a genuine commitment to achieving and maintaining mechanical joint operations procedures to a high standard.
Scope and Target Audience

The guidance sets out a structured approach to the principles of managing competence for those involved in mechanical joint operations. It describes how to train, develop and assure competence, reducing the risk of personal injury and hydrocarbon and non-hydrocarbon release when working with mechanical joint related activities such as construction, maintenance and disassembly operations.

The guidance is intended to reflect industry ‘good practice’ for the management of competence in relation to mechanical joint operations. It applies to the onshore and offshore oil and gas industry to the extent that it is reasonably practicable to do so. It also has general application to all industries where mechanical joint operations are undertaken.

These guidelines are therefore aimed at all personnel involved in mechanical joint operations, particularly those who are expected to undertake related duties in the workplace. Correspondingly those who are expected to plan these operations and the supervisors of those personnel performing them should be familiar with these principles.

Additionally those involved with the management of training and competence, including the delivery of related material should be aware of

- the importance of utilising good practice in the demonstration of competence of new and existing workers;
- a revised and restructured development routes

Risk Reduction

The main focus is on risks to the safety of people and avoiding loss of containment, particularly where activities present potential major accident hazards. It will also improve environmental protection and reduce business interruption. For all assembly and disassembly operations the risks should be formally assessed.

Overview of Hazard

Fire and explosion

Uncontrolled release of pressure resulting in personal injury through exposure to hydrocarbons or flying components
Basic Principles

Control of the training and competence assurance of personnel working on mechanical joints is a critical factor in achieving asset integrity. Therefore an important element of the competence assurance and management system is to ensure that any person working on a given joint has been trained and assessed as competent to perform the task.

All personnel involved in mechanical joint operations should have sufficient knowledge of the specific tasks to be undertaken and the risks which the work will entail, along with sufficient experience and ability to carry out their duties in relation to mechanical joint integrity operations, whilst recognising their limitations and be able to take appropriate action in order to prevent harm to themselves and those affected by the work.

Moreover personnel should be assessed as technically competent. Formal assessment should be underpinned by national occupational standards and provides demonstrable capability for all personnel, including third-party vendors and contractors, who are expected to make, break or maintain mechanical joints.

Personnel Undertaking Mechanical Joint Integrity Operations

The diagram on page 3 shows the four key stages that an individual has to pass through to reach full competency and maintain ongoing performance development.

The chart on page 8 and 9 identifies the categories of personnel who undertake or are involved with Mechanical Joint operations and the suggested training and competence assessment for these groups of personnel.

There are a number of training courses available, which are based upon and meet industry occupational standards developed by the ECITB a training standards organisation.

Four Key Stages in Achieving Competency

The first stage of all training comprises initial training and assessment. This is normally carried out at a training establishment.

At the completion of Stage 1, the level of competency is deemed sufficient for that person to undertake Mechanical Joint Integrity operations under the direct supervision of a competent person as part of their Stage 2 training.

Stage 2 is consolidation of skills, experience building and the practical application of the learning obtained in Stage 1.

Stage 3 is the assessment of technical competency at an approved test centre with Stage 4 as the ongoing performance development.

These four stages of achieving competency in Specialist Critical Bolting and Small Bore Tubing are shown in Fig 1.

In order to conduct mechanical joint integrity operations to today's high standards, it is important that employers have a system in operation which permits personnel to progress through the stages to become competent to undertake mechanical joint integrity operations and to maintain this competence.

In the case of non-core personnel employed on short-term contracts, employers must have a system in operation to validate the competency of these personnel and, if necessary, update and refresh the skills and knowledge of such personnel.
Figure 1

Based on the ECITB National Occupational Standards for Pipefitting / Mechanical Maintenance

Stage 4
Assessment Centre
Reassessment every 3 years

Stage 3
Assessment Centre

Stage 2
Workplace

Stage 1
Onshore Training Centre

Personnel undertaking operations on bolted connections using hand and hydraulic torque & tensioning techniques
Specialist Critical Bolting Route

Technical Competence
Preparing and Assembling Small Bore Tube
Coned & Threaded

Technical Competence
Preparing and Assembling Small Bore Tube
Compression Fittings

Technical Competence
Preparring and Assembling Non-Ferrous Small Bore Tube
Coned & Threaded

Technical Competence
Preparing and Assembling Non-Ferrous Small Bore Tube
Compression Fittings

Technical Competence
Hydraulic Torque Flanges

Technical Competence
Hydraulic Torque Clamps

Technical Competence
Hydraulic Tension Flanges

Technical Competence
Hydraulic Torque Clamps

Preparing and Assembling Small Bore Tube
Coned & Threaded

Preparing and Assembling Small Bore Tube
Compression Fittings

Preparing and Assembling Small Bore Tube
Coned & Threaded

Preparing and Assembling Small Bore Tube
Compression Fittings

Preparing and Assembling Small Bore Tube
Coned & Threaded

Preparing and Assembling Small Bore Tube
Compression Fittings

Personnel undertaking operations on non-ferrous small bore tubing using compression and coned & threaded techniques
Small Bore Tubing Route

At time of print, ECITB reviewing numbering for SBT Route.
New Workers and Existing Workers

New Workers who have no experience in working with mechanical joints must start at Stage 1 of the training and progress through Stages 2, 3 & 4 over time.

Existing workers may go straight to Stage 3 (as shown in Fig. 2) if their company can endorse that the existing worker has previously attended a training course in bolting or small bore tubing and has recent experience in that subject area.

Some existing workers may require refresher training on the knowledge aspects and computer based training modules will be available that are aligned with ECITB's technical training standards.

Stage 1

Personnel involved in mechanical joint integrity activities will attend an ECITB approved training provider to undertake a period of training in either specialist critical bolting or small bore tubing assemblies. The training will normally take place onshore and consist of classroom and workshop learning activities. The courses are normally from one day to two and half days depending upon the subject matter. Each person will be taught theoretical and practical skills regarding the relevant subject matter to a technical training standard specified by the ECITB. The training courses require each person to demonstrate the attainment of knowledge and practical skills through an individual knowledge test and practical workshop exercises. Successful personnel will gain a certificate of training and be issued with a Work Based Task Assignment to be used in Stage 2.

Stage 2

Each person after attending an approved training course and attaining the training certificate requires a period of workplace experience to practise new skills and knowledge. This period allows for the consolidation of skills and knowledge against work based tasks. The learner is issued with a Work Based Task Assignment specifying the range of tasks and complex jobs required before the person can move on to Stage 3. A workplace consolidation period of 3 to 12 months is recommended to give the person the opportunity to complete the Work Based Task Assignment. The individual must satisfactorily demonstrate that they have carried out each of the steps indicated in the Work Based Task Assignment on a minimum of three occasions. This may mean in practice that they complete more than three task assignment records as they may not carry out every step on each occasion.

The task assignment record may be verified by any person with overall responsibility for the correct, safe and accurate completion of the task. This could be:

- A supervisor or team leader
- A line manager
- Any other person with responsibility for the final approval and quality assurance for the relevant task, for example a QC Inspector or permit authority

When the person has achieved satisfactory completion of the Work Based Task Assignment they can move onto Stage 3.

Stage 3

Stage 3 requires each person to complete a formal assessment of their job knowledge, skills and ability in each Mechanical Joint Integrity subject. The ECITB technical competence validation tests are standards based consisting of a bank of online knowledge questions and a practical task to validate the learner's skills, knowledge and ability. Successful learners achieve the certificate of achievement which is valid for a period of 3 years. Unsuccessful personnel must wait a minimum period of 4 weeks between the unsuccessful test session and next test session to allow a period of training to address any skills or knowledge gaps.

Stage 4

To confirm the individual's current skills, knowledge and ability the ECITB technical competence validation test is undertaken every 3 years to prove ongoing performance development. If required the individual can undertake a short computer based training module to refresh their job knowledge before attempting the technical test.
Is the candidate already practising in this skill area?

Yes

Is there clear evidence of knowledge and skills?

Yes

OPTION
Complete Mechanical Joint Integrity CBT

Carry out the technical competence validation test

Did the candidate successfully complete the technical competence validation test?

No

Direct learning subject to examiner feedback

Yes

Certificate of Achievement issued for individual (valid 3 years)

No

Stage 1
Complete the endorsed training course(s)

Stage 2
Complete a work based task assignment

Stage 3
Carry out the technical competence validation test

Stage 4
Refresher training to maintain currency

Candidates for Stage 3 assessment require:
• A Valid Stage 1 Training Certificate and
• A complete and valid work based task assignment or
• A formal letter from the candidates employer representative stating that the candidate has met the equivalent of the ECETB Stage 2 experience WBTA criteria.

The formal letter should include details of the employers’ representative position in the company, full contact details and be signed and dated by the employer representative.

Figure 2
Roles & Responsibilities

The following matrix provides guidance on the roles and responsibilities in mechanical joint integrity operations to be applied in conjunction with the training and competence Fig. 1. The numbers refer to the 4 stage model described on page 3.

### Specialist Critical Bolting

<table>
<thead>
<tr>
<th>Activity</th>
<th>Supervisor</th>
<th>Decommissioning Operative</th>
<th>Maintenance Technician</th>
<th>Production Operator</th>
<th>Construction Craftsperson</th>
<th>Bolting Technician/ Supervisor</th>
<th>Inspector</th>
</tr>
</thead>
<tbody>
<tr>
<td>Work safely and minimise risk in mechanical joint integrity operations</td>
<td>1</td>
<td>1,2,3</td>
<td>1,2,3,4</td>
<td>1,2,3</td>
<td>1,2,3,4</td>
<td>1,2,3,4</td>
<td>1,2,3,4</td>
</tr>
<tr>
<td>Identify and deal with hazards and emergencies in mechanical joint integrity operations</td>
<td>1</td>
<td>1,2,3</td>
<td>1,2,3,4</td>
<td>1,2,3</td>
<td>1,2,3,4</td>
<td>1,2,3,4</td>
<td>1,2,3,4</td>
</tr>
<tr>
<td>Prepare the work area, materials and equipment in accordance with health and safety and quality stipulations for mechanical joint integrity operations</td>
<td>1</td>
<td>1,2,3</td>
<td>1,2,3,4</td>
<td>1,2,3</td>
<td>1,2,3,4</td>
<td>1,2,3,4</td>
<td>1,2,3,4</td>
</tr>
<tr>
<td>Ensure intended task conforms to related specification, methods, processes, techniques and procedures</td>
<td>1</td>
<td>1,2,3</td>
<td>1,2,3,4</td>
<td>1,2,3</td>
<td>1,2,3,4</td>
<td>1,2,3,4</td>
<td>1,2,3,4</td>
</tr>
<tr>
<td>Dismantle bolted connections (torque or tension)</td>
<td>1</td>
<td>1,2,3</td>
<td>1,2,3,4</td>
<td>1,2,3</td>
<td>1,2,3,4</td>
<td>1,2,3,4</td>
<td>1,2,3,4</td>
</tr>
<tr>
<td>Remove components from bolted connection systems</td>
<td>1</td>
<td>1,2,3</td>
<td>1,2,3,4</td>
<td>1,2,3</td>
<td>1,2,3,4</td>
<td>1,2,3,4</td>
<td>1,2,3,4</td>
</tr>
<tr>
<td>Replace components in bolted connection systems</td>
<td>1</td>
<td>1,2,3</td>
<td>1,2,3,4</td>
<td>1,2,3</td>
<td>1,2,3,4</td>
<td>1,2,3,4</td>
<td>1,2,3,4</td>
</tr>
<tr>
<td>Assemble, secure and hand torque bolted connections</td>
<td>1</td>
<td>1,2,3</td>
<td>1,2,3,4</td>
<td>1,2,3</td>
<td>1,2,3,4</td>
<td>1,2,3,4</td>
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</tr>
<tr>
<td>Assemble, secure and hydraulically tension bolted connections</td>
<td>1</td>
<td>1,2,3</td>
<td>1,2,3,4</td>
<td>1,2,3</td>
<td>1,2,3,4</td>
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<tr>
<td>Assemble, secure and hydraulically torqued bolted connections</td>
<td>1</td>
<td>1,2,3</td>
<td>1,2,3,4</td>
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<td>1,2,3,4</td>
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<tr>
<td>Verify the integrity of the assembled joint</td>
<td>1</td>
<td>1,2,3,4</td>
<td>1,2,3</td>
<td>1,2,3</td>
<td>1,2,3,4</td>
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<tr>
<td>Activity</td>
<td>Key role – stages required</td>
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<tr>
<td>Work safely and minimise risk in mechanical joint integrity operations</td>
<td>Designer: 1, Supervisor: 1, Decommissioning Operative: 1, 2, 3, Maintenance Technician: 1, 2, 3, Production Operator: 1, 2, 3, 4, Construction Craftsperson: 1, 2, 3, 4, SBT Technician / Supervisor: 1, 2, 3, 4, Inspector: 1, 2, 3, 4</td>
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<tr>
<td>Identify and deal with hazards and emergencies in mechanical joint integrity operations</td>
<td>Designer: 1, Supervisor: 1, Decommissioning Operative: 1, 2, 3, Maintenance Technician: 1, 2, 3, 4, Production Operator: 1, 2, 3, 4, Construction Craftsperson: 1, 2, 3, 4, SBT Technician / Supervisor: 1, 2, 3, 4, Inspector: 1, 2, 3, 4</td>
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<tr>
<td>Plan and configure small bore tubing assemblies in the engineering construction industry</td>
<td>Designer: 1, Supervisor: 1, Decommissioning Operative: 1, 2, 3, Maintenance Technician: 1, 2, 3, 4, Production Operator: 1, 2, 3, 4, Construction Craftsperson: 1, 2, 3, 4, SBT Technician / Supervisor: 1, 2, 3, 4, Inspector: 1, 2, 3, 4</td>
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<tr>
<td>Dismantle and remove components from small bore tubing assemblies in engineering construction</td>
<td>Designer: 1, Supervisor: 1, Decommissioning Operative: 1, 2, 3, Maintenance Technician: 1, 2, 3, 4, Production Operator: 1, 2, 3, 4, Construction Craftsperson: 1, 2, 3, 4, SBT Technician / Supervisor: 1, 2, 3, 4, Inspector: 1, 2, 3, 4</td>
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<tr>
<td>Shape small bore tubing components in the offshore/ engineering construction industry</td>
<td>Designer: 1, Supervisor: 1, Decommissioning Operative: 1, 2, 3, Maintenance Technician: 1, 2, 3, 4, Production Operator: 1, 2, 3, 4, Construction Craftsperson: 1, 2, 3, 4, SBT Technician / Supervisor: 1, 2, 3, 4, Inspector: 1, 2, 3, 4</td>
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<tr>
<td>Replace components in small bore tubing assemblies in engineering construction</td>
<td>Designer: 1, Supervisor: 1, Decommissioning Operative: 1, 2, 3, Maintenance Technician: 1, 2, 3, 4, Production Operator: 1, 2, 3, 4, Construction Craftsperson: 1, 2, 3, 4, SBT Technician / Supervisor: 1, 2, 3, 4, Inspector: 1, 2, 3, 4</td>
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<tr>
<td>Assemble small bore tubing components to meet specification in the engineering construction industry</td>
<td>Designer: 1, Supervisor: 1, Decommissioning Operative: 1, 2, 3, Maintenance Technician: 1, 2, 3, 4, Production Operator: 1, 2, 3, 4, Construction Craftsperson: 1, 2, 3, 4, SBT Technician / Supervisor: 1, 2, 3, 4, Inspector: 1, 2, 3, 4</td>
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<tr>
<td>Install small bore tubing in the engineering construction industry</td>
<td>Designer: 1, Supervisor: 1, Decommissioning Operative: 1, 2, 3, Maintenance Technician: 1, 2, 3, 4, Production Operator: 1, 2, 3, 4, Construction Craftsperson: 1, 2, 3, 4, SBT Technician / Supervisor: 1, 2, 3, 4, Inspector: 1, 2, 3, 4</td>
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<tr>
<td>Test small bore tubing assemblies in the engineering construction industry</td>
<td>Designer: 1, Supervisor: 1, Decommissioning Operative: 1, 2, 3, Maintenance Technician: 1, 2, 3, 4, Production Operator: 1, 2, 3, 4, Construction Craftsperson: 1, 2, 3, 4, SBT Technician / Supervisor: 1, 2, 3, 4, Inspector: 1, 2, 3, 4</td>
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<tr>
<td>Inspect small bore tubing in the engineering construction industry</td>
<td>Designer: 1, Supervisor: 1, Decommissioning Operative: 1, 2, 3, Maintenance Technician: 1, 2, 3, 4, Production Operator: 1, 2, 3, 4, Construction Craftsperson: 1, 2, 3, 4, SBT Technician / Supervisor: 1, 2, 3, 4, Inspector: 1, 2, 3, 4</td>
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</tbody>
</table>

SBT Qualification – A vocational qualification Installing Engineering Construction Plant and Systems Small Bore Tubing Assemblies is available from the ECITB.
## TRAINING AND COMPETENCE MANAGEMENT RESPONSIBILITY

### The right person for the right task

<table>
<thead>
<tr>
<th>Level</th>
<th>The task</th>
<th>Training and supervision</th>
<th>Measuring performance</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>New worker</strong></td>
<td>Specify the tasks for the new worker, the tools, PPE and equipment, specify limits on tasks, assign to a supervisor</td>
<td>Provide approved training provision and supervision in accordance with 4 stage model; provide opportunities to consolidate skills and knowledge in the workplace using the work based task assignments to a satisfactory standard ready to undertake the technical competence validation test.</td>
<td>Set and monitor training targets, monitor performance and behaviours of new worker and supervisor. \nAchievement of technical test in relevant subject area.</td>
</tr>
<tr>
<td><strong>Existing worker</strong></td>
<td>Specify and authorise tasks that can be undertaken, according to valid technical test certificates and experience.</td>
<td>Check technical test certificates, provided refresher training and ongoing performance development.</td>
<td>Confirm validity of technical test certificates; carry out assessments against company/client competence management systems.</td>
</tr>
<tr>
<td><strong>Designer</strong></td>
<td>Awareness and knowledge of SBT systems, components and materials to aid design skills.</td>
<td>Provide approved SBT Assemblies training provision and supervision in design project tasks.</td>
<td>Set and monitor training targets, monitor performance and behaviours in design project tasks.</td>
</tr>
<tr>
<td><strong>Supervisor</strong></td>
<td>Specify the awareness and knowledge of tasks and associated risks.</td>
<td>Check qualifications and task experience, relevant approved course training, provide management and technical support to workers</td>
<td>Set, monitor performance and behaviours of workers in tasks, task completed safely with a do it right first time approach, HCR reduction target met.</td>
</tr>
<tr>
<td><strong>Decommissioning Operative</strong></td>
<td>Specify the awareness and knowledge of tasks and associated risks when destructing plant and systems.</td>
<td>Provide approved relevant training provision and supervision in decommissioning tasks.</td>
<td>Set and monitor training targets, monitor performance and behaviours in decommissioning tasks.</td>
</tr>
<tr>
<td><strong>Maintenance Technician</strong></td>
<td>Specify and authorise tasks that can be undertaken, according to valid technical test certificates and experience.</td>
<td>Check technical test certificates, provider refresher training and ongoing performance development.</td>
<td>Confirm validity of technical test certificates; carry out assessments against company/client competence management systems.</td>
</tr>
<tr>
<td><strong>Production Operator</strong></td>
<td>Awareness and knowledge of MJ systems, components and materials to aid basic maintenance task skills.</td>
<td>Provide approved training provision and supervision in accordance to 4 stage model if technical test certificate required; provide opportunities to consolidate skills and knowledge in the workplace using the work based task assignments to a satisfactory standard ready to undertake the technical competence</td>
<td>Set and monitor training targets, monitor performance and behaviours in basic maintenance task skills.</td>
</tr>
<tr>
<td>Level</td>
<td>The task</td>
<td>Training and supervision</td>
<td>Measuring performance</td>
</tr>
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</tr>
<tr>
<td>Construction Craftsperson</td>
<td>Specify and authorise tasks that can be undertaken, according to valid technical test certificates and experience.</td>
<td>Check technical test certificates, provider refresher training and ongoing performance development.</td>
<td>Confirm validity of technical test certificates, carry out assessments against company/client competence management systems.</td>
</tr>
<tr>
<td>SBT/Bolting Technician</td>
<td>Specify and authorise tasks that can be undertaken, according to valid technical test certificates and experience.</td>
<td>Check technical test certificates, provider refresher training and ongoing performance development.</td>
<td>Confirm validity of technical test certificates; carry out assessments against company/client competence management systems.</td>
</tr>
<tr>
<td>Inspector</td>
<td>Specify and authorise tasks that can be undertaken, according to valid technical test certificates and experience.</td>
<td>Check technical test certificates, provider refresher training and ongoing performance development.</td>
<td>Confirm validity of technical test certificates; carry out assessments against company/client competence management systems.</td>
</tr>
</tbody>
</table>

**Step Change in Safety Resources**

- Asset Integrity Toolkit
- Hydrocarbon Release Reduction Toolkit
- Good Practices – Breaking of Containment Golden Rules
- Good Practices – Breaking of Containment Checklist