

Bolting of Flanged Joints for Pressurised Systems

Introduction

1 The purpose of this notice is to highlight poor practice and to provide guidance on safe practice. Bolting associated with flanged joints for pressurised systems used on offshore installations requires correct assembly, tightening and inspection. This is essential to ensure the continued safe performance of these systems.

Background

2 There have recently been two major incidents on offshore installations of hydrocarbon release caused by the incorrect torque being applied to bolting while assembling flanged joints. The incidents involved:

- The failure of a 14-inch 1500lb rated ring-type flanged joint during service testing in a gas system; and
- The failure of a 10-inch 300lb rated raised-face weld-neck flanged joint during commissioning after replacement of a piping spool in an oil system.

3 These incidents are examples of failure in making up flange joints. This can be caused by:

(a) **The incorrect torque being applied to bolting during assembly**

Bolted flange connections involve two main types of application: the sealing type and the mechanical type. The mechanical type consists of a rigid clamp designed to prevent separation by breakage due to fatigue or by nuts shaken loose due to vibration. The sealing type requires the effect of the gasket to be taken into consideration. In both cases it is important to ensure that the correct bolt load is applied to produce an effective sealing connection. It is important that the procedure for making up flanged joints should include the required bolt loads for all the flange sizes and for all the pressure classes used on the installations.

(b) **Poor training**

Two methods are widely used in the offshore industry for tightening up the flange bolts to require bolt loads. Both have training and competence implications. They are:

i. Torque tightening

Torque tightening utilises the applied force to turn the nut, which reacts through the thread helix to elongate the bolt. The torque required to achieve the required bolt load will be affected by the following factors: nominal bolt diameter, bolt material grade, bolt lubrication, thread form, pitch and assembly conditions. Flogging and impacting are highly inaccurate and should not be used.

Controlled torque tightening requires the correct tightening sequence to ensure that the gasket is not damaged and that the most uniform bolt loads are achieved.

Torque tightening is a specialist skill. Only trained and competent personnel should undertake torque tightening, and they should use equipment which is correctly maintained and calibrated.

ii. Hydraulic bolt tensioning

Hydraulic bolt tensioning is the preferred method of bolt tightening. In this method, the bolt tensioners operate by hydraulically stretching the stud bolts to a predefined limit followed by the operator hand tightening the nuts to the flange face. The hydraulic load is transferred from the tensioner to the bolt by depressurising the tensioner.

Hydraulic bolt tensioning is a specialist skill. Only trained and competent personnel should carry out bolt tensioning, and they should use equipment which is correctly maintained and calibrated.

(c) **Poor supervision and verification**

Records of applied torque/bolt loads used in the bolting up of safety-critical flanged joints should be kept. The person responsible for making these joints should sign the records to acknowledge joint integrity in accordance with the company's procedure. It is also important that the duty holder procedures for making up flanged joints in safety-critical systems includes arrangements for independent verification of the suitability of bolted flanged joints.

Action Required

4 Owners of offshore installations should ensure that:

- a. there are clear instructions and procedures for making flange joints;
- b. correct tools with clear instructions on their proper use are available to personnel involved in making flanged joints;
- c. personnel involved in supervising and performing these activities are adequately trained and competent to work on this equipment;
- d. the verification scheme addresses the integrity of bolted flanged joints in safety-critical systems; and
- e. appropriate records are kept.

Relevant Legal Requirements

5 The main legal requirements are:

- The Provision and Use of Work Equipment Regulations 1998 (SI 1998/2306) (PUWER), Regulations 4 and 9
- The Offshore Installations (Prevention of Fire and Explosion and Emergency Response) Regulations 1995 (SI 1995/743) (PFEER), Regulation 9
- The Offshore Installations (Safety Case) Regulations 1992 (SI 1992/2885) (SCR), Regulations 15A-D.

Further Information

6 Any queries relating to this notice should be addressed to:

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This guidance is issued by the Health and Safety Executive. Following the guidance is not compulsory and you are free to take other action. But if you do follow the guidance you will normally be doing enough to comply with the law. Health and safety inspectors seek to secure compliance with the law and may refer to this guidance as illustrating good practice.