

## SPO Compact Flange performance in corrosive exposures

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### 1. Introduction

The SPO Compact flange has been designed with a view to creating a connection with an improved performance in corrosive exposures. The principle features of this design is a ring seal which is protected by a contact seal along the external and internal perimeter of the flange face. Normally ring seals are located on the bore of the connector or in a seal ring groove in direct communication with the conduit. The crevices formed between the ring seal and the groove collect debris, and segregated fluids such as water and easily become a site of corrosion or crevice corrosion.

In the case of the SPO Compact Flange the contact seals prevent ingress of moisture and oxygen as well as other corrosive agents, to the seal. Even in the event that these contact seals should accidentally suffer modest undetected damage such that the ring seal is exposed to pressure there still will not be any transport through the seals. Without any circulation of corrosive media to the flange face and the ring seal a corrosion process cannot be supported. This is a unique feature of the SPO Compact Flange.

### 2. Bolts

The SPO Compact Flanges use carbon steel bolts, also for stainless steel flanges. The nuts have a high bearing pressure on the flanges forming a seal preventing ingress along this path. SPO also recommends the use of Gleitmo 545 bolt lubricant. This product has been qualified as a seal and is used in this capacity for the threaded connectors of the tethers for the "Snorre" TLP. The SPO Compact Flange design ensures that the stressed length of the bolt is not exposed to a transport of agents that can sustain a corrosion process. This feature is also unique to the SPO compact flange.

When hydrogen sulphide is present in the piped product, a leakage of both the bore seal and the ring seal is an extremely low probability occurrence. In the extreme event that this should occur some build up of pressure could occur against the seal of the external perimeter. Hydrogen sulphide would only be present in the same concentration as in the piped product and only in an amount corresponding to the volume of the free annulus in the bolt hole. For B7 or L7 bolts subsea with cathodic protection there is no tendency to hydrogen embrittlement. With regard to corrosion the fact that there is no circulation applies also in this case such that this is not a concern in this case either. (To ensure that this process would not occur it would be sufficient and without consequence for the flange performance to introduce a minute discontinuity in the perimeter seal to ensure venting of the pressure. This is, however, not necessary.)

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### **3. Galvanic corrosion**

When interfacing carbon steel flanges with flanges in stainless steel it is industry practice to provide an Inconel welded overlay to the complete face of the carbon steel flange. In the case of the SPO Compact Flange a corrosion process will not be maintained on the mating face and there is no need to provide such an overlay. For critical applications where cathodic protection is not provided consideration may be given to provide a surface coating or an overlay weld to the external surface or the internal bore surface of the flange immediately adjacent to the mating face. At these locations somewhat accelerated corrosion rates may occur.

### **4. Seal rings and grooves**

The seal rings are, like the bolts, completely confined. For SPO Compact Flanges in carbon steel there is therefore no requirement to overlay weld the seal groove whatever the piped medium composition is. The ring itself may in principle be in any suitable quality, carbon or stainless steel, as galvanic corrosion is not of concern.

### **5. Crevice corrosion**

When interfacing some stainless steel qualities crevice corrosion may occur in locations where gaps of a critical width are maintained. In the case of the SPO Compact Flanges it will again apply that when ingress of corrosive agents is prevented a corrosion process cannot be supported. Thus crevice corrosion will not be a concern either.