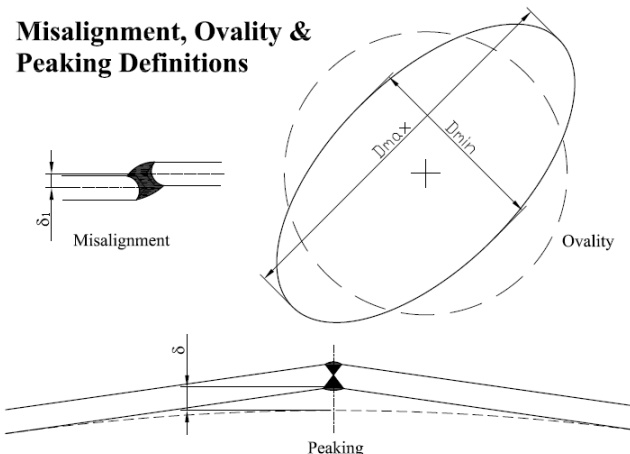


DEVIATIONS FROM DESIGN SHAPE

FCL's expertise in the design and assessment of pressurised equipment enables us to offer our clients far more than just a resource for the initial design of equipment. Where required, FCL can also provide support during manufacture when fabrication tolerances are inadvertently exceeded. An example of this involved the assessment of considerable deviations from the design shape in the form of misalignment, peaking and ovality identified during manufacture of the cylindrical shell of a vertical pressure vessel. The vessel was destined for service in an offshore facility located in the UK sector of the North Sea.

For vessels designed and constructed in accordance with PD5500 the limits on misalignment, ovality and peaking are given in the section of the Code which deals with manufacture and workmanship. When these limits are exceeded the significance of the deviations from the design shape must be assessed to ensure that the vessel remains suitable for its intended service conditions. It is a common misconception that this assessment has to be performed using linear elastic finite element methods. Methods exist within PD5500 to both calculate stresses attributable to the as-built geometry and to assess the significance of these stresses.

The presence of deviations from the design shape give rise to stresses that can lead to premature failure due to fatigue or incremental collapse, the latter defined as the accumulation of plastic strain leading to collapse as a consequence of repeated load application when the stress field is unable to shakedown to elastic behaviour. PD5500 provides the necessary methods of assessment and prescribes limits for stresses to ensure the safe operation of the vessel.



The deviations from the design shape for the particular vessel in question were significant and, without repair, the permitted design pressure would have needed to be reduced by some 33%. However, following a partial repair and the use of actual material properties, as permitted by PD5500 for the consideration of a local manufacturing deviation, it was shown that it was safe to operate the vessel at its original design pressure.

FCL's report provided our client, the equipment owner and the Notified Body with the necessary assurance that the vessel was safe to operate, thereby minimising delays in completing the construction of the unit. The project also provided another example of the way in which FCL's knowledge of potential failure mechanisms of pressurised equipment and their thorough understanding of the relevant pressure vessel design codes, were able to be applied to identify a cost effective and timely solution for the client which may have been missed by a less experienced eye.