





Jacking of flat bottomed storage tanks

| Health and Safety Executive - Safety Notice | |
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| Department Name: | HID Chemical Industries |
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| Target Audience: | Chemical processing and production ^[1] , Chemicals and downstream oil industries ^[2] , Construction ^[3] , Engineering ^[4] , Warehousing and storage ^[5] , United Kingdom Petroleum Industry Association (UKPIA)  ^[6] , Tank Storage Association (TSA)  ^[7] , Engineering Equipment and Materials Users Association (EEMUA)  ^[8] , Chemical Industries Association (CIA)  ^[9] . Those involved in flat bottomed storage tank design, construction, repair and use. |
| Key Issues: | This Notice deals with safety issues associated with the jacking of large flat bottomed cylindrical storage tanks. In a recent incident such a tank fell from its jacks. No-one was injured but subsequent investigation identified a lack of clear guidance aimed at such an operation and issues that could affect long term integrity of tank floors, as well as risks to people. |

Introduction:



A 54m storage tank slipped sideways on its jacks

An incident where a 54m storage tank slipped sideways on its jacks causing one side of the tank to land demonstrated the importance of proper planning and execution of tank jacking. This safety notice is aimed at operators and is intended to raise awareness of some of the issues to be considered when engaging contractors to undertake tank jacking operations. This will enable operators to demonstrate that reasonable care has been taken to ensure the competence of any third party undertaking such work. The UK Petroleum Industry Association, Tank Storage Association and EEMUA have contributed to this Safety Notice.

Background:

Tank and ground stability when jacked

It is important that the loads imposed on the jacks and the ground during any lifting operation are fully considered in planning the operation and designing the jacking arrangement. The

following key issues should be included within the assessment and jacking calculations where appropriate:-

- Tank survey e.g. weight of the tank, roundness, thickness, modifications
- Maximum horizontal wind loading taking into account local effects such as influence of other tanks, shape of bund wall, etc.
- Allowance for jack failure
- Possible strain of tank welds due to sagging between jacking points
- Allowable design code stresses in tank components not exceeded following attachment of jacks.
- Degradation of main tank components (e.g. annular ring section of tank bottom)
- Loss of structural stiffness if roofs/roof plates/wind girders/floors/annular plates are removed
- The need to brace the tank shell (e.g. at door sheets cut into tank), to retain structural stiffness
- The need to monitor the shell (e.g. dents, cracks in jack weld points, roundness, etc.)
- The ability of jacks to support any extra load exerted by bracing
- Assessment of ground conditions, e.g. are they firm and level, could they be undermined? Do they need additional temporary support plinths?
- Stability of temporary ground works at all times during planning process and whilst the tank is raised.
- Extended periods of tanks in jacked position, e.g. if lift planned for summer but extends into autumn, ensure design takes into account weather conditions for both seasons.
- The use of Finite Element analysis to demonstrate that anticipated loads will not lead to jack or weld failure.

Jacking with floor attached to shell

Jacking a tank with its floor and annular ring attached may subject the shell/annular ring and floor welds to excessive stress if the weight of the floor is not supported in some way. Where a tank is jacked with its floor and annular ring attached then it should be demonstrated that either:-

- The tank is designed to be lifted in one piece or,
- Stresses in floor welds will not exceed those allowed by tank design code or,
- Additional support arrangements are provided to ensure that stresses in floor welds will not exceed those allowed by tank design code.

Even where design codes allow lifting of the shell with the floor and annular plate intact, then the lift should be assessed for the potential for additional loads to be imposed, over and

above the floor weight (e.g. ground suction). This can lead to a need for further bracing in some cases, from an adequately assessed roof, shell or temporary structures.

Working under the tank floor

Work under the raised floor of a jacked tank requires exceptional scrutiny. Where temporary support structures are used to give protection in the case of catastrophic jack failure they should be properly designed and thoroughly assessed. Supports should be on firm ground, which is not liable to weakening e.g. by subsidence. Suitability of the ground support should be reviewed as necessary during the period the tank is raised, especially if it becomes necessary to excavate around support pads.

Action required:

When planning to carry out tank jacking operations, operators should use the information above in the demonstration that reasonable care has been taken to ensure the competence of tank jacking contractors.

Relevant legal documents:

- Health and Safety at Work etc. Act 1974
- Provision and Use of Work Equipment Regulations 1998
- Construction (Design and Management) Regulations 2007

Other relevant references:

- EEMUA 159 Appendix C 'Users guide to the inspection, maintenance and repair of above ground vertical cylindrical steel storage tanks'

Further information:

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General note:

Please pass this information to a colleague who may have this Product/ Equipment or operate this type of system/process.