

**Title:** Proper application of Internal Pressure for design liquid height

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**Purpose:** For tanks with small internal pressure conforming to Annex F, is it mandatory to consider the internal pressure as an additional equivalent liquid height when computing unrestrained radial growth and rotation of the shell using Annex P equations under P.2.5.1 and P.2.5.2?

**Source:** Inquiry–650-D113

**Revision:** 0

**Impact:** Cost impact of the proposed change will be neutral.

**Rationale: P.2.3 Nomenclature**

*H* is the maximum allowable tank filling height, in mm (in.);

*H* is used in Equations P.2.5.1 for calculating the Unrestrained Radial Growth of the tank shell as well as P.2.5.2 for Rotation of the Tank Shell. The definition for *H* in 2.3 does not provide reference for when the tank is designed for internal pressure to increase the height of the maximum filling height (Design Liquid Level). However, in Section F.2.1 below, when the internal pressure is greater than 1 kPa (4 in. of water), *H* shall be increased by the internal pressure in the form of meter or feet based upon whether metric or Standard Imperial Units are being used.

**F.2.1** In calculating shell thickness for Annex F tanks and when selecting shell manhole thicknesses in Table 5.3a and Table 5.3b and flush-type cleanout fitting thicknesses in Table 5.10a and Table 5.10b, *H* shall be increased by the quantity  $P/(9.8G)$  for SI units, or  $P/(12G)$  for USC units—where *H* is the design liquid height, in m (ft), *P* is the design pressure kPa (in. of water), and *G* is the design specific gravity. Design pressures less than 1 kPa (4 in. of water) do not need to be included.

The definition of *H* in P.2.3, should reference F.2.1 when the tank is designed for internal pressures. Also, F.2.1 should refer you to Annex P for calculations of Shell Growth and Rotation.

**P.3.2.4** Load cases shall include product and hydrostatic conditions at design liquid level. Loads on nozzles resulting from thermal movement of the tank shall be considered. Internal pressure shall be added as additional product head.

**Proposal** Rev 0 Changes shown in Red,

**P.2.3 Nomenclature**

*H* is the maximum allowable tank filling height, in mm (in.). See also F.2.1 for tanks designed with internal pressures greater than 1 kPa (4 in. of water).

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**P.3.2.4** Load cases shall include product and hydrostatic conditions at design liquid level ([See P.2.3](#)). Loads on nozzles resulting from thermal movement of the tank shall be considered. ~~Internal pressure shall be added as additional product head.~~

**F.2.1** In calculating shell thickness for Annex F tanks, ~~and~~ when selecting shell manhole thicknesses in Table 5.3a and Table 5.3b and flush-type cleanout fitting thicknesses in Table 5.10a and Table 5.10b, ~~and when performing Annex P nozzle calculations (specifically P.2.5.1 and P.2.5.2);~~ when calculating,  $H$  shall be increased by the quantity  $P/(9.8G)$  for SI units, or  $P/(12G)$  for USC units—where  $H$  is the design liquid height, in m (ft),  $P$  is the design pressure kPa (in. of water), and  $G$  is the design specific gravity. Design pressures less than 1 kPa (4 in. of water) do not need to be included.