PED compliance for equipments designed according to ASME

NextGen supports the calculation of pressure vessels and heat exchangers according to the American ASME standards in accordance with the European PED standard.
Online version: https://nextgen.sant-ambrogio.it/KB466984
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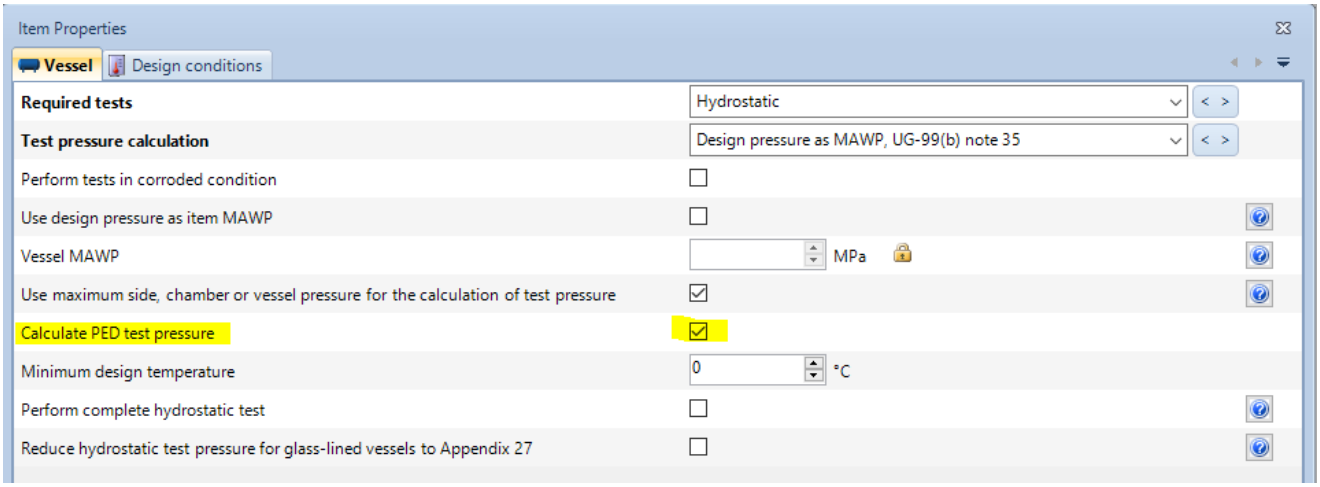
For some appliances designed according to the ASME code, in particular ASME VIII Div. 1, it is necessary to verify that these appliances comply with the safety criteria of the PED, the European pressure equipment directive.

NextGen supports this process in two key points:

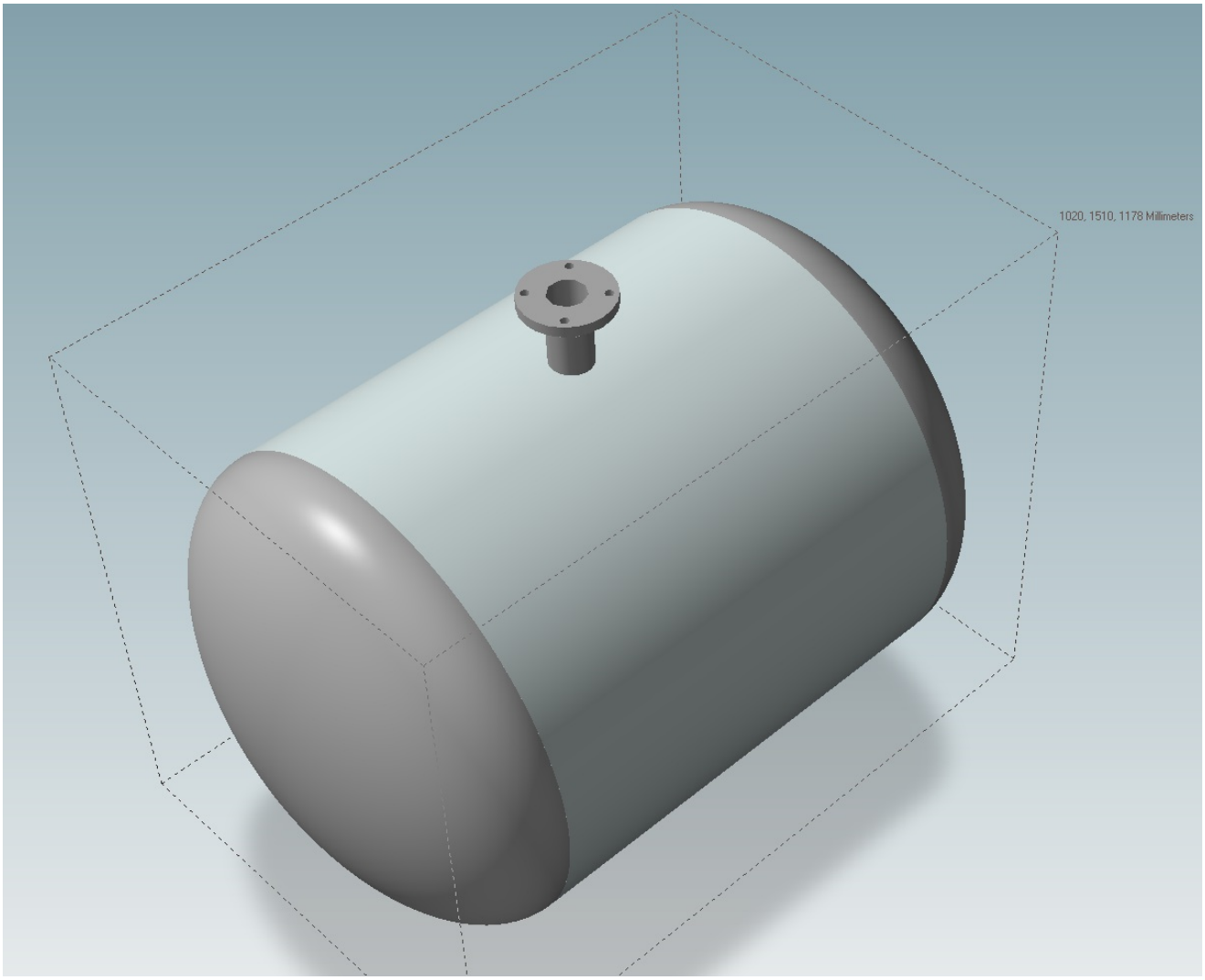
- Support in choosing the allowable in compatibility with the PED
- Calculation of hydraulic test pressure according to PED

Enabling PED compliance

The operation can be performed via a simple *flag* to be set in the Item properties, in the section relating to tests:



The demo item is composed of heads, main shell, nozzle and flange:



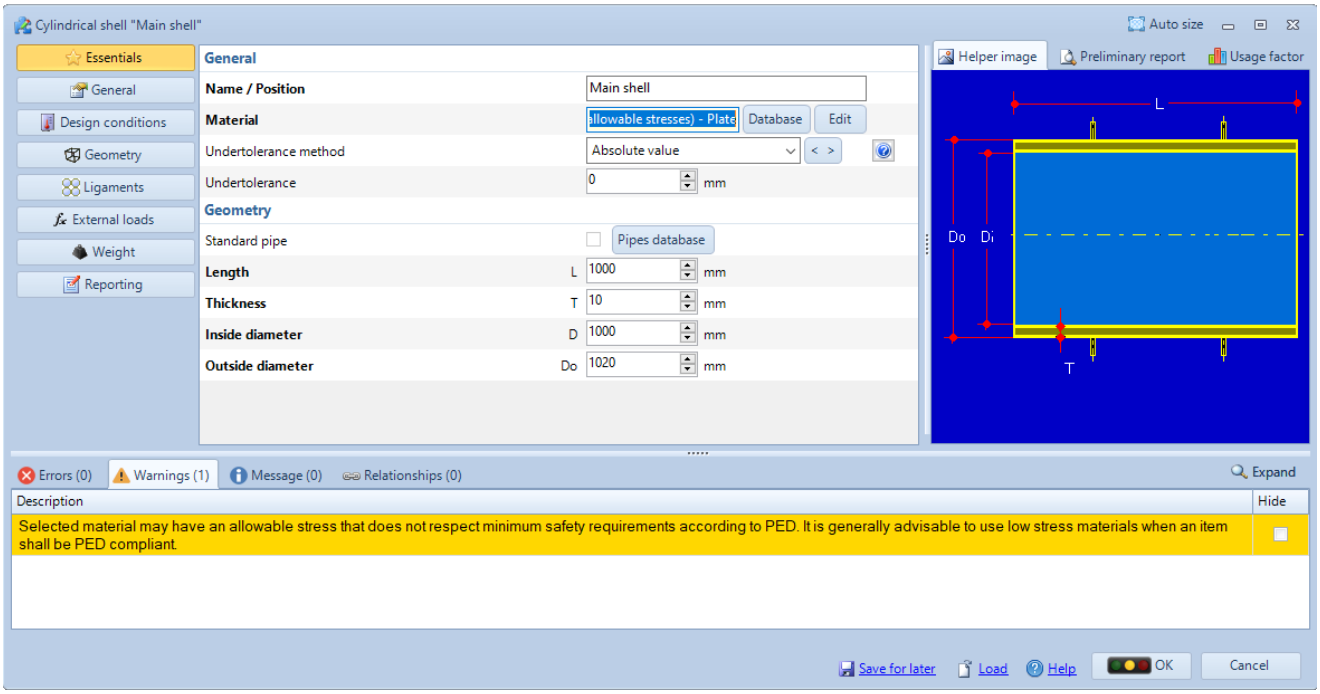
Choice of materials

For a 304L austenitic steel construction, not considering compatibility with PED, the choice would fall on the following:

Name	Material
Left head (Ellipsoidal head)	SA-240 304L (high allowable stresses)
Main shell (Cylindrical shell)	SA-240 304L (high allowable stresses)
N1 Nozzle (3" STD)	SA-312 TP304L (high allowable stresses)
N1 Flange (WN 3" 150)	SA-182 F304L (low allowable stresses)
Right head (Ellipsoidal head)	SA-240 304L (high allowable stresses)

The parts under pressure which in the event of deformation would not lead to the loss of fluid (sheets, pipes) would be sized considering the highest allowables according to note G5 of the material, while the flanges would use the reduced allowables.

However, NextGen will show the following warning on cylinders, heads and nozzle:



> *Selected material may have an allowable stress that does not respect minimum safety requirements according to PED. It is generally advisable to use low stress materials when an item shall be PED compliant.*

This happens due to the fact that austenitic steels in their "low allowable stress" version have an allowable calculated by ASME which is lower, therefore compliant, than the allowable according to PED. This is not the case for "high allowable stress" variants. It is therefore sufficient, to comply with the safety criteria, to use the "low allowable stress" variants for all the materials used.

> *The other types of steel, such as carbon steel, have an ASME admissible grade that is always lower than the PED admissible grade and therefore no particular precautions are necessary in that case.*

Calculation of hydraulic test pressure

In the calculation report, in the section relating to the calculation of the hydraulic test, two distinct summary tables will be shown: one for ASME and one for PED. The ASME table will also report the maximum value between the ASME and the PED as the calculated pressure.

Test pressure - Hydrostatic (MPa)

Component	*P*	*Static head (design)*	*Static head (test)*	*MAP N&C*	*MAWP H&C*	*Stress ratio*
Left head	1.00	0	0.01	2.30	1.44	1.591
Main shell	1.00	0	0.01	2.27	1.43	1.591
N1 Nozzle	1.00	0	0.002	1.71	1.07	1.591
N1 Flange	1.00	0	0.0007	1.59	1.00	1.591
Right head	1.00	0	0.01	2.30	1.44	1.591

All pressures in MPa.

Item design pressure P = 1.00 MPa
Item MAWP (Hot & Corroded conditions) = 1.00 MPa (limited by N1 Flange)
Item MAP (New & Cold conditions) = 1.59 MPa (limited by N1 Flange)
Item lowest stress ratio = 1.591 (limited by Left head)
Item test pressure according to UG-99(b) note 35 = Pt=max[Pt(ASME);Pt(PED)] = 2.07 MPa
Item maximum allowable test pressure = 2.21 MPa (limited by N1 Nozzle)

PED test pressure (MPa)

Component	*Design pressure*	*1.43·P*	*Stress ratio*	*1.25·Ratio·P*
Left head	1.00	1.43	1.591	1.99
Main shell	1.00	1.43	1.591	1.99
N1 Nozzle	1.00	1.43	1.591	1.99
N1 Flange	1.00	1.43	1.591	1.99
Right head	1.00	1.43	1.591	1.99

All pressures in MPa.

Item PED test pressure = Pt(PED) = max(1.43·P, 1.25·Item Lowest Stress Ratio·P) = 1.99 MPa