

Modeling Fixed Tubesheet Exchangers with PV Elite Webinar Questions & Answers. (held on April 15, 2010)

Please note the recorded version of this webinar can be accessed at our Insider Blog in the Webinar-Archives category: <http://coade.typepad.com/coadeinsider/>

Contents:

PV Elite - Heat Exchanger	1
PV Elite	5
General Questions	5

PV Elite - Heat Exchanger

Q: How does PVElite calculate MAWP and MAP for the complete assembly when you have a standard channel flanges?

A: For standard flanges their pressure rating is used to get the MAWP at design and the ambient temperatures. If it is a custom flange then that flange is analyzed per the appropriate design code. For the overall exchanger, the MAWP/MAP of each component is computed and the controlling value is shown in the output.

Q: How does PV Elite compute Tubesheet MAWP, how is related to hydrotest case?

A: Just to define the terms before the explanation,

MAWP – Maximum allowable working pressure in operating condition (temperature, corrosion considered).

MAP – Maximum allowable pressure in new and cold condition.

ASME does not provide a procedure to find the MAWP and MAP of the exchanger. There is no book reference that we know of. But, we have to run the calculations many times by setting the pressure to 0 on one side and then increasing the pressure on the other side such that the actual stress is just below the allowable stress. This is done for each qualification criteria for the heat exchanger.

It is important to note that these are not operating condition MAWPs. But, instead these MAWP/MAP represent the condition during a typical hydrotest, when there is pressure only one side (shell or channel).

The basic test of MAWP is to put it in the place of the design pressure, and then the calculation should still work out. For the operating MAWPs with shell side and channel side pressures acting at same time, you would have to perform the check yourself. In the future we can address this in PV Elite.

To compute the hydrotest pressure you have following options,

Pressure per UG99b = 1.3 * M.A.W.P. * Sa/S
Pressure per UG99b[34] = 1.3 * Design Pres * Sa/S
Pressure per UG99c = 1.3 * M.A.P. - Head(Hyd)
Pressure per UG100 = 1.1 * M.A.W.P. * Sa/S
Pressure per PED = 1.43 * MAWP

But, none of the ASME Sec. VIII codes tell us how to check the exchanger in the hydrotest condition. There are many failure criteria for different types of stresses, so the allowable would be different for them. There is some work going on in ASME regarding this and once it is incorporated in the code we can implement it in PV Elite.

If you really want to run a hydrotest case in PV Elite, you can add 1 more load case, put the hydrotest pressures, set temperatures to ambient, and then you have to compare the stresses to some higher allowables.

Q: Can you supply the guidelines for calculating the interface pressures Po and Pt values on the Blog?

A: The interface pressures account for the pressure at the interface of the outside of the tubes and inside of the tubesheet hole. Po is the interface pressure after the tube expansion process and Pt is the interface pressure during operation of the exchanger. These pressures are used in ASME App. A for expanded joints (ASME type l,j,k) to get the allowable tube-tubesheet joint load. ASME code indicates to use either analytical or experimental methods to establish them, but does not provide actual equations to use (as of current Addenda-09). We can share some reference that we have as a supporting document to this webinar.

Q: Clients normally require fabricators to indicate base shear and base moment due to wind and seismic loads. Can a future version of PVElite list these values at the end of the Saddle Analysis calculations?

A: Currently PV Elite provides the horizontal shear forces and vertical load acting on the saddle, you can multiply the shear force by the distance from Vessel center down to saddle base (dimension B in PV Elite) to get the moment at the base. The longitudinal load will not cause the overturning moment at the sliding saddle. The transfer shear load will cause overturning moment at both the saddles.

Q: Does the tubesheet calculation output a maximum operating temperature differential output?

A: Not at this time, but you can perform some trial runs the metal temperatures to find this out. If many users ask for it, we can investigate this.

Q: Does PV Elite calculate maximum reactions on a given nozzle based on the operating/design conditions of the vessel? If so, which standards does it use as a basis for these calculations?

A: I think you would have to model the piping attached to the nozzle in a pipe stress analysis program to find that out. Please clarify further if this does not answer your question.

Q: How to determine the mean metal temperature of tubesheet, tube and shell near the tubesheet rim?

A: Typically you may get that from process design software. But, if that is not available then use your engineering judgment, consult with an experienced engineer familiar with heat exchanger and use past operating data (if available).

Q: In tubesheet design menu, 8 load cases are shown. Why in report only 7 cases are printed?

A: ASME prescribes 7 load cases to perform, but if you have vacuum condition, an additional 8th load case is run by us with Shell and tube side vacuum pressures along with thermal loading. In our opinion, this case very rarely controls.

Q: Can PVElite evaluate the bolts in the flange?

A: Yes, as part of the flange design, the bolt stress is checked in the seating and in the operating conditions.

Q: How do we know if the design fails?

A: We plan to incorporate enhancements for more on-screen report of errors.

Q: When is better to use Simply Supported Fixed Tubesheet (UHX-13.9.1)

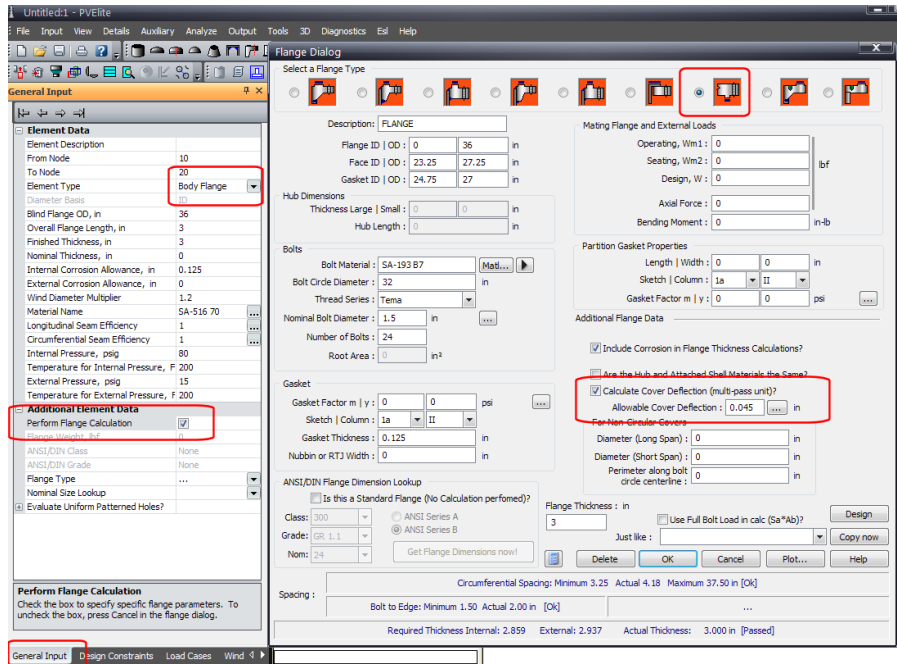
A: When the joint between the tubesheet and the integral shell or channel fails and the tubesheet passes. In that case, you can reduce the junction stress at the cost of higher tubesheet stress. Refer to the ASME UHX for all the requirements.

Q: Can you perform mechanical calculations for a bayonet type of heater

A: You can attach the tubesheet and tube bundle to a main element in PV Elite such as a shell course, flange or a head. But, if you have some other configuration, then you can always model just heat exchanger separately and in the main model, includes its weight and its projected area.

Q: How do I enter a TEMA channel cover (also check for deflection)

A: Click on the flange icon, click on the button to perform flange analysis, and then select the flange as a blind flange and then you can specify it as TEMA channel cover. Refer to the attached screen shot.



Q: How to check stress at tube to tubesheet joint?

A: Actually the tube stress is converted to an axial load which is applied to the tubesheet. The force at the tube-tubesheet joint is checked per ASME App. A, ASME UW-20 and appropriate sections in PD5500 codes.

Q: For a fixed TS, failure modes are both by pressure and thermal expansion forces. Does PV Elite assume the MMT does not change with a change in pressure?

A: PV Elite uses the mean metal temperatures (MMT) specified by the user for that case. But, when analyzing the pressure only cases the metal temperatures are set to ambient.

Q: Can I model hairpin exchangers with PV Elite?

A: No. You are limited to designs per various codes available in PV Elite.

Q: Can you design stacked exchangers?

A: Yes, you would have model that as 2 separate files in PV Elite. Then, transfer the load from the top to the bottom exchanger. After you model the top exchanger, include its weight using the “Miscellaneous Weight” button on the lower exchanger and give it exposed wind area and you can also offset it.

Q: Does PV Elite model hubbed tubesheets?

A: PV Elite performs analysis of tubesheets per ASME UHX, TEMA, PD-5500 and EN13445. You have to enter the dimension of tubesheet per these standards.

Q: Can PV Elite show recessed flange face instead of raised face flanges

A: The raised face or recessed face does not make a difference in the flange calculation as long as the appropriate face/groove dimensions have been specified. So, at this point PV Elite does not show this detail, but the calculation is correct.

PV Elite

Q: Is there anyway to keep the text between datum numbers and component names from overwriting each other.

A: Right click on the 3D view and click on Options then check the box 'Hide Overlapping Text'. Then press the 'Apply' button. You will have to restart PV Elite for this option to take effect.

Q: Does PV Elite have the capability to perform a rigging analysis and does it analyze the load on the attachments as it is lifted? Vertical – Horizontal

A: Yes it does. You can either model the lifting lugs on the vessel or just specify the lug locations on the Load Cases tab -> Installation | Miscellaneous Options.

General Questions

Q: Can we obtain the examples of this webinar? PV files?

A: Yes, we will provide them in a zip file along with these questions.