Visual Vessel Design

Product: Visual Vessel Design (VVD)

Version: 20 (20.00.00)

Date: January-2020

Description: Hexagon PPM® Visual Vessel Design is the industry leading pressure vessel, shell and tube exchanger, and boiler design and analysis solution. The software offers a strong emphasis on European codes and standards, including EN1591, EN13480, AD 2000 Merkblatt, EN13445, PD5500 and ASME Section VIII, Div. 1.

Sections:

System Requirements

Important: Beginning with Windows 10 and Oracle 12.1.0.2, Microsoft and Oracle will enforce the Internet Host Table Specification RFC 952 which mandates that component hostname labels can contain only alphanumeric characters. Hostnames using underscores ('_') are not allowed. Refer to Oracle Support Articles 1603775.1 and 1957895.1 and Microsoft KB 101785.

Operating System	Compatibility Information
Windows 7 Professional (32 & 64 bit) Windows 7/8/8.1 Ultimate (32 & 64 bit) Windows 7/8/8.1 Enterprise (32 & 64 bit) Windows 10 Pro (32 & 64 bit)	These operating systems are tested by Intergraph. Visual Vessel Design does not support Windows 7/8/8.1 Starter, Home Basic, and Home Premium. The software does not support Windows XP, Windows Vista and Home versions of Windows 7/8/8.1/10 (i.e., Starter, Home Basic, Home Premium).

Recommended System Requirements for Visual Vessel Design

Processor: 3.0 GHz Intel Pentium IV or higher AMD Athlon dual-core processor or higher
Memory: 8 GB RAM or higher (Windows 7/8/8.1) Display: 1280X1024 or higher, with True Color
Video Card: 256 MB or greater video RAM, Open GL 1.1 or later, DirectX 9.0 or later, drivers updated with the latest manufacturer's drivers (Motherboard-integrated video cards not recommended for desktop systems.)

Version Compatibility

For up-to-date information on the software compatibility of this product in a standalone or integrated environment, please refer to the Compatibility Matrix on the Hexagon PPM Support Web site at https://smartsupport.intergraph.com/.

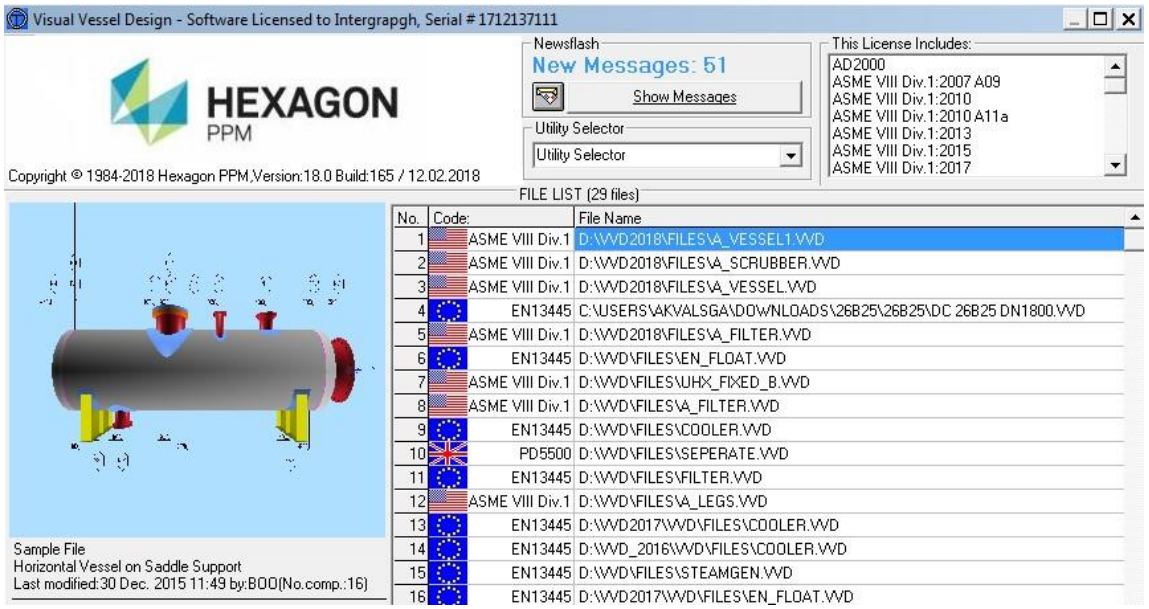
Log on and perform the following steps:

1. Click the **View Downloads** tab.
2. Click the **Product Compatibility** link under **Useful Links** on the right side.
3. On the **PPM Compatibility Matrix - Product Report** page, from the Select Product list, select **Visual Vessel Design**.
4. From the **Version** list, select the version of **Visual Vessel Design**.

   For information about authoring tool versions that work with a particular version of SmartPlant Foundation, select **SPFoundation** in step 3.

Special Instructions

Existing users should install this latest version in a different directory from any earlier existing version. Visual Vessel Design displays the version number and build date in the upper left corner of the main menu for your reference.



Documentation

General

Use the Help menu to access the Help files and Printable Guides for this product. For the latest support information for this product, connect to https://hexagonppm.com/ppm-support. Also, you can submit any documentation comments or suggestions you might have on the Hexagon PPM support site.

Printed documentation is not available for separate purchase.

PDF Files

The documentation is provided as .pdf files. You can use any PDF viewer to view the files.

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To register for training on Hexagon PPM products, call Training Registration at (800) 766-7701 in the U.S. Outside the U.S., call (256) 730-5400 or contact your local Hexagon PPM office.

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New Features in this Version

Version 20.0 includes a number of improvements and additions. This version is also in compliance with:

- ASME VIII Div.1: 2019 Edition - EN13445-3:2014/A8:2019
- EN13445-3:2014/A6:2019
- EN13445-2:2014/A2:2018
- EN13445-2:2014/A3:2018
- PD5500:2018+A2:2019
- AD2000:2019

The material libraries have been expanded and updated to be in compliance with the latest edition of the following material standards:

- ASME II Part D: 2019 Edition
- EN 10217-1:2019
- EN 10217-2:2019
- EN 10217-3:2019
- EN 10217-4:2019
- EN 10217-5:2019
- EN 10217-6:2019

The material and dimensional library for EN standard flanges has been updated to the latest edition of the standard EN 1092-1:2018.

MAWP and the maximum test pressure will now always be calculated for flanges designed to EN1591 and EN13445 Annex G, this was not done previously in case a warning message was triggered.

Enhanced the 3D drawing features.

Added a new option to check the flange rating combined with external loads to ASME VIII Div.1 UG-44(b).

Added a new option that allows the user to apply the user specified components for each individual load case, this increases the load flexibility analysis by enabling the user to analyze any combination of loads for all specified load cases.

8 APPLICATION MATRIX FOR USER SPECIFIED COMPONENTS

1-13	--ID--	--Description--	LC9 Hydrotest	LC4 Shut Down	LC5 Installation	LC1&2&3 Oper.Wind	Oper.Seismic
5	U.PL5	Platform	No	Yes	Yes	Yes	Yes
6	U.PL6	Platform	No	Yes	Yes	Yes	Yes
7	U.LD1	Ladder	No	Yes	Yes	Yes	Yes
8	U.LD4	Ladder	No	Yes	Yes	Yes	Yes
9	U.LD5	Ladder	Yes	Yes	Yes	Yes	Yes
10	U.LD6	Ladder	Yes	Yes	Yes	Yes	Yes
11	U.LD2	Ladder	No	Yes	Yes	Yes	Yes
12	U.LD3	Ladder	Yes	Yes	Yes	Yes	Yes
13	U.1	Demister Section(Empty & Test)	No	Yes	No	Yes	Yes

Included the new load cases as specified in Table 5.3.2.4-1in EN13445-3:2014/A8:2019 and updated all load weighing factors. The loads and load cases in Table 5.3.2.4-1 is the minimum to be taken into consideration if they are applicable. These load cases are now **applicable for both vertical and horizontal vessels**. The rules now also includes minimum loads to be considered for lifting loads (1.5*Gmax) and transportation loads (1.4*Gtrans sideward, 0.5*Gtrans upward and 0.8*Gtrans in driving direction).

Table 5.3.2.4-1 — Load combinations

Load Case	Types of load included	Load combination including weighting factors	Allowable tensile stress for shells	Allowable compressive stress for shells	Allowable tensile stress for anchor bolts	Explanations
LC0	P_i, G_{max}	P_i and G_{max}	f_d	$\sigma_{c,all}$	$f_{B,op}$	Operation with internal pressure
LC1	P_i, G_{max}, L, F, W	$0,9 \cdot P_i$ and G_{max} and L and F and $1,1 \cdot W$[b]	f_d	$\sigma_{c,all}$	$f_{B,op}$	Operation with internal pressure and wind
LC2	P_e, G_{max}, L, F, W	P_e and G_{max} and L and F and $1,1 \cdot W$	f_d	$\sigma_{c,all}$	$f_{B,op}$	Operation with external pressure and wind
LC3	G_{max}, L, F, W	G_{max} and L and F and $1,1 \cdot W$	f_d	$\sigma_{c,all}$	$f_{B,op}$	Operation without pressure but with wind
LC4	G_{corr}, W	G_{corr} and $1,1 \cdot W$	f_d	$\sigma_{c,all}$	$f_{B,op}$	Shut down (no pressure, contents and thermal reactions)
LC5	G_{min}, W	G_{min} and $0,7 \cdot W$	f_d	$\sigma_{c,all}$	$f_{B,op}$	Installation
LC6	P_i, G_{max}, L, E	$0,9 \cdot P_i$ and G_{max} and L and E	f_{exp}[c]	$\sigma_{c,all,test}$	$1,2 \cdot f_{B,op}$	Operation with internal pressure and earthquake
LC7	P_e, G_{max}, L, E	P_e and G_{max} and L and E	f_{exp}[c]	$\sigma_{c,all,test}$	$1,2 \cdot f_{B,op}$	Operation with external pressure and earthquake
LC8	G_{max}, L, E	G_{max} and L and E	f_{exp}[c]	$\sigma_{c,all,test}$	$1,2 \cdot f_{B,op}$	Operation without pressure but with earthquake
LC9	P_{test}, G_{max}, L_{test}, W	P_{test} and G_{max} and L_{test} and $0,6 \cdot W$	f_{test}	$\sigma_{c,all,test}$	$f_{B,op}$	Test with test pressure, test filling and wind
LC10	G_{max}	$\geq 1,5 * G_{max}$	f_{test}	$\sigma_{c,all,test}$	N/A	Lifting (Crane)
LC11	G_{trans}	[a]	f_{test}	$\sigma_{c,all,test}$	N/A	Transport

Added a new option to split the nozzle loads into ‘Mechanical+Thermal Loads’ and ‘Mechanical Loads Only’ according to the latest changes in section 16 in EN134453:2014/A8:2019. This will in most cases significantly relax the utilization and improve results.

Split Loads into Mechanical+Thermal and Mechanical Only

1-13	-- Load Description --	-ID	Units	Load Case 1	Load Case 2
1	Pressure	P	MPa	-0.1	0.42
2	Radial Load(Mechanical+Thermal)	Fz	kN	-7.5	7.5
3	Longitudinal Moment(Mechanical+Thermal)	My	kNm	-3	3
4	Circumferential Moment:(Mechanical+Thermal)	Mx	kNm	-2.5	2.5
5	Longitudinal Shear Force(Mechanical+Thermal)	Fl	kN	-7.5	7.5
6	Circumferential Shear Force(Mechanical+Thermal)	Fc	kN	-5.5	5.5
7	Torsional Moment(Mechanical+Thermal)	Mt	kNm	-3	3
8	Radial Load(Mechanical Only)	Fz		-6.75	6.75
9	Longitudinal Moment(Mechanical Only)	My	'C	-2.7	2.7
10	Circumferential Moment:(Mechanical Only)	Mx	'C	-2.25	2.25
11	Longitudinal Shear Force(Mechanical Only)	Fl	kN	-6.75	6.75
12	Circumferential Shear Force(Mechanical Only)	Fc	kN	-4.95	4.95
13	Torsional Moment(Mechanical Only)	Mt	kNm	-2.7	2.7

The nozzle loads can also be transformed from the flange face to the mid section of the applicable shell.

In EN13445:2014 Issue 5:2018+A5 the material reduction factor of 0.9 times nominal design stress has been removed for vessels designed to Test Group 4 (TG4).

Added Minimum Nozzle Standout tables to BASF E-S-MC 900, Table4.2.2-1, 4.2.2-2 and 4.2.2-3.

Added nozzle loads tables to API 660 Edition 9, 2015.

Added the new rules for vortex shedding to EN13445-3 section 22.10.

EN13445 Section 22.10.2 - Criteria for Vortex Shedding

The effect of vortex shedding need not be investigated when at least one of the following conditions is met:
h/Dc13 < 15, Vcr > 1.25*vm, 0.004*me/(ro*Dc13^2) > 0.8 for oper.cond and 1.1 for erection cond.

LOAD CASE	Dc13(mm)	me(kg/m)	Vm(m/s)	Vcr(m/s)	h/Dc13	0.004*me/(ro*Dc13^2)	Status
NO: 1 - LC9 HYDROTEST	2028.12	3891.50	39.62	4.55	24.68	2.97	OK
NO: 2 - LC4 SHUT DOWN	2028.12	662.50	39.62	10.59	24.68	0.5051	NOT OK
NO: 3 - LC5 INSTALLATION	2028.12	662.50	39.62	10.92	24.68	0.5051	NOT OK
NO: 4 - LC1&2&3 OPER.WIND	2028.12	3891.50	39.62	4.41	24.68	2.97	OK

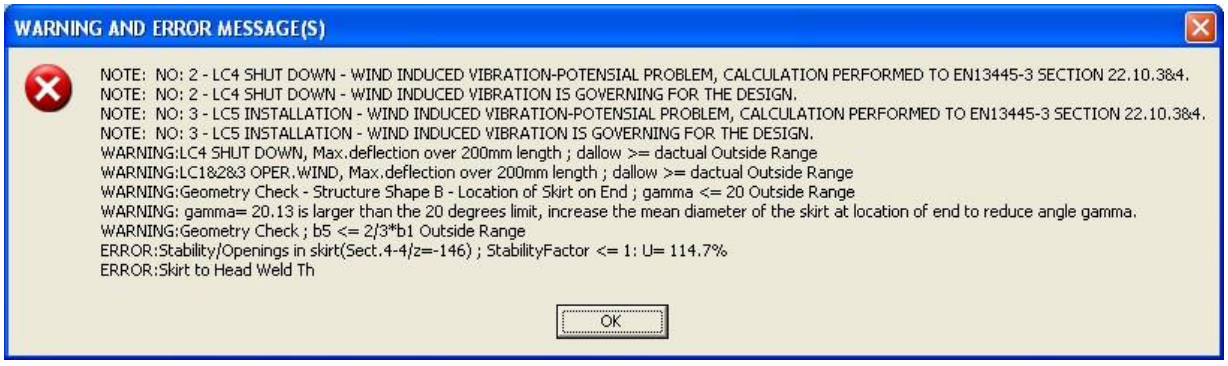
Nomenclature:
h = Total height above ground level =50.06 m
Dc13 = Average diameter(including insulation) of upper third of height of column.
me = Eqvivalent mass per unit length of the upper third of height of column.
vcrit = Critical wind velocity for mode 1.
vm = 10 minute mean wind velocity with a 0.02 annual risk of beeing exceeded at elevation 41.71 m above ground level.

Forces and moments due to vortex shedding are calculated to the new section 22.10.4.

22.10 Vortex Shedding - Forces and Moments

Load Case	Sc	K	Kw	clat	yF,max(mm)	Force(kN)	Moment(kNm)
LC9 Hydrotest	59.34	0.1300	0.6000	0.2000	16.45	6.89	258.55
LC4 Shut Down	3.03	0.1300	0.6000	0.2000	322.18	124.14	4660.55
LC5 Installation	3.03	0.1300	0.6000	0.2000	322.18	132.16	4961.49
LC1&2&3 Oper.Wind	59.34	0.1300	0.6000	0.2000	16.45	6.47	242.85

The governing loads are used in the analysis of the support and in the tall tower analysis.



Added new functionality so that all nozzle load cases are included in the report section, not only the load range as previous.

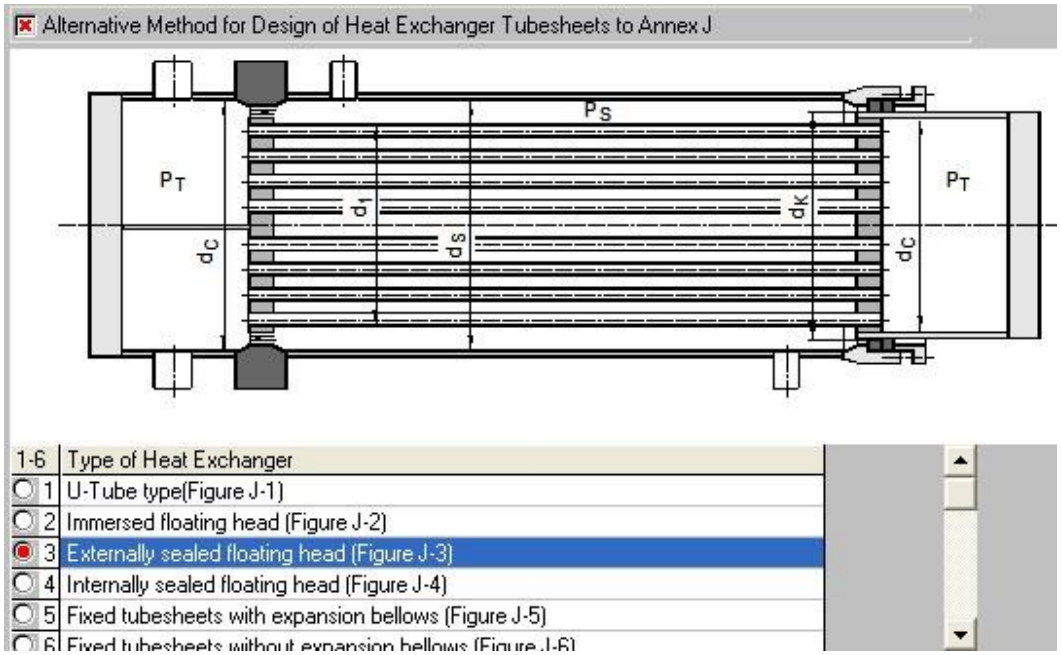
Nozzle Loads

ID	Load Desc.	Nozzle Loads
N.1*	Outlet Vap, Load Case 1	P=-0.1 MPa, Fz=-7.5 kN, My=-3.0 kNm, Mx=-2.5 kNm, Fl=-7.5 kN, Fc=-5.5 kN, Mt=-3.0 kNm,
N.1*	Outlet Vap, Load Case 2	P=0.420 MPa, Fz=7.5 kN, My=3.0 kNm, Mx=2.5 kNm, Fl=7.5 kN, Fc=5.5 kN, Mt=3.0 kNm,
N.A	Inlet, Load Case 1	P=-0.1 MPa, Fz=-2.5 kN, My=-0.29 kNm, Mx=-0.29 kNm, Fl=-2.5 kN, Fc=-1.9 kN, Mt=-3.0 kNm,
N.A	Inlet, Load Case 2	P=0.420 MPa, Fz=2.5 kN, My=0.290 kNm, Mx=0.290 kNm, Fl=2.5 kN, Fc=1.9 kN, Mt=3.0 kNm,
N.A	Inlet, Load Case 3	P=0.400 MPa, Fz=1.6 kN, My=1.0 kNm, Mx=0.960 kNm, Fl=-1.0 kN, Fc=1.4 kN, Mt=2.4 kNm,
N.B	Outlet Liq, Load Case 1	P=-0.1 MPa, Fz=-2.5 kN, My=-0.29 kNm, Mx=-0.29 kNm, Fl=-2.5 kN, Fc=-1.9 kN, Mt=-3.0 kNm,
N.B	Outlet Liq, Load Case 2	P=0.420 MPa, Fz=2.5 kN, My=0.290 kNm, Mx=0.290 kNm, Fl=2.5 kN, Fc=1.9 kN, Mt=3.0 kNm,
N.C	Outlet Vap, Load Case 1	P=-0.1 MPa, Fz=-7.5 kN, My=-3.0 kNm, Mx=-2.5 kNm, Fl=-7.5 kN, Fc=-5.5 kN, Mt=-3.0 kNm,
N.C	Outlet Vap, Load Case 2	P=0.420 MPa, Fz=7.5 kN, My=3.0 kNm, Mx=2.5 kNm, Fl=7.5 kN, Fc=5.5 kN, Mt=3.0 kNm,

The alternative method for design of tube sheets to EN13445 Annex J has been updated to EN 13445:2014/A6:2019.

Added additional checks to ensure that the values for different input parameters are within allowable ranges.

Corrected a problem for tubesheet design to EN13445-3 Annex J, the alternative method for design of heat exchanger tubesheets. The maximum allowable test pressure on shellside and tubeside are now picked up for from the input section. This method is however unable to determine the maximum test pressure automatically, so the user needs to enter the values for the applicable test pressure on shellside and tubeside manually in case the values shall be higher than given in the process cards.



Included the new method for calculating the permissible compressive stresses and check against longitudinal buckling to EN13445-3:2014/A8:2019.

Table 16.14–2 — Fabrication quality parameter Q

Fabrication tolerance quality class	Fabrication quality parameter Q
Class A (Excellent)	40
Class B (High)	25
Class C (Normal)	16

Table 16.14–5 — Maximum non-intended misalignment $U_{n,max}$

Fabrication tolerance quality class	Recommended value of $U_{n,max}$
Class A (Excellent)	0,14
Class B (High)	0,20
Class C (Normal)	0,30

When calculating the allowable compressive stress, VVD will assume by default that fabrication tolerance quality class is Class C (Normal), and use all associated design parameters.

Fixes

Corrected an issue for the AD2000 module related to selecting materials from the material library 'Other Standards/Steels', an incorrect error message could be shown and then locking the use of this selection.

Corrected an issue for nozzles located in bolted flat ends to ASME VIII Div.1. In some cases if the nozzle reinforcement was insufficient, an unexpected error could be generated and calculation terminated.

Corrected an issue for groups of openings located in flat ends to ASME VIII Div.1. The value for trmin from UG-39(d)(1) could in some cases be too high causing the results to become too conservative.

For EN1591/EN13445 Annex G, the weight of the blind flange could be incorrectly calculated when the flange thickness was different than the thickness of the central part.

Corrected an issue related to 3D drawing of slip on flanges, sometime an additional disk was shown at the back of the flange.

Corrected an issue related to bolting materials, in some cases the software could incorrectly notify the user that the applied material was not a bolting material.

Corrected an issue related to saddle design without a wrapper plate, an incorrect warning could be displayed related to parameter Delta2. This problem had no impact on results.

Corrected an issue for the AD2000 module related to 3D drawing of non-circular openings located in ends.

Corrected an issue related to calculation of required minimum test pressure for pipe system operating in the creep temperature region to EN13480.

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