FAQ

OhmTech A/S

Visual Vessel Design

Frequently Asked Questions

PART OF HEXAGON

INTERGRAPH®

Contents

1. About Intergraph®

Intergraph Process, Power & Marine (PP&M) is the leading global provider of engineering software for the design, construction, and operation of plants, ships, and offshore facilities. Intergraph PP&M is one of two divisions of Intergraph Corporation. Intergraph is part of Hexagon.

1.1. Who Uses Intergraph Software?

Nine out of ten of the world's major engineering firms and corporate owner operators use Intergraph products. They know our products are accepted as industry standards for design and engineering, so they are assured of proven solutions that are used and accepted worldwide by their peers. For more information, please visit www.intergraph.com/ppm.

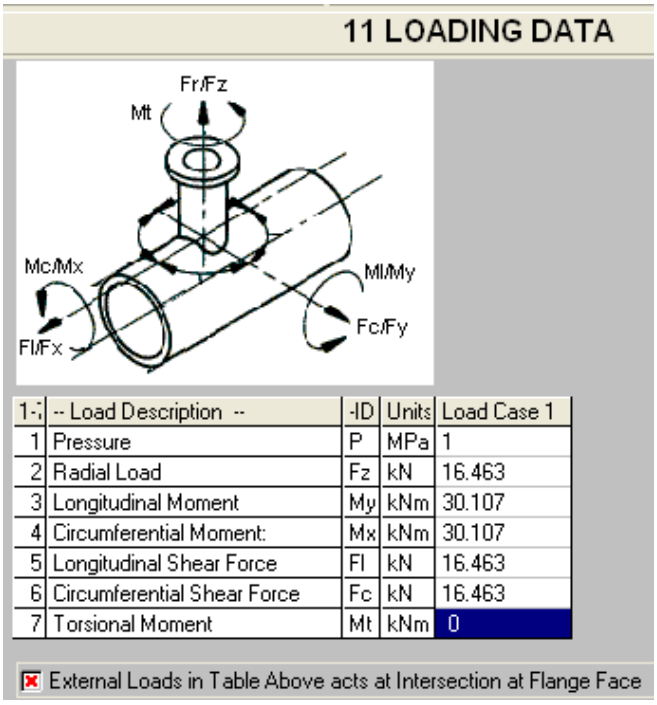
2. About Visual Vessel Design

Visual Vessel Design (VVD) is a graphical-based Microsoft® Windows® program for the calculation and design of pressure vessels, shell and tube heat exchangers, and boilers to different international and local design codes. It has been on the market for more than 30 years.

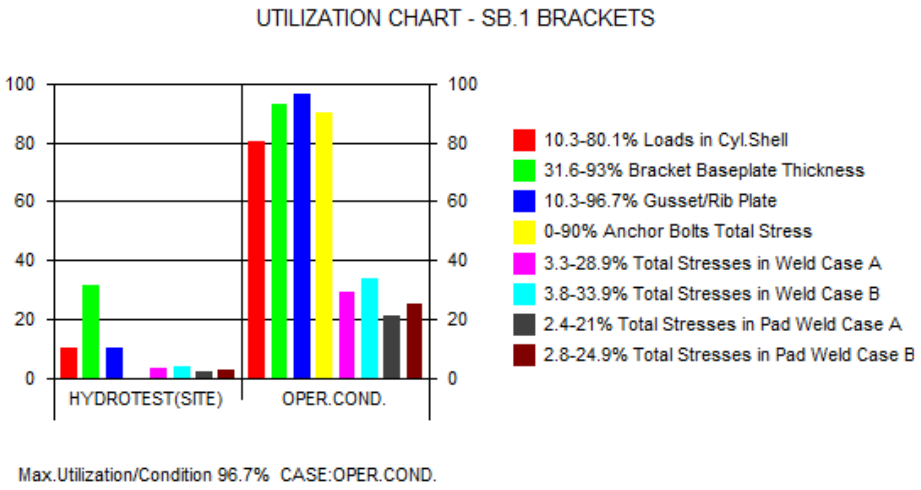
The software is in use by vessel fabricators, petroleum refiners, oil companies, engineering companies, various process companies, and a number of independent consultants. The VVD reference list includes more than 80 different notified bodies. A complete reference list is available upon request.
www.ohmtech.no

2.1. What Are the Main Benefits and Capabilities of Visual Vessel Design?

- 2D integrated vessel drafting utility.
- 3D drawing utility.
- Flexible input – The input section can be set up to display sketches and information to guide the user through the design process.
- Flexible Printouts can include all sketches, equations referenced to the standard, and values put into each equation. All intermediate calculation results can be included in the report, and the report can be stored in PDF file format.



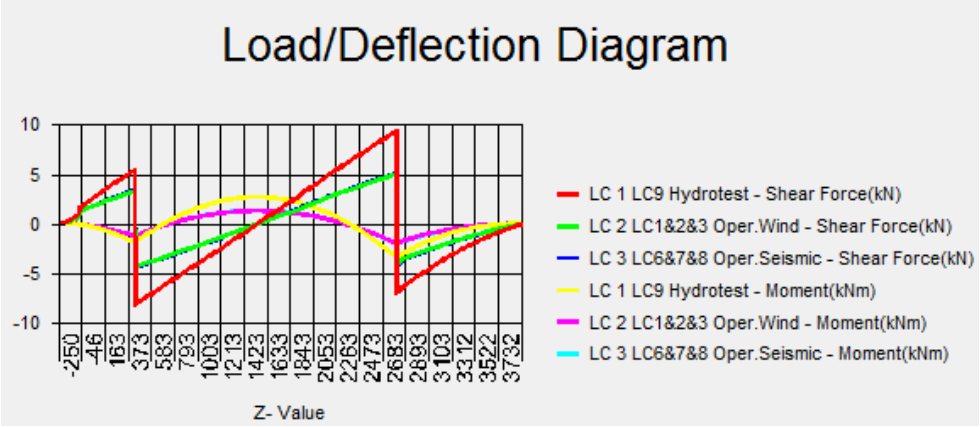
- Utilization Charts provide an instant overview of the calculation results.



- The Integrated Database includes more than 4,000 materials and dimensions for flanges, pipes, and bolts. With the Report Generator, the user may choose any of the following sections:
  - History of revisions
  - Design data and process information
  - Maximum allowable pressure calculations MAWP
  - Drawings
  - Weight and volume of vessel
  - Center of gravity
  - Test pressure
  - Warning and error messages
  - Nozzle list
  - Nozzle loads
  - Utilization charts
  - Material data/mechanical properties
  - Impact test requirements
  - NDT requirements
  - Surface area
  - Bill of material

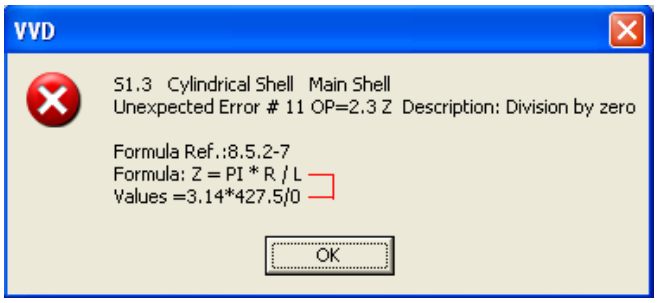
- External Loads Module – Calculates the loading on the support and the foundation loading for all load cases and for all types of support, including skirt, leg, bracket, and saddle support. External loads can include seismic loads, wind loads, dead loads, live loads on platforms, acceleration loads, nozzle loads, and blast/explosion loads.

The loads, shear forces, moments, and deflection can also be plotted alongside the length of the vessel. Below is a plot of shear forces and moments for a horizontal vessel supported on two saddles subjected to three different load cases.



- Tall Tower Analysis is used to determine the total stress level in each component along the axis of the vessel that is caused by a combination of internal/external pressure and external loads. This module also includes the requirements of the new section EN13445-3:2014 Section 22, Static Analysis of Tall Vertical Vessels. This new section provides all necessary design rules to perform a complete analysis of tall vertical vessels/columns (with the definition of columns as vessels with a total height $h < 10$ m and with a ratio of total height to outside diameter $h/d > 6.5$, and vessels with $h > 10$ m and with a ratio $h/d > 4$). This new section of the standard also gives the requirements for:
  - Dead loads
  - Live loads
  - Wind loads
  - Seismic loads
  - Loads from external piping at nozzles
  - Load cases
  - Load-weighing factors
  - Safety factor for anchor bolts
  - Recommended minimum torque for anchor bolts
  - Considerations for foundation loads
  - Detailed design of skirt base including base ring, gussets, chairs, and top ring
- VVD is backward-compatible with previous editions of the standards.
- VVD Code Assistant offers help on technical issues.
- Section-sensitive online help.
- Almost any type of vessel geometry can be accommodated, including tall towers, rectangular and spherical vessels, and multi-chamber jacketed vessels and shell and tube heat exchangers.

- Includes the alternative method for flange calculation to EN1591 and EN13445 Annex G, which can give significant savings compared with the Taylor Forge method. This method can accommodate almost any flange geometry and considers the effect of external loads, thermal expansion, and deflection of the flange.
- The EN13445 module includes the alternative method for tubesheet calculation to Annex J, which can give significant reduction in tubesheet thickness for fixed tubesheet designs.
- Includes a PED classification tool to determine the required category and applicable modules that can be applied for the vessel.
- Includes an advanced and flexible tube layout module.
- VVD is a multi-linguistic software and includes translation to 10 languages, including German, Finnish, Polish, Hungarian, Czech, French, Italian, Turkish, Bulgarian and Russian. The input can be created in one language and results/output produced in a different language.
- Includes a link via STEP files to export 3D solid models to other 3D CAD systems.
- The software includes an error handler which provides valuable feedback to the user with regard to the cause of the error/problem. Below is an example of a cylindrical shell subjected to external pressure. The value for the unsupported length L was incorrectly set to zero by the user. In this case, a division by zero is encountered for the calculation of parameter Z. A reference to the formula in the standard is provided. The formula along with the values are displayed so that the problem can easily be identified and corrected.



- The software has a long track record – the first license was sold in 1982.
- Extensive code checks:
  - Vessel Codes
    - EN 13445 – European Standard for Unfired Pressure Vessels
    - ASME VIII Div.1 for Rules for Construction of Pressure Vessels
    - PD 5500 – British Standard for Unfired Fusion Welded Pressure Vessels
    - AD 2000 – Merkblatt
    - TKN – Swedish Standard Tryckkärlsnormer
  - Others
    - EN1 591 – Alternative Design Rules for Flanges
    - EN 13480 – Metallic Industrial Piping

3. PV Elite® and VVD

3.1. Why is Intergraph Offering Two Vessel Analysis Programs?

The acquisition of OhmTech and its VVD software by Intergraph means that Intergraph can now offer a solution for our customers which meets the needs of a greater proportion of the user base. Though there is inevitably a degree of overlap, the strengths of each combine to create a formidable offering.

Intergraph wishes to address the needs of the vessel and exchanger analysis user community as fully as possible. Intergraph also wishes to grow its user base. Corporate acquisitions are a good way to do this. Therefore, Intergraph will be offering two vessel analysis programs.

3.2. Is VVD Compatible With PV Elite?

No. The programs are both intuitive to use and can be used independently. Check back with us from time to time for more information on product cross-compatibility.

3.3. Will VVD Replace PV Elite?

There are no plans to replace PV Elite with VVD. Our intention is to ensure that customers continue to benefit from the strengths of both products. Customer feedback will be important in shaping how the solutions evolve. Check back with us from time to time for more information on product cross-compatibility.

3.4. Will PV Elite Replace VVD?

There are no plans to replace VVD with PV Elite. Our intention is to ensure that customers continue to benefit from the strengths of both products. Customer feedback will be important in shaping how the solutions evolve.

3.5. Can I Upgrade My Copy of VVD to PV Elite?

Current VVD customers will be offered the opportunity to enhance their vessel/exchanger design capability by acquiring PV Elite at a preferential price. Please contact your local sales representative for details.

3.6. Can I Upgrade My Copy of PV Elite to VVD?

Current PV Elite customers will be offered the opportunity to enhance their vessel/exchanger design capability by acquiring VVD at a preferential price. Please contact your local sales representative for details.

3.7. Which Languages Do PV Elite and VVD Support?

PV Elite is available in the following languages:

- English
- French
- Italian
- Portuguese
- Spanish

VVD is localizable into multiple languages. Currently the product is available in the following languages:

- Bulgarian
- Czech
- English
- Finnish
- French
- German
- Hungarian
- Italian
- Polish
- Russian
- Turkish

VVD input can be performed in any selected language and the printout can be in a different language.

4. Hardware and Software Platform

4.1. What Are the Suggested Computer Requirements?

- Processor: 3.0 GHz Intel Pentium IV or higher AMD Athlon dual-core processor or higher
- Memory: 4 GB RAM or higher (Windows 7/8/8.1)
- Display: 1280x1024 or higher, with True Color
- Video Card: 256 MB or greater video RAM, OpenGL 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)

4.2. Remote Technologies

- Citrix XenApp 6.0 required on Windows Server 2008 R2 Enterprise

5. Evaluations and Demonstrations

5.1. Can I Try a Free Evaluation?

Yes, free, time-limited evaluations are available for both VVD and PV Elite to prospective customers to facilitate informed decisions. Please consult your local sales representative.

5.2. Can I Schedule an Online Demo?

Yes. Please consult your local sales representative.

5.3. Can My Local Reseller or Intergraph Sales Representative Give a Live Presentation?

Depending on your geographic location, your local sales representative will qualify your requirement and arrange a presentation accordingly.

6. Licensing

6.1. Can I Purchase or Lease VVD?

Yes. VVD is offered in both purchase and lease license options.

6.2. Which Software Security Systems Are Available?

VVD is immediately available using the ESL (or dongle) security system used by PV Elite. SmartPlant® License Manager (SPLM) will be made available later.

6.3. Are VVD Licenses Perpetual?

Not at this time.

6.4. Can Licenses Be Purchased for a Single User?

Yes. Single user standalone (individual PC) and network licenses may be purchased.

6.5. Can Multi-seat Licenses Be Purchased?

Yes. Single user standalone (individual PC) and network licenses may be purchased.

7. Support and Training

7.1. What Are the Benefits to Choosing Support?

VVD maintenance includes program updates and qualified technical support from the reseller and Intergraph. Customers will be given access to the Intergraph Smart Support portal, which also provides other benefits such as Knowledge Base, downloads, development requests, etc. Learn more at support.intergraph.com.

7.2. Does Intergraph Offer Local Support?

Yes. Support for VVD is offered globally and by region.

7.3. Do Local Resellers and Representatives Host Training?

Yes. Training for VVD is offered globally and by region.

7.4. Can Customers Receive In-house Training?

Yes. In-house training for VVD is offered to all customers globally.

8. Product Enhancements

8.1. Will VVD Continue to Be Updated and Maintained?

All users with current maintenance contracts have access to the latest updates. VVD will be updated and maintained. Customer feedback will be important in shaping how the solutions evolve. Check back with us from time to time for more information on product cross-compatibility.

9. Get Involved with Intergraph and VVD

9.1. Can Customers Submit Product Enhancement Requests Directly to Intergraph?

Yes. Everyone may submit product enhancement requests. Intergraph interacts with and listens to customers, then responds by developing new solutions and enhancing current products to address customers' needs in ways that improve their work processes. This customer-centric focus helps us to grow our product line to serve an ever broader base of users and applications, which in turn further increases opportunities for our clients to enjoy the benefits of interdisciplinary collaboration with other departments and organizations. Our portal, Intergraph Smart Support, also provides a platform for such requests.

9.2. How Are These Enhancement Requests Monitored?

Enhancement requests are evaluated and prioritized based on a given industry and market. Intergraph prioritizes requests based on the highest priorities of industry requirements.

9.3. How Can I Register to Beta Test VVD?

Every year, Intergraph looks for beta testers. If you are interested in participating, please email us at query.icas@intergraph.com or contact your local support team.

10. Online Resources

10.1. How Can I Connect with Intergraph on Social Networking?

Stay updated on the latest news from Intergraph through your favorite social networking sites:

- LinkedIn
  - Intergraph CADWorx & Analysis Solutions https://www.linkedin.com/company/113184
  - Intergraph CADWorx and Analysis Group https://www.linkedin.com/groups?gid=2475768
  - Intergraph PV Elite and TANK Group https://www.linkedin.com/groups?gid=6665174
- Insider Blog http://coade.typepad.com/coadeinsider/
- Facebook https://www.facebook.com/intergraphcas
- Twitter https://twitter.com/CADWorxAnalysis
- YouTube https://www.youtube.com/playlist?list=PL2431A59651C9FC3C

11. More Information

For more information about any of these topics, please email us at query.icas@intergraph.com.

12. Appendix

12.1. What Are the Detailed Descriptions of the Included Codes?

12.1.1. EN 13480 – Metallic Industrial Piping

Sections include:

Section	Description
6.1	Straight pipes
6.2	Pipe bends and elbows
6.3	Mitre bends
6.4	Reducers
6.6	Bolted flange connections

7.1	Dished ends
7.2	Circular flat ends
8	Openings and branch connections
9	Design of piping elements under external pressure (including stiffeners)

12.1.2. EN 1591 AND EN 13445 ANNEX G – Alternative Design Rules for Flanges

The new rules, known as the Alternative Method (EN 1591/EN 13445 Annex G), are based on a method used successfully in East Germany for many years. While most aspects of flange design were considered afresh by the authors of this method, the most notable features must be the use of limit analysis, the recognition that the bolt load has its own tolerance, the calculation of the way the bolt load changes as pressure (or other loads) are applied, and the detailed analysis of gasket behavior.

The Alternative Method is the only method for taking into account the leak tightness requirements. By using the Alternative Method and careful bolt tensioning, the design becomes more reliable and economical than by the more traditional Taylor Forge method.

Some advantages of using the Alternative Method include:

- Gives a more economical solution, in many cases
- Ensures a leak-free joint/leak tightness
- Allows the designer to analyze existing flanges to determine cause of slackness
- Includes effect of thermal expansion effects due to differences in bolt temperature and/or materials
- Determines the rotation/deformation of joint in all conditions
- Includes effect of external loading (moments and axial forces)
- Determines minimum required bolt torque based on selected bolting-up method
- The flange can be attached to a conical shell or a domed end, not only a cylinder
- Considers the non-linear elastic behavior of the gasket
- Considers the influence of the number of mounting cycles on the gasket
- The range of the allowable bolt forces for installation can be determined
- Determines the fluctuation of bolt force based on the bolting up method

Even though the method itself is quite complex, **the input and the use of the VVD software is quite simple**.

12.1.3. AD 2000 – Merkblatt

The AD 2000 module includes the following sections:

Section	Description
B1	Cylindrical and spherical shells under internal pressure
B2	Conical shells under internal and external pressure
B3	Dished ends under internal and external pressure
B5	Welded and bolted flat ends
B6	Cylindrical shells under external pressure (including stiffener rings)
B8	Flanges (EN1591)
B9	Openings and nozzles in cylindrical, conical, and spherical shells
B10	Thick-walled cylindrical shells under internal pressure
S1	Conical shells under internal pressure
S 3/1	Skirt support
S 3/2	Horizontal vessels on saddle support
S 3/4	Bracket and leg support for vertical vessels
S 3/5	Ring support for vertical vessels

12.1.4. ASME VIII DIV.1

- ASME VIII – American Standard for Construction of Pressure Vessels
- ASME VIII Div.1 Rules for Construction of Pressure Vessels

12.1.5. EN 13445

- EN 13445 – European Standard for Unfired Pressure Vessels

VVD includes the following sections of EN 13445:

Section	Description
6	Derivation of allowable stresses
7	**SHELLS UNDER INTERNAL PRESSURE**
7.4	Cylindrical and spherical shells
7.5	Dished ends
7.6	Cones and conical ends
7.7	Nozzles which encroach into the knuckle region
8	**SHELLS UNDER EXTERNAL PRESSURE**
8.5	Cylindrical shells (including design of light and heavy stiffener rings)
8.6	Conical shells
8.7	Spherical shells
8.8	Vessel ends (spherical, ellipsoidal, and torispherical ends)
9	**OPENINGS IN SHELLS**
9.5	Isolated and openings in shells
9.6	Multiple openings (groups of openings)
9.7	Openings close to a shell discontinuity
10	**FLAT ENDS**
10.4	Unpierced circular flat ends welded to cylindrical shells
10.5	Unpierced bolted circular flat ends
10.6	Pierced circular flat ends
10.7	Flat ends of non-circular or annular shape

11	**FLANGES**
11.5	Narrow face gasketed flanges
11.6	Full face flanges with soft ring type gasket
11.7	Seal welded flanges
11.8	Reverse narrow flanges
11.9	Reverse full face flanges
11.10	Full face flanges with metal to metal contact
12	**BOLTED DOMED ENDS**
12.5	Bolted domed ends with narrow face gaskets
12.6	Bolted domed ends with full face joints
13	**HEAT EXCHANGER TUBESHEETS**
13.4	U-tube tubesheets heat exchangers
13.5	Fixed tubesheets heat exchangers
13.6	Floating tubesheets heat exchangers
13.7	Ligament efficiency and effective elastic constants of tubesheets
13.8	Maximum permissible tube to tubesheet joint stress limit
13.9	Maximum permissible buckling stress limit of tubes
13.10	Design of tubesheets flange extensions
14	**EXPANSION BELLOWS**
14	Expansion bellows (also including fatigue evaluation)
15	**RECTANGULAR PRESSURE VESSELS**
16	**ADDITIONAL NON-PRESSURE LOADS**
16.4	Local loads on nozzles in spherical shells
16.5	Local loads on nozzles in cylindrical shells
16.6	Line loads

16.7	Lifting eyes
16.8	Horizontal vessels on saddle support
16.9	Horizontal vessels on ring support
16.10	Vertical vessels on bracket support
16.11	Vertical vessels with leg support
16.12	Vertical vessels with skirt support
16.13	Vertical vessels with ring support
16.14	Global loads, tall tower analysis including any combinations of external loads (wind, blast, seismic, internal and external pressure, weight, etc.)
17	**SIMPLIFIED ASSESSMENT OF FATIGUE LIFE**
17	Simplified assessment of fatigue life
18	**DETAILED ASSESSMENT OF FATIGUE LIFE**
18	Detailed assessment of fatigue life
19	**CREEP DESIGN**
20	**REINFORCED FLAT WALLS**
21	**STAYED FLAT WALLS**
22	**STATIC ANALYSIS OF TALL VERTICAL VESSELS ON SKIRTS**
	ANNEXES
Annex E	Procedure for calculating the departure from the true circle of cylinders and cones
Annex F	Allowable external pressure for vessels outside circularity tolerance
Annex G	Alternative design rules for flanges and gasketed flange connections
Annex H	Table H-1 gasket factors m and y
Annex I	Load cases of heat exchanger tubesheet design
Annex J	Alternative method for design of heat exchanger tubesheets
Annex M	In-service monitoring of vessels operating in fatigue or creep range

Annex O	Physical properties of steels
Annex S	Creep rupture strength
UG-27	Thickness of Shells Under Internal Pressure
UG-28	Thickness of Shells and Tubes Under External Pressure
UG-29	Stiffening Rings for Cylindrical Shells Under External Pressure
UG-30	Attachment of Stiffening Rings
UG-31	Tubes and Pipes. When Used as Tubes or Shells
UG-32	Formed Heads, and Sections, Pressure on Concave Side
UG-33	Formed Heads, and Sections, Pressure on Convex Side
UG-34	Unstayed Flat Heads and Covers
UG-35	Other Types of Closures
UG-36	Openings in Pressure Vessels
UG-37	Required for Openings in Shells and Formed Heads
UG-38	Flued Openings in Shells and Formed Heads
UG-39	Reinforcement Required for Openings in Flat Heads
UG-40	Limits of Reinforcement
UG-41	Strength of Reinforcement
UG-42	Reinforcement of Multiple Openings
UG-43	Methods of Attachment of Pipe and Nozzle Necks to Vessel Walls
UG-44	Flanges and Pipe Fittings
UG-45	Nozzle Neck Thickness
UG-46	Inspection Openings
UG-53	Ligaments
App.2	Rules for Bolted Flange Connections with Ring Type Gaskets
UG-98	Maximum Allowable Working Pressure

UG-99	Standard Hydrostatic Pressure
App.1-1	Thickness of Cylindrical And Spherical Shells
App.1-2	Thick Cylindrical Shells
App.1-3	Thick Spherical Shells
App.1-4	Formulas for the Design of Formed Heads Under Internal Pressure
App.1-5	Rules for Conical Reducer Sections and Conical Heads Under Internal Pressure
App.1-6	Spherically Dished Covers (Bolted Heads)
App.1-7	Large Openings in Cylindrical Shells
App.1-8	Rules for Reinforcement of Cone-To-Cylinder Junction Under External Pressure
Part UHX	Tubesheets (U-Tube, Fixed and Floating Head)
App.13	Vessels of Non-Circular Cross Sections
App.26	Expansion Bellows
UCS-66 UHA-51	Calculation of MDMT (Minimum Design Metal Temperature). All materials have been given a curve designation A, B, C, or D in Fig. UCS-66, and the reduction in MDMT is determined from Fig. UCS-66.1.
UW	Requirements in UW-16 included for design of Nozzle attachment weld, UW-20 for tube to tubesheet joints, etc.
	Vertical Vessels on Skirt Support Including External Loads (seismic, acceleration, wind, blast, etc.)
	Vertical Vessels on Bracket Support (seismic, acceleration, wind, blast, etc.)
	Vertical Vessels with Supporting Legs (seismic, acceleration, wind, blast, etc.)
	Vertical Vessels on Ring Support (seismic, acceleration, wind, blast, etc.)
	Tall Tower Design Analysis (seismic, acceleration, wind, blast, etc.)
	Horizontal Vessels on Saddle Support Including External Loads (seismic, acceleration, wind, blast, etc.)
	Horizontal Vessels on Ring Support (seismic, acceleration, wind, blast, etc.)
	Lifting LUGs, Including Rotational Lift from Horizontal to Vertical
	External Loads on Nozzles

3	Design
4	Fabrication
5	Inspection and Testing
6	Vessels and Pressure Parts Constructed from Spheroidal Graphite Cast Iron
7	Guidance on the Use of the Conformity Procedures
8	Additional Requirements for Pressure Vessels of Aluminium and Aluminium Alloys (Under Approval)

12.1.6. PD 5500

- PD 5500:2003 – Former British Standard BS5500
- PD 5500 – Unfired Fusion Welded Pressure Vessels

Section	Description
2.1-2.3	Material selection and determination of allowable stresses
3.4	Construction categories and design stresses
3.5.1	Cylindrical/spherical shells under internal pressure
3.5.2	Domed ends
3.5.3	Conical ends and truncated cones
3.5.4	Openings and branch connections
3.5.5	Flat ends and flat plates
3.5.6	Spherically domed and bolted ends of the form shown in fig. 3.5-36
3.6.2	Cylindrical shells under external pressure (including design of stiffeners)
3.6.3	Conical shells under external pressure
3.6.4	Spherical shells
3.6.5	Hemispherical ends
3.6.6	Torispherical ends

3.6.7	Ellipsoidal ends
3.6.8	Procedure by which the departure from the mean circle may be obtained
3.6.4	Spherical shells under external pressure
3.8.3	Narrow faced flanges
3.8.4	Full faced flanges with soft type gaskets
3.8.5	Ungasketed seal welded flanges
3.8.6	Reverse narrow face flanges
3.8.7	Reverse full face flanges
3.8.8	Full faced flanges with metal to metal contact
3.9.2	Characteristics of perforated plates
3.9.3	Tubesheets of exchangers with floating heads or U-tubes
3.9.4	Tubesheets of fixed tubesheet exchangers
3.9.5	Allowable shell and tube longitudinal stresses
3.9.6	Allowable tube joint end load
5.8.5	Standard test pressure
Annexes	B.2-B.3, F, G.2.2, G.2.3, G.2.5, G.3.2, G.3
Enq.Cas 5500/122	Local Loads on Nozzles

12.1.7. TKN

- TKN – Swedish Standard for Pressure Vessels
- TKN – Swedish code “Tryckkärlsnormer”

Section	Description
4	Material selection and determination of allowable stresses
5	Thin-walled spherical shells under internal pressure
6	Thin-walled spherical shells under external pressure
7	Thin-walled cylindrical shells under internal pressure
8	Cylindrical shells under external pressure
8.2	Stiffening rings
9	Thick-walled cylindrical shells under internal pressure
10	Unstayed domed ends under internal pressure
11	Unstayed domed ends under external pressure
12	Conical shells under internal pressure
15	Reinforcement of openings and branch connections
16	Strength factors
17	Bolts in flange connections
18	Flanges
19	Composite flanges
20	Flat internal covers
21	Bolted flat external covers
26	Flat heat exchanger tubesheets

For more information about Intergraph, visit our website at www.intergraph.com.