MICRO TECHNO

MT-VESS

Mechanical Design of Pressure Vessels

MT-MECH: mechanical codes at your fingertips

A complete suite of programs for mechanicals design in Chemical Engineering

- MT-EXCH shell & tube heat exchangers
- MT-VESS horizontal & vertical vessels
- MT-COMP exchangers & vessels components
- MT-LAYOUT tubesheet layout analysis

The program MT-VESS allows the mechanical design and the stability check of horizontal/vertical pressure vessels. Rating of existing pressure vessels is also allowed.

The following main functions are provided:

- Calculation of thicknesses and dimensions of all vessels components.
- Assembling and geometrical sizing of the vessel as a whole.
- Vessel stability check.

ALLOWED CODES

- ASME VIII division 1 (U.S.A.)
- AD-MERKBLATT (Germany)
- ISPESL-VSR (Italy)
- BS5500 (App. G) (U.K.) (Brackets)

ALLOWED COMPONENTS

The following components can be analyzed by the program, as individual components or assembled in a complete vessel configuration:

- Formed Heads (Spherical, Elliptical, Torispherical)
- Flat Heads (Welded, Flanged)
- Cylindrical Shells
- Conical Sections
- Main Flanges
- Nozzles (Radial, Inclined, Hillside)

ELEMENT TYPE

For allowing the maximum of freedom in defining a complex vessel, ensuring, at the same time, a complete consistency of the defined configuration, the following elements are taken into account by the program:

MAIN	Structural resistent elements
INTERMEDIATE	Elements to divide the vessel in different pressure chambers
APPENDIX	Elements with axis orthogonal to the main vessel axis
JACKET	Elements for heat exchanging with external fluids

SUPPORTS

The following supports can be analyzed and dimensioned:

- Saddles
- Brackets
- Legs
- Skirts

NOZZLES

Nozzle capabilities are as follows:

- Nominal diameters between 10 and 1.500 mm (3/8" to 60")
- Automatic material selection from pipe or plate
- Automatic verification of the nozzle hole and pad reinforcement calculation
- Nozzle welding analysis

INTERNALS

For allowing a more detailed weight definition the following internals can be specified:

- Demister
- Distillation Trays
- Packings
- Inerts
- Catalysts
- Liquid Distributors
- Coatings

ANALYSIS CAPABILITIES

MT-VESS is a powerfull, full featured program, that allows engineers, estimators, manifacturers to perform quick and accurate analysis on vessels components and/or on the entire vessel.

- Internal pressure calculation.
  All the vessel components are calculated to the internal conditions of design and hydraulic test. For each element the user can specify two different pressure and temperature conditions to be verified.
- Geometrical sizing of the vessel.
  The program provides for a comprehensive geometrical sizing including all the quotas, distances and dimensions of each component and of the vessel as a whole.
- Weight calculation.
  The program calculates all the weight of each component and in addition the weight of the vessel in operation, in hydraulic test, in erection.

- Check to the external pressure.
  The program automatically verifies the equipment for external pressure and, if necessary, installs stiffening rings, increases thickness or does both according to the user specifications.

- Stability check to the combined effects of forces and moments generated by the vessel weight, by the wind and earthquake loads, and by forces and moments specified by the user. The resultant forces and moments are applied to the supports for checking stability and calculating loads acting over the foundations. The wind and earthquake analysis can be carried out according to the following codes:

WIND	EARTHQUAKE
ANSI	ANSI 1982
ASCE 7-95	ASCE 7-95
BSI CP3	CNR 1986
CNR 1982	PARASISMIQUE PS92
CNR 1996	UBC 1988
NEIGE ET VENT	UBC 1994
UBC 1994	UBC 1997
UBC 1997	USER
USER	

- Supports positioning and stability checks

  Saddles — The check is carried on according to the method of Prof. Zick

  Brackets — The check is carried on according to the method of Prof. Bijlaard and B.S.5500

- Vibration Analysis

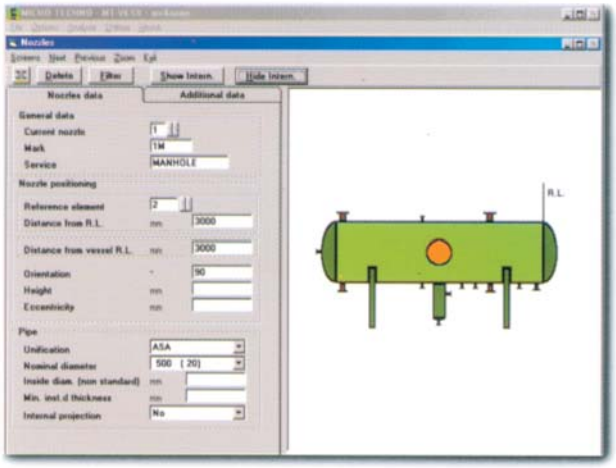
INPUT

The input for MT-VESS is very easy:

- The vessel is defined interactively adding one component after the other selecting them from the icons tabs in the command line. The vessel is automatically redrawn after each operation for checking the results.Other screens, operating in the same way allow for inserting other components (Support, Nozzles, Internals) until the vessel geometry is completely defined.

- The majority of the data are preset and the user simply selects from a list.

- When needed, drawing are associated to the input fields to make the selection even easier.



- Extended data banks, user customizable, are included in the program covering:

  - Materials
    Mechanical properties for over 350 materials (ASME and UNI, EUROMARK)

  - Nozzle (pipes and flanges)
    (ASA, UNI)

  - Gaskets
    Table include data for 80 gaskets (ASME/VSR and AD-MERKBLATT)

  - ASME charts for external pressure
    All the charts provided by the ASME are included

- Supports Standards

  - Saddles — For horizontal vessels
  - Brackets, Skirt, Legs — For vertical vessels

- All the data, common to a project, can be stored and shared by all the vessels belonging to the same project.

- Units measurement systems are completely free and customizable. The user can insert new units, define new unit systems or modify on the fly a single unit for a property

- Definition of materials classes avoids that the user needs to specify the materials for all the components of the vessel.

OUTPUT

The results of the vessels calculation consist of a tabular report and two or more vessel drawings.

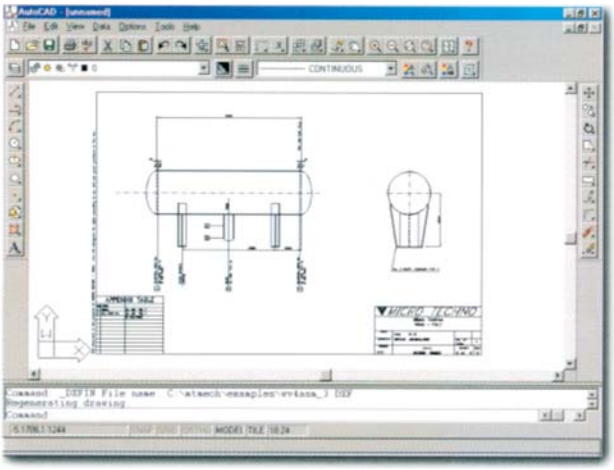
- **Tabular Report**
  All the data of the vessel are printed out including the results of numerical calculation and geometrical dimensions.

- **Bill of Material**
  All components belonging to the vessel under design are summarized in a table with dimensions, weights, number of items.

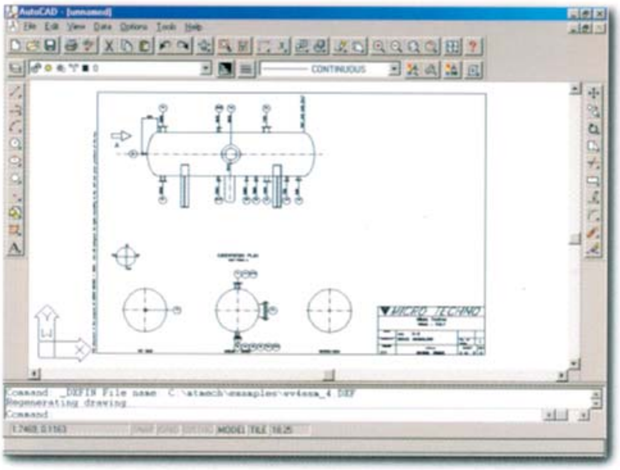
- **Drawings**
  Two or more sheets are automatically generated by the program, depending from the vessel complexity:

  - Tables related to:
    Design data, Loads on foundation, Materials, Nozzles, General notes, Flanges details, Flat flanged heads details, Revisions.

  - General view of the vessel
    The front and side view of the vessel is scaled in order to show the relative dimensions of the vessel components.



  - Nozzles and internals details
    This scaled drawing shows the nozzles, in both longitudinal and circumferential view, and internals details. For simple vessels this drawing and the previous one can be combined in only one.



- Appendices details
  If appendices are present, a sheet is generated by the program showing the appropriate details.

Drawing can be generated in English or in Italian language (Additional languages can be easily implemented).

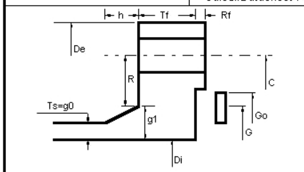
The measurement system units of the drawings is user definable.

The drawing is generated in DXF format and can be imported by the most common and diffused CAD programs (AUTOCAD, MICROSTATION etc.). This gives the user the further possibility to manage the drawing in order to modify or add details according to its own standards.

- **Audit Reports Book**
  For all the vessel components datasheets reporting formulas and substituitions are shown on the screen and can be printed or saved on a file.
  Datasheets can be produced in english or italian languages, selecting S.I. or English system of measurement units.

Micro Techno - Roma

Project: Testrun — Date: 11-09-2001
Item: ASMFLAN2 — Sh. 2 of 4
Calculation Code: ASME VIII - DIV.1 — Par. App.2-App.S
Calcul.Datasheet : Girth Flanges Testrun



Material
Shell: SA 387 GR11 CL1
Flange: SA 182 F11 CL2
Bolts: A 193 B16-A194 4
Lining: SA 240 304
Gasket: 4-6 cr free asbs jackete
Flange facing: FLAT-FLAT
Bolts series: ANSI B18.22

(Flange 1)

DESIGN CONDITIONS

Flange check
A = De - 2*Ce = 2233. g0c = g0 - Ci - Ce - Pli = 29. Sf = Tf - Ce - Cfg - Pfg = 141.
B = Di + 2*Ci + 2*Pli = 2006. g1c = g1 - Ci - Ce - Pli = 37. R = .5*(C - B) - g1c = 44.5

Forces and moments - internal pressure
Wop = MAX(Wm1 flange 1, Wm1 flange 2) = 8706058.
HD = .25*π*B^2*P =7748531. hd = R + .5*g1c = 63. MD = HD * hd = 488157500.
HG = Wop - H = 754185.7 hg = .5*(C - G) = 68.42 MG = HG * hg = 51604820.
HT = H - HD = 203341.7 ht = .5*(R + g1c + hg) = 74.96 MT = HT * ht = 15242960.
Mpi = MD + MG + MT = 555005200.

Forces and moments - bolts seating
Amx = MAX(Am flange 1, Am flange 2) = 50505.29 Wat = .5*(Amx + Ab)*fbo = 8896253.
Mat = Wat * hg = 608722200.

Forces and moments - external pressure
HE = .25*π*G^2*Pe =95422.47
HDE = .25*π*B^2*Pe =92982.38 hde = hd - hg = -5.42 MDE = HDE * hde = -504389.
HTE = HE - HDE = 2440.09 hte = ht - hg = 6.54 MTE = HTE * hte = 15953.
Mpe = MDE + MTE = -488436.

Corrected moments
MF0 = MAX(Mpi, Mat*fb/fbo, Mpe) = 608722200. MV0 = MAX(Mpi, Mat*fv/fvo, Mpe) = 608722200.

CF = 1.

MF = MF0 * CF / B = 303451. MV = MV0 * CF / B = 303451.

Calculation parameters
K = A/B = 1.113 ho = $(B*g0c)^{1/2}$ =241.193 h/ho = 0.199 g1c/g0c = 1.276
T = 1.872 from figure: ASME 2-7.1 U = 19.876 from figure: ASME 2-7.1 Y = 18.087 from figure: ASME 2-7.1
Z = 9.364 from figure: ASME 2-7.1 F = 0.899 from figure: ASME 2-7.2 V = 0.465 from figure: ASME 2-7.3
FC = 1.061 from figure: ASME 2-7.6 d = U*ho*$g0c^2$ / V =8674020.
e = F / ho = 0.00373 b = 1.33*Sf*e + 1 = 1.699 L = (Sf*e + 1)/T + Sf^3/d =1.138

Stresses
SHv = MV*FC / (L*$g1c^2$) =206.53 < 2.5*fv = 294.77
SH = MF*FC / (L*$g1c^2$) =206.53 < 1.5*ff = 206.85
SR = MF*b / (L*Sf^2) =22.78 < ff = 137.9
ST = MF*Y / Sf^2 - Z*SR =62.74 < ff = 137.9
0.5*(SH + SR) = 114.65 < ff = 137.9
0.5*(SH + ST) = 134.64 < ff = 137.9

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