## ENHANCEMENTS AND NEW FUNCTIONS IN CONVAL® 9

CONVAL® 9 is compatible to Microsoft Windows 7 and Windows 8 (32 and 64-bit).

### GENERAL, COMPREHENSIVE ENHANCEMENTS COMPARED TO CONVAL® 8

### OPERATION AND USER INTERFACE

Language support for English and German (further languages soon to come)

CONVAL® is now fully supporting Unicode. Text and comments can be typed in in any character set of any language, e.g. Asian, east European or symbol character sets.

We simplified the user interface by introducing a new file menu and revised toolbars.

An examples section is accessible through the new file menu, allowing you to quickly explore documented examples. This facilitates starting to use CONVAL® and exploring the enhanced features of CONVAL® 9.

Clear presentation of detailed calculation information by new "info views":

- Display of several different info views giving you various perspectives, depending on your interest in the special case.
- Info views contain help, error and information messages as well as hints and support finding a solution by traffic light color coding.

Visual navigation between info views and the calculation data:

- Info views containing drawings with dimensioning allow you to click a dimension to navigate to the corresponding data field in the calculation.
- Changing to a data field in the calculation related to a dimension in a drawing will mark the dimension there.
- Parameters, messages and help information navigate you to the corresponding data fields in the calculation.

The usability of dependency charts is improved:

- Active dependency charts will be displayed in list.
- Dependency charts are now assigned to and will be saved with a calculation.
- Dependency charts will automatically recalculated for printing
- There are extensible templates for popular dependency charts.

### LICENSING

There are more flexible licensing options using Sentinel HASP from Safenet. Existing Hardlock license modules of CONVAL®8 are still supported and can be used after an update from earlier CONVAL® versions.

### FLUID PROPERTY CALCULATION

Improved calculation of the isentropic exponent for those gases from the database, which are not based on thermodynamic equations of state.

Mixtures compositions off any substances in the database can be defined. The property calculation is based on approximation methods.

Calculation of gas mixtures:

Any for CONVAL® 9 relevant mixture properties can be calculated (assuming sufficient data for all components)

Calculation of liquid mixtures:

Mainly the mixture density will be calculated. An estimation of the lowest vapor pressure will be given.

For liquids, aside of the mass flow and volume flow at operating conditions, you can also enter volume flow at standard conditions can be entered.

## NEW CALCULATION MODULES

### RUPTURE DISCS

Sizing and calculation of rupture discs according to the flow resistance method and the coefficient of discharge method.

Calculation of the maximum allowable working pressure in consideration of the maximum working pressure, manufacturer range, burst tolerance, backpressure and maximum pressure operating ratio.

Rough estimate of the temperature dependency of the burst pressure.

Sizing and calculation is done according to the following standards:

- AD 2000-Merkblatt A1

- ISO 4126-1:2004

- API 520:2008

- ASME:2004 Section VIII

Rupture discs can be selected form a manufacturer database, filtered by size, conditions, temperature and pressure limits.

### THERMOWELLS

Sizing and selection according to the following standards:

- ASME PTC 19.3 2010

- ASME PTC 19.3 1974

### LEVEL TRANSMITTER CALIBRATION

Calculation of the differential pressure and the output signal at the transmitter for any level.

Option to simulate the startup of a boiler.

## ENHANCEMENTS IN VARIOUS MODULES

### CONTROL VALVES

Introduction of the Key Performance Indicator "Ri".  It's the base of an expert system with detailed alarms, warnings and hints in order to improve the overall reliability of a valve solution for liquid, gas and steam applications.

Here we check and predict the possible impact on the valve reliability caused by the combination of multiple influencing factors, such as cavitation, flashing, flow velocity, noise level, differential pressure, energy conversion, corrosion, abrasion… and more.

Enhanced calculation of valves by allowing a more detailed specification and use size and type specific valve recovery factors (FL, xFz, XT, Fd).

Enhanced usability and comfort allowing either the input of $p_2$ or $\Delta p$.

Implementation of noise prediction for multistage trims according to IEC 60534-8-3:2010

Improved noise prediction for downstream resistance structures (Silencer, Multihole baffles) by a modified calculation according to IEC 60534-8-3 respectively IEC 60534-8-4.

## CONTROL VALVE DATABASE

Update of several type series in the manufacturer database for various vendors.

Assessment of additional parameters for a more detailed calculation, analysis and prediction of the reliability index ("Ri").

## DIFFERENTIAL PRESSURE FLOW ELEMENTS

Additional standards supported by the module:

- AGA 3 / API MPMS 14.3-2003
- ASME PTC 19.5-2004

Sizing and indication of the dimensions for venturi tubes.

Enhance calculation for rectangular venturi nozzles and venturi tubes.

## ORIFICE PLATES

Enhanced noise prediction for restriction orifice plates by the adapted calculation according to IEC 60534-8-3 respectively IEC 60534-8-4.

## PRESSURE RELIEF VALVES

Fire case calculation for the subsequent flow according to API 521.

The calculation of an upstream rupture disc is provided.

Aside of the option to select relief valves out of a database with manufacturer devices, there is now an option to select relief valves according to API 526.

Pressure rating for the flanges of the relief valves according to:

- EN 1092-1:2007
- ASME B16.5-2009
- API 526

Enhanced filtering in the relief valve database for easier relief valve section.

## IMPORVEMENTS AND NEW FUNCTION IN CONVAL® 8

## GENERAL, NON-MODULE-SPECIFIC IMPROVEMENT

### INTERFACE

The Export of calculation was improved and simplified.

With gases at standard conditions besides molar mass, standard density and specific gas constant the specific gravity can be given.

In the substance selection dialog the aliases of the selected fluid can be shown.

New pressure unit *kgf/cm²* and for liquid density *specific weight*.

Graphics exports as wmf, bmp, jpg and pdf files.

An auto-save function allows recovering calculations after an abnormal program termination of CONVAL.

The performance of the dependency graphs was optimized for multi-processor systems and multi kernel processors.

In the dependency graphs a history list and incremental parameter search was introduced.

When changing the pipe class from metric to ANSI and vice versa the nominal size and pressure class was converted.

### SUBSTANCES

Improved density calculation of liquids from the substance database.

The calculation of mixtures according to new **GERG2004 XT08** in the liquid phase, in the gaseous phase, or for two-phase systems. Apart from an improved computing speed and stability the GERG2004 was expanded with further components.

For many fluids the specific isobar heat capacity was added, which allows to calculate the density at two-phase conditions.

### MATERIALS

The material database was enhanced by some plastics.

For many materials new data for thermal conductivity, density, and elasticity modulus were added.

The pipe database was enhanced by large ANSI pipe sizes.

### COM-SERVER

The COM-server has a new function for showing and hiding detailed values (+/- view).

A new interface IConcentration for access to substance compositions is available (further information in COM server documentation).

A new interface ICVCharacteristics for better control over the characteristics graphics is available. Features include reading parameters (ruler values) in dependence on stroke or flow (further information in COM server documentation).

## MODULE-SPECIFIC IMPROVEMENTS

### CONTROL VALVES

The most important innovations are:

Improved user interface for entering up to three operating points.

Analysis of the controllability using the characteristics to optimize the dynamic control and to find the optimal tuning point for positioners.

Better Cv100 suggestion taking into account the plant system.

Standard values for double and triple eccentric butterfly valves.

Prediction of the aerodynamic noise level according to **IEC 60543-8-3:2008 (Draft)**

The noise prediction for gases and steams is done now according to the updated **IEC 60534-8-3 (2010-11**) by default.

Restricted stroke or angle for control valves (reduced Cv100).

Export to an English or German data sheet (Excel) according to **IEC 60543-7**.

New in the database: Fisher GX series.

Help system for operating characteristics.

### DIFFERENTIAL PRESSURE FLOW ELEMENTS

The following differential pressure flow elements and calculation standards are supported by CONVAL 8:

**ISO 5167** for corner orifice plates, D and D/2 orifice plates, flange orifice plates, ISA 1932 nozzles, long-radius nozzles, Venturi tubes und Venturi nozzles.

**ISO/TR 15377** for quarter circle nozzles, conical entrance orifice plates, eccentric orifice plates, and orifice plates with drain holes.

**ISO 9300** for critical flow Venturi nozzles

**VDI/VDE 2041** for segmental orifice plates and quarter circle nozzles

**ASME MFC-7M** for corner orifice plates, D and D/2 orifice plates, flange orifice plates, ISA 1932 nozzles, long-radius nozzles, Venturi tubes und Venturi nozzles.

**ASME PTC 6** for ASME PTC 6 nozzles

**Pitot tubes** with selection of a manufacturer database

Special differential pressure flow elements Rosemount 405 C, Rosemount 405 P, and Rosemount 1595

Orifice with **2.5D and 8D pressure taps** according to R. W. Miller, "Flow Measurement Engineering Handbook", Third Edition.

Unspecified non-standard orifice flow meters

### RESTRICTION ORIFICE PLATE

Orifice plates with drain holes can be calculated.

The range of validity had been enhanced to $\beta > 0.75$.

Flow velocities are calculated.

## TANK DEPRESSURIZATION

Different noise prediction standards can be selected.

## SAFETY RELIEF VALVES

CONVAL 8 calculates the rated mass flow for safety valves according to:

**AD Specification A2**
**ISO 4126-1:2004**
**API 520:2008**
**ASME:2004 Section VIII**

The calculation of two-phase systems including flashing liquids is according to the Omega Method in API 520:2008

The calculation of the built-up back pressure of the discharge pipe with up to four pipe extensions and the pressure loss of the feeding pipe according to **ISO 4126-9:2008**.

The calculation of reaction forces and the noise level for gases according to **ISO 4126:9-2008**.

Standard valves according to API 526 (2009-04) were added to the database.

## IMPORVEMENTS AND NEW FUNCTION IN CONVAL® 7

### GENERAL, NON-MODULE-SPECIFIC IMPROVEMENT

#### COM SERVER

"StayAlive" and "RestartServerCalls" properties have been added to the IConval7 interface. They control the behaviour of the COM server if it is automatically started by creating an instance. Please refer to the documentation for more information.

The options for setting and reading simple switch states have been extended.

#### THERMODYNAMIC 2 MODULE (OPTIONAL)

The Thermodynamic module enables the user to calculate and plot thermo-physical properties of selected substances in the fluid phase. The properties are calculated by the most accurate equations of state that are accepted as international standard in some cases. Transport properties are calculated by the best equations that have been published. The equations used can also be extrapolated over the range of validity of the corresponding equations, whereas no more conclusions on the uncertainty of the equations can be made.

By providing an arbitrary combination of the properties temperature T, pressure p, density r, specific entropy s, specific enthalpy h, or steam quality x as input values, the module is able to calculate a couple of thermo-physical properties depending on the input values.

Iso lines of the properties temperature T, pressure p, density $\rho$, specific enthalpy h, specific entropy s, and steam quality x can be calculated and printed as tables. Along these iso lines, all available thermo-physical properties of the module can be calculated. Depending on the fluid up to 35 different diagrams can be created.

#### FLUID MIXTURES ACCORDING TO GERG-2004 (OPTIONAL)

The GERG-2004 equation is valid in the gas phase, in the liquid phase, in the supercritical region and for the vapour-liquid equilibrium (VLE). Calculation of thermodynamic properties of natural gases, other multi-component mixtures and binary mixtures can be performed and (pv-t)-diagrams of the mixtures can be plotted. The mixture computation is integrated in all CONVAL modules as e.g. in the control valve calculation.

#### EXPORT

For each calculation module specific export templates were provided for the export of several computations into an overview list.

PDF documents generated by CONVAL can be protected alternatively from subsequent changes. There is a compatibility mode for older Acrobat versions.

### MODULE-SPECIFIC IMPROVEMENTS

#### CONTROL VALVE CALCULATION

User interface is more clearly structured and configurable with full view and overview options.

Improved control valve database with additional information, such as maximum flow velocities and a Kc valve modifier for the onset of choked flow in liquids.

Installed flow characteristics and valve modifier functions can be directly entered in the calculation without having to go through the valve database.

Valves can be specified more precisely by indicating the valve type and the throttling element.

Different nominal diameters are supported in the inlet and outlet, and you can optionally enter the nominal pressure rating of the valve.

Standard valves are mapped more precisely thanks to a comprehensive library of valve modifiers for $FL^2$, Kc, xFz, Fd, and XT as a function of the:

- Valve type

- Throttling element

- Inflow of the throttling element

- Discharge coefficient kv100

- Valve workload kv/kv100

Expert system with new alarms, warnings and hints, including a new Kc valve modifier for the onset of choked flow:

- Danger of mechanical damage due to excessive flow velocity (depending on the state of flow and the valve type).

- Danger of mechanical damage due to cavitation if a critical differential pressure is exceeded (depending on the valve type and the trim).

- Danger of icing with natural gas and humid gases, depending on the temperature in the vena contracta.

- Hint about armouring if gases and vapours are close to the boiling point.

Improved noise prediction for liquids because the xFz valve modifier is calculated more precisely as a function of the valve type in accordance with the latest edition of the IEC 60534-8-4 draft standard.

Cavitation prediction according to ISA-RP75.23. Minimum values for the manufacturers recommended cavitation index come from the control valve data base.

For globe valves with multi hole plugs the valve style modifier can be computed by the number of flow passages.

Improved calculation of downstream resistance structures:

- Calculation of the design features for each perforated plate.

- Graphical optimization to determine the optimum inter-stage pressure and flow resistance coefficient.

Easier entry of additional operating points, e.g. with the help of sort and search functions.

Calculation data can be directly exported to a valve specification sheet in Excel format.

Information about the manufacturer and series is displayed when a valve is selected from the database.

Improved graphical output of calculated characteristics because critical regions with inferior control quality, excessive flow velocity or critical flow states are now clearly marked.

Configurable value table for calculated characteristics with export functions based on Excel, ASCII, HTML, and XML.

Automatic hints about individual curves and regions in the characteristic view (quick hints).Differential pressure transmitter calculation

In addition to calculations of nozzles, orifice plates and venturi tubes in accordance with ISO 5167, the differential pressure transmitter module also facilitates:

Calculations of nozzles in accordance with **ASM PTC 6-1996**

Calculations of **pitot tubes** with selection from an extensible equipment database (currently Rosemount Anubar and Systec Controls).

Information about the manufacturer and series is displayed.

Materials in accordance with EN 13480 can be selected from a user extensible Material Database for the differential pressure transmitter and the pipe.

A list of individual components can be printed out for calculations with natural gas.

## SAFETY VALVE CALCULATION

This calculation now conforms to ISO 4126:2004. Calculations in accordance with AD Specification A2 are still allowed.

Information about the manufacturer and series is displayed when a valve is selected from the database.

The calculation takes account of:

- The influence of viscosity for liquids

- Stroke limitation

- Back pressure-dependent functions for the flow coefficient $\alpha$

- Stroke-dependent functions for the flow coefficient $\alpha$

## PRESSURE LOSS CALCULATION

The pressure loss in the pipe is now calculated more precisely.

The selection of flow resistances from a user extensible flow resistance database is supported. The calculation can be optionally printed with a list of internals.

## PRESSURE SURGE CALCULATION

The calculation limits have been extended. You can now enter pressures greater than 2000 bar and pressure differences greater than 150 bar.

## PIPE COMPENSATION

Pipe materials in accordance with EN 13480 can be selected from a user extensible Material Database.

The coefficient of linear expansion, the elasticity modulus of the pipe and the minimum yield strength are calculated for the materials in this database.

## SPAN CALCULATION

The calculation of the design span and the installation span for pressure testing with water has been extended.

Pipe materials in accordance with EN 13480 can be selected from a user extensible Material Database.

The elasticity modulus and the density of the pipe are calculated for the materials in this database.

## TANK DEPRESSURIZATION

The calculation now also supports limiting by means of pressure regulators.

Low-noise valve types are supported.

## PIPE WALL THICKNESS CALCULATION

The calculation now conforms to EN 13480:2002. Calculations in accordance with DIN 2413 are still allowed.

Pipe materials in accordance with EN 13480:2002 can be selected from a user extensible Material Database and you can also calculate all relevant parameters, such as tensile strength, creep rupture strength and yield strength.

Pipe bends with or without a constant wall thickness can be calculated for pulsating and static loads in addition to straight pipes.

## NEW: MATERIAL DATA CALCULATION

Calculation of pipe and equipment materials in accordance with EN 13480:2002, including operating limit tests.

Physical properties (coefficient of expansion, density, thermal conductivity, elasticity modulus and sound velocity).

Design strength values under operating conditions (elongation at rupture, yield strength and creep rupture strength).

Design strength values at 20°C (yield strength and creep rupture strength).

Pipe materials can be selected from a user extensible Material Database.

## DATABASES

## CONTROL VALVE DATABASE

The program offers improved handling and a more clearly structured user interface:

- Navigation tree with valve manufacturers and series.
- Overview of the most important parameters of each manufacturer's series at a glance.
- Simplified entry of characteristics and valve modifier and sound correcting element functions.
- User defined valves are marked.
- The date of the last change to each valve is displayed.
- Changes can now be undone.

The import and export functions for Excel data sheets have been speeded up and now work even if Microsoft Excel is not installed.

When data sheets are entered in Excel format, valve modifier and sound correcting element functions can be specified as stroke or workload-dependent.

The previously separate DIN and ANSI valve series have been combined.

Valves can be mapped more precisely because more information is available.

The throttling element can be specified either for the complete series or for each individual valve.

The maximum permissible flow velocities can be entered as a function of the state of flow.

There is a new $K_c$ valve modifier for the onset of choked flow in liquids.

The valve nominal diameter and nominal pressure rating tables are user maintainable.

The program can be used in a network because the database is locked during editing. Other users can open the database in read-only mode.

Added data for cavitation prediction according to ISA-RP75.23.

Completion of the data of VALTEK, KAEMMER, SAMSON PFEIFFER and POLNA

## NEW: PITOT TUBE DATABASE

User extensible database for entering the equipment parameters of dynamic pressure probes for use in the differential pressure transmitter module.

Pitot tubes of the manufacturers Rosemount, Torbar, Intra and Presco were added.

## NEW: FLOW RESISTANCE DATABASE

User extensible database for entering pipe internals and their flow resistances.
The internals can be selected in any calculation module that takes account of pipe pressure losses.

## SAFETY VALVE DATABASE

The program offers improved handling and a more clearly structured user interface:

- Navigation tree with valve manufacturers and series.
- Overview of the most important parameters of each manufacturer's series at a glance.
- Simplified entry of stroke and back pressure-dependent flow coefficient $\alpha$ functions.
- User defined valves are marked.
- The date of the last change to each valve is displayed.
- Changes can now be undone.

The program can be used in a network because the database is locked during editing. Other users can open the database in read-only mode.

## MEDIA DATABASE

The program offers improved handling and a more clearly structured user interface:

- The author, the revisor and the date of the last change are entered.
- Simplified entry of temperature-dependent parameter functions.
- User defined substances are marked.
- Enhanced search function.

Extended import and export functions.

Synchronization of two databases is now possible.

The program can be used in a network because the database is locked during editing. Other users can open the database in read-only mode.

## NEW: MATERIAL DATABASE

User extensible database for entering the design strength values and physical properties of pipe and equipment materials.
The materials can be selected in any calculation module that requires material data.