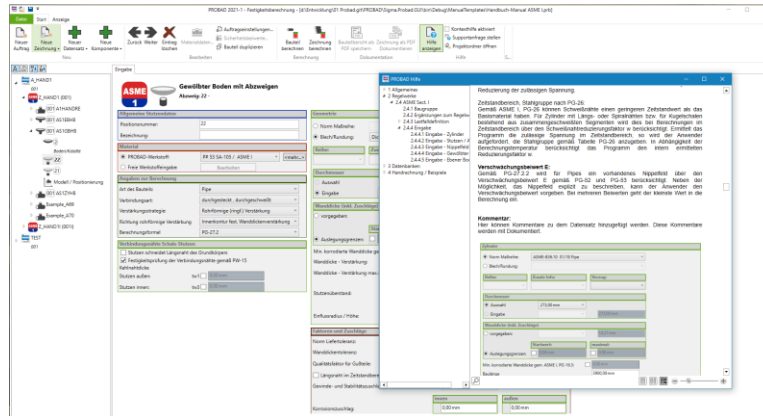




# PROBAD

## Code-based Strength calculations of Pressure parts



## PROBAD 2023-1

### New Features and Improvements

The program system PROBAD is checked and modified continuously within the scope of the maintenance agreement.

List of innovations, improvements and corrections of the new PROBAD-Releases

EN 12952	Water-tube Boilers	Release 4.11
EN 13445	Unfired Pressure Vessels	Release 3.10
EN 13480	Metallic industrial Piping	Release 3.03
EN 1591	Circular Flange Connections	Release 5.07
EN Piping Series	Serial Piping Calculations	Release 4.11
AD 2000	Pressure Vessels	Release 7.11
TRD	Steam Boilers	Release 8.11
WRC 107 / WRC 537	External Nozzle Loads	Release 8.11
WRC 297	External Nozzle Loads	Release 5.11
FEZEN	Material Information System	Release 5.00

### Software Development, Sales and Support



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## FEZEN – Information System, Version 5.00:

ROHR2 and PROBAD now use a new, common material database. Thus also the FEZEN Info system has been revised entirely.

Additionally the following new editions of standards and codes were inserted into the material database FEZEN:

### Reference Standard EN:

- EN 10250-2 03/2022 Open die steel forgings for general engineering purposes
- EN 10250-4 03/2022 Open die steel forgings for general engineering purposes

### Reference Standard DIN:

- AD 2000 - W2 03/2022 Austenitic steels
- AD 2000 – W7 10/2022 Bolts and nuts made from ferritic steels
- The following modified VdTÜV-Material sheets were entered into the material database FEZEN:  
WB 263                      WB 345                      WB 479

## Dimension Standards:

The dimensions database was updated according to the following new editions of standard:

- EN 10253-2 08/2021 Now also the following T-fittings are available:  
DN 900 x DN 450,  
DN 1000 x DN 450 und  
DN 1000 x DN 500 zur Verfügung.
- EN ISO 4014 07/2022: Hexagon head bolts
- EN ISO 4015 07/2022: Hexagon head bolts with reduced shank
- EN ISO 4016 07/2022: Hexagon head bolts
- EN ISO 4017 07/2022: Hexagon head screws
- EN ISO 4018 07/2022: Hexagon head screws
- EN 1514-2 01/2021: Spiral wound gaskets for steel flanges

## PROBAD-Modeler:

A 'PROBAD-Modeler' is now available. This new PROBAD component allows the graphical modelling of vessels or boilers and the determination of the belonging loads. The data, collected in that way, can be exported to the different PROBAD modules for the purpose of calculation in the following.



## EN 12952: Water Tube Boilers, Release 4.11

### User Interface:

The PROBAD module EN 12952 is now available in the revised user interface. The classic user interface will be maintained until the next release in 2024, after which the calculation according to EN 12952 will be possible exclusively with the new user interface.

A complete change log of the new user interface to release 2023-1 is listed at the end of this document.

### EN 12952-3, new Edition 11/2022:

In EN 12952-3, Editione 11/2022

- all formulas are now numbered in ascending order, e.g. instead of formula (7.2-1) now formula (20)
- all tables are now numbered in ascending order, e.g. instead of table 10.2-1 now table 9
- all figures are now numbered in ascending order, e.g. instead of figure 8.1-1 nun figure 7.

User interface, helps and result documentation were revised accordingly.

Formula (8.3-1) concerning the minimum thickness of branches at the shell from EN 12952-3, edition 12/2011 was removed. Now only the minimum thicknesses according section 11.2.3, table 12 are valid.

### Tube bends and Elbows:

Up to now welds in bends or elbows could be placed in the neutral part, at the intrados or the extrados of the bend. Now it s also possible to place the weld ,universal'.

In this cae the weld joint efficiency is taken into account for all parts of thze elbow.

### Additions / corrections:

- Cylindrical shell with nozzles and nipple fields:  
The proof of adjacent openings was limited to the critical branch combinations.  
For nipple fields the circumferential pitch have been limited to inputs up to 180°..
- Nozzles:  
For inclined branches, the pressure area  $A_p$  was calculated too large during the check of the reinforcement of the opening. Thus a little too low allowable pressure was determined. This was corrected.
- Tube bends and elbows:  
Standard elbows according to DIN 2605 could not be calculated. This has been corrected.



## EN 13445: Unfired Pressure Vessels, Release 3.10

### New component: Vertical vessels with ring supports

In the new release the calculation of 'vertical vessels with ring supports according to EN 13445-3, chapter 16.13 is now possible.

- Integral ring supports (permanently welded to the vessel) and also loose ring supports (not joint to the vessel) can be proved.
- The ring supports may be realized as rectangular solid section, as box-, U- or L-profile.
- EN 13445-3, chapter 16.13 contains only the proof of the vessel shell.  
Thus the ring supports are proved according to AD 2000 – S3/5 on demand.

### Fixed tubesheets with expansion joints:

For fixed tubesheets with expansion joints, the axial displacements of the expansion joint are now determined for all load cases in accordance with ASME VIII, UHX-16 and the maximum axial displacements are documented in the results.

### Additions / corrections:

- Branches:  
For inclined branches, the pressure area  $A_p$  was calculated too large during the check of the reinforcement of the opening. Thus a little too low allowable pressure was determined. This was corrected.  
  
For cylindrical shells, the minimum distance between openings and welds may not have been checked for all defined circumferential welds. This has been corrected.  
  
Now for openings in torispherical heads a hint is displayed, if the effective length of the shell protrudes the region of the knuckle.
- Local loads on nozzles:  
For the input field 'Torque MZ' the unit has been corrected from 'kN' to 'Nm'.
- Reducers:  
In the result documentation, a unnecessary note regarding the total length of the reduction was displayed under certain circumstances. This has been corrected.
- Cyclic loading:  
For welded components, the maximum number of cycles is now determined and documented up to the fatigue limit of 5,000,000 in accordance with EN 13445-3, 17.6.4.  
For seamless components, the limit for fatigue strength remains 2,000,000 cycles.



## EN 13480: Metallic industrial Piping, Release 3.03

### Cyclic loading:

Now, on demand, the maximum allowable operation pressure at 20°C is determined for all relevant proof sections of the component and is documented in the results. These values are necessary for the cyclic loading calculation and can be entered or imported as Pmax according to EN 13480-3, 10.3.2.3 in the component 'Cyclic loading' of PROBAD EN 13480.

### Additions / corrections:

- **Branches:**  
For inclined branches, the pressure area  $A_p$  was calculated too large during the check of the reinforcement of the opening. Thus a little too low allowable pressure was determined. This was corrected.  
  
Now for openings in torispherical heads a hint is displayed, if the effective length of the shell protrudes the region of the knuckle.
- **Pipe bends and elbows:**  
Up to now welds in bends or elbows could be placed in the neutral part, at the intrados or the extrados of the bend. Now it is also possible to place the weld 'universal'.  
In this case the weld joint efficiency is taken into account for all parts of the elbow.
- **Reducers:**  
In the result documentation, an unnecessary note regarding the total length of the reduction was displayed under certain circumstances. This has been corrected.



## EN 1591: Circular Flange Connections, Release 5.07

### User Interface:

The PROBAD module EN 1591 is now available in the revised user interface. Here flange connections of standard flanges can be calculated for any number of load cases. Non standardized flange connections (e.g. inversed flanges) can be calculated in the classic user interface furthermore.

### Gasket materials:

- The gasket characteristics of the following gaskets have been updated:
  - Frenzelit Novaflo 300
  - Frenzelit graphit gasket Novaphit SSTC, 2.0 mm
  - IDT corrugated ring gasket WD10, Graphit
  - IDT 3803 KD10/20/30 LE 3 mm
  - Kempchen corrugated ring profile PW1
  - KWO Multiflex Sheet and Ring 2 mm,
  - KWO Uni-F Premium 75
  - Möller grooved metal gasket MMD-GG-FG-CR (MMKKZ)
- The gasket characteristics for the following gaskets are now available:
  - Garlock GYLON 3545 2.0 mm
  - KWO Multiflex Sheet and Ring 3 mm
  - Möller corrugated ring gasket MMD-CG-FG (1.4571, Auflage 0.5 mm)

### Additions / corrections:

- Now also flange connections, consisting of an inward facing flange and a blind plate with loose ring, can be calculated.
- Although not part of EN 1591-1, flange connections with full-facing gasket could be calculated in PROBAD EN 1591, if the effective gasket diameter  $d_{Ge}$  was smaller than the effective bolt circle diameter  $d_{3e}$ . Since this led to some questionable results, flange connections with full-facing gasket will now only be calculated, if the theoretical gasket diameter  $d_{G2}$  is smaller than  $d_{3e}$ .
- The iterative determination of the required gasket force  $FG_{0req}$  is now done under the condition  $0.999 \cdot FG_0 \leq FG_{0req} \leq FG_0$ . Up to now the condition  $0.99 \cdot FG_0 \leq FG_{0req} \leq FG_0$  was taken into account. The more sharp iteration of the gasket forces  $FG_0$  and  $FG_{0req}$  may lead to a greater required gasket force  $FG_{0req}$ .
- For gaskets according to EN 1591-1, figure Bild 4c) - 4f) the ratio  $FLI/miG$  in the third term of formula (102) is not taken into account during the determination of the minimum required gasket force  $FG_{lmin}$  according to prEN 1591-1, edition 2021. (Up to now the total third term has been ignored for those gaskets.)
- The external distance between the two flange plates, which results from the total flange rotation, is checked in the new release.
- For some load cases the maximum allowable calculation pressure  $P$  can not be determined, because the condition  $FG_{0req} \leq FG_0$  according to formula (109) and  $FG_0 \approx FG_{0req}$  according to formula (110) can not be fulfilled. In these cases the iterative determination of the allowable pressure is stopped and a corresponding hint is displayed.
- If correction factor  $c_M < 0$ , formula (134) or if correction factor  $c_S$ , Formel (135) can not be determined, the resistance  $WF$  according to formula (130) can not be determined. The calculation is stopped and a corresponding message is displayed..



## AD 2000: Pressure Vessels, Release 7.11

### Flat heads and plates according to AD-B5, Edition 12/2021:

- For flat plates with staytubes/staybolts/anchor plate, it is now possible to check regular and irregular pitches in one calculation according to AD-B5..
- For fixed tubesheets it is now possible to check circular, elliptical and/or rectangular tubeless areas in one calculation.

### Additions / corrections:

- Dished heads:  
For torispherical heads (Klopper- or Korbbogen-type) with a short skirt, the allowable pressure may have been determined too low. This has been corrected..
- Flanges:  
For  $d_i F + 2 \cdot s F > dt$  a negative lever arm  $a_1$  is determined.  
In this case the calculation is stopped and a corresponding message is displayed.  
  
For flanges welded on dished closures a wrong lever arm  $a_R$  may have been determined.  
This has been corrected.  
  
For blind flanges with weld gasket, the bolt force of the counter flange is now taken into account.  
  
The type of loose flange rings could not be selected. The error has been corrected.
- Tubesheet:  
For exchanger tubes, where the allowable stress results from the tensile strength, the allowable tensile and buckling forces of the tubes were determined incorrectly.
- Expansion Joint:  
In the results, the bending spring constant  $c, \alpha$  was previously displayed in Nmm/degree.  
Now it is documented in the correct unit Nm/degree.



## DIN/EN-Piping Series, Release 4.11

### User interface:

The design of the user interface was brought into line with the modern PROBAD interface.

### Documentation of results:

Now in the result display a short documentation can be ordered. In this word document the results of the piping calculation are displayed on the basis of DIN 21057.

### Check of additional temperature values:

- The component relevant for the maximum allowable pressure may not have been fully documented.
- Under certain circumstances, too low allowable external pressures were determined. This has now been corrected.

### Additions / Corrections:

- Determination of the required test pressure:  
When ignoring branch combinations for which T-fittings are available, an insufficient required test pressure was determined under certain circumstances. This has been corrected..
- Pipe bends:  
In certain circumstances not all ranges of the straight pipes could be selected during the individual selection of the bended pipes. This has been corrected.
- Caps:  
Up to now the geometric conditions concerning the knuckle radius  $r_i$  according to EN 13480-3, 7.1.3 were checked via the net dimensions of the cap. Now (as in the PROBAD modules for single calculations) the check is done via the nominal dimensions.

**WRC 107: Local Stresses at cylindrical and spherical Shells, Release 8.11**

**WRC 297: Local Stresses at cylindrical Shells, Release 5.11**

**TRD: Technical rules for steam boilers, Release 8.11**