List of Innovations, Improvements and Corrections of the new PROBAD-Releases EN/AD/TRD/Pipe Series/WRC/FEZEN

SIGMA
Ingenieurgesellschaft mbH

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FEZEN – Information system, Version 4.11

Material datasheet:
In all PROBAD modules after selecting a material from the integrated material database FEZEN the correspondent material sheet may be requested via the button ‚F7 – Mat.sheet'. This document lists all data, which is stored in the material database for the selected material.
The material datasheet was revised in the new release:

- If there exist different material strength values for different codes (e.g. AD 2000 and EN 13480), these values are now listed in seperate tables.
- Columns in the tables, which are not relevant for the material, are no longer displayed now.
- Different material strength values for different wall thicknesses are now documented in separat columns of the tables.

The following new editions were inserted into the matateriał database FEZEN:

Reference Standard EN:

EN 10222-1	Edition 2017	Steel forgings for pressure purposes
EN 10222-2	Edition 2017	Steel forgings for pressure purposes
EN 10222-3	Edition 2017	Steel forgings for pressure purposes
EN 10222-4	Edition 2017	Steel forgings for pressure purposes
EN 10222-5	Edition 2017	Steel forgings for pressure purposes
EN 10028-3	Edition 2017	Flat products made of weldable steels
EN ISO 683-1	Edition 2017	Heat-treatable non-alloy steels
EN ISO 683-2	Edition 2017	Heat-treatable alloy steels
EN ISO 3183	Edition 2017	Steel pipe for pipeline transportion systems
EN 13480-2	Edition 2017	Metallic industrial piping – materials

Reference Standard DIN:

• AD 2000 - W 1	Edition 05/2018	Flat products made of non-alloy steels
AD 2000 - W 9	Edition 06/2017	Steel flanges

The following modified VdTÜV-Material sheets were entered into the material database FEZEN:
110, 230/3, 305 , 352 bis 355, 364, 377/3, 395/3, 399/3,
400, 412 , 421 , 424, 432/1, 434, 479, 499,
502, 505 , 511/3, 522/3, 546, 550, 552/2, 580

EN 12952 Water tube boilers, Release 4.7

- **Kind of heating:**
  Up to now the selected kind of heating was allways documented in the results.
  In the new release ‚Kind of heating = unknown' can now be selected, if the calculation temperature or the temperature allowance is entered.
  In this case no kind of heating is displaed in the results.

- **Additional axial force at cylindrical shells:**
  For heated tubes with diameter d < 45 mm the wall thickness minus tolerance is not taken into account according to EN 12952-3, 11.2.1 for internal pressure calculations. But in this case up to now an additional axial force Q was proved according to EN 12952-3, 11.2.4 with minus tolerance c1 = 0 mm also. In the new release the minus tolerance c1 is taken into account during the proof of the additional axial force.

- **Set-through nozzles on spherical shells and dished heads:**
  For dset-through nozzles on sherical shells and dished heads the stress loaded sectional area Afs of the shell was determined too small. The program has been corrected.

- **Y-shaped branches on spherical shells:**
  For Y-shaped branches on spherical shells in certain circumstances the relevant reinforcement areas were not displayed completely in the results. Abzweige auf Kugelschalen wurde u.U. die relevanten Verstärkungsflächen in der Ergebnisausgabe nicht vollständig dokumentiertk. The program has been corrected.

- **Calculation of usage due to creep:**
  For components, which are not allowed in the creep range on reason of their measure ratio, the allowable lifetime was determined to be the value, where the components are just in yield strength range.
  In the new only a correspondent message is displayed. The allowable lifetime is now determined based alone on the actual stresses in the single operation classes.

EN 13445 Unfired pressure vessels, Release 3.6

- **New pressure part: Simplified Analysis for Cyclic loading**
  In the new release a simplified analysis for cyclic loading according to EN 13445-3, chapter 17 is possible now. This calculation is valid for vessels under cyclic pressure fluctuation only. According to EN 13445-3, 17.4 the allowable number of load cycles for the various sections of the vessel must be determined. The smallest value is the relevant one for the vessel.
  - Up to 20 proof sections may be defined in the input panels.
  - The user can define up to 10 load cycles with different cycle stress ranges and / or relevant temperature.
  - Either the allowable number of load cycles or, entering the operational number of load cycles for the single load regimes, the correspondent usage ratio and the total usage ratio for the single proof sections are determined.

- **Surveillance of creep exhaustion:**
  Up to now components in creep range were calculated for 100.000 h with safty factor SFcr = 1.5 by default. According to EN 13445-3, 19.5.1 this corresponds to a calculation without surveillance of the creep exhaustion.
  In the new release via a switch ‚surveillance of the creep exhaustion = yes‘ the calculation can be switched to a calculation with safety factor SFcr = 1.25 according to EN 13445-3, 19.5.2.

- **Circumferential heating or cooling channels:**
  In case of circumferential heating or cooling channels the cylindrical shell has to be proved against the pressure in the channals according to EN 13445-3, 8.5.3.5. For this reason in the new release
  - the mean diameter a of the heating or cooling channels at the cylindrical shell and
  - the design pressure Pc and/or the test pressure Ptc in the heating or cooling channels
  may be entered. The correspondent proof is done according to formula (8.5.3-23).

- **Allowable pressure of stiffening rings:**
  In case of external pressure the actual stress in the stiffening rings was determined according to EN 13445-3, formula (8.5.3-37), but up to now no correspondent allowable pressure was determined. In the new release the allowable external pressure of the stiffening rings is determined by iteration and is documented in the results additionally.

- **Dimensions of stiffening profiles:**
  In case of external pressure the dimensions in the stiffening profiles may be selected.
  In the new release after selecting the height of a profile, only the width available for this selected height are listed for selection.

- **Local external loads at flange rings:**
  Up to now additional local external loads could only be defined for nozzles or branches.
  In the new release this is also true for flange rings.
  The calculation is done according to EN 13445-3, 16.4.5 (for flange rings in spherical shells) or 16.5.5 (for flange rings in cylindrical shells).

- **Semi-ellipsoidal heads with openings:**
  Openings in torispherical heads, which are not comletely within a radius of Radius 0.4 Do are reinforced via the factor βk according to EN 13445-3, 7.7.
  In the new release this is also true for semi-ellipsoidal heads. According to EN 13445-3, 7.7.2 for semi-elliipsoidal heads with K > 2 an additional warnung is displayed.
  For openings completely outside the knuckle region a hint is displayed, if the effective length of the shell protrudes into the knuckle region.

- **Flat heads with relief groove:**
  Up to now the allowable pressure of flat heads with relief groove was determined without taking the stress in the relief groove into account. In the new release the actual stress and the allowable pressure in the remaining rest thickness above the groove is now documented in the results. Additionally a rest thickness below the minimum value = ‚connection thickness * fs/f' is announced.

- **Flat heads with opening:**
  For openings in flat heads the types ‚nozzle' or ‚opening' may be selected. For openings with bolted pipe flange the following values may be entered additionally:
  - the inside flange diameter dFi,
  - the depth of the blind hole lt and
  - the thread diameter dBt.

  In this case the conditions according to EN 13445-3, section 10.6.1.2 are checked additionally. If the conditions $d \leq dFi$ and $e - lt \geq 0.5\ dBt$ are fulfilled, the blind holes need not be reinforced.

- **Support skirt:**
  In the new release support skirts can be checked for the loadcases ‚Assembly' and ‚Earthquake'. By default the correspondent allowable stresses are determined internally according to EN 13445-3, Tabelle 22-1.

- **Offset of nozzle axis:**
  The inclination angle of non-radial nozzles can be entered either via the ‚Angle to the circumferential tangent' or via the ‚Offset of the nozzle axis from the radial'.
  By mistake for the , Offset of the nozzle axis' the unit ‚degree' was displayed on the input panel. The mistake was corrected.

EN 13480 Metallic industrial piping, Release 2.6

- **Surveillance of creep exhaustion:**
  Up to now components in creep range were calculated for 200.000 h with safty factor SFcr = 1.25 by default. According to EN 13480-3, Table 5.3.2-1 this corresponds to a calculation with surveillance of the creep exhaustion.
  In the new release via a switch ‚surveillance of the creep exhaustion = no‘ the calculation can be switched to a calculation with safety factor SFcr = 1.5 according to EN 13480-3, Table 5.3.2-1.

- **Allowable pressure of stiffening rings:**
  In case of external pressure the actual stress in the stiffening rings was determined according to EN 13480-3, formula (9.3.3-4), but up to now no correspondent allowable pressure was determined. In the new release the allowable external pressure of the stiffening rings is determined by iteration and is documented in the results additionally.

- **Dimensions of stiffening profiles:**
  In case of external pressure the dimensions in the stiffening profiles may be selected.
  In the new release after selecting the height of a profile, only the width available for this selected height are listed for selection.

- **Semi-ellipsoidal heads with openings:**
  Openings in torispherical heads, which are not comletely within a radius of Radius 0.4 Do are reinforced via the factor βk according to EN 13445-3, 7.7.
  In the new release this is also true for semi-ellipsoidal heads. According to EN 13445-3, 7.7.2 for semi-elliipsoidal heads with K > 2 an additional warnung is displayed.
  For openings completely outside the knuckle region a hint is displayed, if the effective length of the shell protrudes into the knuckle region.

- **Flat heads with relief groove:**
  Up to now the allowable pressure of flat heads with relief groove was determined without taking the stress in the relief groove into account. In the new release the actual stress and the allowable pressure in the remaining rest thickness above the groove is now documented in the results. Additionally a rest thickness below the minimum value = ‚connection thickness * fs/f‘ is announced.

- **Flat heads with opening:**
  For openings in flat heads the types ‚nozzle‘ or ‚opening‘ may be selected. For openings with bolted pipe flange the following values may be entered additionally:
  - the inside flange diameter dFi,
  - the depth of the blind hole lt and
  - the thread diameter dBt.

  In this case the conditions according to EN 13480-3, section 7.2.5.1 are checked additionally. If the conditions $d \leq dFi$ and $e - lt \geq 0.5\ dBt$ are fulfilled, the blind holes need not be reinforced.
  In diesem Fall findet eine zusätzliche Überprüfung der Bedingungen

- **Offset of nozzle axis:**
  The inclination angle of non-radial nozzles can be entered either via the ‚Angle to the circumferential tangent‘ or via the ‚Offset of the nozzle axis from the radial‘.
  By mistake for the , Offset of the nozzle axis‘ the unit ‚degree‘ was displayed on the input panel. The mistake was corrected.

EN 1591 Flanges, Release 5.3

- **Surveillance of creep exhaustion:**
  Up to now by default for flange connections in creep range the design stresses according to EN 13480 and EN 12952 were determined for 200.000 h with safety factor SFcr = 1.25. According to EN 13480-3, Table 5.3.2-1 this corresponds to a calculation with surveillance of the creep exhaustion. In the new release via a switch ‚surveillance of the creep exhaustion = no' the calculation can be switched to a calculation with safety factor SFcr = 1.5 according to EN 13480-3, Table 5.3.2-1.
  The design stresses according to EN 13445 were determined for 100.000 h with safety factor SFcr = 1.5. In the new release via a switch ‚surveillance of the creep exhaustion = yes' the calculation can be switched to a calculation with safety factor SFcr = 1.25 according to EN 13445-3, 19.5.2.

- **Incorrect formulas in EN 1591-1:2001+A1:2009/AC:2011:**
  Instead of the formulas (68), (E.7) und (E.8) in EN 1591-1:2001+A1:2009/AC:2011 D:
  FGI = {FG0d x YG0 x **PQRI** - [FQI x YQI + (FRI x YRI - FR0 x YR0) + DelUI]} / YGI}
  FGImin = {FG0min x YG0 x **PQRI** - [FQI x YQI + (FRI x YRI - FR0 x YR0) + DelUI]} / YGI}
  FGImax = {FG0max x YG0 x **PQRI** - [FQI x YQI + (FRI x YRI - FR0 x YR0) + DelUI]} / YGI}
  the following modified formulas are used in the new release:
  FGI = {FG0d x YG0 - [FQI x YQI + (FRI x YRI - FR0 x YR0) + DelUI]} **x PQRI** / YGI}
  FGImin = {FG0min x YG0 - [FQI x YQI + (FRI x YRI - FR0 x YR0) + DelUI]} x **PQRI** / YGI}
  FGImax = {FG0max x YG0 - [FQI x YQI + (FRI x YRI - FR0 x YR0) + DelUI]} **x PQRI** / YGI}
  Reason:
  In Edition 2009 the creep factor ‚PQR with index I' was established.
  Caused by the gasket relaxation the gasket force in the subsequent conditions I is not as high, as it should be on the basis of the actual forces, but reduced by the factor PQRI. Erroneously on this occasion the gasket force in assembly condition was multiplied by PQRI.
  But the gasket force in subsequent conditions depends on the ‚gasket force in assembly condition reduced by the unloading due to internal pressure, external loads ect.'!
  Thus the factor PQRI must be placed behind the curved bracket.
  Meanwhile the CEN-committee TC74 concluded this correction for the next edition of EN 1591. Consequently these corrections where realized already in the new release.

- **Threaded flange:**
  In PROBAD EN 1591 up to now theaded flanges were treated as slip-on flanges, in which the had to be placed outside of the threaded cylindrical shell.
  But according to EN 1591-1, 6.2.1 theaded flanges have to be considered as loose flanges, in which the inside diameter (mean thread diameter) of the flange corresponds to the diameter d7 for the load transition. According to EN 1591-1, figure 14 the gasket has to be placed in the area of rhe threaded-in cylindrical shell.
  The input penals, the calculation and the result documentation were revised comletely.

- **Gasket materials:**
  The PROBAD database of gasket materials was updated to the current state 06/2018 of data available under "http://www.gasketdata.org" and contains about 290 gasket materials now.
  Now the date of issue of the selected gasket data sheet from gasketdata.org is documented in the wird PROBAD results.

- **Input of bolt assembly torque Mt0,spec:**
  The input of the bolt assembly torque MT0,spec or of the nominal bolt assembly force FB0,spec according to EN 1591-1, section 5 makes sense only,

- if the number and the nominal diameter of the bolts is fix per input
  (standard dimensions or input).
- for tightening methods wth measured bolt force and
- for limited leakage ratio.

Otherwise the calculation is canceled with a corresponding message in the new release.

- **Tightening method: Wrenching technique**
  For tightening method ‚wrenching technique' probably undefined values as ‚*****' or ‚INF' were documented in the results. The program was corrected.

- **Input of gasket factor m:**
  By mistake for unlimited leakage rate an entered gasket faktor m was ignored in the former release. The program was corrected.

EN-Pipe Series, Release 4.7

- **Rename of a project:**
  Via the menu ‚File > Project > rename' the name and number of an existing project can now be modified. In following calculations the new project name and project number are documented.

- **Result documentation:**
  The date of issue of the selected validation standard is now documented in the results.

- **Surveillance of creep exhaustion:**
  Up to now components in creep range were calculated
  - according to AD 2000 or EN 13445 with design lifetime 100.000 h
    and with safety factor SFcr = 1.5.
  - according to EN 13480 or EN 129523 with design lifetime 200.000 h
    and with safety factor SFcr = 1.25.

  In the new release via a switch ‚surveillance of the creep exhaustion' the calculation is done optionally
  - with safety factor SFcr = 1.25 in case of surveillance of the creep exhaustion
  - with safety factor SFcr = 1.50 in case of missing surveillance of the creep exhaustion.

- **Non-standard diameters:**
  In the new release of PROBAD-Piping series non-standard diameters can now be calculated for ‚straight pipes', ‚branches' and ‚bended pipes'.
  Selecting a dimensions standard, which doesn't contain standard diameters (e.g. ‚EN 10029' or ‚1.0 mm rounding'), the required diamters can now be entered explicitly.
  If no wall thickness is entered, the correspondent nominal thicknesses are determined according to the selected dimensions standard in full, half or tenth millimeter steps.

- **Blinding plates:**
  Up to now blinding plates could only be calculated as simply supported flat plates according to AD-2000, B5, Tafel 1 g) with calculation facter C = 0.4 .
  Now according to DIN 2626, Annex A the calculation can also be done optionally according to EN 13480-3, formula (7.2.4-6) or EN 13445-3, formula (10.5-7) with C = 0.41 and mean gasket diameter as calculation diameter.

- **Flanges according to ASME B16.5:**
  Now according to ASME B16.5, Edition 2017 for Class 150 – 600 also the standard dimensions of flanges NPS 22 are available additionally.
  Also for material group 1.18 the rating table at T = 650°C (1200°F) was revised according to ASME B16.5, Edition 2017.

AD 2000, Release 7.7

AD-S6, Edition 05/2018:
By default components in creep range are calculated without surveillance of the creep exhaustion. In this case the design stress fc is determined according to AD-S6, Table 2 as quote fc = Rm,t,T / Sfc = mean creep rupture strength value at design lifetime t / 1.5.
For casting steel a safety factor Sfc = 2.0 is valid according to AD-S6, Table 3.

In the new release via a switch ‚surveillance of the creep exhaustion = yes' the calculation can be switched to a calculation with safety factor Sfc = 1.25 according to AD-S6, Table 2.
For casting steel the safety factor Sfc = 2.0 is still valid according to AD-S6, Table 3.

- **Flanges:**
  For flange connections PROBAD determines a ‚maximum allowable number of bolts', for which the distance between the bolts guarantees the assembly.
  Now a message is displayed, if the actual or the required number of bolts is greater than this maximum value.größer als der einbaubedingte Maximalwert, so wird dies nun in einer Meldung.

- **Tubesheet:**
  For tubesheets with a floating head or with expansion joint PROBAD in a first step checks, if the 2 outer rows of tubes carry the actual tensile and pressure load according to AD-B5, 6.7.4.4 or AD-B5, 6.7.5.2.
  Otherwise a further outer row of tubes is regarded as load carrying tubes. This results in a smaller radius l', which enters into the calculation.
  In the new release a correspondent hint is displayed, if more than the 2 outer rows of tubes were regarded as load carying tubes.

- **Support skirts according to AD-S3/1:**
  In AD-S3/1, Edition 05/2018 the formula (31) for the thickness of the base ring was revised. The program was modified.

  Up to now in case of overloading only the first found overloading was announced in a message. Now the overloads in all areas of the support skirt are announced in details.

TRD, Release 8.7

WRC 107, Release 8.7

WRC 297, Release 5.7