PolPartDesign

Tools for development and design of plastic molded parts

User Manual

Snap-fits · Gear calculations · Plastic tanks

Based on PolPartDesign 3.2.3.1 · October 2026

Makrolar GbR Berlin

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1 Introduction

PolPartDesign helps you design typical plastic design elements. The software contains three calculation modules, which you reach via the tabs on the left edge of the window:

- **Snap-fits:** elongation, joining and loosening force for 12 connection types or spring elements – bending springs, torsion springs, ball and cylindrical snap-fits – with different snap-in elements and cross-sections (chapter 3).
- **Gear calculations:** load capacity of plastic spur gears based on DIN 3990 (chapter 4).
- **Calculation of cylindrical plastic tanks:** minimum wall thickness and proof of strength of upright tanks with liquid filling (chapter 5).

In addition, the **“Calculation modules”** menu contains three stand-alone auxiliary calculations for the modulus of elasticity, permissible elongation and heat penetration coefficient (chapter 6).

Each module works with its own **projects**. A project contains all inputs of a calculation; it can be saved, loaded again and printed as a report. The results are recalculated immediately after every change.

> **Note:** The **“Commercial products”** and **“Logging”** tabs are not described in this manual. There is a separate manual for the commercial products.

2 User interface

The main window has the same structure in all modules. The figure shows the **Snap-fits** module with **Project management** open.

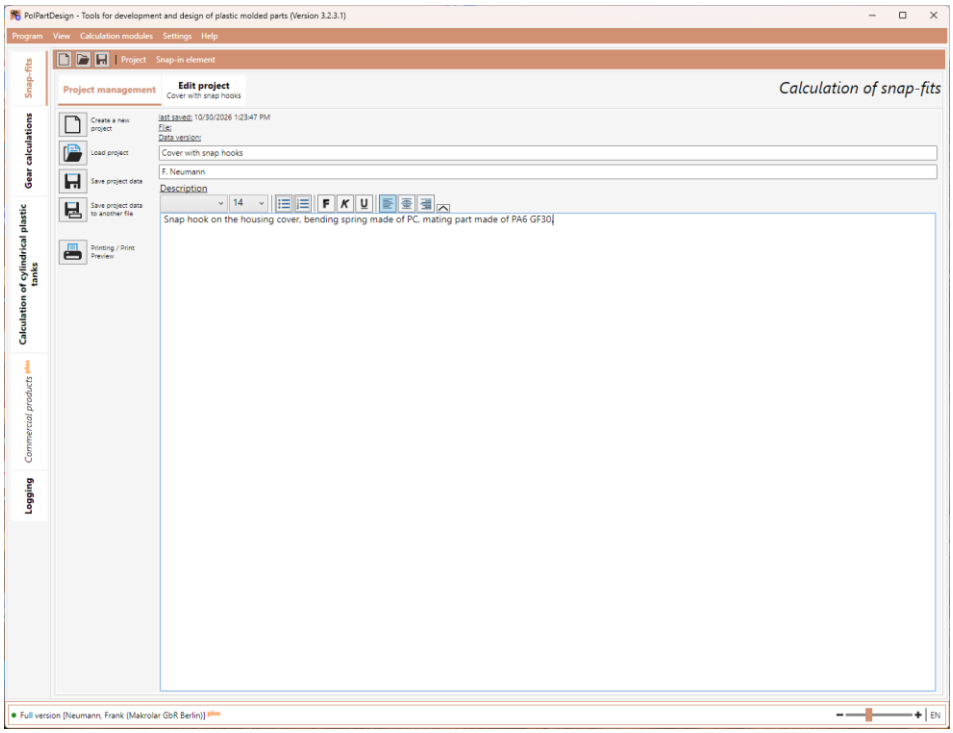


Figure 1: Main window with project management (Snap-fits module)

Element	Meaning
Menu bar	**“Program”**, **“View”**, **“Calculation modules”**, **“Settings”** and **“Help”** (chapter 7).

Element	Meaning
Tabs on the left edge	Switch between the modules **Snap-fits**, **Gear calculations** and **Calculation of cylindrical plastic tanks**.
Module bar (top)	Icons **New**, **Open** and **Save** as well as the module menus (e.g. **“Project”**, **“Snap-in element”** or **“Data management”**).
Project management	Create a new project, load, save, save under a new name and print a project. To the right you find the time of saving, the file, **Project name**, **Processor** and a formatted **Description**.
Edit project	Inputs and results of the open project; the project name is shown below the tab.
Status bar	License status, zoom slider and language of the user interface (“EN”).

> **Tip:** Project name, processor and description appear in the header of the printout. Fill them in under **Project management** before printing.

3 Snap-fits

This module calculates the maximum elongation of the spring element as well as the joining and loosening force of a snap-fit. The example used throughout is a **cover with snap hooks**: bending spring made of PC with a rectangular cross-section of 8 × 1.6 mm, trapezoidal catch, mating part made of PA6 GF30.

Snap-fits are a joining technique for quick and easy assembly without additional fasteners such as screws or rivets. They usually consist of two parts that are joined simply by pressing them together: an elastic spring element is deflected during joining and snaps in behind an undercut. Depending on the loosening angle, the connection is detachable or permanent. The design is governed by the maximum edge fiber elongation of the spring element, which is compared with the permissible elongation of the material, and by the joining and loosening forces.

3.1 Creating a new project

Under **Project management**, click **“Create a new project”** and confirm the prompt. The wizard guides you through the basic settings in three steps.

1. **Connection type / principle:** select the spring element, in the example **“Bending spring (constant cross-sectional dimensions)”**. Other options include double- and single-sided torsion springs, bending springs with decreasing height or width, with steps, angled or curved, as well as ball and slotted cylindrical snap-fits.
2. **Type of snap-in element: Trapezoidal catch**, **Triangular catch**, **Snap-in hook** or **Bulge catch**.
3. **Material combination and project details: Plastic/metal**, **same plastics** or **different plastics**; plus **Project name** and **Processor**.
4. Click **“Next”** and, in the last step, **“Finish”**.

> **Important:** The **connection type** or spring element is the basis of a project and cannot be changed afterwards. For a different connection type, create a new project. All other data from the wizard can be changed later in the project view; you can also run through the wizard at any time with **“Next”** and **“Finish”** and complete the data there.

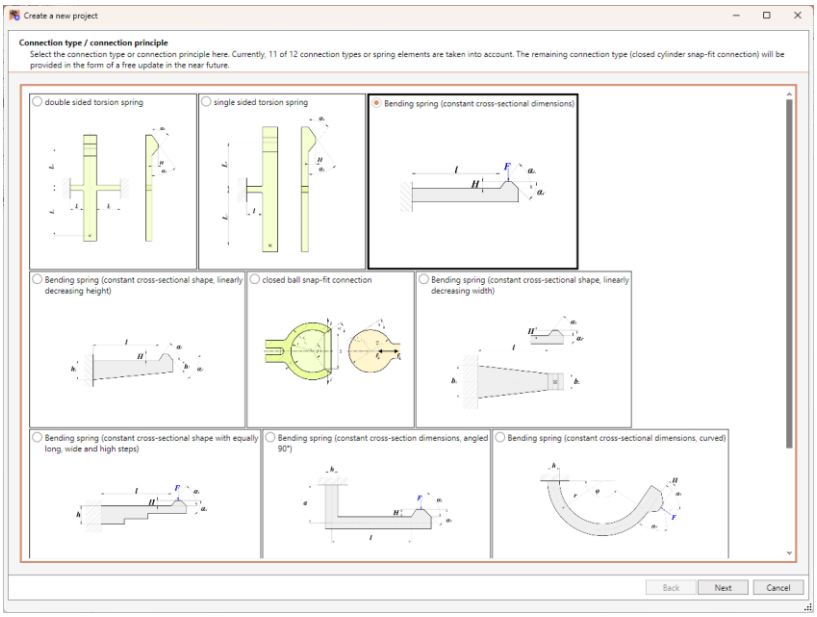


Figure 2: Wizard: selecting the connection type

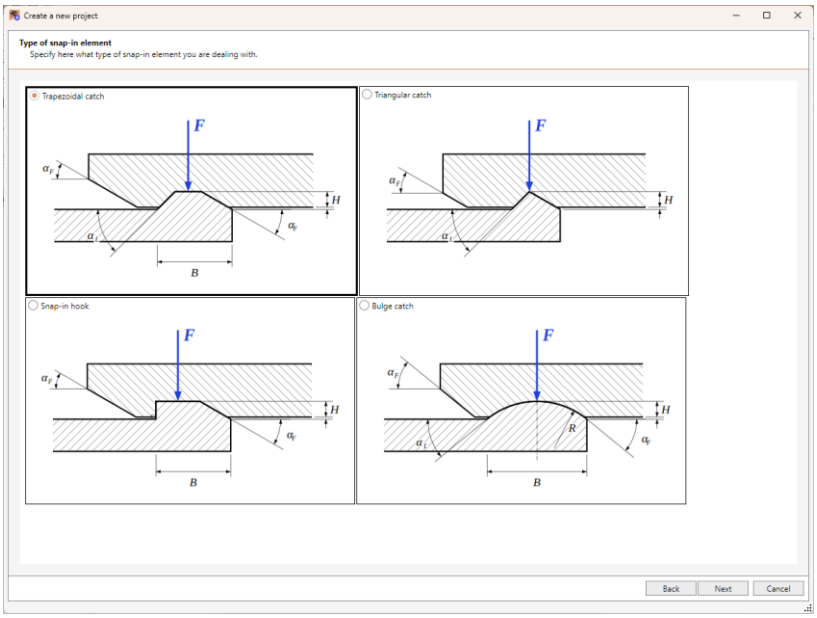


Figure 3: Wizard: type of snap-in element

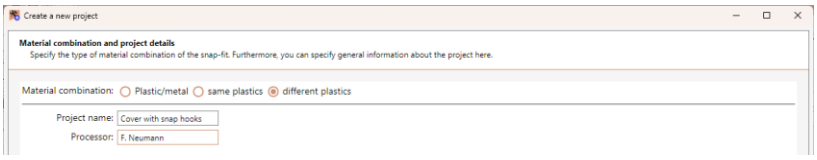


Figure 4: Wizard: material combination and project details

3.2 Entering geometry data

After the wizard, **“Edit project”** opens. The inputs are on the left in four collapsible sections; on the right you find **Notes**, **Results** and **Progression charts**. As long as data is missing, the **“Notes”** area tells you what still needs to be entered.

In the **“Geometry data (spring element / connection type)”** section, enter the dimensions directly into the fields of the principle sketch (all lengths in mm, angles in degrees):

Quantity	Example
Spring length **l**	20 mm
Undercut or snap height **H**	1.5 mm
Joining angle **αF**	30°
Loosening angle **αL**	60°

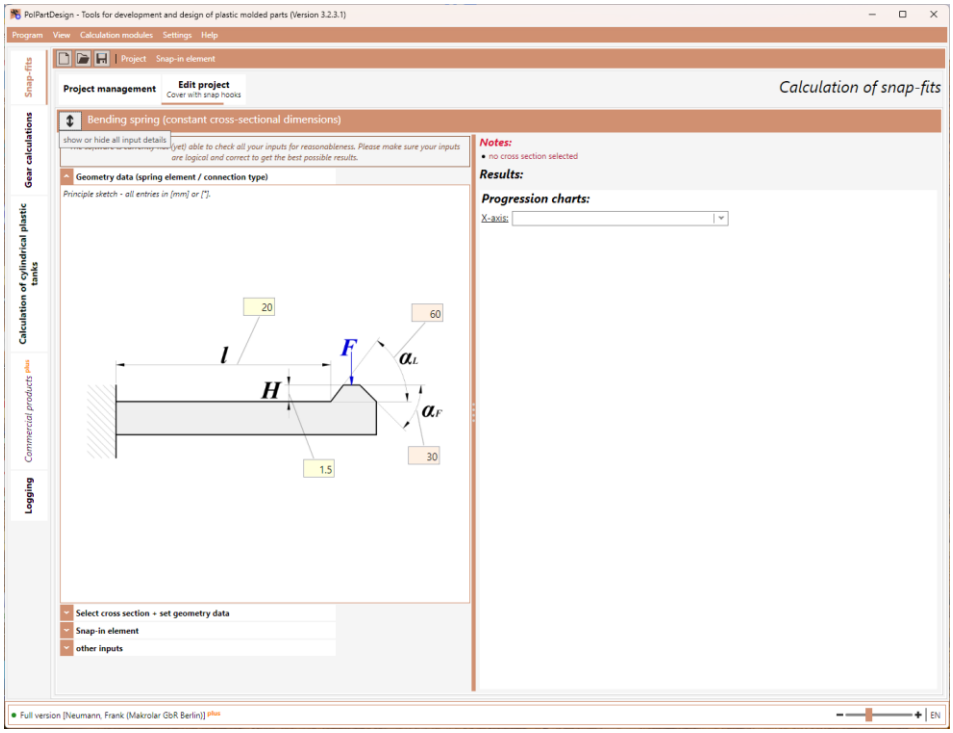


Figure 5: Geometry data in the principle sketch

> **Note:** For bending springs with a linear decrease in height or width, the cross-section dimensions are linked to the height and width at the clamping point. Height or width is therefore only displayed in the principle sketch and entered via the cross-section.

3.3 Selecting the cross-section

Expand **"Select cross section + set geometry data"** and double-click the required cross-section shape (e.g. rectangle, trapezoid, circle segment). Enter the cross-section dimensions in the window that appears and confirm with the Enter key. In the example: rectangle with width a = 8 mm and height h = 1.6 mm.

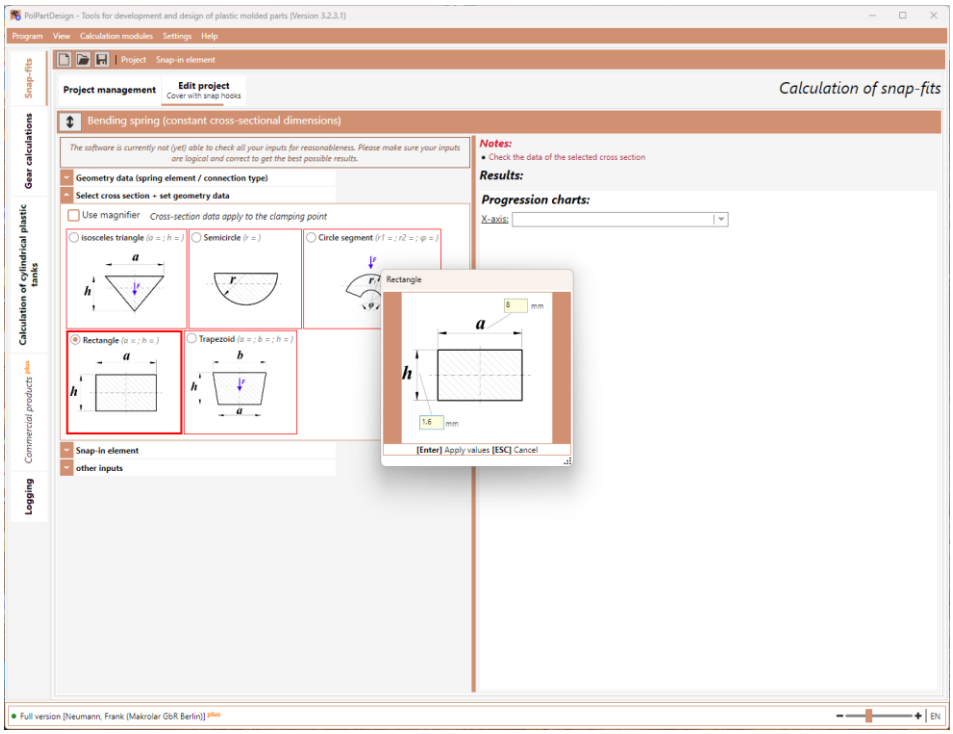


Figure 6: Setting the cross-section dimensions

Which cross-sections are available depends on the connection type. The cross-section dimensions always apply at the **clamping point** of the spring element. Confirm the entry in the cross-section window with the **Enter** key; press **Esc** to cancel it.

Lateral stability of the rectangular cross-section: if, for design reasons, the height of a straight bending spring with a rectangular cross-section is greater than its width, the spring may become unstable due to lateral torsional buckling. In this case, PolPartDesign additionally states the **safety against lateral buckling** in the results. Usual safety factors are in the range of 1.2 … 1.5.

3.4 Snap-in element

The **“Snap-in element”** section shows the selected snap-in element with the usual joining and loosening angles. Use the **“…”** button or the **“Snap-in element”** menu to change the snap-in element later.

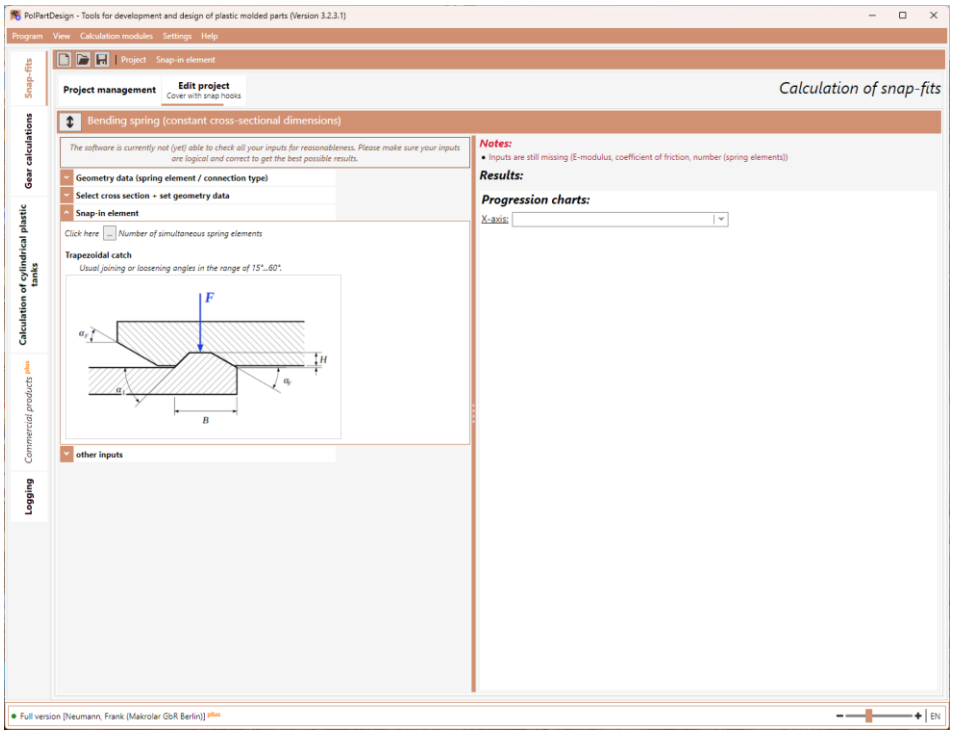


Figure 7: "Snap-in element" section

- If you subsequently select a different snap-in element, the joining and loosening angles are deleted and must be entered again.
- For the **snap-in hook**, the program automatically enters a loosening angle of 90° (permanent connection).
- For the **bulge catch**, you can have the joining and loosening angles calculated from the bulge geometry and apply them.
- Which snap-in elements are possible depends on the connection type; for a closed ball snap-fit, for example, no snap-in element can be selected.

3.5 Other inputs and material data

In the **"other inputs"** section you define the material combination and the material properties:

Field	Meaning
Material combination	Plastic/metal, same plastics or different plastics; for plastics the designations of both partners (example: 1st PC, 2nd PA6 GF30).
Secant E-modulus of the Bending Spring [N/mm²]	Modulus of elasticity at the occurring elongation. The **"…"** button opens an auxiliary calculation (section 3.6).
Coefficient of friction	Friction value between spring and mating part, with auxiliary calculation **"…"**.
Number of simultaneous spring elements	Number of snap hooks acting at the same time; the forces are multiplied accordingly.
Permissible elongation of the bending spring [%]	Limit value for the edge fiber elongation, with auxiliary calculation **"…"**.

The coefficient of friction depends on the material combination. Therefore select the **material combination** first, before you open the auxiliary calculation for the coefficient of friction.

3.6 Auxiliary calculations

PolPartDesign provides approximate auxiliary calculations for three material properties. **“Apply”** enters the result in the input field.

> **Note:** The auxiliary windows remember the most recently entered data independently of the project, even after a restart. This data is **not** saved in the project; only the applied result is.

Secant E-modulus: enter the **E0 modulus** (original modulus), the **Heat deflection temperature** and the **Joining/application temperature**. PolPartDesign calculates the modulus at the current maximum elongation (example: E0 = 2400 N/mm², HDT 130 °C, 23 °C → 2248 N/mm²). If you only know the Shore hardness, the **“…”** button next to the E0 modulus opens an approximate conversion from **Shore-D** or **Shore-A** to the original modulus.

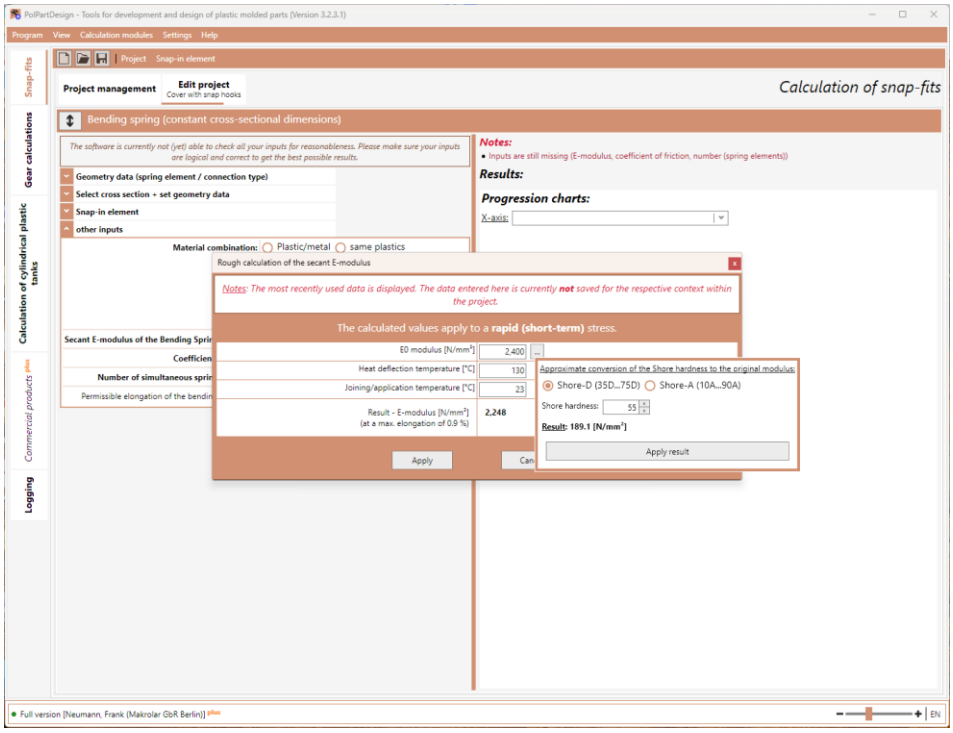


Figure 8: Secant E-modulus with Shore hardness conversion

The secant modulus is the modulus of elasticity at the elongation that actually occurs; for plastics it is considerably lower than the initial modulus and depends on temperature and load duration. The calculation therefore requires the **maximum elongation**, which in turn requires the geometry data. Depending on the connection type, further data may be needed; a note names it if necessary. Check the secant modulus again whenever you change geometry data.

Coefficient of friction: for each of the two plastics select the material assignment (e.g. amorphous or semi-crystalline thermoplastics, each by Shore hardness), the application condition and a friction value. The program derives the friction value of the pairing (example: 0.5 and 0.3 → 0.4).

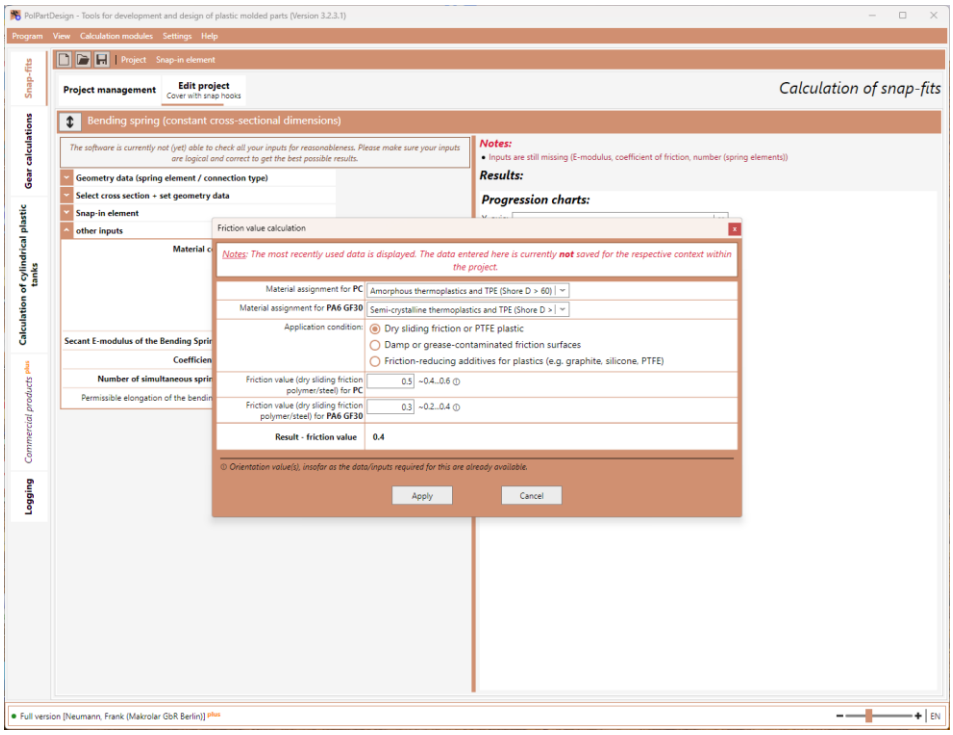


Figure 9: Auxiliary calculation of the coefficient of friction

Permissible elongation: select the **Material deformation characteristics** (brittle plastics, tough hard plastics with limited deformability, tough hard plastics with pronounced stretchability, or flexible plastics) and enter **Fracture/stretch limit elongation**, **Heat deflection temperature** and the **Assembly/disassembly number**. The values apply to a rapid (short-term) stress. In the example the result is 3.81 %.

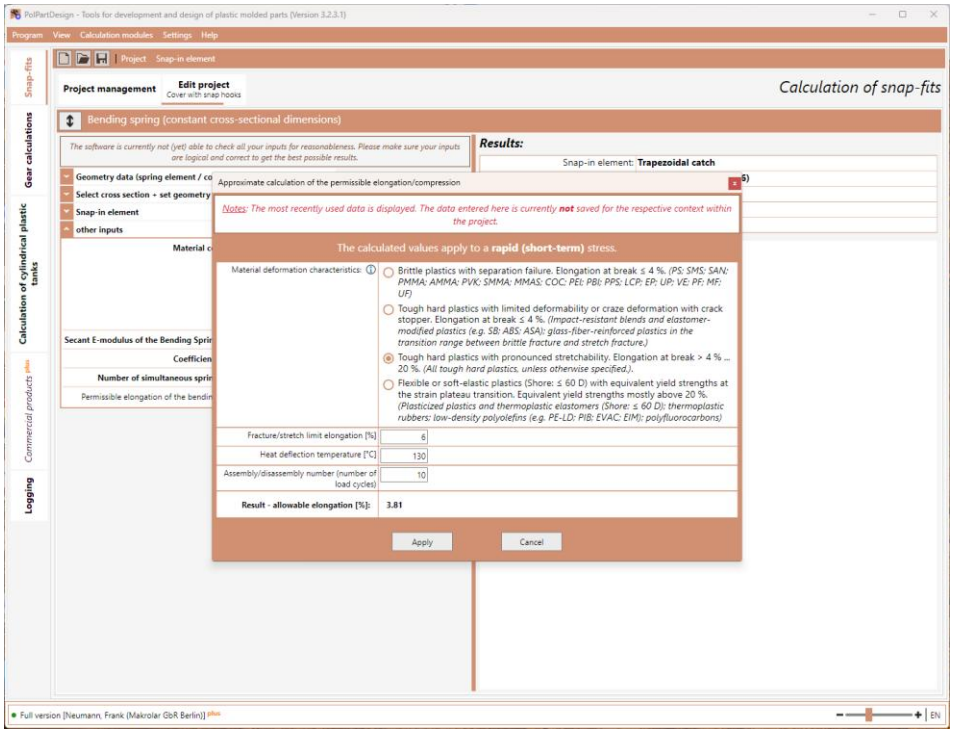


Figure 10: Auxiliary calculation of the permissible elongation

3.7 Results and progression charts

As soon as all data is complete, the **“Results”** area shows snap-in element, cross-section, **maximum edge fiber elongation**, **Joining power** and **Loosening power**. In the example: 0.90 % elongation (permissible 3.81 %), joining force 5.6 N, loosening force 13.2 N.

Under **“Progression charts”** select a quantity for the **X-axis**, e.g. **Snap height**, **Joining angle**, **Loosening angle**, **Coefficient of friction** or **Secant E-module**. The **“Value range”** slider sets the range; the check boxes show or hide **Joining power**, **Loosening power** and **maximum edge fiber elongation**. This shows you immediately how a change in geometry affects the result.

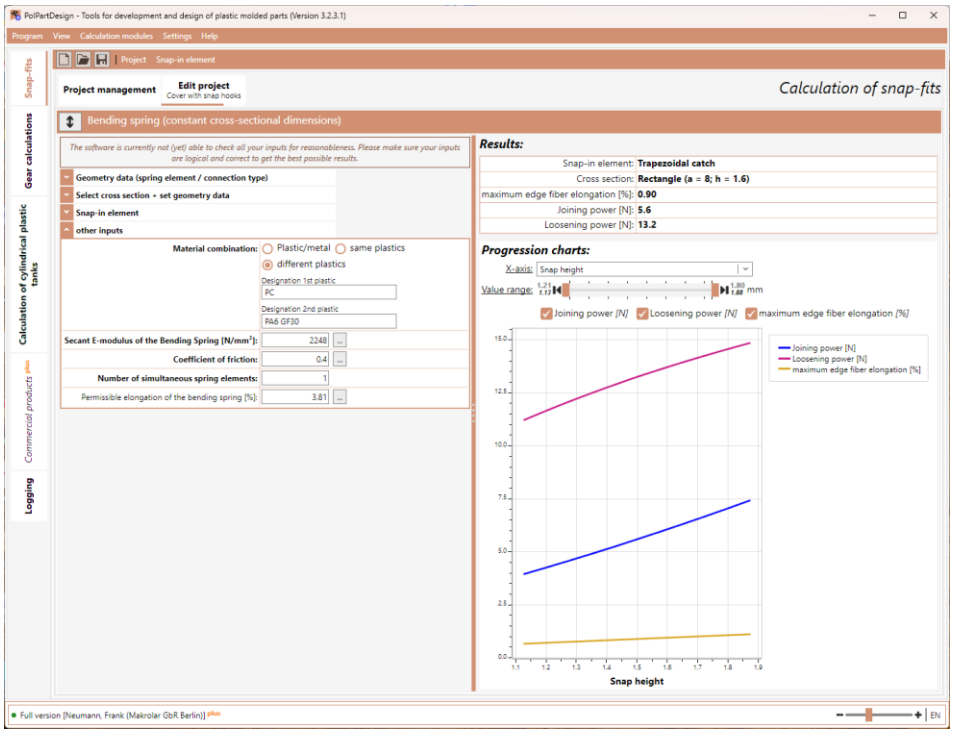


Figure 11: Results and progression chart over the snap height

> **Tip:** The double arrow to the left of the spring element title shows or hides the input area. The divider between inputs and results can be moved with the mouse.

3.8 Special notes

- **Ball snap-fit:** in addition to the insertion height h, the program calculates a minimum insertion height from the ball diameter and the permissible elongation. If the entered insertion height is smaller, a note appears.
- **Influence of shear force on short bending springs:** for very short bending springs, the influence of the shear force must be taken into account as the shear deformation component of the deflection. If the spring length falls below the relevant minimum length, a note appears; the decisive parameters are the cross-sectional area and the area moment of inertia, which you may need to adjust.
- **Plausibility:** the software cannot check all inputs for plausibility. Make sure that your inputs are technically logical and correct.

3.9 Saving and printing

The **“Project”** menu in the module bar contains **Create a new project…**, **Load project…**, **Save project**, **Save project as…** and **Printing / Print Preview…**. By default, projects are saved in the folder **Documents\PolPartDesign Files**.

The print preview contains the project header, results, the principle sketch with all dimensions, snap-in element, cross-section and material data. Use the printer icon to print the report and the zoom slider at the bottom to change the view.

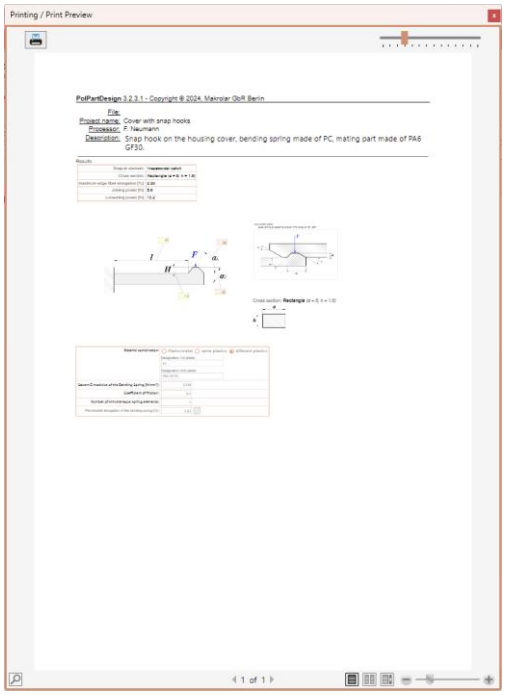


Figure 12: Print preview of a snap-fit

4 Gear calculations

This module calculates plastic spur gears based on DIN 3990: zero gears with 20° involute toothing, straight or helical gearing, for plastics with a modulus of elasticity according to DIN EN ISO 527 of at least 300 N/mm² or a Shore hardness above 60D. The example is a **spur gear stage**: pinion made of PA66-GF30 with 20 teeth, wheel made of PA66 with 60 teeth, module 1 mm, 20 W at 1500 rpm.

The calculated load capacity verifications cover **tooth root strength**, **tooth flank pressure**, **tooth deformation** as well as **tooth bulk and tooth flank temperature**, each with the corresponding calculated safety factors. If necessary, gears with profile shift can be calculated by adapting the relevant calculation variables and influence factors according to DIN 3990. Strength verifications and temperature checks for metal gears in combined gear pairs are not calculated. Process multi-stage gearboxes – taking the power split into account – as separate projects, one per stage.

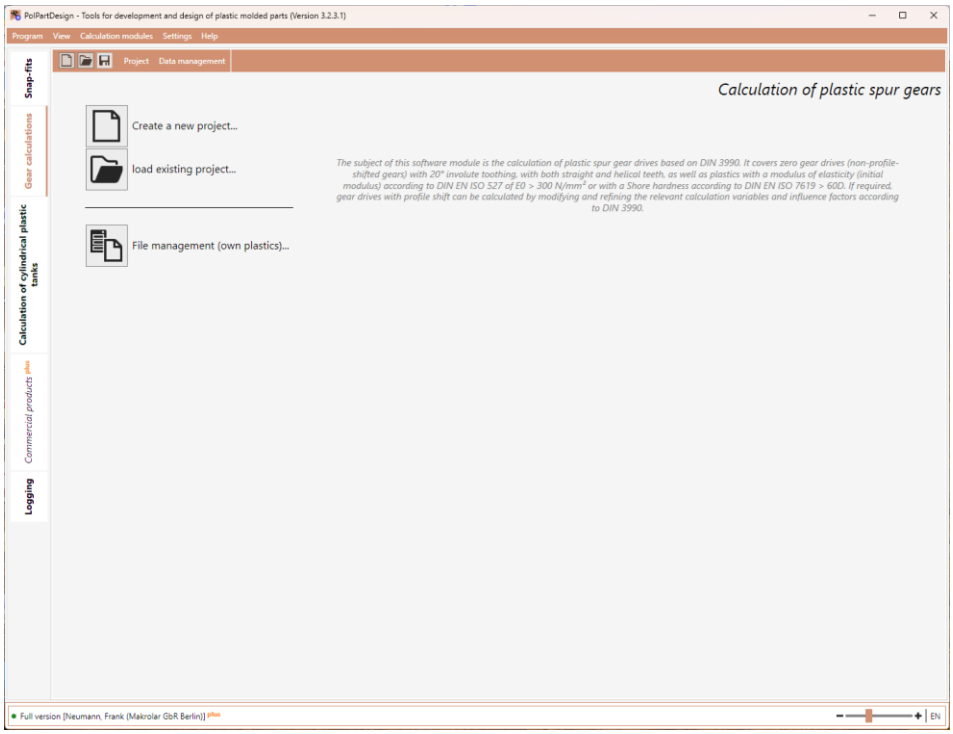


Figure 13: Start page of the "Gear calculations" module

4.1 Creating a new project

Click **"Create a new project..."**. The wizard asks for the data in six steps.

1. **General project information:** project name, processor and description.
2. **Gear stage / normal module: Outer wheel stage**, **Inner gear stage** or **Planetary gear stage**. Enter the **Standard module** directly or select it via **"..."** from preferred series I and II according to DIN 780.
3. **Materials / material pairing:** select the wheel material on the left and the pinion material on the right. The list contains the database materials (each dry and wet) and your own materials (section 4.4).
4. **Toothing / Number of teeth / Tooth width / Shielding:** straight or helical gearing, number of teeth and tooth width for wheel and pinion (the pitch circle diameter is calculated) and the **Gearbox shield**: open, partially closed or closed gearbox. For a closed gearbox, enter the surface of the gearbox housing without bottom surface in m².
5. **Mode of operation / speed / power:** operation of the gearbox with application factor (consistent 1.0; light to moderate impacts 1.35; moderate to medium impacts 1.75; strong impacts 2.25 or own factor). Then specify either the **torque** or the **gearbox nominal power**; speed and torque of the other gear are calculated.
6. **Lubrication / friction coefficient / temperature / running time:** dry operation, single grease lubrication, oil mist or splash oil lubrication; friction value of the material combination or own friction value; gearbox ambient temperature; continuous or intermittent operation and total running time in hours.
7. Click **"Finish"**. You can answer the subsequent question about saving with **"No"** and save later.

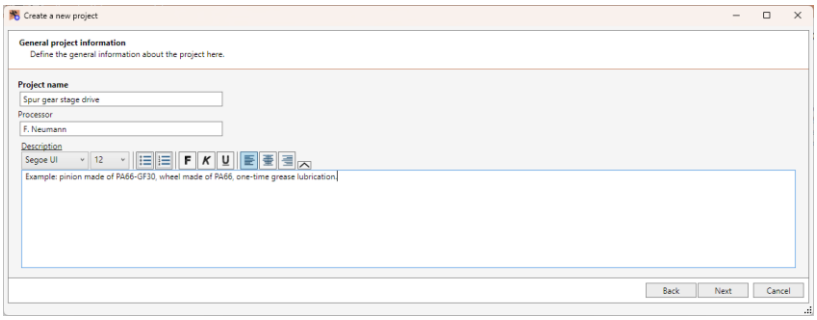


Figure 14: Wizard: general project information

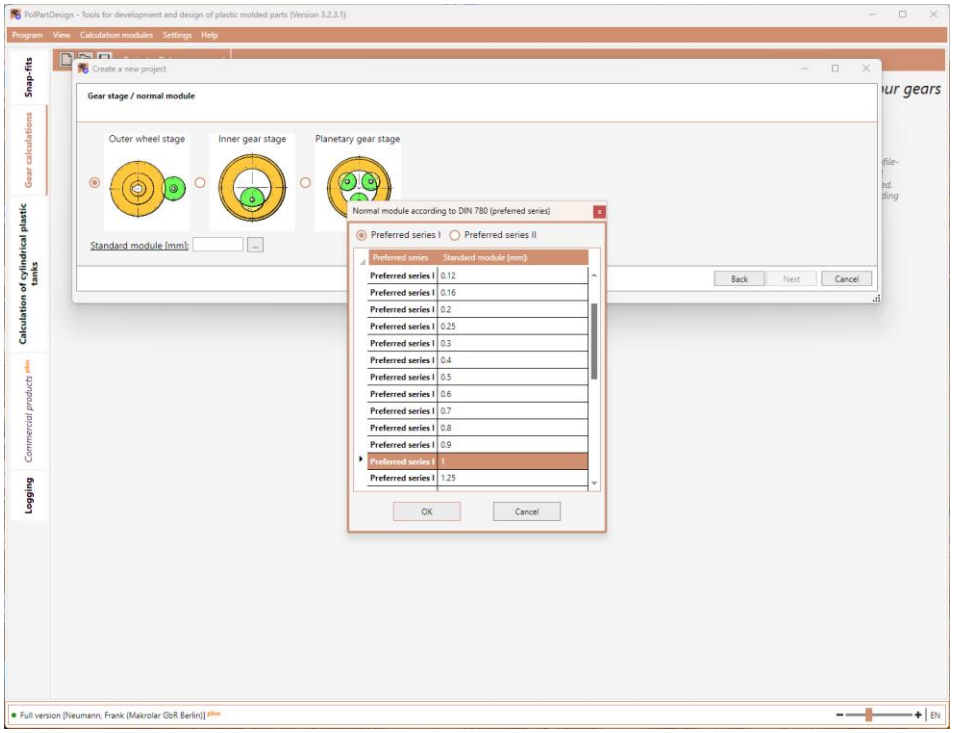


Figure 15: Selecting the normal module according to DIN 780 from the preferred series

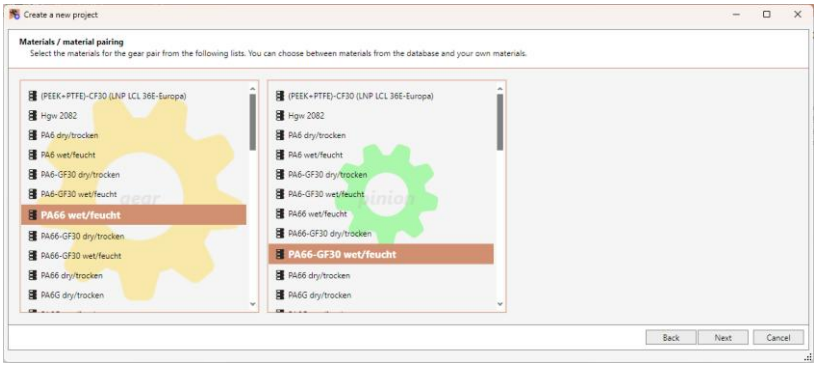


Figure 16: Wizard: material pairing (left wheel, right pinion)



Figure 17: Wizard: toothing, number of teeth, tooth width and shielding

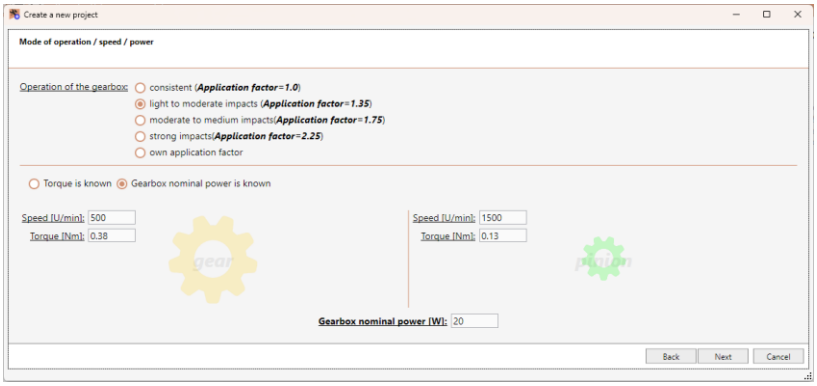


Figure 18: Wizard: mode of operation, speed and power

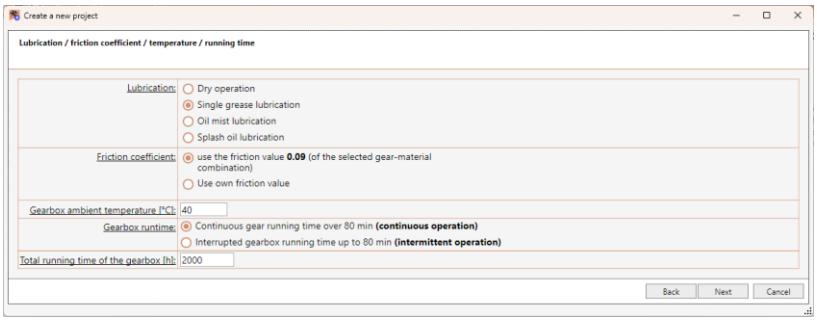


Figure 19: Wizard: lubrication, friction coefficient, temperature and running time

Background to individual inputs:

- **Normal module:** the module is the ratio of pitch diameter to number of teeth (m = d / z). The normal module is the module in the normal section, i.e. in the (spatially curved) section perpendicular to the flank lines. Only gears with the same module can be paired; the preferred series according to DIN 780 make it easier to select matching gears and allow standardized tools.
- **Number of teeth:** the minimum number of teeth is 14. If you change the number of teeth of one gear, the speed of the other gear is recalculated.
- **Gear shielding:** this covers gear housings as well as any enclosures, walls or covers specified by the design that shield the gears from the free environment.
- **Torque and rated power:** if you change the torque, the rated power and the torque of the other gear are calculated; if you change the rated power, both torques are recalculated.
- **Application factor:** additional dynamic forces from the driving and driven machines are taken into account by the application factor according to DIN 3990 Part 1. These can be estimates or specified operating values.
- **Running time:** in intermittent operation, the thermal equilibrium of tooth bulk and tooth flank temperature depends on the running time per cycle. For running times above 80 min, continuous

operation can be assumed; otherwise the **relative duty cycle** (ratio of operating time to rest time) determines the level of the tooth temperatures. The number of load cycles of the pinion is calculated from the total running time.

- **Material pairing:** the material lists contain metals and plastics; at least one gear of the pair must be made of plastic. A symbol in the first column indicates whether the data comes from the supplied database or from an own plastic file. For metals, only the database values can be used. Where possible, the friction coefficient of the pairing is calculated; an own friction coefficient replaces it.

4.2 Results and notes

After the wizard, the inputs are shown on the left in collapsible sections and the **“Results and notes”** area on the right. Every change on the left is recalculated immediately.

Result	Example / meaning
Tooth mass temperature	42 °C
Tooth flank temperature	44 °C (permissible 128.3 °C)
Safety – tooth root strength (pinion)	27.7 (permissible 81.4 / existing 2.9 N/mm²)
Safety – tooth root strength (gear)	13.7 (permissible 37.5 / existing 2.7 N/mm²)
Safety – tooth flank pressure	9.4 (permissible 78.8 / existing 8.4 N/mm²)
Tooth deformation / permissible tooth deformation	0.03 mm / 0.1 mm
Number of load cycles pinion / gear / determining	180,000,000 / 60,000,000 / 180,000,000
Center distance, friction and damping losses	40 mm; 0.31 W; 0.21 W

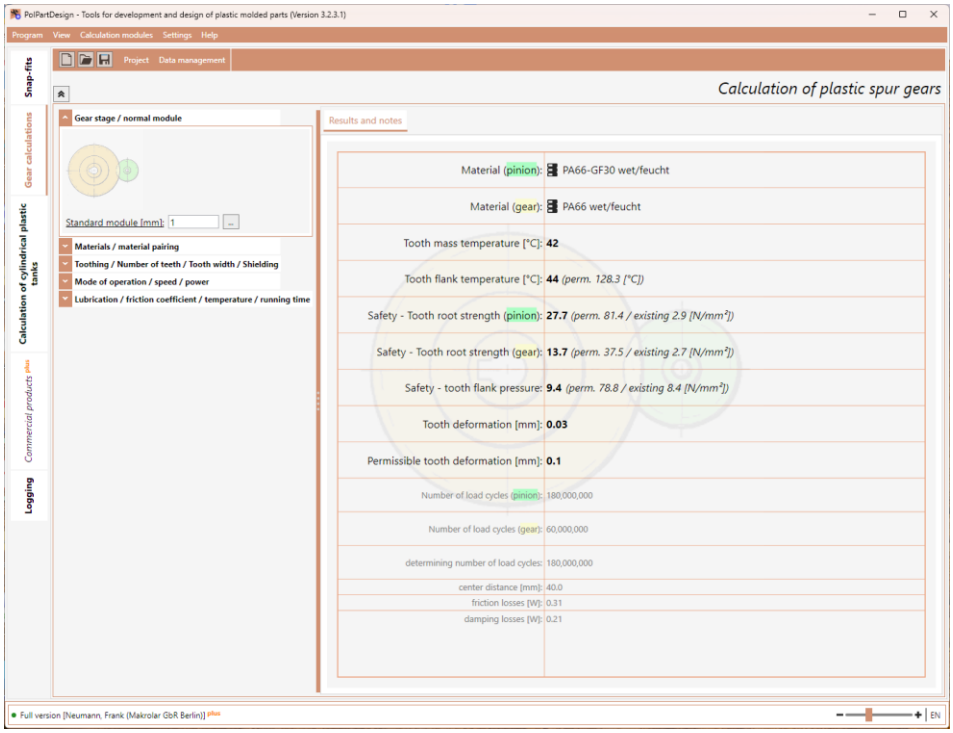


Figure 20: Results and notes of the gear calculation

Calculation basis of the results:

- The **tooth bulk temperature** is based on a heat balance of friction and mechanical damping losses combined with a refined heat transfer model.

- The **tooth flank temperature** is determined with a modified integral temperature method according to DIN 3990. Continuous heat dissipation by oil in oil lubrication is not taken into account.
- For the **permissible tooth flank temperature**, a permissible heat ageing time tperm of 5000 h is used for the plastics of the database. For own plastics, the permissible ageing temperature and permissible heat ageing time must be entered.
- The **safety of the tooth root strength** is not calculated for a metal gear.
- The calculations are not identical in content and scope to the withdrawn VDI 2545; in particular, the tooth temperatures are not based on the empirical relationships of Hachmann/Strickle/Erhard.

To change an input, expand the corresponding section, e.g. **“Materials / material pairing”**, and select a different material.

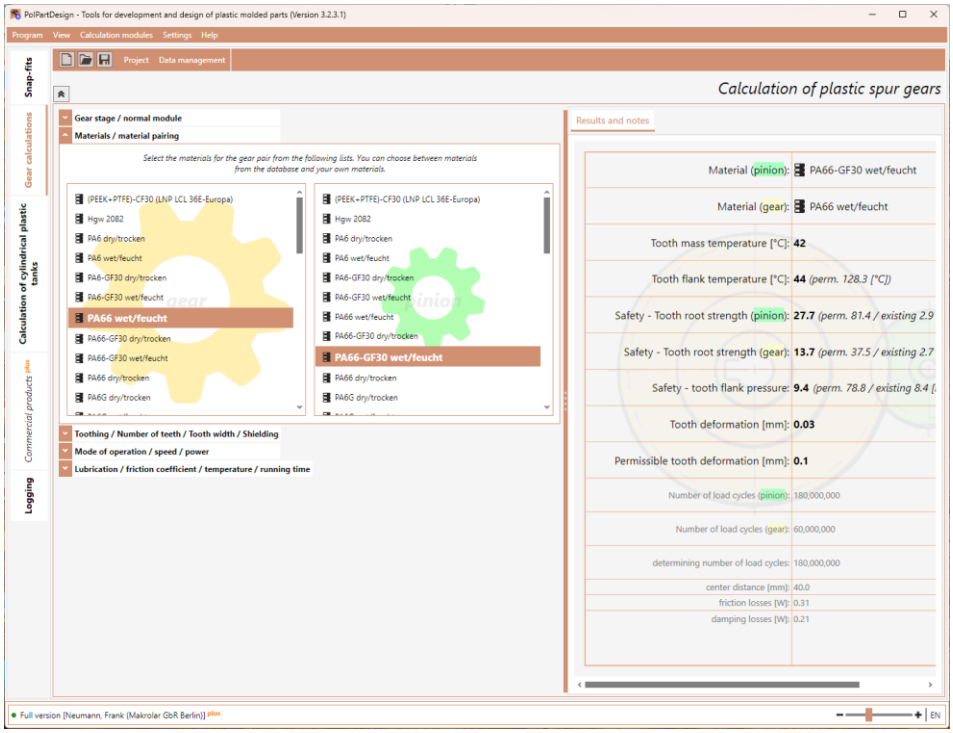


Figure 21: Changing the material pairing afterwards

4.3 Project menu and project details

The **“Project”** menu contains **New project…**, **Load project…**, **Save project**, **Save project as…**, **Close project**, **General project information…** and **Printing / Print Preview…**. Gear projects have the file extension **.polpd**. Use **“General project information…”** to change project name, processor and description.

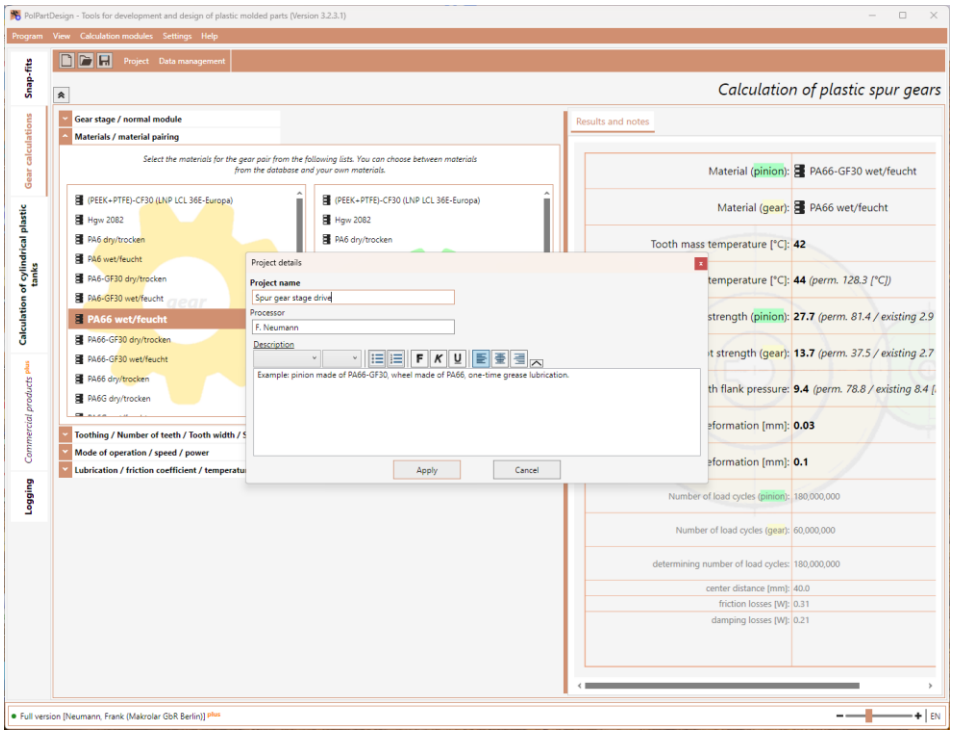


Figure 22: Changing the general project information

The print preview summarizes the project header, results and all inputs and intermediate results with sketches of wheel and pinion on one page.

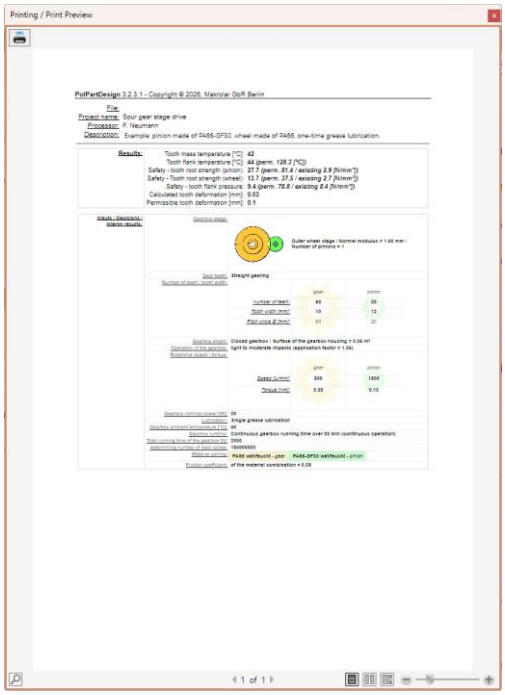


Figure 23: Print preview of the gear calculation

4.4 Data management and own plastics

The **“Data management”** menu contains:

- **File management…** (also via **“File management (own plastics)…”** on the start page): create and maintain your own materials.

- **Molding compound data from the database…**: table of the supplied plastics with heat penetration coefficient, deformation characteristics, heat deflection temperature, modulus of elasticity, transverse contraction coefficient and other properties (read only).
- **Metal data from the database…**: properties of metals for plastic/metal pairings.

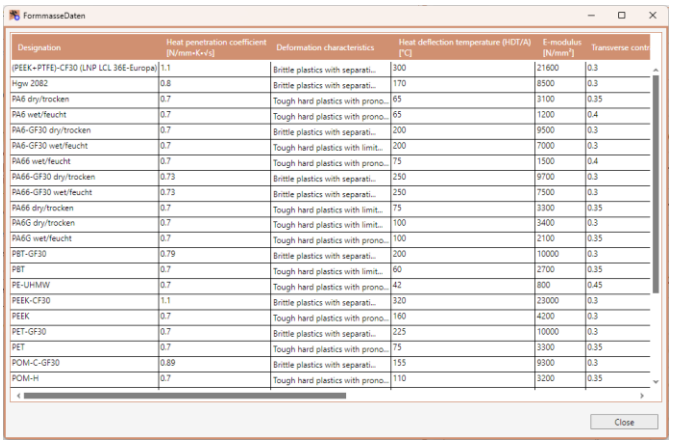


Figure 24: Molding compound data from the database

The plastics data in the database are orientation or average values and can be used without further refinement. Exact property values depend, among other things, on additives, fillers and reinforcements; to take such modifications into account, create your own plastics.

At the top of the **"own plastics"** window you see the storage directory (by default **Documents\PolPartDesign Files**). Your materials are listed on the left, the properties of the selected entry on the right. Use the toolbar icons to create a **new** entry, **edit**, **save** or **delete** it.

An own plastic includes, among others, molding compound designation, material assignment (semi-crystalline or amorphous thermoplastics, PTFE, thermosets, LCP), friction-reducing additives, heat penetration coefficient, deformation characteristics, fracture/stretch limit elongation, heat deflection temperature, E0 modulus, transverse contraction coefficient, damping factor and coefficient of friction for dry running; optionally permissible temperature and number of load cycles. Next to many fields the program shows orientation values; number symbols (e.g. ❸) show which other inputs an orientation value depends on – for example Poisson's ratio and damping factor on the modulus of elasticity.

The permissible ageing temperature and permissible heat ageing time are optional but are needed for the permissible tooth flank temperature; you can determine them with PolSelec, for example. You can calculate the heat penetration coefficient via **"Calculate"** from density, thermal conductivity and specific heat capacity; the list of around 150 materials corresponds to the calculation module in section 6.3. You specify the storage location of the files under **"Settings" → "Options…"**; the files are read from there when the program starts.

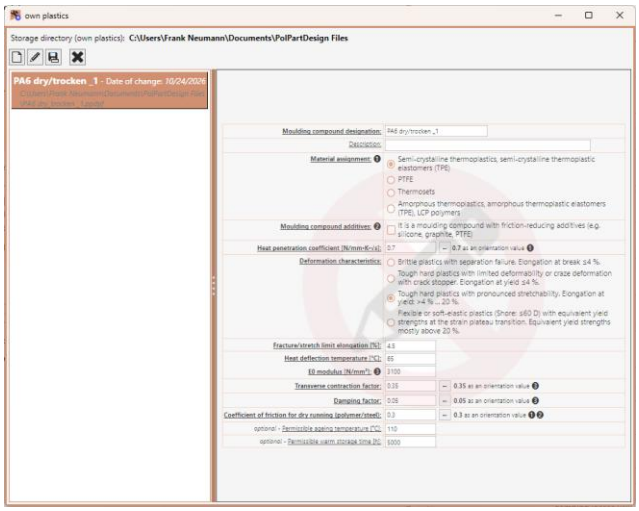


Figure 25: Managing own plastics

> **Note:** Own plastics are saved as files with the extension **.ppdpf** and then appear in the material lists of the wizard and the project view.

5 Calculation of cylindrical plastic tanks

This module calculates the **minimum wall thickness** of upright cylindrical tanks with liquid filling and performs a **proof of strength** with the selected wall thickness. Example: welded **storage tank** made of PP-H for water, diameter 1200 mm, fill level 2000 mm.

For the load during the application time, the program distinguishes two types of time history:

- **static load:** a continuously constant fill level, where the liquid temperature can vary in sub-cycles;
- **intermittent load:** interrupted loading by identical or different load cycles. A load cycle is defined by time, constant liquid temperature and minimum and maximum fill level; the overall load scheme can contain one or more load cycles.

Prerequisites of the calculation:

- The upper edge of the tank is free, the lower edge is fixed to the base so that it cannot move.
- The constant wall thickness s is small compared with the diameter d (membrane state).
- The tank wall consists of an isotropic or orthotropic material.

The program determines the required material data from basic data using an internal procedure and suggests them as orientation values.

5.1 Creating a new project

Under **Project management**, click **“Create a new project”**. The wizard asks for the basic decisions:

- **Type of load:** static or intermittent load.
- **Plastic material:** isotropic or orthotropic plastic.
- **Welded or glued construction:** tick the check box if the tank is welded or glued.
- **Project name** and **Processor**.

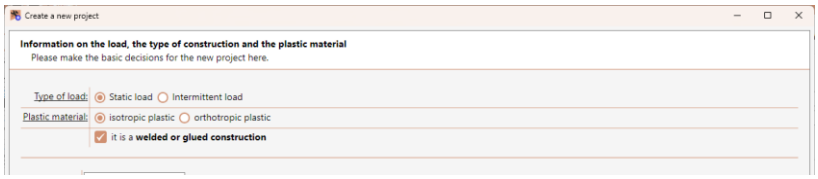


Figure 26: Wizard: load, type of construction and material

> **Important:** For welded or glued constructions you must take a corresponding reduction in strength into account. Reduce the permissible elongation accordingly (section 5.3).

5.2 Basic data and temperature/load scheme

Under **“Basic data”**, enter the **Designation of the liquid** and its **Density** in g/cm³. Under **“Temperature and load scheme”** follow the **Diameter** d in mm and the scheme itself.

Click **“Edit scheme…”**. In the window, set the **Fill level** and enter time periods with **Start**, **Duration** (in hours) and **Liquid temperature** in the table. This lets you model operating phases with different temperatures at the same fill level. The chart on the right shows fill level and temperature over the application time. In the example: 1000 h at 23 °C, then 1000 h at 40 °C.

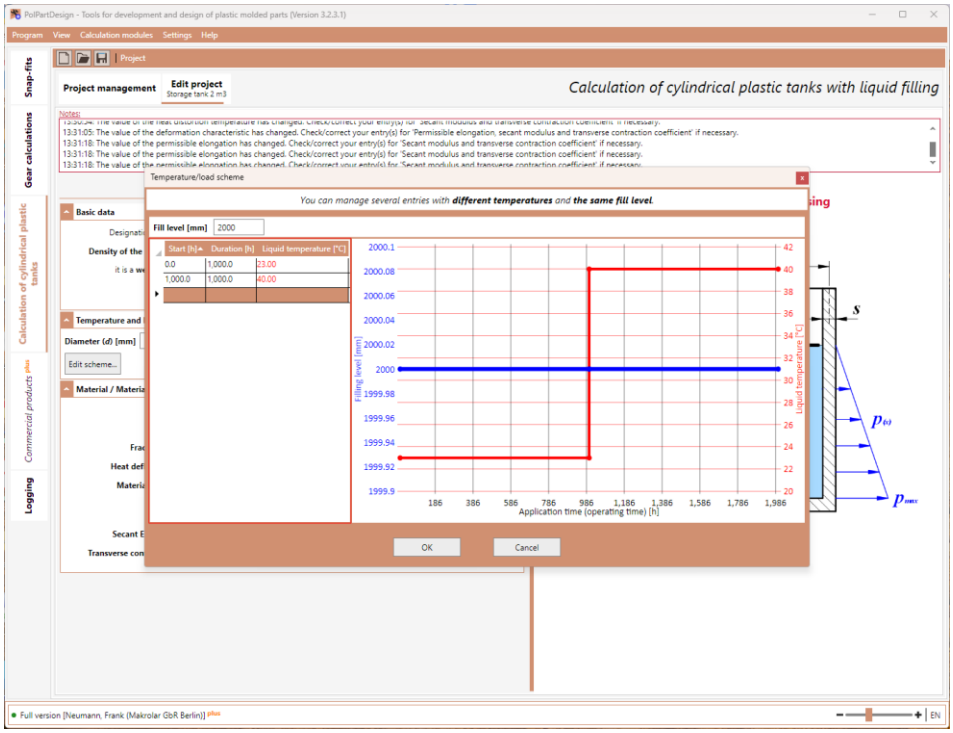


Figure 27: Editing the temperature/load scheme

For **intermittent load**, you define load cycles for the total operating time. For each load cycle you enter the maximum and minimum fill level, the time portions with maximum and minimum load, the number of cycles and the liquid or application temperature. For each load cycle, the program calculates the specific material data as orientation values and an individual minimum wall thickness. The load cycle with the largest minimum wall thickness governs the further calculation.

5.3 Material data

In the **“Material / Material data (isotropic plastic)”** section, enter:

Field	Example / note

Field	Example / note
Moulding compound designation	PP-H
E0 modulus [N/mm²]	1300
Fracture/stretch limit elongation [%]	10
Heat deflection temperature (HDT/A) [°C]	100
Material deformation characteristics	Tough hard plastics with pronounced stretchability
Permissible elongation [%]	1.5 (deliberately below the suggested 3.8 because of the welds)
Secant E-module (tensile stress) [N/mm²]	527
Transverse contraction number (secant module)	0.45

To the right of **Permissible elongation**, **Secant E-module** and **Transverse contraction number**, a button shows the value PolPartDesign calculates from your other inputs. Clicking it applies that value. As long as data is missing (e.g. the load scheme), the button shows **"--"**.

> **Note:** If you change a value that others depend on, the notes list above the inputs tells you which entries to check (e.g. "The value of the E0 module has changed…").

Strength reductions. If there is a risk of stress cracking or similar strength reductions, base the permissible elongation on the critical strain: **εperm ≈ εcrit / 3**. The following guide ranges of critical strains come from tests in air. They result from structural influences of the material and the measuring principle of the test methods, so they are not characteristic values of individual polymers, and should be used in line with the usual safety assessment for different requirements and risks.

Polymers	Service temperature	εcrit [%]	Examples
Amorphous thermoplastics (except PS)	below Tg	0.6 … 0.9	PC, ABS, SAN, PVC-U, PMMA, SB, PSU, PESU, (PC+ABS), (PPE+SB)
Polystyrene	below Tg	0.2 … 0.3	PS
Semi-crystalline thermoplastics	below Tg	0.4 … 0.8	PA6, PA66, PA610 (each dry), PEEK
Semi-crystalline thermoplastics	above Tg	1.5 … 2.5	PA6, PA66, PA610 (each conditioned), PP, PE-HD, POM
Glass-fiber-reinforced thermoplastics (over 15 % GF)	below Tg	0.2 … 0.3	all thermoplastics
Glass-fiber-reinforced thermoplastics (over 15 % GF)	above Tg	0.3 … 0.5	all thermoplastics
Glass-mat-reinforced thermosets (over 10 % GM)	–	0.3 … 0.5	UP, EP
Thermoset molding compounds (compression and injection)	–	(0.2 … 0.3) · εB	all types according to DIN EN ISO 14526 to 14530 (PMC) and DIN EN 14598 (BMC, SMC)

Tg: glass transition temperature of the amorphous polymer phase; εB: elongation at break according to DIN EN ISO 527.

5.4 Results

Under **“Calculations / Results”** on the right you find the **Minimum wall thickness** and the ordinate of the maximum stress. Enter the intended wall thickness in **“Selected wall thickness”**; the **proof of strength** (maximum/permissible stress) and the **safety factor** then appear.

Result	Example
Minimum wall thickness	1.49 mm
Ordinate of the maximum stress (minimum wall thickness)	72 mm
Selected wall thickness	3 mm
Ordinate of the maximum stress (selected wall thickness)	101 mm
Proof of strength (max./permissible tension)	3.92 / 7.91 N/mm²
Proof of strength (safety factor)	2.01
Resulting application or liquid temperature	31.5 °C
Maximum wall pressure	0.020 N/mm²

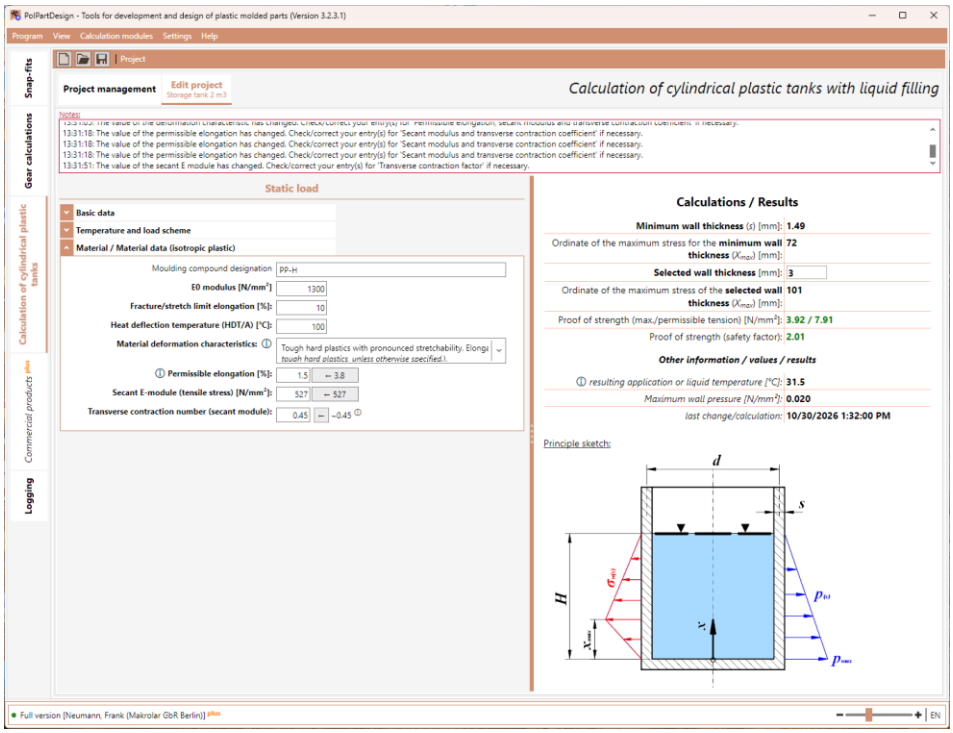


Figure 28: Inputs and results of the tank calculation

5.5 Saving and printing

Saving and printing work in the same way as for snap-fits, via **Project management** or the **“Project”** menu. The report contains all inputs, the load scheme and the results.

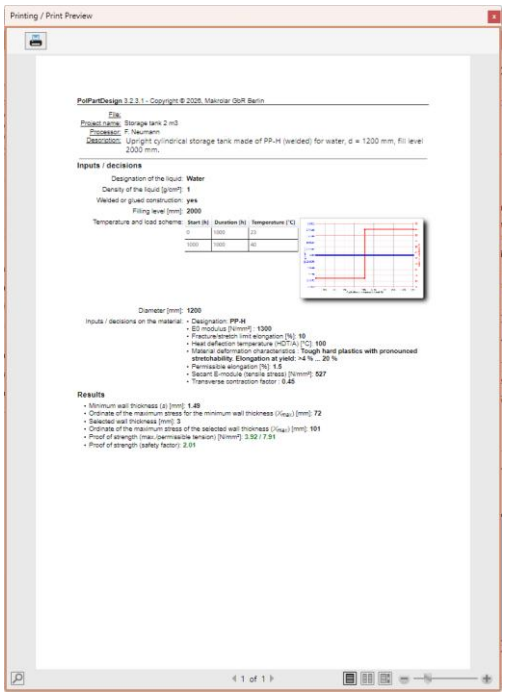


Figure 29: Print preview of the tank calculation

6 Calculation modules

The **“Calculation modules”** menu in the main menu bar contains three auxiliary calculations that you can call independently of a project and from any tab. They are used to quickly estimate material properties, e.g. before creating a project. The results are not saved; **“Close”** closes the window.

6.1 Calculate modulus of elasticity

The **“Secant/tangent e-module”** window estimates the modulus of elasticity of a plastic under operating conditions:

Input	Meaning
E-modulus	**Secant E-module** or **Tangent e-module**.
Type of load	**Tension / compression** or **Bending / torsion / shear**.
Type of time course	**rapid**, **static**, **intermittent**, **oscillating (swelling)** or **oscillating (alternating)**. The principle sketch on the right shows the selected course; depending on the type, further fields appear, e.g. **Load time** for static load.
E0 modulus [N/mm²]	Original modulus of the material.
maximum elongation [%]	Elongation at which the modulus is to be determined.
Heat deflection temperature [°C]	HDT of the material.
Application temperature (TA) [°C]	Temperature in use.

Once all fields are filled in, the **Result of the approximate calculation** appears at the bottom. Example: PP with E0 = 1300 N/mm², 1 % elongation, HDT 100 °C, 40 °C and 10,000 h static load → secant modulus 450.6 N/mm².

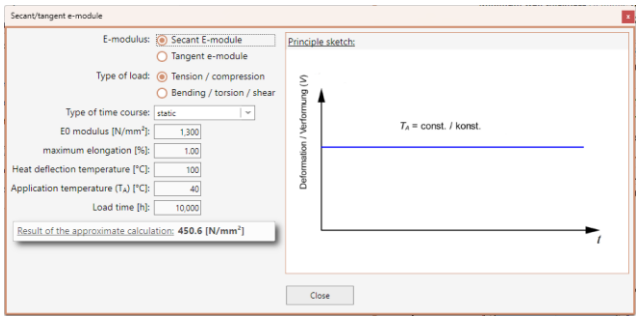


Figure 30: Calculation module "Calculate modulus of elasticity"

6.2 Calculate permissible elongation

The **"Permissible elongation"** window estimates the permissible elongation of a plastic. Select the **Type of time course** and the **Material deformation characteristics** (brittle plastics, tough hard plastics with limited deformability, tough hard plastics with pronounced stretchability or flexible plastics; the info icon explains the groups with examples) and enter **Fracture/stretch limit elongation**, **Heat deflection temperature** and, if applicable, the **Load time**.

Example: tough hard plastic, yield elongation 10 %, HDT 100 °C, 10,000 h static load → permissible elongation 3.48 %.

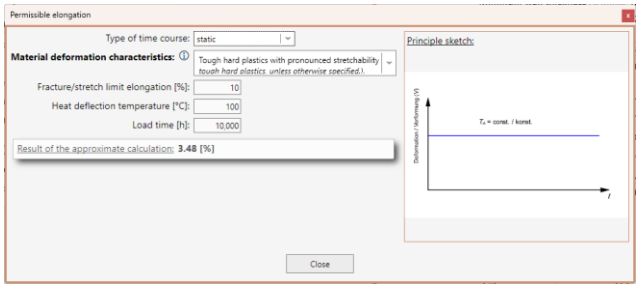


Figure 31: Calculation module "Calculate permissible elongation"

6.3 Calculate heat penetration coefficient

The heat penetration coefficient b = √(λ · ρ · c) describes how quickly a material absorbs heat; it is needed, for example, for the temperature calculation of gears. Enter **Density** [g/cm³], **Thermal conductivity coefficient** [W/m·K] and **Specific thermal capacity** [J/g·K]; the result is shown in N/(mm·K·√s).

On the left, the window lists **orientation values** of common plastics (abbreviation and designation). **Double-clicking** a row copies its values into the input fields. Example: PA6 GF30 → density 1.36 g/cm³, thermal conductivity 0.24 W/m·K, thermal capacity 1.5 J/g·K → heat penetration coefficient 0.7.

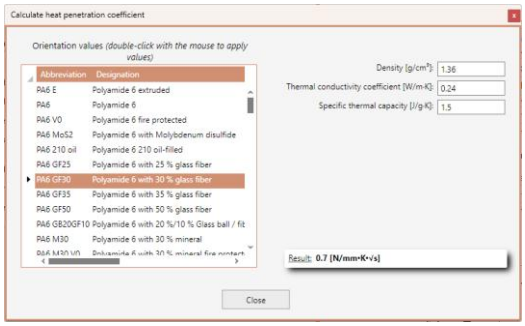


Figure 32: Calculation module "Calculate heat penetration coefficient" with orientation values

> **Tip:** The auxiliary calculations within the projects (e.g. the **"…"** buttons for snap-fits) use the same methods but apply the result directly to the project.

7 Menus

Menu	Commands
Program	**Exit Program**; **Info about…**
View	Switch between **Snap-fits**, **Gear calculations**, **Plastic tank calculations** and **Commercial products**; **Original size (100%)**; results change view.
Calculation modules	**Calculate modulus of elasticity…**, **Calculate permissible elongation…**, **Calculate heat penetration coefficient…** (chapter 6)
Settings	**Server connection…**; **Activate the license…**; **Reset the license…**; **Options…**; **Language/Sprache…**
Help	**Check for software update…**; **To our homepage…**; **Register for the software…**; **View online help**; **View local help…** (F1 key); **View local Help (Commercial products database)…**
Project (module bar)	New project, Load, Save, Save as, Printing / Print Preview; for gears additionally **Close project** and **General project information…**
Snap-in element (snap-fits)	Select a different snap-in element.
Data management (gears)	**File management…**; **Molding compound data from the database…**; **Metal data from the database…**

8 Tips and frequently asked questions

Question	Answer
Why are no results shown?	Inputs are still missing. The "Notes" area or the red message "Inputs/decisions are still missing" names the missing data.
Can I change decisions from the wizard later?	Yes. All data can be changed in the project view; the results are updated immediately.
Are the values of the auxiliary calculations saved?	No, only the applied result is saved in the project.
How do I find the best geometry for a snap-fit?	Use the progression charts: select the quantity to vary as X-axis and read off forces and elongation.
My material is missing from the gear database.	Create it as an own plastic under "Data management → File management…".
The tank is welded. What do I need to consider?	Tick the check box for welded or glued construction and reduce the permissible elongation according to the weld quality.