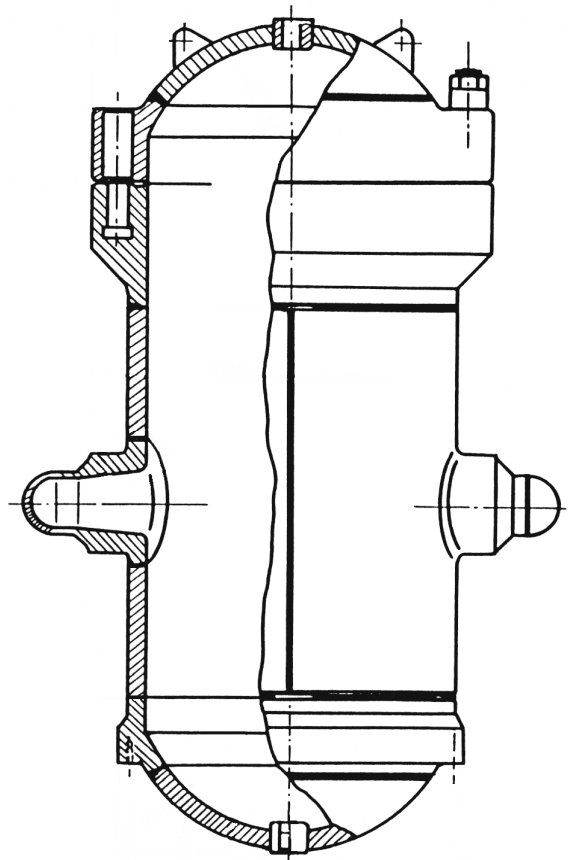

Manual for the program

EN13445



Lauterbach Verfahrenstechnik
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1 / 2011

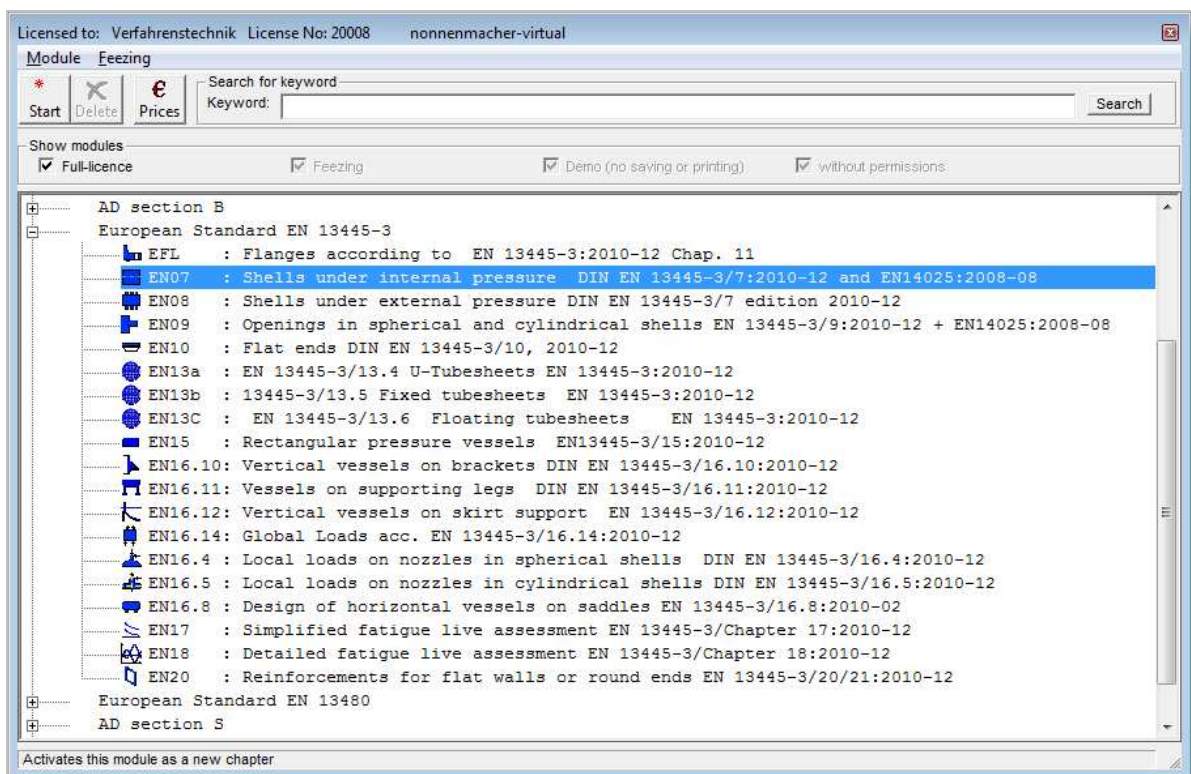
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Working with a single module in pressure vessel design

Program start

The basic features and the graphical interface are identical in all strength calculation modules. Start the strength calculation program and select the **'EN07'** module in the tree view. In the next window select **'cylindrical shell'** as construction type.



Input of design data

Enter your design and material data into the input mask. Input values are printed in **black** and calculated values are printed in **blue**.

The screenshot shows the software interface with the following data:

Material:	
Material designation	Number 1.0345
Wall thinning allowance	δe 0.4 mm
Corrosion allowance	c 1 mm
Thinning allowance during manufacturing	δm 0 mm
Sum of allowances	$\Sigma(\delta)$ 1.4 mm
Material strength (Re, Rp, Rm)	K 207 N/mm ²
Safety factor acc. EN 13445	S 1.5
Allowable stress	f 138 N/mm ²

Result	
Inside diameter	Di 592.8 mm
Mean diameter	Dm 596.4 mm
Geometrical ratio	e/De 0.004314
Analysis thickness	ea 3.6 mm
Required thickness	e 2.589 mm
Required thickness with allowances	e δ 3.989 mm
Maximum permissible pressure	Pmax 16.66 bar

Load case: Operation
 The strength condition is valid
 The geometrical condition is valid
The design is adequate for EN13445-3 requirements

Selecting the material

Enter the material number **1.0345** into the material field:

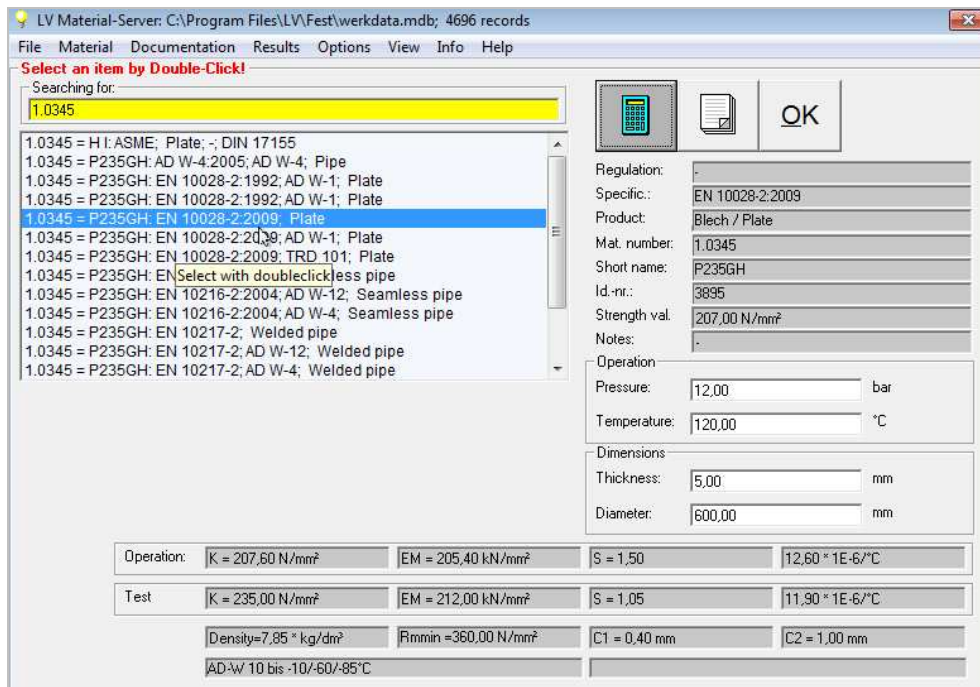
The screenshot shows the software interface with the following data:

7.4.2 Cylindrical shells under internal pressure

Regulation (0=EN13445-3, 1=EN14025)	TFZ	0 (0,1)
EN 13445-3: Unfired pressure vessels		
Load case: Operation = 1 / Test = 2	lc	1 1,2
Calculation temperature	t	120 °C
Calculation pressure	P	12 bar
Final wall thickness acc. drawing	en	5 mm
Outside diameter	De	600 mm
Weld factor (= λ acc. EN 14025)	Z	

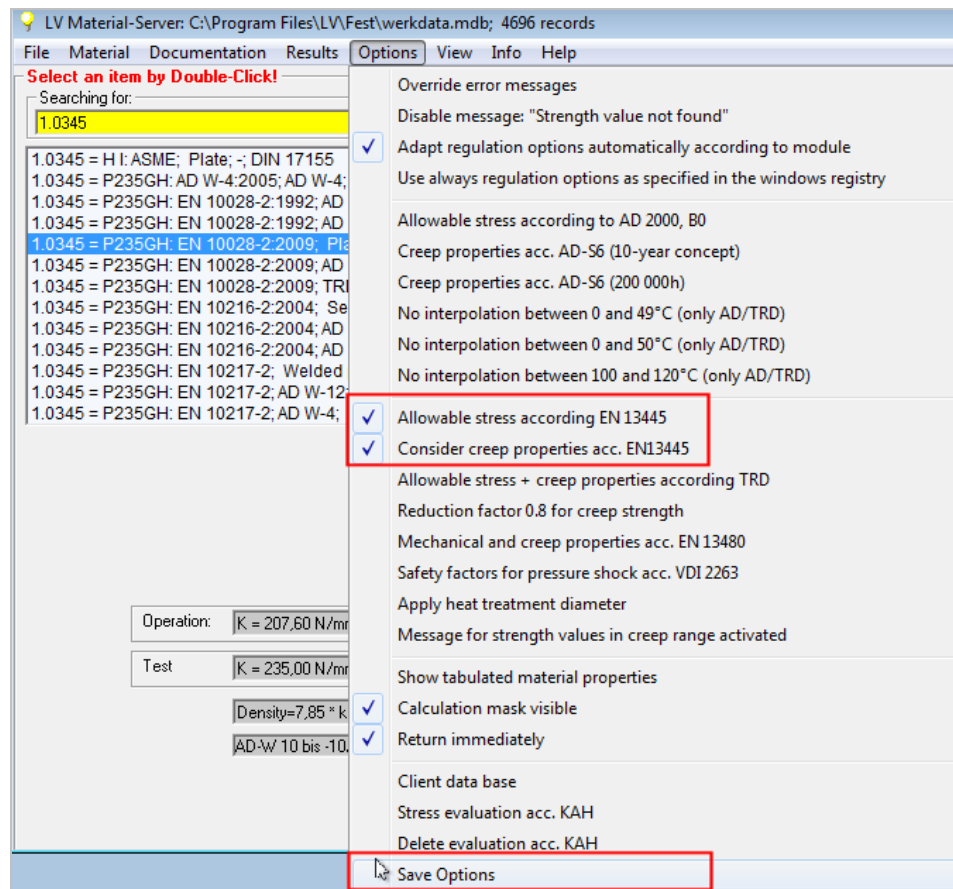
Material:	
Material designation	Number 1.0345
Wall thinning allowance	δe [Material code]
Corrosion allowance	c mm
Thinning allowance during manufacturing	δm 0 mm
Sum of allowances	$\Sigma(\delta)$ mm
Material strength (Re, Rp, Rm)	K N/mm ²
Safety factor acc. EN 13445	S
Allowable stress	f N/mm ²


In the next field select the plate according EN 10028-2:2009 by double-click:




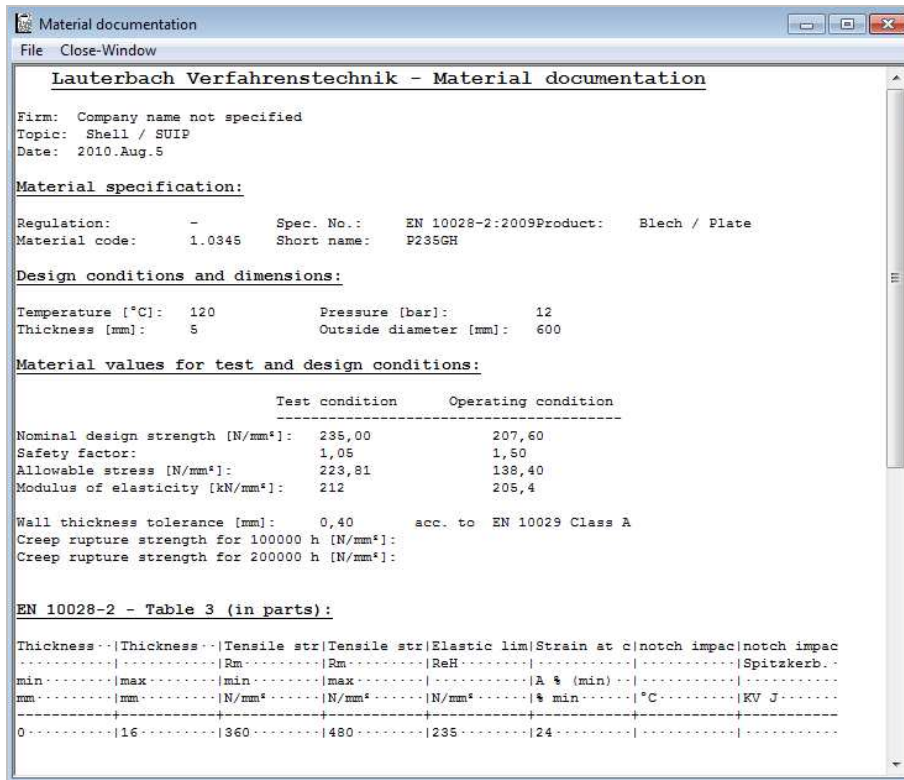
1. The regulation → -
2. The material → Plate
3. The standard → EN 10028-2:2009
4. The material number → 1.0345

Please make sure that the options '**Safety factors according EN 13445**' is activated and save the options for a new start:



By clicking the button '**Update strength**'  , the material data are updated on the mask. The button

Documentation:  shows a detailed material documentation with characteristic values and comments from the according regulations.



By clicking the **OK** button, the material values are transferred to the input mask and the program switches back.

Calculation

Enter the missing data. Each input value leads to possible calculations, which are performed immediately. For example after having entered the material code, the analysis wall thickness **ea** is calculated at once.

7.4.2 Cylindrical shells under internal pressure	
Regulation (0=EN13445-3, 1=EN14025) EN 13445-3: Unfired pressure vessels	TFZ 0 (0.1)
Load case: Operation = 1 / Test = 2	lc 1 1.2
Calculation temperature	t 120 °C
Calculation pressure	P 12 bar
Final wall thickness acc. drawing	en 5 mm
Outside diameter	De 600 mm
Weld factor (= λ acc. EN 14025)	Z
Material:	
Material designation	Number 1.0345
Wall thinning allowance	δ e 0.4 mm
Corrosion allowance	c 1 mm
Thinning allowance during manufacturing	δ m 0 mm
Sum of allowances	Σ(δ) 1.4 mm
Material strength (Re, Rp, Rm)	K 207 N/mm²
Safety factor acc. EN 13445	S 1.5
Allowable stress	f 138 N/mm²
Result	
Inside diameter	Di 592.8 mm
Mean diameter	Dm 596.4 mm
Geometrical ratio	e/De
Analysis thickness en - Σ(δ)	ea 3.6 mm
Required thickness	e mm
Required thickness with allowances	eδ mm
Maximum permissible pressure	Pmax bar

If a field has not been calculated, the required input values are missing. To see which values are required to calculate the missing value, right click on the variable and select 'Ask variable' or enter a 'question mark (?)'. All dependent values are highlighted:

7.4.2 Cylindrical shells under internal pressure	
Regulation (0=EN13445-3, 1=EN14025) EN 13445-3: Unfired pressure vessels	TFZ 0 (0.1)
Load case: Operation = 1 / Test = 2	lc 1 1.2
Calculation temperature	t 120 °C
Calculation pressure	P 12 bar
Final wall thickness acc. drawing	en 5 mm
Outside diameter	De 600 mm
Weld factor (= λ acc. EN 14025)	Z
Material:	
Material designation	Number 1.0345
Wall thinning allowance	δ e 0.4 mm
Corrosion allowance	c 1 mm
Thinning allowance during manufacturing	δ m 0 mm
Sum of allowances	Σ(δ) 1.4 mm
Material strength (Re, Rp, Rm)	K 207 N/mm²
Safety factor acc. EN 13445	S 1.5
Allowable stress	f 138 N/mm²
Result	
Inside diameter	Di 592.8 mm
Mean diameter	Dm 596.4 mm
Geometrical ratio	e/De
Analysis thickness en - Σ(δ)	ea 3.6 mm
Required thickness	e ? mm
Required thickness with allowances	eδ mm
Maximum permissible pressure	Pmax bar
Load case	Operation
The strength condition is	
The geometrical condition is	

In our example it is required to enter the missing weld factor to obtain a result.

1 EN07

7.4.2 Cylindrical shells under internal pressure

Regulation (0=EN13445-3, 1=EN14025) EN 13445-3: Unfired pressure vessels	TFZ	0 (0,1)
Load case: Operation = 1 / Test = 2	lc	1 1,2
Calculation temperature	t	120 °C
Calculation pressure	P	12 bar
Final wall thickness acc. drawing	en	5 mm
Outside diameter	De	600 mm
Weld factor (= λ acc. EN 14025)	Z	1

Material:

Material designation	Number	1.0345
Wall thinning allowance	δ e	0.4 mm
Corrosion allowance	c	1 mm
Thinning allowance during manufacturing	δ m	0 mm
Sum of allowances	Σ(δ)	1.4 mm
Material strength (Re, Rp, Rm)	K	207 N/mm²
Safety factor acc. EN 13445	S	1.5
Allowable stress	f	138 N/mm²

Result

Inside diameter	Di	592.8 mm
Mean diameter	Dm	596.4 mm
Geometrical ratio	e/De	0.004314
Analysis thickness en - Σ(δ)	ea	3.6 mm
Required thickness	e	2.589 mm
Required thickness with allowances	eδ	3.989 mm
Maximum permissible pressure	Pmax	16.66 bar

Load case: **Operation valid**
The strength condition is: **valid**
The geometrical condition is: **valid**
The design is adequate for EN13445-3 requirements

Reverse calculation

The program allows you to enter result values to obtain input values. Enter for example a maximum permissible pressure **Pmax** = 20 bar to obtain the final wall thickness **en** with allowances. After having entered **Pmax** = 20 bar a list with all depending variables is displayed. Clear the variable "Final wall thickness".

Clear value of variable in 1 EN07

Expert Help

Please clear a dependent value for the calculation:

Clear value of variable Cancel input

---> Maximum permissible pressure
Strength for operation
Safety factor for operation
Weld joint factor
Wall thickness tolerance
Corrosion allowance
Forming allowance
Final thickness
Outside diameter

The original input value for the final wall thickness **en** is overwritten by the calculated value:

1 EN07

7.4.2 Cylindrical shells under internal pressure

Regulation (0=EN13445-3, 1=EN14025) EN 13445-3: Unfired pressure vessels	TFZ	0 (0,1)
Load case: Operation = 1 / Test = 2	lc	1 1,2
Calculation temperature	t	120 °C
Calculation pressure	P	12 bar
Final wall thickness acc. drawing	en	5.716 mm
Outside diameter	De	600 mm
Weld factor (= λ acc. EN 14025)	Z	1

Material:

Material designation	Number	1.0345
Wall thinning allowance	δ e	0.4 mm
Corrosion allowance	c	1 mm
Thinning allowance during manufacturing	δ m	0 mm
Sum of allowances	Σ(δ)	1.4 mm
Material strength (Re, Rp, Rm)	K	207 N/mm ²
Safety factor acc. EN 13445	S	1.5
Allowable stress	f	138 N/mm ²

Result

Inside diameter	Di	591.4 mm
Mean diameter	Dm	595.7 mm
Geometrical ratio	e/De	0.004304
Analysis thickness en - Σ(δ)	ea	4.316 mm
Required thickness	e	2.582 mm
Required thickness with allowances	eδ	3.982 mm
Maximum permissible pressure	Pmax	20 bar

Load case **Operation**

The strength condition is **valid**

The geometrical condition is **valid**

The design is adequate for EN13445-3 requirements

Parameter study

With the option "**Parameter study**" in the "**Atlas**" menu you can determine the effects of one respectively two values on a third value.

Find detailed information in the **ATLAS manual**.

Connect modules

Starting and loading several modules

All the modules of the program system ATLAS are similar in usage and they offer nearly similar options. Often, it is not possible to solve a problem by one module only. Then several modules interchanging information among each other are necessary for solution. To calculate a cylindrical shell with a nozzle, start the strength calculation program and perform a calculation with the EN07 module as described in the previous chapter:

Shells under internal pressure
DIN EN 13445-3/7:2010-12 and EN14025:2008-08
Lauterbach Verfahrenstechnik

1 EN07

7.4.2 Cylindrical shells under internal pressure

Regulation (0=EN13445-3, 1=EN14025) EN 13445-3: Unfired pressure vessels	TFZ	0	(0,1)
Load case: Operation = 1 / Test = 2	lc	1	1,2
Calculation temperature	t	120	°C
Calculation pressure	P	12	bar
Final wall thickness acc. drawing	en	5.716	mm
Outside diameter	De	600	mm
Weld factor (= λ acc. EN 14025)	Z	1	

Material:

Material designation	Number	1.0345	
Wall thinning allowance	δ e	0.4	mm
Corrosion allowance	c	1	mm
Thinning allowance during manufacturing	δ m	0	mm
Sum of allowances	Σ(δ)	1.4	mm
Material strength (Re, Rp, Rm)	K	207	N/mm ²
Safety factor acc. EN 13445	S	1.5	
Allowable stress	f	138	N/mm ²

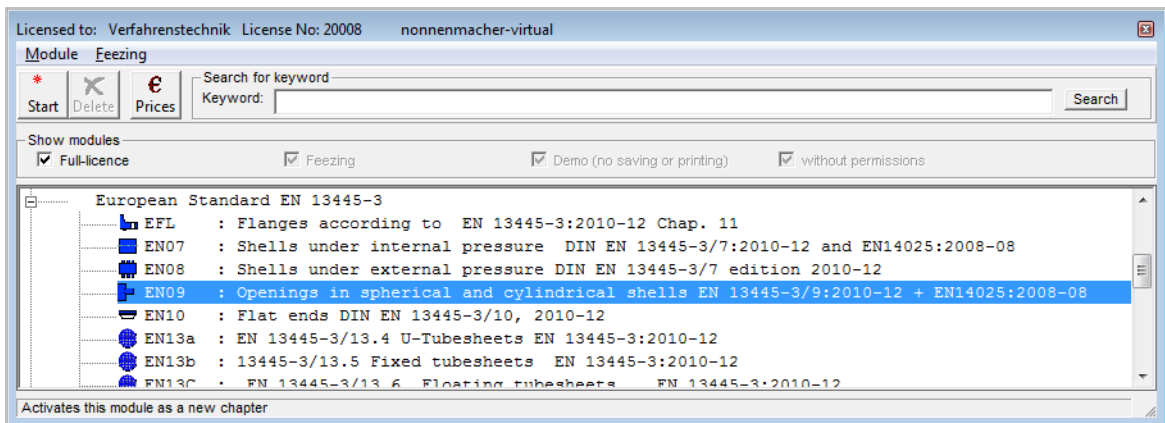
Result

Inside diameter	Di	591.4	mm
Mean diameter	Dm	595.7	mm
Geometrical ratio	e/De	0.004304	
Analysis thickness en - Σ(δ)	ea	4.316	mm
Required thickness	e	2.582	mm
Required thickness with allowances	eδ	3.982	mm
Maximum permissible pressure	Pmax	20	bar

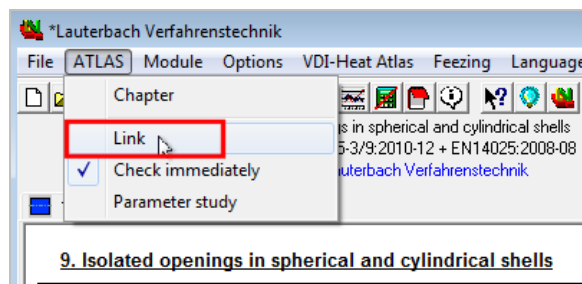
Load case **Operation**
The strength condition is **valid**
The geometrical condition is **valid**
The design is adequate for EN13445-3 requirements

1 EN07 129 Tank vehicles acc. DIN 14025 0 -

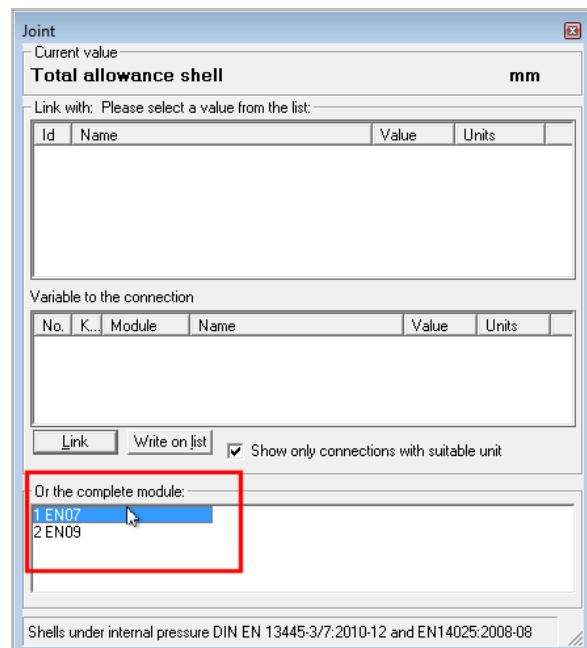
In this cylindrical shell there is a nozzle with an outside diameter of 60 mm. This opening must be proofed according EN09. Select **"Atlas/chapter"** and then EN09 in the tree view:



The input mask of the EN09 modules is displayed. Activate the **'Link'** option in the **'Atlas'** menu.

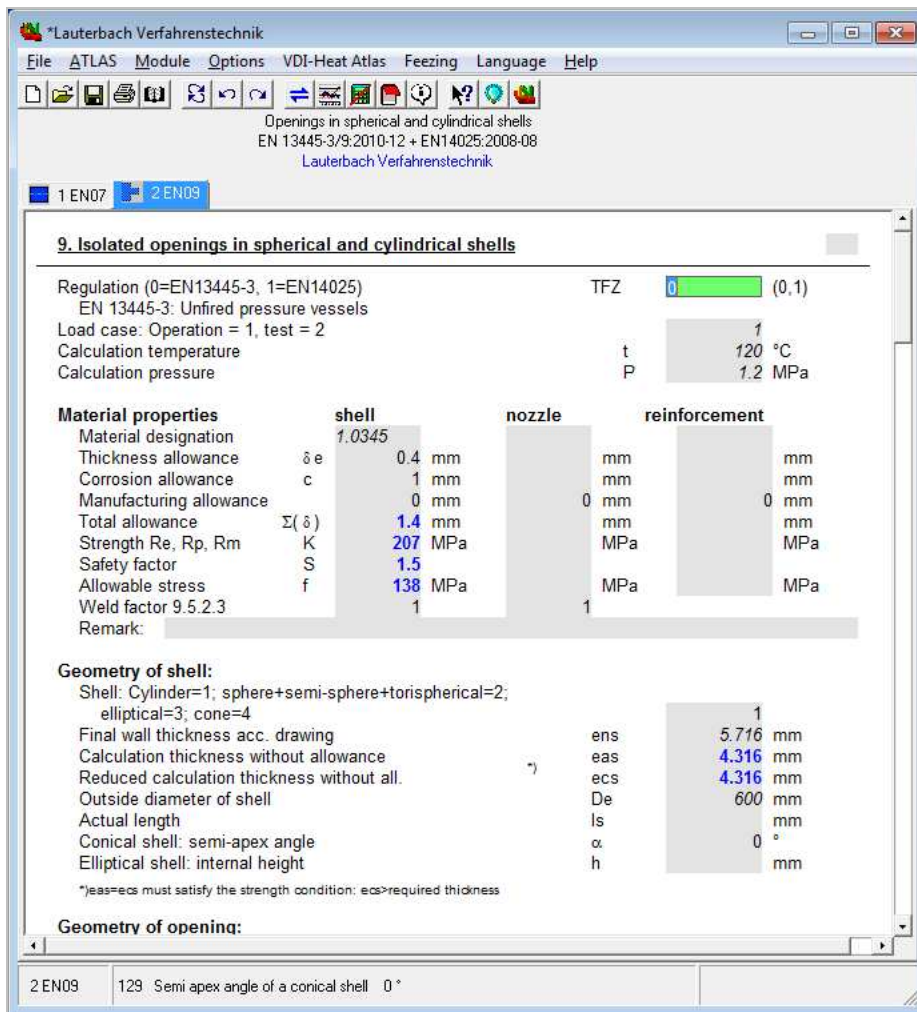


Then select "the EN07 module and link the complete module by double-click.




All values of the shell in EN07 are now linked to the values of the EN09 module and are displayed in italics on the mask.

If such a linked variable is changed in one module, the data is automatically transferred to the linked module.



Drag and drop

Alternatively you can link complete modules by drag and drop. Drag the EN07 module tab into the EN09 input mask by holding the left mouse button. The linking sign () will appear and the modules are now linked.

