E-CFW PIPE DESIGN PROGRAM HANDBOOK

TOPFIBRA

EFFECTIVE FILAMENT WINDING® PIONEERS

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TABLE OF CONTENTS

1. USING TOPFIBRA DESIGN PROGRAM FOR GRP PIPES PRODUCED ON TOPFIBRA'S CONTINUOUS FILAMENT WINDING MACHINE

1.1. General provisions and references

This Handbook is referring to the Excel worksheet supplied by TOPFIBRA, titled:

E-CFW Pipe Design Ryy.nn COMPANY.xlsm

"Ryy.nn" is the revision tag of the program, where "yy" indicates the year and "nn" is the revision date.

The file is supplied in XLMS format for Office 2007, but can also be opened with a fully upgraded Office 2003 with a compatibility pack.

Basic input and operations can be made from the [Input] sheet. This includes diameter selection, the input of the pressure and stiffness class, change of the mortar core type, change of the resin system, and all the output print.

The sheet [Process settings] allows you to define the optional parameters that are not frequently changed.

The file has the archive attribute set to it in order to prevent accidental overwriting. To save settings made in the [Process setting] sheet, save a copy of the file with a different name or save it in a different directory. Topfibra is not liable for any changes that the User may carry out to the program. Keep one or more copies of the original file in different places.

1.2. Installation of the program

There are no special requirements for the installation of the program, since it is a simple Excel worksheet with macros, apart from a proper installation of the "Solver" Add-In for Excel.

The macro protection must be deactivated, or you have to save the program file into a trusted directory.

The "Solver" is an external function, supplied with Excel, which must be installed and correctly referenced in the Microsoft Visual Basic for Application (MS-VBA).

- The E-CFW Pipe Design Program itself checks the availability and activation of the "Solver" Add-In for Excel.
- If this check is not passed, please verify the installation of Excel.

- In Office 2007, where the "round" Office Button is in the top right corner, select "Excel Options" in the low window frame, then "Add-Ins" in the left vertical choices. In the "combo box" at the bottom of the window the "Excel Add Ins" should already be visible, otherwise, find it and press the "Go" button. Finally check the "Solver Add-In" entry.
- In Office 2003, chose "Add Ins" in the "tools" menu and check the "Solver Add In" entry.
- The Solver's files should be in the \OfficeNN\Library\Solver\ directory or in a directory with a similar name, where "NN" is 11 for Office 2003 or 12 for Office 2007. The program cannot be run with older releases of Office.

The program can be run from any directory on the PC, as well as from a USB Key or a Network Drive. The program can be saved with a different name.

Sometimes, we have experienced problems with the non-standard Windows International Settings. If you get a series of "######" or "#VALUE" in some cells, please try using the US international setting or reset to the default values for the International Setting of your country.

1.3. Input sheet

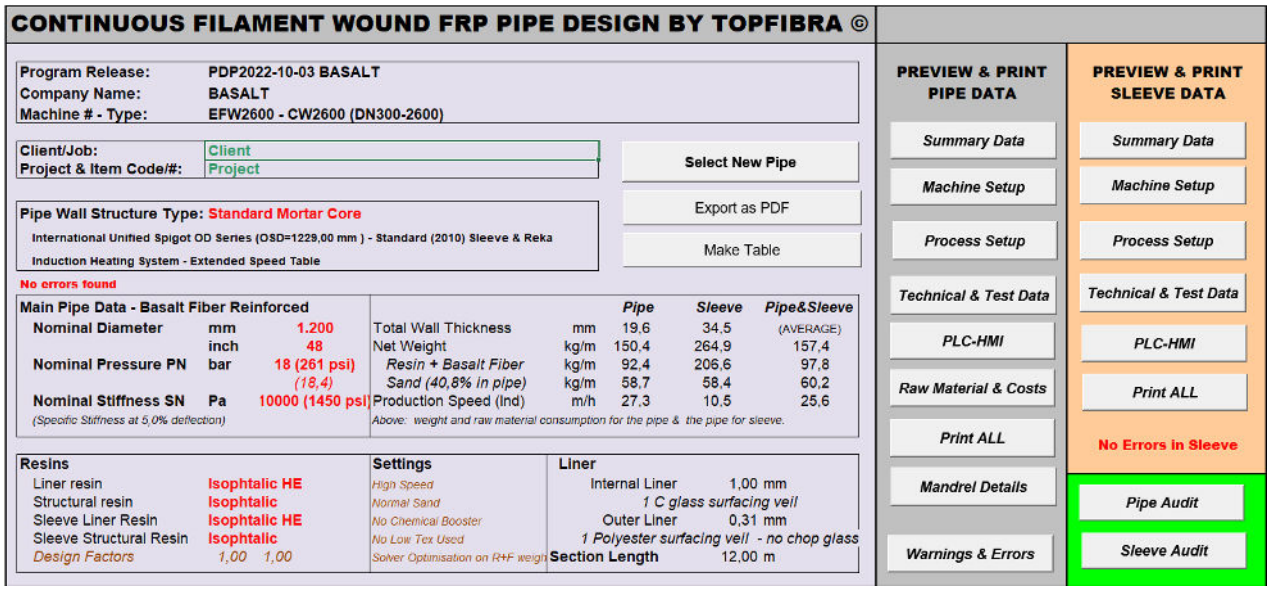


Figure 1

At the top of the page, you can find the "Program Release", the "Company Name" and the "Machine Type".

In the lower bo,x you can input the "Client/Job" name and the "Project /Reference" name, which will be printed on the headings of the output pages.

Pressing the combination [Ctrl]+[Shift]+[Z] allows you to resize the Input Page to the available window.

Clicking the Select New Pipe push button allows the User to access the form in which they can select a new pipe specification.

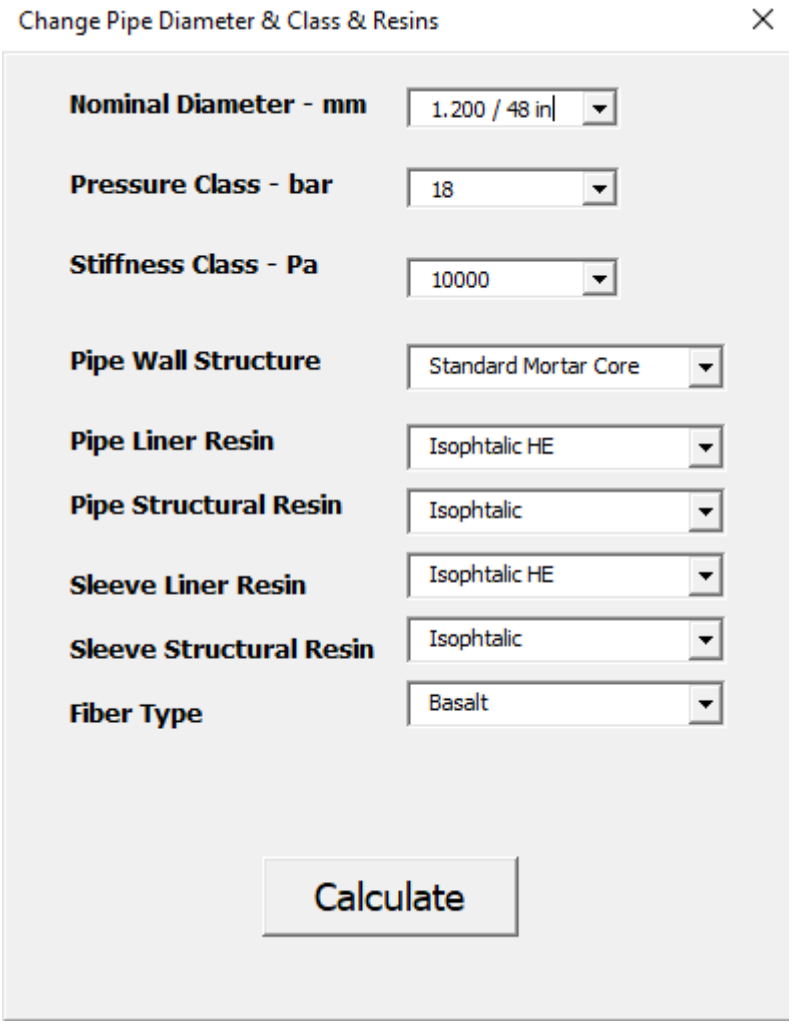


Figure 2

- The "Nominal Diameter" combo has already pre-set all the diameters to be produced.
- The "Pressure Class" combo has already pre-set all the pressures to be produced
- The "Stiffness" combo has already pre-set all the stiffness to be produced

The "Pipe wall structure" combo box allows the choice between:

- Standard Mortar Core;
- Premix Mortar Core;
- Full Glass
- Full Mortar

"Premix Mortar Core" is valid only if the machine is fitted with the premix system.

If a high pressure/low stiffness pipe class is selected, or if the User chooses a pipe with the mortar (since addition of mortar is not required to reach the stiffness class), the calculation can lead to a "Full Glass" pipe. Please see the "warning" on the next page.

NOTE: The selection of different resin types is possible for the pipes and sleeves using the proper input combo.

NOTE: The selection of different fiber types is possible for the pipes and sleeves using the proper input combo.

If you click the Calculate button, the program calculates the pipe and the sleeve. The program optimizes the pipe structure in order to get the cheapest pipe (lowest weight of the fiberglass and resin). If an invalid pressure class is selected, the diameter may be set to the maximum if this control has not been disabled (see chapter 4 - "

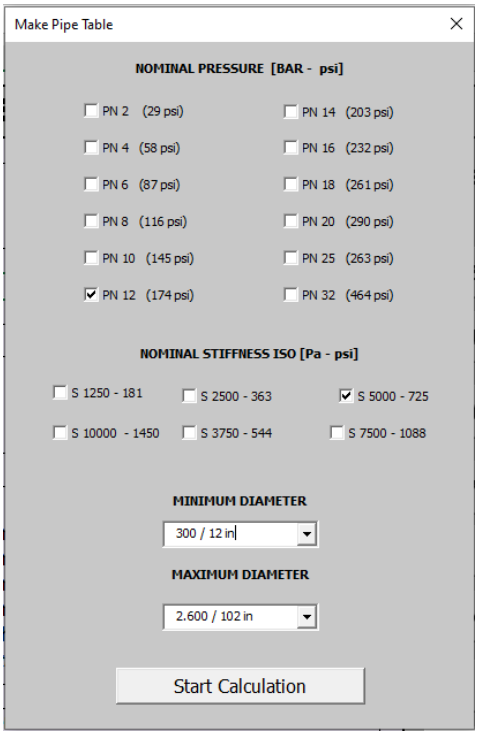


Figure 4

The push button Make Table shows the form on the left, which allows you to make tables of several pipes with different pressures and stiffness classes.
Select the check boxes relevant to the pressure and stiffness classes that you want calculated and choose the maximum and minimum diameter. By default, the maximum and the minimum diameters for the selected machine types are shown.

Process setting input sheet). The calculation takes a few seconds.

The main results of the calculation are shown in the lower boxes of the "Input" page.

Warnings or Errors, if any, are shown before returning to the input page. Warnings or Errors for the sleeve are shown when you display and print the relevant pages. If errors for the sleeve are present, a note is shown at the bottom of the "Preview & Print Sleeve Data" menu, on the right of the main Input screen.

If calculated classes for the pressure or stiffness are different from the ones required by the User, they are shown in brackets below the rated ones.

WARNING:

GRP pipes are designed for the Pressure Class and for the Stiffness. It may happen that a pipe, designed for the pressure class lower than 6 bar, will have an actual pressure resistance higher than the required one, since the thickness calculated to satisfy the stiffness requirement is higher than the thickness required for the pressure. So while a PN6 S2500 pipe is really a PN6 pipe, a PN6 S5000 could actually be a PN7, and a PN6 S10000 could have a PN8 pressure class (it also depends on the selected resin system).

According to the Standards and to the Code, the minimum pressure class for a GRP pipe can be 1 to 3 bar (50 psig = 3.4 bar for AWWA C950; generally, 1 bar for ISO Standards; 0.5 bar for a BS5480 Gravity pipe).

On the other hand, if the Specification asks for a pipe with a very high-pressure class and low stiffness, you will probably get a pipe with a stiffness class higher than the requirement, and without a mortar core, which is not required to get the required stiffness. For example, a PN32 pipe has at least a stiffness of 3000 Pa.

This characteristic (impossibility to get a matching pressure and stiffness contemporarily) is the rule for designing a pipe without the sand core.

The meaning of the stiffness is a little different if the Project/Client Specification refers to the AWWA (US) Standards or to the ISO Standards. The AWWA Standards require you to test and calculate the Pipe Stiffness at a 5% pipe deflection. The ISO Standards require testing stiffness at a 3% deflection and to back calculate the Specific Stiffness at a 0% deflection (Initial Specific Stiffness). Hence, a pipe designed by our CFW Pipe Design program, which has an Initial Specific Stiffness of 5000 Pa, will not show a Specific Stiffness of 5000 Pa when tested and calculated at 5%. For this reason, it is possible (in the [InputAdv] page) to select at which deflection the Stiffness will be determined and tested. The criteria are shown on the Output page, in brackets under the "Stiffness Class" label.

Please also see the "Engineering Handbook" for these two matters.

The thickness and the reinforcement of the liner can be modified on the second input page, tabbed as [InputAdv]. This worksheet page includes the optional parameters, which are not usually changed.

The columns of push buttons on the right allow you to preview and print the output screens/pages.

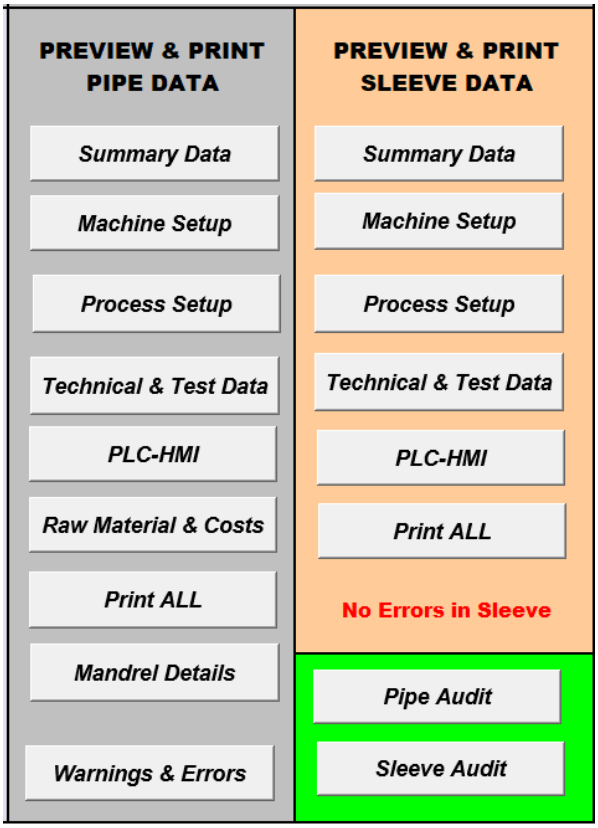


Figure 3

- ***Summary Data*** shows the main characteristics of the pipe or of the sleeve;
- ***Machine Setup*** gives the main characteristics of the machine, the mandrel data, and the support tables settings;
- ***Process Setup*** gives the raw materials distribution settings and a suggestion for the selection of the resin trough;
- ***Technical & Test Data*** gives the technical properties of the pipe and the sleeve and other data, useful for the testing of the product;
- ***PLC-HMI*** consists of data for setting the CFW machine control computer;
- ***Raw Materials & Costs*** are the raw material consumptions and the costs. Unit costs have to be defined in the [InputAdv] page.

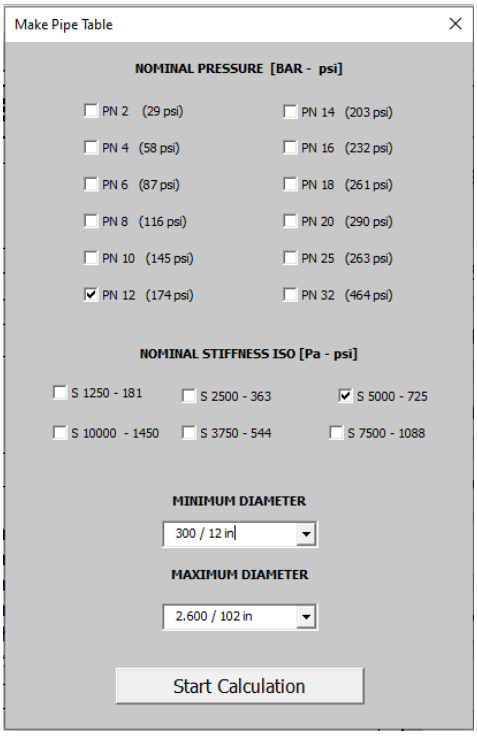


Figure 4

The push button Make Table shows the form on the left, which allows you to make tables of several pipes with different pressures and stiffness classes.
Select the check boxes relevant to the pressure and stiffness classes that you want calculated and choose the maximum and minimum diameter. By default, the maximum and the minimum diameters for the selected machine types are shown.

1.4. Process setting input sheet

The sheet is structured in columns. The first column gives the description of the parameter and the unit. The column which is colour shaded is the only one where it is possible to change or input the data.

Data must be entered in the yellow shaded cells. In the light cyan shaded cells, the User may input a parameter to modify the default/standard parameter shown in the STD VALUE column (STANDARD VALUE).

USED VALUE is shown in the proper column and is the *STANDARD VALUE* if the *INPUT/CHANGE* cell is empty, otherwise it is taken from the *INPUT/CHANGE* cell.

To reset a changed parameter, it is advisable to delete the cell content rather than to input a 0 (zero). Sometimes 0 (zero) has a meaning! To delete the cell content, select the cell and press the "Delete" or "Del" key on the keyboard. Alternatively, select the cell, press the right mouse button and, chose "Delete content".

These parameters should not be changed frequently and most of them are selected from a database, depending on the machine type or the pipe diameter. Using the optional input is useful, for instance, to change the fiberglass tex if the suggested tex is not available.

					BASALT		
PROCESS SETTINGS							0
Machine Type		CW2600 (DN300-2600)					
Machine Serial Number		EFW2600					
Basalt Fiber FRP Pipe DN 1.200 / 48 in - PN18 - SN10000 - Standard Mortar Core Structure							**Description / Comment**
Project		**INPUT**		**USED**	**STD**		*G=General setting; M=Machine Model metting*
No Standard Process Parameters Modified		**CHANGE**		**VALUE**	**VALUE**		*S= Machine Serial Number depending setting*
							U= User setting
Design Options							
Spigot OD Series (1-5)				**1**	1	S	International Unified Spigot OD Series
Fixed Diameter = OD (1) or ID=ND (2)				**1**	1	S	OD Pipe: Fixed - ID Sleeve: Fixed
Calculate Stiffness at % deflection	%			**5**	5	G	5% for AWWA/ASTM Specific Stiffness - 0% for ISO Initial Specific Stiffness
Design factor for stiffness	-			**1**	1	U	use to fine tune the pipe stiffness
Design factor for pressure	-			**1**	1	U	for manufacturer experience fine tuning (0.5 to 1.5)
Design factor for Ultimate Hoop Tensile Strength	-			**4**	4	U	4 according to AWWA-ASTM standard
Sleeve & Reka Ring Series (1-4)	-			**1**	1	MSU	Standard (2010)
Activate Ultimate Hoop Tensile Strength Design		☐				U	*<-SEE COMMENT*
Activate pressure limitation for single pipe		☐				U	*<-SEE COMMENT*
Activate pressure limitation for tabled pipe		☐				U	*<-SEE COMMENT*
Activate Solver Add-In optimisation based on fiber and glass raw materials weight		☑				U	*<-SEE COMMENT*
- OR on raw materiel cost (if costs available)						U	*<-SEE COMMENT*
Threshold for the comparision Full Glass / Standard Core		1,50%				U	Full Glass Stucture is selected also if it is 1,50 % more consuming/expensive
Production Speed							
Use extend speed table	1-0			**1**	1	S	
Mandrel advance speed reduction for sleeve pipe	%			**30,0**	30,0	G	
Max mandrel advance speed	m/h			**27,32**	27,32	U	For the actual pipe
Min mandrel advance speed	m/h			**0,76**	0,76	U	For the actual pipe
Mandrel advance speed	m/h			**27,32**	27,32	U	REM - Variable with DN and thickness
Induction: Blank=Default , 0-1 = No-Yes				**1**	1	U	
Section Length	m			**12**	12	U	Cutting length of the pipe section
Section Length for Sleeve Pipe	m	6				U	Cutting length for the pipe for making sleeves
Use shrinkage for calculation of mandrel OD		☑				U	Since pipe ID expands with curing, this option calculates a smaller mandrel OD.
Mylar release film							
Mylar width	mm			**50**	50	G	
Mylar thickness	mm			**0,03**	0,03	G	
Mylar weight	g/m2			**36**	36	G	

Figure 5

Internal liner						
Type of S.V. (1="C" glass; 2=Polyester)		1			G	**C glass**
Surfacing Veil (S.V.) weight	g/m²		**30**	30	G	
Resin content by weight for S.V.	%		**90**	90	G	
Liner resin density (cured)	-		**1,2**	1,2	G	
Number of veils	Nr.	1			G	1 C glass veil — 90% of resin
Roll width	mm		**50**	50	G	steel band width + 10 mm
Total liner thickness (S.V. & chop)	mm	1,00			G	
Resin content by weight for chop liner	%	70			G	
Number of Roving Strands for Chopper	Nr.	4			G	
Liner Hoop Roving Tex	Tex		**600**	600	G	
Liner Hoop Roving Number	Nr.	3			G	Polyester Yarns may be used as alternative
Sleeve Liner built with structure up to DN <	mm		**500**	500	M	For machines where applicable.
Low Tex						
Use Low Tex (LT) Hoop over the liner		☐			G	
Use Low Tex Hoop before and after the core		☐			G	TEMPORARLY NOT APPLICABLE FOR SLEEVE AND PREMIX
Use Low Tex Hoop after the outer skin		☐			G	
Structural Wall Thickness Limitations						
Minimum skin thickness	mm		**0,6**	0,6	G	The maximum of the two values is choosen
-minimum skin thickness ratio to DN	-		**0,001**	0,0010	G	For full glass pipe total structural wall is doubled
Standard Mortar Core						
Min thickness for core sand layer	mm		**0,5**	0,5	M	If a mortar core thinner than this comes from the calculation, pipe
but not less than 5% of the structural thickness	%		**5**	5	G	is made without mortar core.
Core max thickness for 1 mandrel rotation	mm	**2,40**				
equal to ND/500 (2,4 mm with the actual pipe)			**500**	500	G	These parameters can be used to change the thickness of the
but not more than	mm		**4,00**	4,00	G	mortar core for each revolution of the mandrel, with the limitations
and not less than	mm		**0,50**	0,50	G	due to the length of the distribution area.
Premix Mortar Core						
Number of used premix extruder	nr		**2**	2	M	*machine default*
Max Premix sand layer thickness (1 extruder)	mm		**25**	25	M	*machine default*
Min Premix sand layer thickness (1 extruder)	mm		**10**	10	M	*machine default*

Figure 6

Chopper Setup						
Roving Tex for Chopper	tex		**2400**	2400	G	1200 tex for ND<300; otherwise 2400 tex
Optimum chop roving linear speed	m/s		**0,5**	0,5	G	
Chopper "inset"	mm		**0,0**	0,0	U	
Minimum spacing of chop roving	mm		**13,0**	13,0	G	>= 1x the chop comb pitch
Maximum spacing of chop roving	mm		**39,0**	39,0	G	= 3x the pitch
Outer Liner						1 Polyester surfacing veil - no chop glass
Chopped Glass Liner (1=Yes)			**No**		G	
Resin content by weight for chop liner	%	70			G	
Total liner thickness including Surfacing Veil	mm	1,0			G	
Outer Surfacing veil (1=Yes)		1	**Yes**		G	
Surfacing veil weight	g/m²	30			G	
Number of veils	Nr.	1			G	1 Polyester surfacing veil - 50 mm roll width - 90% of resin
Roll width	mm		**50**	50	G	
Type of S.V. (1="C" glass; 2=Polyester)		2			G	**Polyester**

Figure 7

Most of the modifiable parameters are self-explanatory. When you pass over the input cells with the mouse cursor, a comment/clarification is shown where it is thought necessary or advisable (cells with red triangle in the top right corner).

The first block (on the previous page in red) defines the main parameters for the machine.

The Fixed Diameter choice allows you to select if the internal diameter is fixed and equal to the nominal diameter. In this case, the outer diameter will be variable, depending on the thickness of the pipe. The sleeve will also not be a standard one. Special end closures will be required for the hydrotesting machine.

The "OD from AWWA/ASTM/ISO (1) or Old ASTM (2) Table" allows you to choose the OD Series. The (1) choice is the last standard OD according to the AWWA Table 5, ASTM "International Standard Series" or ISO Series B1, which have been unified in the last years. The (2) choice is the previous ASTM Standard OD. A Special Series (3) may be available for the backward compatibility with the other machines/standards.

The Reka Ring Series choice is for the new (2010) (1) or old (2) series of the Reka Gasket and groove grinding equipment.

The percentage deflection at which to calculate the stiffness has been outlined above. If the requirement of the specification is for the "Initial" Specific Stiffness according to ISO, input 0 % instead 5 %.

The "Deflection coefficient" lets you rectify the pipe structure calculation if the found stiffness of the pipe is lower or higher than the design stiffness. If, for example, the actual stiffness, tested on the first produced pipe, is 4500 Pa instead of 5000 Pa (10% less), input 1.1 as a "Deflection coefficient" and calculate the pipe thickness and structure again from the Input Page, and modify it on the CFW machine. Please note that the stiffness has a high sensitivity towards the pipe thickness, since the wall thickness is at cube power in the stiffness definition, and for this reason a 10% change in the stiffness will result in 3.5% change in the thickness.

If the pressure limitation is activated, the program will not calculate the pipe, so set the pressure to the maximum for the diameter for the single pipe, or skip the pipe in the "Make Table" procedure.

Taking the shrinkage into account influences the calculation of the mandrel OD. Shrinkage is relevant in a pipe with a high hoop glass content.

The block (below) defines the Pipe Structural Wall composition.

Pipe Structural Wall Composition (% by weight)						
Auto select composition from Hoop and Sand Content		☑				
Factor for Resin Impregnation			**1**	1	G	Max 1.2 (more resin) ; min 0.8 (less resin)
Low Tex after the liner for squeezing						
Roving Tex	Tex		**600**	600	G	
Liner Hoop Roving Spacing	mm		**8**	8	M	from the machine
Number of helix advaces involved	nr.		**2**	2	G	
Number of strands	nr.		*10*			
Inner / Outer Skin						
Use always second comb to keep the structure shorter		☑ 1				
Hoop in skins (Basalt Fiber)	%		**58,9**	58,9	G	
Roving Tex in skins	Tex		**2400**	2400	G	(100; 200; 300; 600; 740; 900; 1100; 1200; 1800; 2000; 2200; 2400; 4400; 4800)
Chop in skins (Basalt Fiber)	%		**15,8**	15,8	G	
Structural resin density (cured)	-		**1,20**	1,20	G	
Resin - Must be >= 20	%		*25,3*			
Low Tex before and after the core						
Hoop content (Basalt Fiber)	%		**35,0**	35,0	G	
Chop content (Basalt Fiber)	%		**35,4**	35,4	G	
Resin - Must be >= 20	%		*29,6*			
Hoop Roving Tex	Tex		**600**	600	G	
Number of helix advaces involved	nr.		**2**	2	G	
Number of hoop strands	nr.		*13*			
Standard Mortar Core		☐ Higher sand content				
Sand in core	%		**65,0**	65,0	G	
Hoop in core	%		**2,0**	2,0	G	
Roving Tex in core	Tex		**600**	600	G	(100; 200; 300; 600; 740; 900; 1100; 1200; 1800; 2000; 2200; 2400; 4400; 4800)
Chop in core	%		**10,4**	10,4	G	10,37820513
Resin - Must be >= 20	%		*22,6*			
Design resin flow ratio per unit length core/skin		2,00			G	*Increase this value in order to shorten the core length (and vice versa).*

Figure 8

Premix Mortar Core							
Sand in core	%		**80,0**	80,0	G		
Resin	%		*20,0*				
Low Tex for Premix	Tex		**600**	600	G		
Number of strands (for 1 extruder)	nr.		**10**	10	G		
Low Tex after the Outer Skin							
Roving Tex	Tex		**600**	600	G		
Number of strands (with double spacing)	nr.		**4**	4	G		
Sleeve Structural Wall Composition (% by weight)							
Grinding Thickness - Standard Mortar Core							
Sand in core	%		**46,0**	46,0	G		
Hoop in core	%		**5,0**	5,0	G		
	Tex		**600**	600	G	(100; 200; 300; 600; 740; 900; 1100; 1200; 1800; 2000; 2200; 2400; 4400; 4800)	
Chop in core	%		**16,0**	16,0	G		
Resin	%		*33,0*				
Outer Skin							
Minimum thickness							
Absolute minimum thickness	mm		**4,0**	4,0	G		
Diameter Ratio (DN/x)	n		**250,0**	250,0	G	*4,8 mm for the actual ND (1.200)*	
Hoop in skins	%		**46,0**	46,0	G		
	Tex		**2400**	2400	G	(100; 200; 300; 600; 740; 900; 1100; 1200; 1800; 2000; 2200; 2400; 4400; 4800)	
Chop in skins	%		**26,4**	26,4	G		
Structural resin density (cured)	-		**1,20**	1,20	G		
Resin	%		*27,6*				

Figure 9

The default composition is chosen according to the function of the product (pipe or sleeve) and to the structure of the mortar core.

The block below define the resin missing percentages.

These percentages are intended only for average consumption calculation.

Actual percent for the resin preparation and curing to be defined for the specific resin used, ambient conditions and needed curing time. "

Resin Mixing (part per hundred of resin)						
Catalyst Ratio (% by weight)						
- for liner resin	%		**1,50**	1,50	G	These percentage are intended only for average consumption calculation. Actual percent for the resin preparation and curing to be defined for the specific resin used, ambient conditions and needed curing time.
- for structure resin	%		**1,50**	1,50	G	
- for premix resin	%		**1,50**	1,50	G	
Promoter Ratio (% by weight)	%		**0,15**	0,15	G	
Inhibitor Ratio (% by weight)	%		**0,05**	0,05	G	
Styrene	%		**3,50**	3,50	G	
Consumables (acetone for cleaning tools)	%		**1,00**	1,00	G	
Resin Viscosity	cps	250			G	

Figure 10

The block below allows you to define the raw materials loss coefficient:

Raw Materials Loss Coefficients					
Liner Resin		**1,050**	1,050	G	These Loss Coefficients are intended for increasing the raw materials consumption to take account of the losses of material during production and for the evaluation of the final cost of the pipe.
Structural Resin		**1,050**	1,050	G	
Surfacing Veils		**1,020**	1,020	G	
Chopped Fiber		**1,050**	1,050	G	
Hoop Fiber		**1,005**	1,005	G	
Sand		**1,050**	1,050	G	
Mylar		**1,020**	1,020	G	
Styrene		**1,050**	1,050	G	
Acetone		**1,000**	1,000	G	
Catalyst		**1,050**	1,050	G	
Promoter		**1,050**	1,050	G	
Inhibitor		**1,050**	1,050	G	

Figure 11

On the right side, two columns for the cost are available, and the User can switch between the main column in Euros and the second column in an alternative currency. All the costs in the two right-hand columns can be modified.

1.5. Brief page

The [Brief] page shows the results of the Make Table calculations in a tabular form. The User can copy and paste the table for further analysis and calculation.

The column “Errors” shows the number of warnings and errors.

The “Net Weight” is the weight per linear meter of the simple pipe: “With Sleeve” includes the overweight due to the sleeve.

The “Production Rate” is given for the pipe and for the sleeve separately and as a mean production rate, to directly calculate the total production time. The “Raw Material Consumption” includes sleeve and wastes.

Clear All

							Pipe Thicknesses						Pipe Net RawMat						Sleeve Thicknesses				Sleeve Net RawMat					
Dn	Dn	Design Pressure	Design Stis	Fiber Type	Solver	Design Goal	Liner	IntSkin	Core	OutSkin	OutLin	TotWall	LinRes	MecRes	TotRes	Fiber	Tot.R+F	Sand	Liner	Core	OutSkin	TotWall	LinRes	MecRes	TotRes	Fiber	Tot.R+F	Sand
mm	inch	bar	Pa			Weight/Cost	mm	mm	mm	mm	mm	mm	kg/m	kg/m	kg/m	kg/m	kg/m	kg/m	mm	mm	mm	mm	kg/m	kg/m	kg/m	kg/m	kg/m	kg/m
1200	48	18,0	10000	Basalt	TRUE	Weight	1,00	3,43	11,41	3,43	0,31	19,59	3,96	35,64	39,60	52,78	92,38	58,69	1,00	17,00	16,48	34,48	4,10	80,30	84,40	123,26	207,66	58,36

Client

							Pipe Thicknesses						Pipe Net RawMat						Sleeve Thicknesses				Sleeve Net RawMat					
Dn	Dn	Design Pressure	Design Stis	Fiber Type	Solver	Design Goal	Liner	IntSkin	Core	OutSkin	OutLin	TotWall	LinRes	MecRes	TotRes	Fiber	Tot.R+F	Sand	Liner	Core	OutSkin	TotWall	LinRes	MecRes	TotRes	Fiber	Tot.R+F	Sand
mm	inch	bar	Pa			Weight/Cost	mm	mm	mm	mm	mm	mm	kg/m	kg/m	kg/m	kg/m	kg/m	kg/m	mm	mm	mm	mm	kg/m	kg/m	kg/m	kg/m	kg/m	kg/m
1600	63	12,0	5000	Basalt	TRUE	Weight	1,00	2,98	14,11	2,98	0,31	21,39	5,31	51,75	57,06	67,11	124,18	96,97	1,00	20,30	14,04	35,34	5,46	110,16	115,62	151,35	266,97	92,64
1600	63	12,0	5000	Basalt	TRUE	Weight	1,00	2,98	14,11	2,98	0,31	21,39	5,31	51,75	57,06	67,11	124,18	96,97	1,00	20,30	14,04	35,34	5,46	110,16	115,62	151,35	266,97	92,64
1200	48	12,0	10000	Basalt	TRUE	Weight	1,00	2,04	16,01	2,04	0,31	21,40	3,95	38,35	42,29	41,02	83,31	82,23	1,00	17,00	10,21	28,21	4,10	66,06	70,16	86,39	156,55	58,36
1200	48	12,0	10000	Basalt	TRUE	Weight	1,00	2,04	16,01	2,04	0,31	21,40	3,95	38,35	42,29	41,02	83,31	82,23	1,00	17,00	10,21	28,21	4,10	66,06	70,16	86,39	156,55	58,36
1200	48	12,0	10000	Basalt	TRUE	Weight	1,00	2,04	16,01	2,04	0,31	21,40	3,95	38,35	42,29	41,02	83,31	82,23	1,00	17,00	10,21	28,21	4,10	66,06	70,16	86,39	156,55	58,36
1200	48	12,0	10000	Basalt	TRUE	Weight	1,00	2,04	16,01	2,04	0,31	21,40	3,95	38,35	42,29	41,02	83,31	82,23	1,00	17,00	10,21	28,21	4,10	66,06	70,16	86,39	156,55	58,36
1200	48	12,0	10000	Basalt	TRUE	Weight	1,00	2,04	16,01	2,04	0,31	21,40	3,95	38,35	42,29	41,02	83,31	82,23	1,00	17,00	10,21	28,21	4,10	66,06	70,16	86,39	156,55	58,36
1200	48	12,0	10000	Basalt	TRUE	Weight	1,00	2,04	16,01	2,04	0,31	21,40	3,95	38,35	42,29	41,02	83,31	82,23	1,00	17,00	10,21	28,21	4,10	66,06	70,16	86,39	156,55	58,36
1200	48	12,0	10000	Basalt	TRUE	Weight	1,00	2,04	16,01	2,04	0,31	21,40	3,95	38,35	42,29	41,02	83,31	82,23	1,00	17,00	10,21	28,21	4,10	66,06	70,16	86,39	156,55	58,36
1200	48	12,0	10000	Basalt	TRUE	Weight	1,00	2,04	16,01	2,04	0,31	21,40	3,95	38,35	42,29	41,02	83,31	82,23	1,00	17,00	10,21	28,21	4,10	66,06	70,16	86,39	156,55	58,36
1200	48	12,0	10000	Basalt	TRUE	Weight	1,00	2,04	16,01	2,04	0,31	21,40	3,95	38,35	42,29	41,02	83,31	82,23	1,00	17,00	10,21	28,21	4,10	66,06	70,16	86,39	156,55	58,36
1200	48	12,0	10000	Basalt	TRUE	Weight	1,00	2,04	16,01	2,04	0,31	21,40	3,95	38,35	42,29	41,02	83,31	82,23	1,00	17,00	10,21	28,21	4,10	66,06	70,16	86,39	156,55	58,36
1200	48	12,0	10000	Basalt	TRUE	Weight	1,00	2,04	16,01	2,04	0,31	21,40	3,95	38,35	42,29	41,02	83,31	82,23	1,00	17,00	10,21	28,21	4,10	66,06	70,16	86,39	156,55	58,36
1200	48	18,0	10000	Basalt	TRUE	Weight	1,00	3,43	11,41	3,43	0,31	19,59	3,96	35,64	39,60	52,78	92,38	58,69	1,00	17,00	16,48	34,48	4,10	80,30	84,40	123,26	207,66	58,36
1200	48	18,0	10000	Basalt	TRUE	Weight	1,00	3,43	11,41	3,43	0,31	19,59	3,96	35,64	39,60	52,78	92,38	58,69	1,00	17,00	16,48	34,48	4,10	80,30	84,40	123,26	207,66	58,36
1200	48	18,0	10000	Basalt	TRUE	Weight	1,00	3,43	11,41	3,43	0,31	19,59	3,96	35,64	39,60	52,78	92,38	58,69	1,00	17,00	16,48	34,48	4,10	80,30	84,40	123,26	207,66	58,36
1200	48	18,0	10000	Basalt	TRUE	Weight	1,00	3,43	11,41	3,43	0,31	19,59	3,96	35,64	39,60	52,78	92,38	58,69	1,00	17,00	16,48	34,48	4,10	80,30	84,40	123,26	207,66	58,36
1200	48	18,0	10000	Basalt	TRUE	Weight	1,00	3,43	11,41	3,43	0,31	19,59	3,96	35,64	39,60	52,78	92,38	58,69	1,00	17,00	16,48	34,48	4,10	80,30	84,40	123,26	207,66	58,36
1200	48	18,0	10000	Basalt	TRUE	Weight	1,00	3,43	11,41	3,43	0,31	19,59	3,96	35,64	39,60	52,78	92,38	58,69	1,00	17,00	16,48	34,48	4,10	80,30	84,40	123,26	207,66	58,36
1200	48	18,0	10000	Basalt	TRUE	Weight	1,00	3,43	11,41	3,43	0,31	19,59	3,96	35,64	39,60	52,78	92,38	58,69	1,00	17,00	16,48	34,48	4,10	80,30	84,40	123,26	207,66	58,36
1200	48	18,0	10000	Basalt	TRUE	Weight	1,00	3,43	11,41	3,43	0,31	19,59	3,96	35,64	39,60	52,78	92,38	58,69	1,00	17,00	16,48	34,48	4,10	80,30	84,40	123,26	207,66	58,36
1200	48	18,0	10000	Glass	TRUE	Weight	1,00	4,12	10,85	4,12	0,31	20,41	3,93	36,80	40,73	58,49	99,21	55,45	1,00	17,00	15,93	33,93	4,08	77,57	81,64	116,88	198,52	57,86
1200	48	18,0	10000	Basalt	TRUE	Weight	1,00	3,43	11,41	3,43	0,31	19,59	3,96	35,64	39,60	52,78	92,38	58,69	1,00	17,00	16,48	34,48	4,10	80,30	84,40	123,26	207,66	58,36
1200	48	18,0	10000	Basalt	TRUE	Weight	1,00	3,43	11,41	3,43	0,31	19,59	3,96	35,64	39,60	52,78	92,38	58,69	1,00	17,00	16,48	34,48	4,10	80,30	84,40	123,26	207,66	58,36
1200	48	18,0	10000	Basalt	TRUE	Weight	1,00	3,43	11,41	3,43	0,31	19,59	3,96	35,64	39,60	52,78	92,38	58,69	1,00	17,00	16,48	34,48	4,10	80,30	84,40	123,26	207,66	58,36
1200	48	18,0	10000	Basalt	TRUE	Weight	1,00	3,43	11,41	3,43	0,31	19,59	3,96	35,64	39,60	52,78	92,38	58,69	1,00	17,00	16,48	34,48	4,10	80,30	84,40	123,26	207,66	58,36

Figure 12

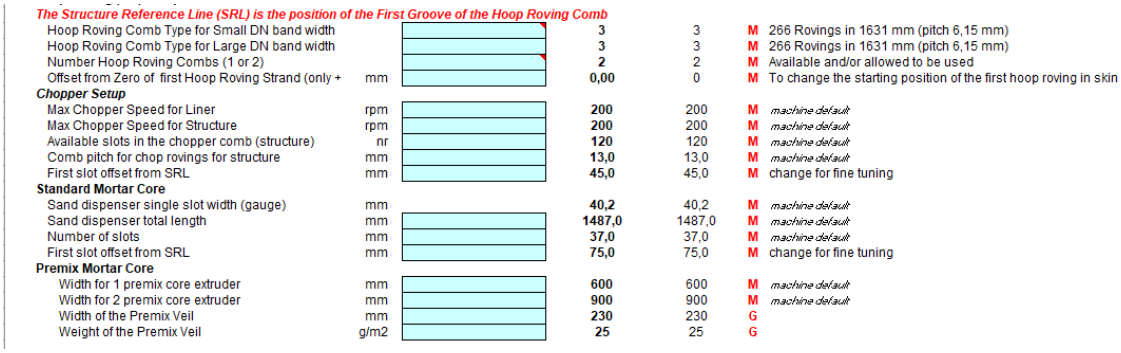
1.6. Machine settings

The machine setting page allows you to define the parameters of the E-CFW WINDER.

The parameters for the winder have been pre-set but they could be modified as per the needs.

Machine Settings						
					BASALT	
Machine Type		CW2600 (DN300-2600)				
Machine Serial Number		EFW2600				
Basalt Fiber FRP Pipe DN 1.200 / 48 in - PN18 - SN10000 - Standard Mortar Core Structure						Description / Comment
Project		INPUT	USED	STD		G=General setting; M=Machine Model setting
No Machine Standard Parameters Modified		CHANGE	VALUE	VALUE		S= Machine Serial Number depending setting
Chemical booster			0	0	S	
Sleeve calculation (1=std; 2=rubber band; 3=none)			1	1	S	To avoid the calculation of the pipe for making sleeves
PLC/HMI Type (1=new kg/m; 2=old kg/min; 3= last)			3	3	S	Input screen of the recipe in the machine
DN Max for small mandrel - band width	mm		600	600	M	
Small DN band width / advancing pitch	mm		40	40	M	
Large DN band width / advancing pitch	mm		40	40	M	
Small DN steel band thickness	mm		1,2	1,2	M	
Large DN steel band thickness	mm		1,7	1,7	M	
Used Steel band width for actual pipe size	mm		40			
Used Steel band thickness	mm		1,7			
Grinding thickness	mm		0,1	0,1	G	For fine tuning the pipe spigot OD.
Resin Pumps Capacity						
Liner MAX			15	15	M	
Liner MIN			0,05	0,05	M	
Structure 1 MAX			15	15	M	
Structure 1 MIN			0,05	0,05	M	
Structure 2 MAX			25	25	M	
Structure 2 MIN			0,05	0,05	M	
Premix MAX			15	15	M	
Premix MIN			0,05	0,05	M	
Liner Setup						
The Liner Reference Line (LRL) is the position of the First Groove of Liner Hoop Roving Comb						
Mylar Offset from the LRL	mm		-300	-300	G	
Surfacing Veil 1 Offset from the LRL	mm		-100	-100	G	
Surfacing Veil 2 Offset from the LRL	mm		-75	-75	G	
Resin Trough Offset from the LRL	mm		0	0	G	
Chopper Offset from the LRL	mm		0	0	G	
Fiber Type: Basalt						
Hoop Roving (HR) Setup						

Figure 13



The Structure Reference Line (SRL) is the position of the First Groove of the Hoop Roving Comb						
Hoop Roving Comb Type for Small DN band width			3	3	M	266 Rovings in 1631 mm (pitch 6,15 mm)
Hoop Roving Comb Type for Large DN band width			3	3	M	266 Rovings in 1631 mm (pitch 6,15 mm)
Number Hoop Roving Combs (1 or 2)			2	2	M	Available and/or allowed to be used
Offset from Zero of first Hoop Roving Strand (only +	mm		0,00	0	M	To change the starting position of the first hoop roving in skin
Chopper Setup						
Max Chopper Speed for Liner	rpm		200	200	M	*machine default*
Max Chopper Speed for Structure	rpm		200	200	M	*machine default*
Available slots in the chopper comb (structure)	nr		120	120	M	*machine default*
Comb pitch for chop rovings for structure	mm		13,0	13,0	M	*machine default*
First slot offset from SRL	mm		45,0	45,0	M	change for fine tuning
Standard Mortar Core						
Sand dispenser single slot width (gauge)	mm		40,2	40,2	M	*machine default*
Sand dispenser total length	mm		1487,0	1487,0	M	*machine default*
Number of slots	mm		37,0	37,0	M	*machine default*
First slot offset from SRL	mm		75,0	75,0	M	change for fine tuning
Premix Mortar Core						
Width for 1 premix core extruder	mm		600	600	M	*machine default*
Width for 2 premix core extruder	mm		900	900	M	*machine default*
Width of the Premix Veil	mm		230	230	G	
Weight of the Premix Veil	g/m2		25	25	G	

Figure 14

1.7. Unit costs

In this page it is possible to define the unit cost to determine the final cost per meter of the produced pipe

RAW MATERIAL UNIT COSTS AND OTHER PRODUCTION COSTS *PDP2022-10-03 BASALT*

ALLOW VISUALIZATION AND PRINTING OF PIPE COST			☑ Allow Costs		Visualization and Printing of Pipe Costs - Allowed		
			☑ Use Local Currency		Local Currency Selected		
PRICE BASE (unit prices at the generation of the program)		***EUROPE***					
MAIN CURRENCY		**USD**					
Standard costs are given in USD. Insert a different currency and exchange rate to convert into local currency.							
LOCAL CURRENCY		USD					
Rounding		2					
Exchange Rate:		1,00					
Used Currency:	---->>>>	**USD**					
Liner Resins Costs	**HDB F(*)**	**Cost**		***Local C.***	***Varied Cost***	***Used Cost***	***Default Cost***
and correction factor for HDB prediction		USD/kg		USD/kg	USD/kg	USD/kg	USD/kg
Isophtalic HE	100%	3,32		3,32		3,32	3,32
Isophtalic	100%	2,40		2,40		2,40	2,40
Terephthalic	100%	1,60		1,60		1,60	1,60
Ortophtalic	100%	1,99		1,99		1,99	1,99
Vinylester HE	100%	3,50		3,50		3,50	3,50
Vinylester	100%	4,10		4,10		4,10	4,10
Bisphenolic	100%	3,00		3,00		3,00	3,00
Special	100%	-		-		-	
(*) *HDB correction factor. HDB is predicted for ISO HE liner*							
and ISO Std resin in the structure. Other resin system may require							
correction factors. User can change reduction factors.							
Structure Resins Costs	**HDB F**	**Cost**					
		USD/kg					
Isophtalic	100%	2,40		2,40		2,40	2,40
Terephthalic	100%	1,60		1,60		1,60	1,60
Ortophtalic	100%	1,99		1,99		1,99	1,99
Vinylester	100%	3,50		3,50		3,50	3,50
Bisphenolic	100%	3,00		3,00		3,00	3,00
Special	100%	-		-		-	

Figure 15

Fiber & Reinforcements Costs		**Cost**					
ONLY COST FOR GLASS FIBER TILL NOW !!!!!!							
"C" Glass Veil	USD/kg	5,00		5,00		5,00	5,00
Polyester Veil	USD/kg	15,00		15,00		15,00	15,00
Premix Veil	USD/kg	5,30		5,30		5,30	5,30
Roving for chopper (2400 Tex)	USD/kg	1,31		1,31		1,31	1,31
Hoop Roving 100 Tex	USD/kg	1,97		1,97		1,97	1,97
Hoop Roving 200 Tex	USD/kg	1,97		1,97		1,97	1,97
Hoop Roving 300 Tex	USD/kg	1,24		1,24		1,24	1,24
Hoop Roving 600 Tex	USD/kg	1,24		1,24		1,24	1,24
Hoop Roving 740 Tex	USD/kg	1,20		1,20		1,20	1,20
Hoop Roving 900 Tex	USD/kg	1,20		1,20		1,20	1,20
Hoop Roving 1100 Tex	USD/kg	1,13		1,13		1,13	1,13
Hoop Roving 1200 Tex	USD/kg	1,13		1,13		1,13	1,13
Hoop Roving 1800 Tex	USD/kg	1,20		1,20		1,20	1,20
Hoop Roving 2000 Tex	USD/kg	1,20		1,20		1,20	1,20
Hoop Roving 2200 Tex	USD/kg	1,20		1,20		1,20	1,20
Hoop Roving 2400 Tex	USD/kg	1,20		1,20		1,20	1,20
Hoop Roving 4400 Tex	USD/kg	1,20		1,20		1,20	1,20
Hoop Roving 4800 Tex	USD/kg	1,20		1,20		1,20	1,20
Sand	USD/kg	0,06		0,06		0,06	0,06

Figure 16

Auxiliary Materials Cost								
	Mylar (50 mm wide - 30 micron)	USD/kg	4,50		4,50		4,50	4,50
	Styrene	USD/kg	1,90		1,90		1,90	1,90
	Acetone	USD/kg	1,71		1,71		1,71	1,71
	Catalyst	USD/kg	3,95		3,95		3,95	3,95
	Promoter	USD/kg	8,70		8,70		8,70	8,70
	Inhibitor	USD/kg	9,30		9,30		9,30	9,30
	Reka Gaskets per kg	USD/kg	4,00		4,00		4,00	4,00
	Steel Band	USD/kg	3,50		3,50		3,50	3,50
Machine and Labor								
	Machine cost	USD	3.000.000		3.000.000		3.000.000	3.000.000
	Auxiliary equipments	USD	1.500.000		1.500.000		1.500.000	1.500.000
	Other plant costs for amortization	USD	1.000.000		1.000.000		1.000.000	1.000.000
			5.500.000		**5.500.000**			
	Amortization period	years	5,00				5,00	5,00
	Interest rate		10,00%				10,00%	10,00%
	Annual quota	USD	1.450.886					
	Production hours in 1 year	hours	3.000				3.000	3.000
	Machine & Plant Hourly cost	**USD/h**	**480,00**					
	Workers per shift	nr	12,00				12,00	12,00
	Labor cost	USD/h	15,00		15,00		15,00	15,00
	Energy cost	USD/kWh	0,05		0,05		0,05	0,05
General expenses			15,00%				15,00%	15,00%
Profit			12,00%				12,00%	12,00%

Figure 17

1.8. Custom design

The pipe design program is prepared to calculate the most optimized recipe for any stiffness and any pressure.

- Press: Ctrl + Shift + S
- The below POP UP will appear

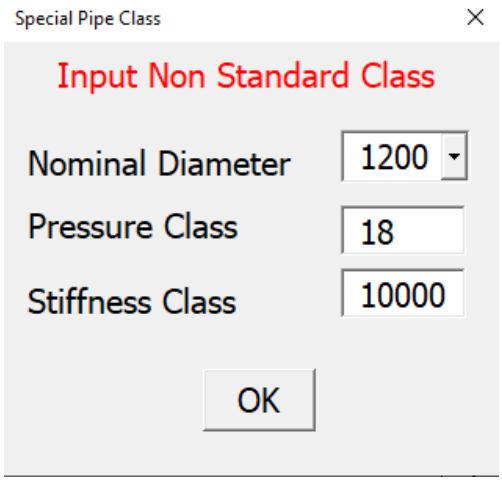


Figure 18

- Choose the required Pressure and Stiffness
- Press OK

1.9. Input thickness of the layers manually

The pipe design program is prepared to do reverse-engineering of a certain pipe, with the manual input of the Layers

- Press Ctrl + Shift + M
- The below POP UP will appear

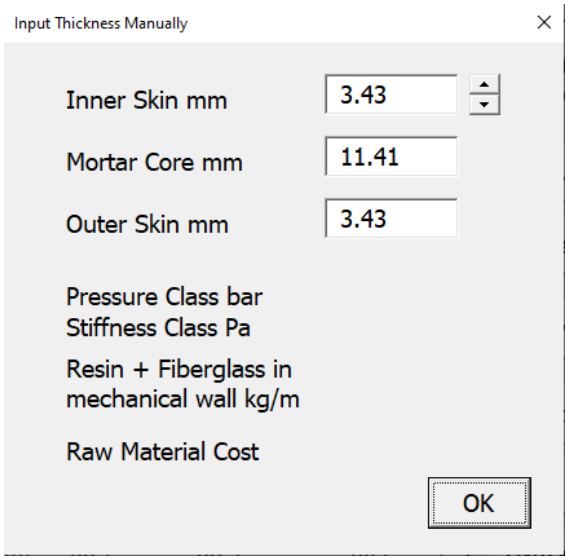


Figure 19

- Input manually the Inner Skin, Mortar Core and Outer Skin
- Press OK

1.10. Audits

The Quality Control needs to perform Audits on the Blank for Sleeve and Pipe being produced

The Pipe design software automatically prepares the Audit Formats.

- Go to the Input Page and Press on Pipe Audit or Sleeve Audit as per your needs

Figure 20

- The following POP UP will appear

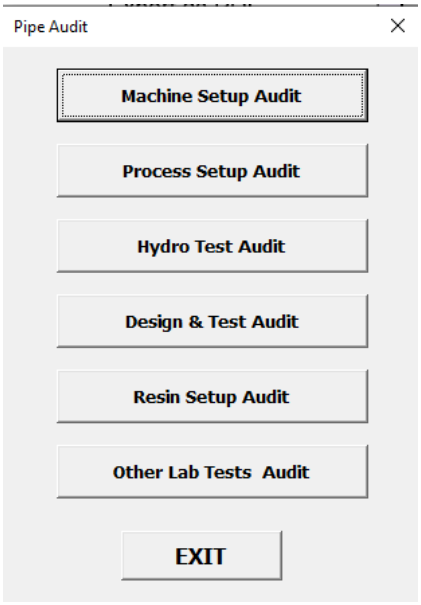
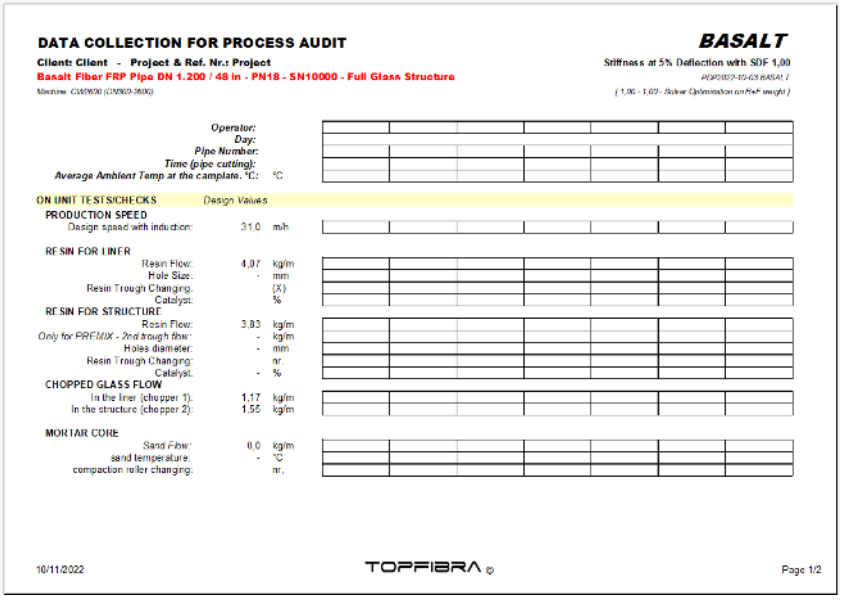


Figure 21

Pressing on the Options you will get the prepared Audit Forms

For example:



DATA COLLECTION FOR PROCESS AUDIT

BASALT

Client: Client - Project & Ref. Nr.: Project

Basalt Fiber FRP Pipe DN 1.200 / 48 in - PN18 - SN10000 - Full Glass Structure

Machine: CW2600 (DN300-3600)

Stiffness at 5% Deflection with SDF 1,00

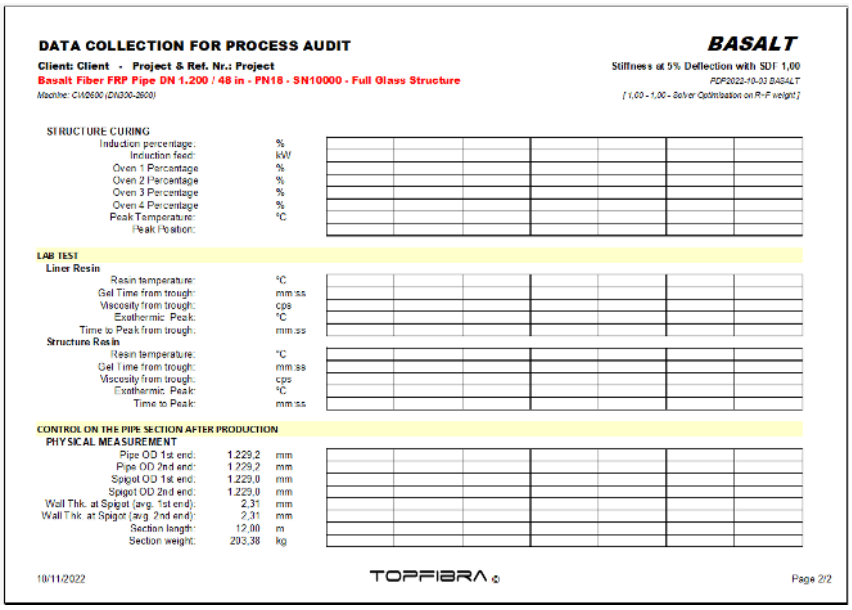
PDP2022-10-03 BASALT

[1,00 - 1,00 - Solver Optimization on R+F weight]

Operator:								
Day:								
Pipe Number:								
Time (pipe cutting):								
Average Ambient Temp at the camplate. °C:		°C						
ON UNIT TEST/SICHECKS	Design Values							
PRODUCTION SPEED								
Design speed with induction:	31,0	m/h						
RESIN FOR LINER								
Resin Flow:	4,07	kg/m						
Hole Size:	-	mm						
Resin Trough Changing:		(X)						
Catalyst:		%						
RESIN FOR STRUCTURE								
Resin Flow:	3,83	kg/m						
Only for PREMIX - 2nd trough flow:	-	kg/m						
Holes diameter:	-	mm						
Resin Trough Changing:		nr.						
Catalyst:	-	%						
CHOPPED GLASS FLOW								
In the liner (chopper 1):	1,17	kg/m						
In the structure (chopper 2):	1,55	kg/m						
MORTAR CORE								
Sand Flow:	0,0	kg/m						
sand temperature:	-	°C						
compaction roller changing:		nr.						

10/11/2022 TOPFIBRA © Page 1/2

Figure 22



DATA COLLECTION FOR PROCESS AUDIT

BASALT

Client: Client - Project & Ref. Nr.: Project

Basalt Fiber FRP Pipe DN 1.200 / 48 in - PN18 - SN10000 - Full Glass Structure

Machine: CW2600 (DN300-3600)

Stiffness at 5% Deflection with SDF 1,00

PDP2022-10-03 BASALT

[1,00 - 1,00 - Solver Optimization on R+F weight]

STRUCTURE CURING								
Induction percentage:		%						
Induction feed:		kW						
Oven 1 Percentage		%						
Oven 2 Percentage		%						
Oven 3 Percentage		%						
Oven 4 Percentage		%						
Peak Temperature:		°C						
Peak Position:								
LAB TEST								
Liner Resin								
Resin temperature:		°C						
Gel Time from trough:		mm:ss						
Viscosity from trough:		cps						
Exothermic Peak:		°C						
Time to Peak from trough:		mm:ss						
Structure Resin								
Resin temperature:		°C						
Gel Time from trough:		mm:ss						
Viscosity from trough:		cps						
Exothermic Peak:		°C						
Time to Peak:		mm:ss						
CONTROL ON THE PIPE SECTION AFTER PRODUCTION								
PHYSICAL MEASUREMENT								
Pipe OD 1st end:	1.229,2	mm						
Pipe OD 2nd end:	1.229,2	mm						
Spigot OD 1st end:	1.229,0	mm						
Spigot OD 2nd end:	1.229,0	mm						
Wall Thk. at Spigot (avg. 1st end):	2,31	mm						
Wall Thk. at Spigot (avg. 2nd end):	2,31	mm						
Section length:	12,00	m						
Section weight:	293,38	kg						

10/11/2022 TOPFIBRA © Page 2/2

Figure 23

For more information contact us writing at

support@topfibra.eu

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