Design of Process Equipment

Introduction to the subject

Lecture

doc. Ing. Martin Juriga, PhD.

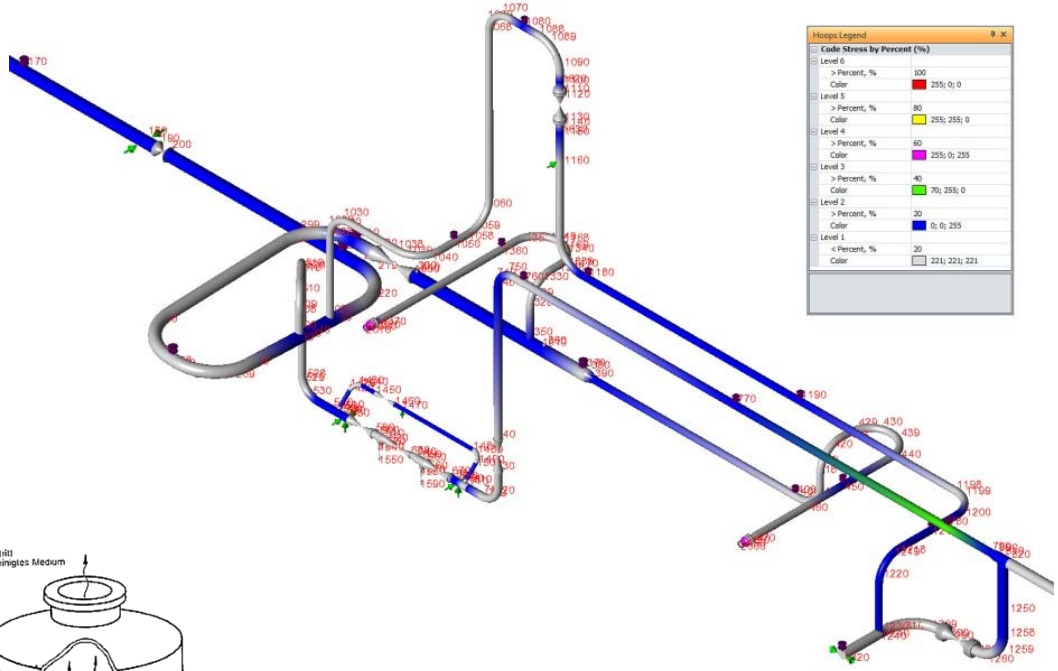
Bratislava, February 2024

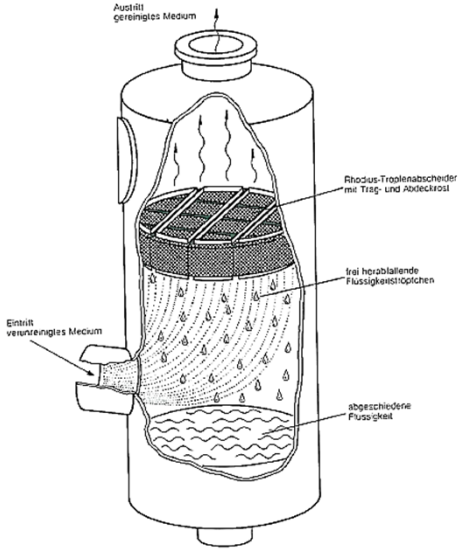
Technical documentation

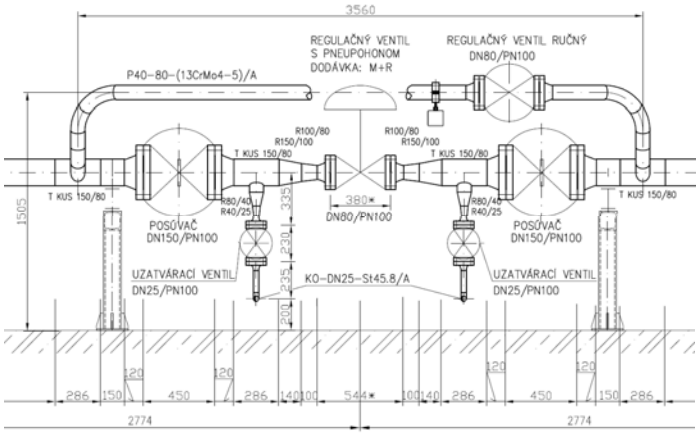
Technical documentation – is a summary of documents, the purpose of which is to describe a technical product or a technological unit:

- comprehensive,
- interdisciplinary,
- contains a text and drawing part.

It serves to describe and specify technical properties, parameters, functions and requirements. Its task is to ensure the production or installation, use, maintenance of equipment or technological systems.







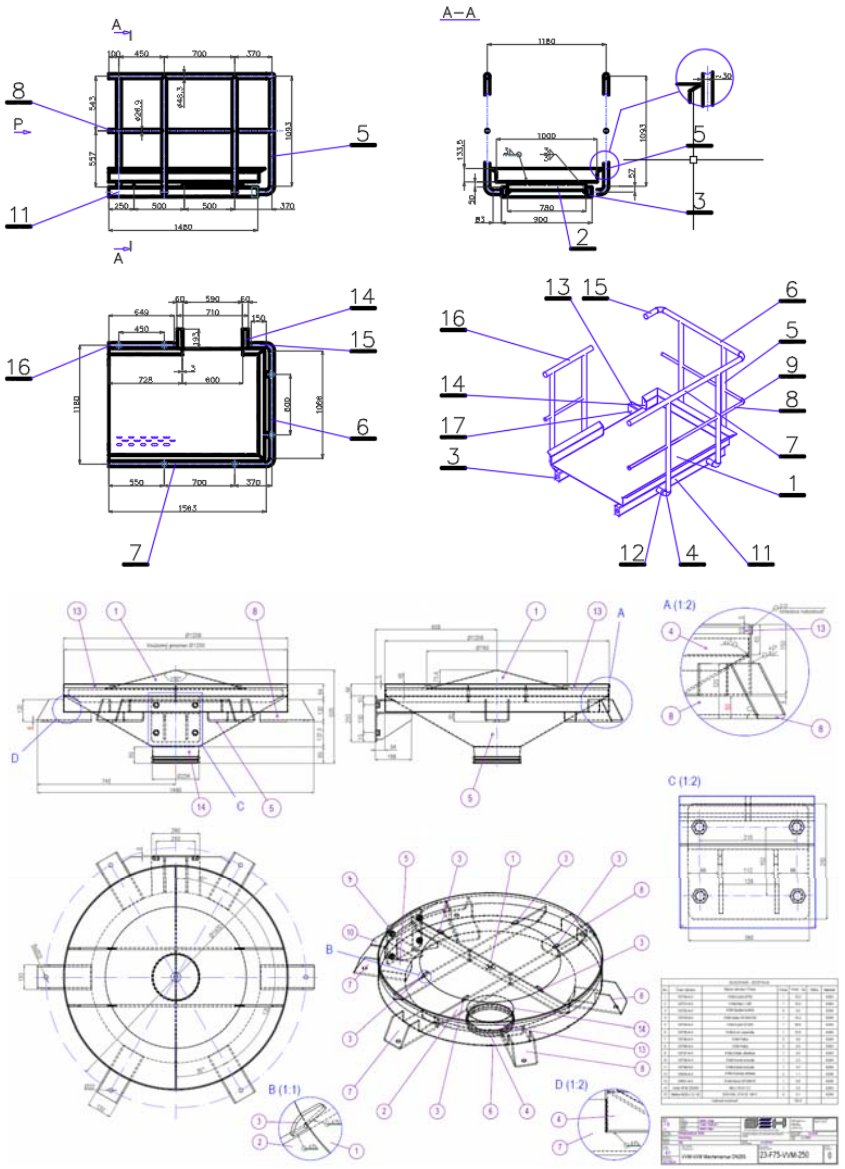
Technical documentation

Essential for understanding of technical documentation is

- communication language,
- expertise,
- basics of technical drawing,
- knowledge of norms and standards.

What form of technical documentation will you encounter?

- Technical specifications
- Technical drawings and diagrams
- Calculation reports and calculations
- Standards and norms
- Manuals
- Maintenance and service instructions



Technical documentation

The technical project is a complex document that contains all the necessary information for the successful implementation of the technical plan.

Project for Building Permit Application (PSP)

The project for the building permit is the basic project documentation that every investor needs to start construction. On the basis of this documentation, the building authority will decide on the issuance of a building permit.

Implementation project (RP)

The implementation project is the highest "level" of project documentation. The content and scope of the documentation is not determined by Slovak legislation. The implementation project should contain everything for the successful implementation of the project

STAVBA - AKCIA PLANT	Repasia potrubných rozvodov nádržového parku a čerpacej stanici v objekte KLF Energetika a.s.
ČÍSLO STAVBY PLANT NO.	-
MIESTO STAVBY PLANT PLACE	KLF Energetika a.s., Kysucké Nové Meste
INVESTOR CLIENT	Sonic Slovakia s.r.o., Bratislava
STUPEŇ DOKUMENTÁCIE STEP	RP
STAVEBNÝ OBJEKT TECHNOLOGICAL UNIT	SO-001 Mobilná technológia BLOWDEC a nádržový park
PREVÁDZKOVÝ SÚBOR ELEMENTARY SYSTEM	PS-001 Technologické zariadenia a hlavne prevádzkové potrubie
DIELČÍ PREVÁDZ. SÚBOR PARTIAL ELEMENT. SYSTEM	DPS-001.1 Technologické zariadenia a hlavne prevádzkové potrubie
ČASŤ PROJEKTU DESIGN PART	STROJNÁ
DIEL PROJETKU DIVISION	
ZOŠIT ITEM	ZOZNAM DOKUMENTOV

SPRACOVATELIA DOKUMENTÁCIE DOCUMENTATIONS ORIGINATORS		
VYPRACOVAL ISSUED BY	**KONTROLOVAL** CHECKED BY	**SCHVÁLIL** APPROVED BY
Ing. JURIGA Martin, PhD.	Ing. CEBO Vladimír	Ing. CEBO Vladimír

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Technical documentation

Technical report for a technological project / from a mechanical engineer's point of view/

What's inside?

- Text part
- P&ID / Piping and Instrumentation Diagram/

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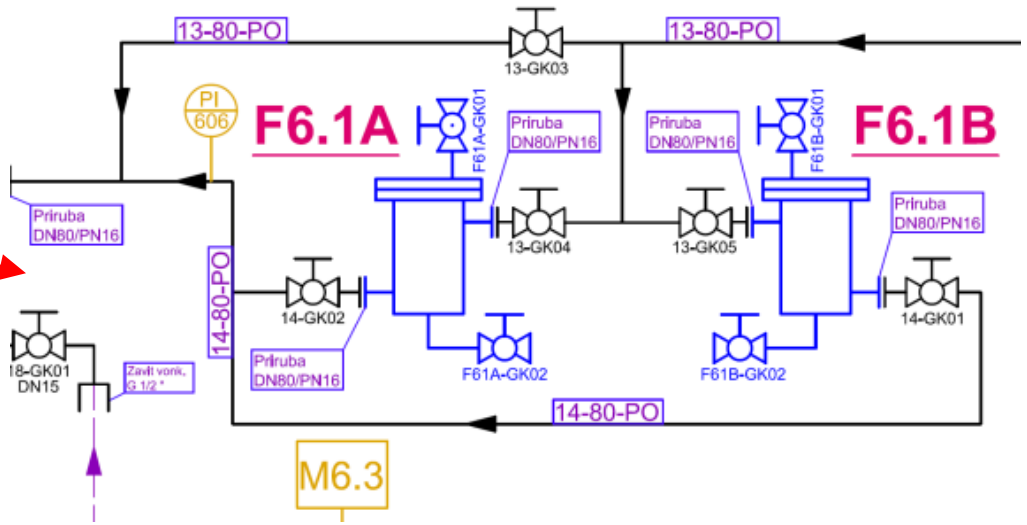
Pružinové závesy sa odistia až po tlakovej skúške.

7.3. Stavebná skúška

Stavebná skúška sa vykoná po dohotovení a zmontovaní potrubia. Zisťuje sa ňou, či celkové vyhotovenie, použitý materiál, odpovedá dokumentácii. Kontroluje sa pripravenosť k hydrostatickej skúške, pričom sa zisťuje najmä: funkcia ovládacích, uzavieracích a poistných zariadení, funkcia odvzdušnenia a odvodnenia, správnosť uloženia potrubia a jeho spád, dokončenie zváracích prác, možnosť tepelnej dilatácie, vyhotovenie zváraných spojov, úplnosť dokumentácie, atď.

O priebehu a výsledku stavebnej skúšky sa musí spísať zápis za účasti technickej kontroly odberateľa, v ktorom sa potvrdí správnosť výsledku.

Potrubie pred odovzdaním do užívania musí byť premývané, resp. prefukované, aby bolo zbavené všetkých nežiaducich nečistôt. Premývanie vodou sa vykoná vodou o dostatočnej rýchlosti (v = 1 až 1,5 m/s), aby došlo k únosu nečistôt. Prefukovanie vzduchom sa vykoná pri tlaku rovnom pracovnému tlaku po dobu min. 10 minút. O premývaní, resp. prefukovaní, je potrebné spísať zápis.



Technical documentation

Technical report for a technological project / from a mechanical engineer's point of view/

What's inside?

- Drawing documentation
- 3D model of the building

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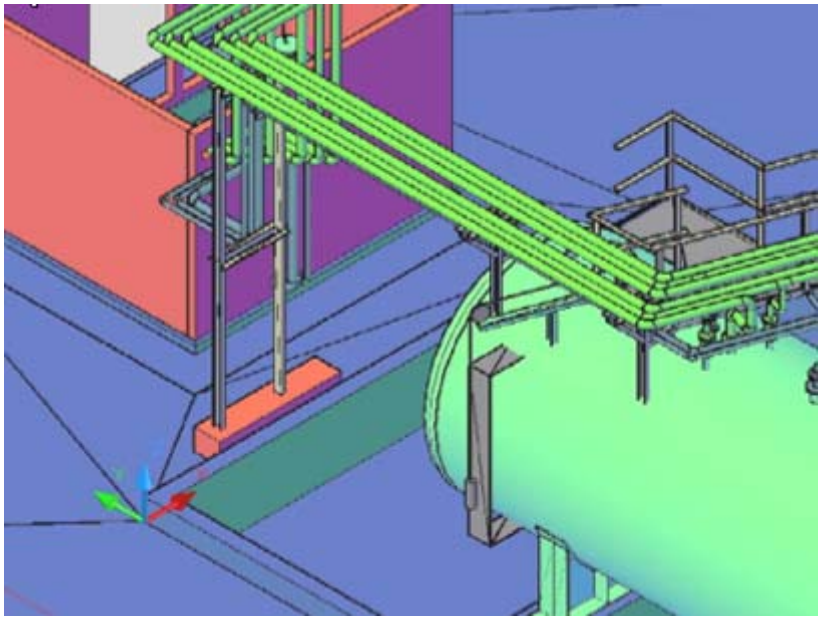

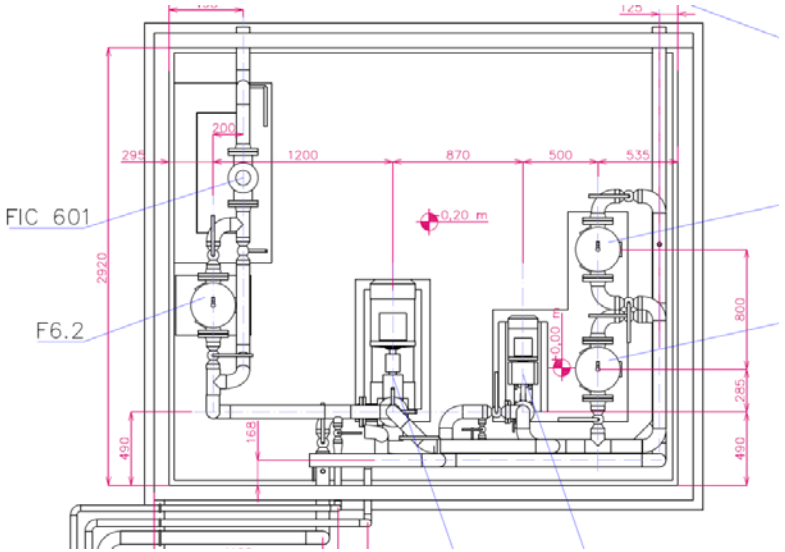

Technical documentation

Technical report for a technological project / from a mechanical engineer's point of view/

What's inside?

- Drawings of machines and devices
- Modification of existing equipment

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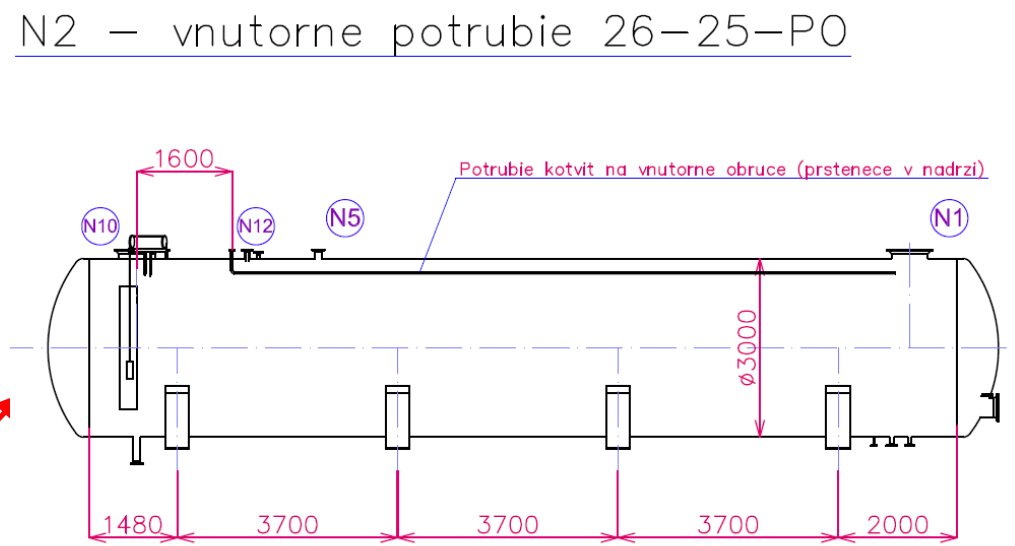
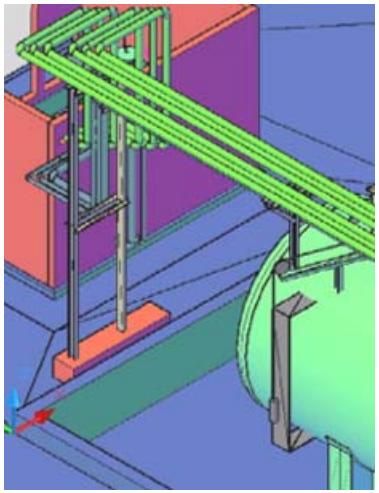


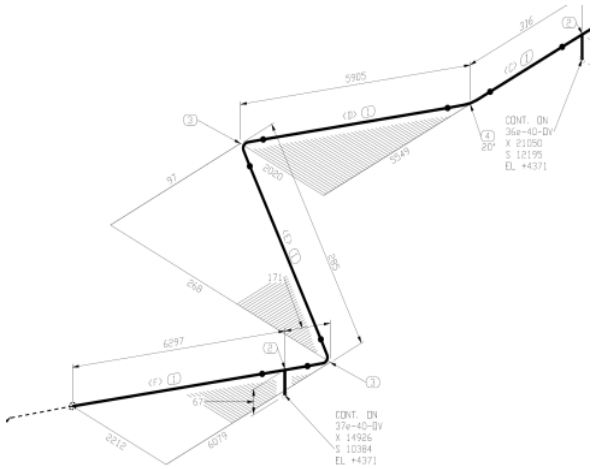
Technical documentation

Technical report for a technological project / from a mechanical engineer's point of view/

What's inside?

- Isometric drawings of pipelines
- BOM /Bill of Materials /





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PROPLANT s r.o. Zoznam potrubných komponentov pre nové potrubia Rev.G

MARK Označ. [-]	QTY Počet [ks]	SIZE DN [mm]	DESCRIPTION Popis potrubného komponentu	LENGTH Dĺžka [mm]	WEIGHT Hmot. [kg]
1	1	15	Pipe, seamless /Rura, bezosva/ x 2.6mm ; EN 10216-1 ; Mat. P235TR1 /DIN: St.37.0; STN: 11 353/	300	0.36
2	1	25	Pipe, seamless /Rura, bezosva/ x 2.6mm ; EN 10216-1 ; Mat. P235TR1 /DIN: St.37.0; STN: 11 353/	133825.4	266.85
3	1	32	Pipe, seamless /Rura, bezosva/ x 2.6mm ; EN 10216-1 ; Mat. P235TR1 /DIN: St.37.0; STN: 11 353/	71052.6	181.33
4	1	40	Pipe, seamless /Rura, bezosva/ x 2.6mm ; EN 10216-1 ; Mat. P235TR1 /DIN: St.37.0; STN: 11 353/	116599.9	341.64
5	1	80	Pipe, seamless /Rura, bezosva/ x 3.6mm ; EN 10216-1 ; Mat. P235TR1 /DIN: St.37.0; STN: 11 353/	23809.9	180.29
6	1	15	Elbow /Koleno/, 90° typ 3D ; EN 10253-1 ; Mat. S235 /DIN: St.37.0; STN: 11 353/		0.07
7	36	25	Elbow /Koleno/, 90° typ 3D ; EN 10253-1 ; Mat. S235 /DIN: St.37.0; STN: 11 353/		4.32
8	20	32	Elbow /Koleno/, 90° typ 3D ; EN 10253-1 ; Mat. S235 /DIN: St.37.0; STN: 11 353/		3.80
9	2	32	TRIMMED Elbow /Koleno/, 90° typ 3D ; EN 10253-1 ; Mat. S235 /DIN: St.37.0; STN: 11 353/ (70.54%%d)	59.1	0.30
10	55	40	Elbow /Koleno/, 90° typ 3D ; EN 10253-1 ; Mat. S235 /DIN: St.37.0; STN: 11 353/		14.85
11	2	40	Elbow /Koleno/, 90° typ 3D ; EN 10253-1 ; Mat. S235 /DIN: St.37.0; STN: 11 353/	89.3	0.54
12	1	40	Elbow /Koleno/, 90° typ 3D ; EN 10253-1 ; Mat. S235 /DIN: St.37.0; STN: 11 353/	89.8	0.27
13	1	40	TRIMMED Elbow /Koleno/, 90° typ 3D ; EN 10253-1 ; Mat. S235 /DIN: St.37.0; STN: 11 353/ (70%%d)	69.6	0.21
14	1	40	TRIMMED Elbow /Koleno/, 90° typ 3D ; EN 10253-1 ; Mat. S235 /DIN: St.37.0; STN: 11 353/ (70.54%%d)	70.2	0.21
15	31	80	Elbow /Koleno/, 90° typ 3D ; EN 10253-1 ; Mat. S235 /DIN: St.37.0; STN: 11 353/		37.82
16	5	25	TRIMMED Elbow /Koleno/, 45° typ 3D ; EN 10253-1 ; Mat. S235 /DIN: St.37.0; STN: 11 353/ (15%%d)	19	1.53
17	1	25	TRIMMED Elbow /Koleno/, 45° typ 3D ; EN 10253-1 ; Mat. S235 /DIN: St.37.0; STN: 11 353/ (20%%d)	25.3	0.41
18	2	25	TRIMMED Elbow /Koleno/, 45° typ 3D ; EN 10253-1 ; Mat. S235 /DIN: St.37.0; STN: 11 353/ (7.5%%d)	9.5	0.31
19	1	32	TRIMMED Elbow /Koleno/, 45° typ 3D ; EN 10253-1 ; Mat. S235 /DIN: St.37.0; STN: 11 353/ (20%%d)	16.9	0.43
20	5	40	TRIMMED Elbow /Koleno/, 45° typ 3D ; EN 10253-1 ; Mat. S235 /DIN: St.37.0; STN: 11 353/ (15%%d)	28.4	3.07
21	2	40	TRIMMED Elbow /Koleno/, 45° typ 3D ; EN 10253-1 ; Mat. S235 /DIN: St.37.0; STN: 11 353/ (20%%d)	20.2	1.84
22	2	40	TRIMMED Elbow /Koleno/, 45° typ 3D ; EN 10253-1 ; Mat. S235 /DIN: St.37.0; STN: 11 353/ (7.5%%d)	14.2	0.61
23	4	80	Elbow /Koleno/, 45° typ 3D ; EN 10253-1 ; Mat. S235 /DIN: St.37.0; STN: 11 353/		9.76
24	3	25	Tee equal /T-kus / ; EN 10253-1 ; Mat. S235 /DIN: St.37.0; STN: 11 353/		0.84
25	5	40	Tee equal /T-kus / ; EN 10253-1 ; Mat. S235 /DIN: St.37.0; STN: 11 353/		3.20
26	8	80	Tee equal /T-kus / ; EN 10253-1 ; Mat. S235 /DIN: St.37.0; STN: 11 353/		14.82
27	1	80x50	Tee reducing /T-kus redukcny/ ; EN 10253-1 ; Mat. S235 /DIN: St.37.0; STN: 11 353/		1.84
28	8	32x25	Reducer concentric /Redukcia centrická/, Form 1 ; EN 10253-1 ; Mat. S235 /DIN: St.37.0; STN: 11 353/		1.36
29	1	50x32	Reducer concentric /Redukcia centrická/, Form 1 ; EN 10253-1 ; Mat. S235 /DIN: St.37.0; STN: 11 353/		0.30
30	2	50x40	Reducer concentric /Redukcia centrická/, Form 1 ; EN 10253-1 ; Mat. S235 /DIN: St.37.0; STN: 11 353/		0.59
31	1	80x40	Reducer concentric /Redukcia centrická/, Form 1 ; EN 10253-1 ; Mat. S235 /DIN: St.37.0; STN: 11 353/		0.52
32	1	25	Flange, welding neck /Priruba, krkova/, PN16 ; EN1092-1, 11 B ; Mat. P235GH		1.14
33	4	25	Flange, welding neck /Priruba, krkova/, PN6 ; EN1092-1, 11 B ; Mat. P235GH		3.00
34	15	40	Flange, welding neck /Priruba, krkova/, PN16 ; EN1092-1, 11 B ; Mat. P235GH		28.35
35	11	80	Flange, welding neck /Priruba, krkova/, PN16 ; EN1092-1, 11 B ; Mat. P235GH		40.70

Technical documentation

Technical report for a technological project / from a mechanical engineer's point of view/

What's inside?

- Process calculations
- Stress calculations and analysis

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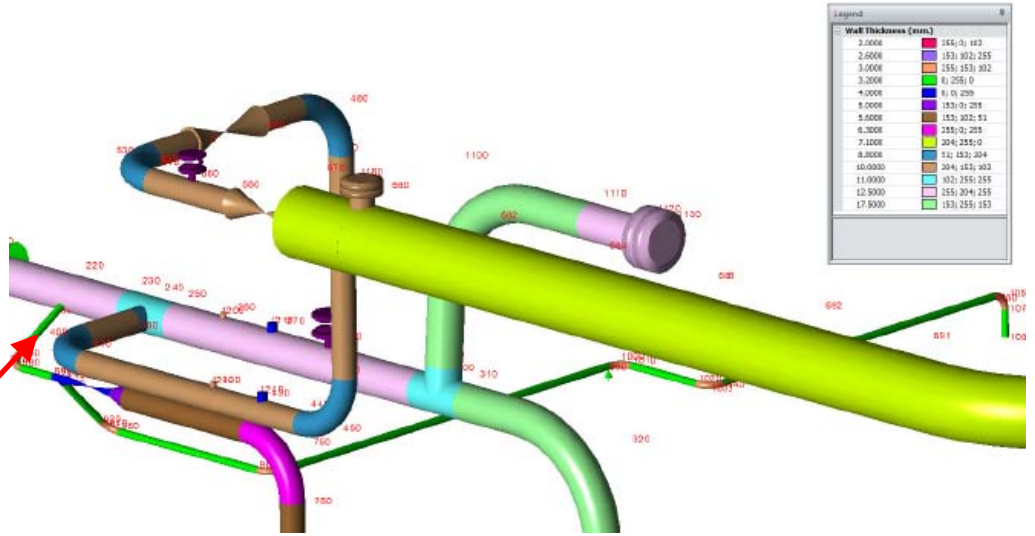


HANGER REPORT
(TABLE DATA FROM DESIGN RUNS)

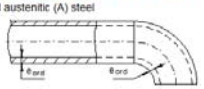
NODE	NO. REQD	FIG. NO.	SIZE	VERTICAL MOVEMENT (cm.)	HOT LOAD (N.)	THEORETICAL INSTALLED LOAD (N.)	ACTUAL INSTALLED LOAD (N.)	SPRING RATE (N./cm.)	HORIZONTAL MOVEMENT (cm.)
100	2	USER	VSH			3770.	230.		
170	2	USER	VSH			1450.	70.		
280	2	USER	VSH			2460.	270.		
550	1	USER	VSH			9270.	810.		
600	1	USER	VSH			7050.	810.		
800	1	MID Gradior	4	-0.444	2766.	2648.	0. LOAD	267. VARIATION =	2.660 4%

** VARIABLE SUPPORT SPRING DESIGNED ..... MID RANGE
MINIMUM ALLOWED SINGLE SPRING LOAD ..... (N.) 1599.999
MAXIMUM ALLOWED SINGLE SPRING LOAD ..... (N.) 3733.293
RECOMMENDED INSTALLATION CLEARANCE ..... (cm.) 29.500

Task				
field of application	EN 13480-3:2002-8 / Code-Revision until 2007: 6.1 pipe, 6.2 pipe elbow standard me			
literature, source	Rohrleitungstechnik, W.W. 9.Auflage Vogel Verlag, TabBuch für Rohrl.Bau,15.Aufl.Vulkan-Ve			
mathematical symbols, units and comments: see red corner triangle are part of computing and shall be considered. To read: move the curser into the				

Pipe calculation. Strength criteria for all pipe components from non-austenitic (NA) and austenitic (A) steel

NA : EN 13480: $A < 30\%$; $f = \min (R_{p0,2\,t}/1,5 ; R_m/2,4)$
A : EN 13480: $A > 35\%$ (DB : A40) : $f = R_{p1,0\,t}/1,5$
A : EN 13480: $30\% \le A \le 35\%$ (DB : A35) : $f = \min (R_{p1,0\,t}/1,5 ; R_m/2,4)$
Test: EN 13480; 5.2.1.2 and 5.2.2.2 *note*



name	unit	formular / symbol	data		
design pressure internal	N/mm²	$p_c \le PS$, $p_c \ge p_{operat}$	10,00		
design temperature in °C		-10 ≤ t ≤ 650 *ending 0 or 5*	100		
			correct		
material selection, pipe					
steel name / $R_{p,t}$ / T / N / S / Bl	–	*data base*	1.0108 / P195TR2, Rp0,2 / T ≤ 16		
additional - safety factor	–	S_Z =1 or $S_Z \ge 1,2$	1,00		
strength value, yield point	N/mm²	$R_{m20°}$, $R_{p0,2\,t}$, $R_{p1,0\,t}$	320,00	0,00	0,00
allowed tension	N/mm²	f_a	0,00		
		note	*incorrect*		
design details					
outer Ø, pipe, cylindrical shell	mm	Ø $D_0 \ge 10$	219,00		
welding seam factor longitudinal seam	–	$0,7 \le z \le 1$	5,00		
guide value, min. wall thickness	mm	e_a*			
order wall thickness: pipe, cylindrical shell	$T > e_a$*,	*recommended* ≥ 2 [mm]	10,00		
field of application, parameter	mm/mm	T / D_0			
	mm/mm	D_0 / D_i			
required thickness minimum	mm	$D_0 / D_i \le 1,7 : e$			

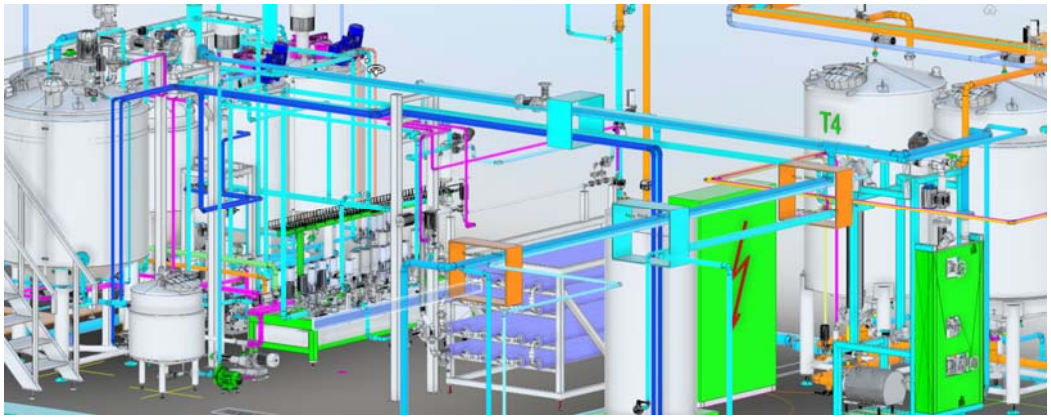
Technical documentation

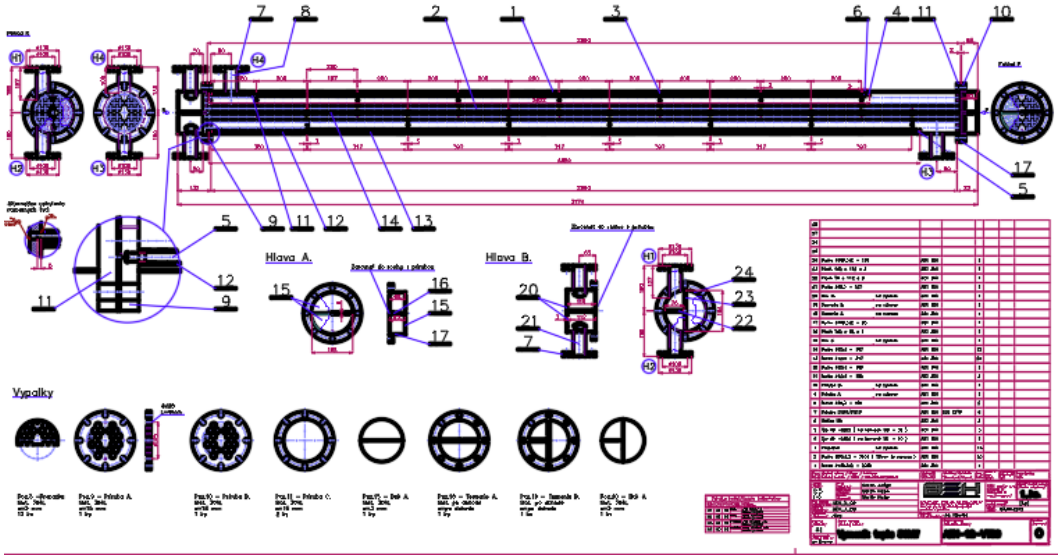
The most common task of a mechanical engineer in a technical project is the creation of drawing documentation

The engineer must, on the basis of the documents / the task of the project / make technical drawings that will be understandable for the manufacturer, taking into account the production technology.

2 examples

- Design based on a technical concept - an idea
- Design based on dimensional sketch

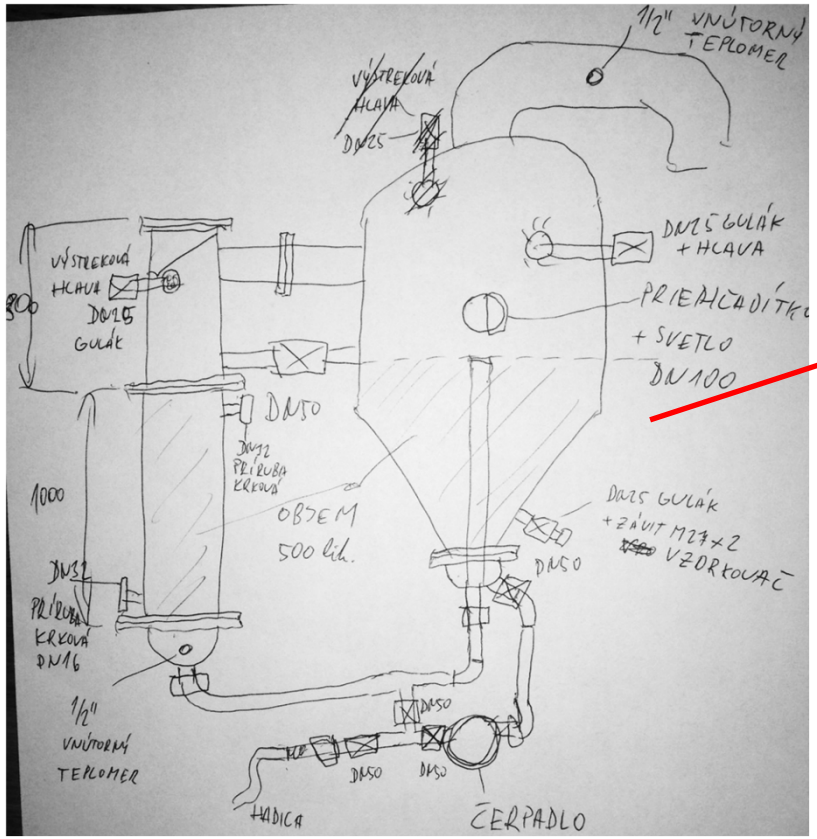




Technical documentation

Experimental evaporator

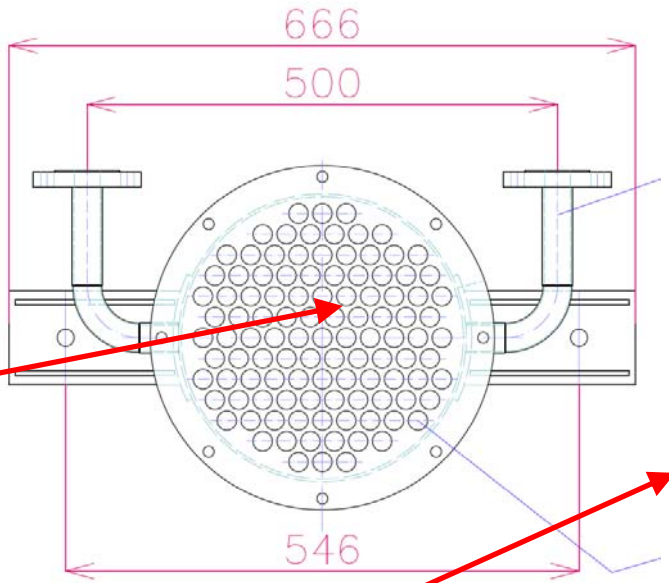
The device serves to thicken milk for experimental purposes.

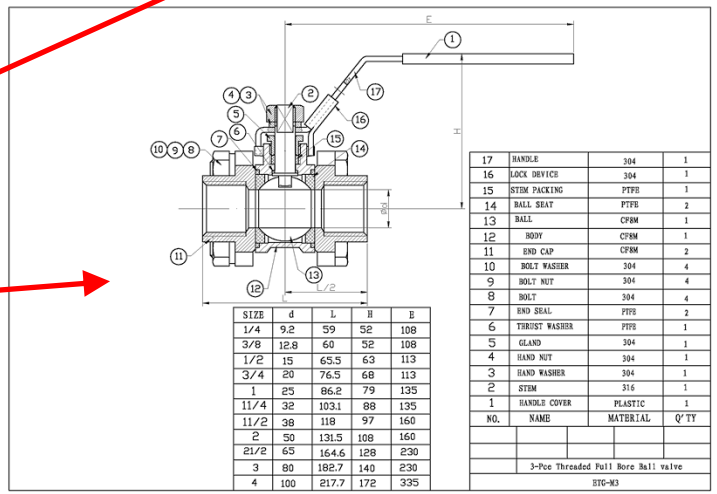


Technical documentation

Experimental evaporator

What do I have to make and what can I buy?





SIZE	d	L	H	E
1/4	9.2	59	52	108
3/8	12.8	60	52	108
1/2	15	65.5	63	113
3/4	20	76.5	68	113
1	25	86.2	79	135
11/4	32	103.1	88	135
11/2	38	118	97	160
2	50	131.5	108	160
21/2	65	164.6	128	230
3	80	182.7	140	230
4	100	217.7	172	335

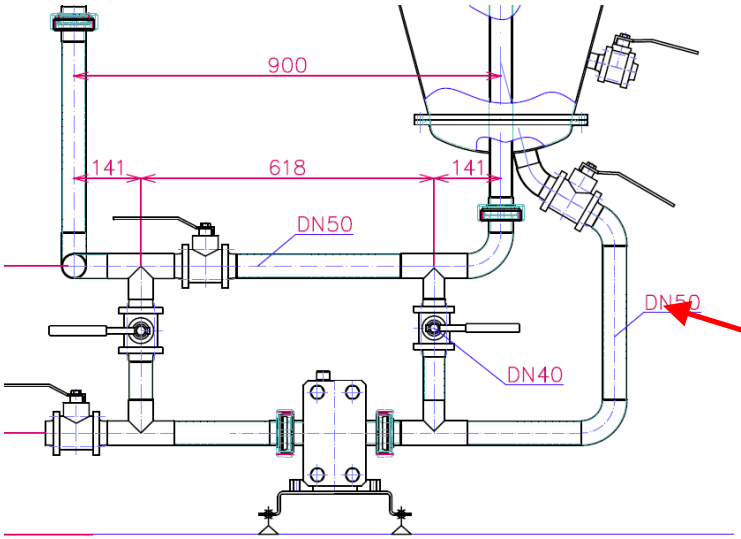
NO.	NAME	MATERIAL	Q'TY
17	HANDLE	304	1
16	LOCK DEVICE	304	1
15	STEM PACKING	PTFE	1
14	BALL SEAT	PTFE	2
13	BALL	CF8M	1
12	BODY	CF8M	1
11	END CAP	CF8M	2
10	BOLT WASHER	304	4
9	BOLT NUT	304	4
8	BOLT	304	4
7	END SEAL	PTFE	2
6	THRUST WASHER	PTFE	1
5	GLAND	304	1
4	HAND NUT	304	1
3	HAND WASHER	304	1
2	STEM	316	1
1	HANDLE COVER	PLASTIC	1

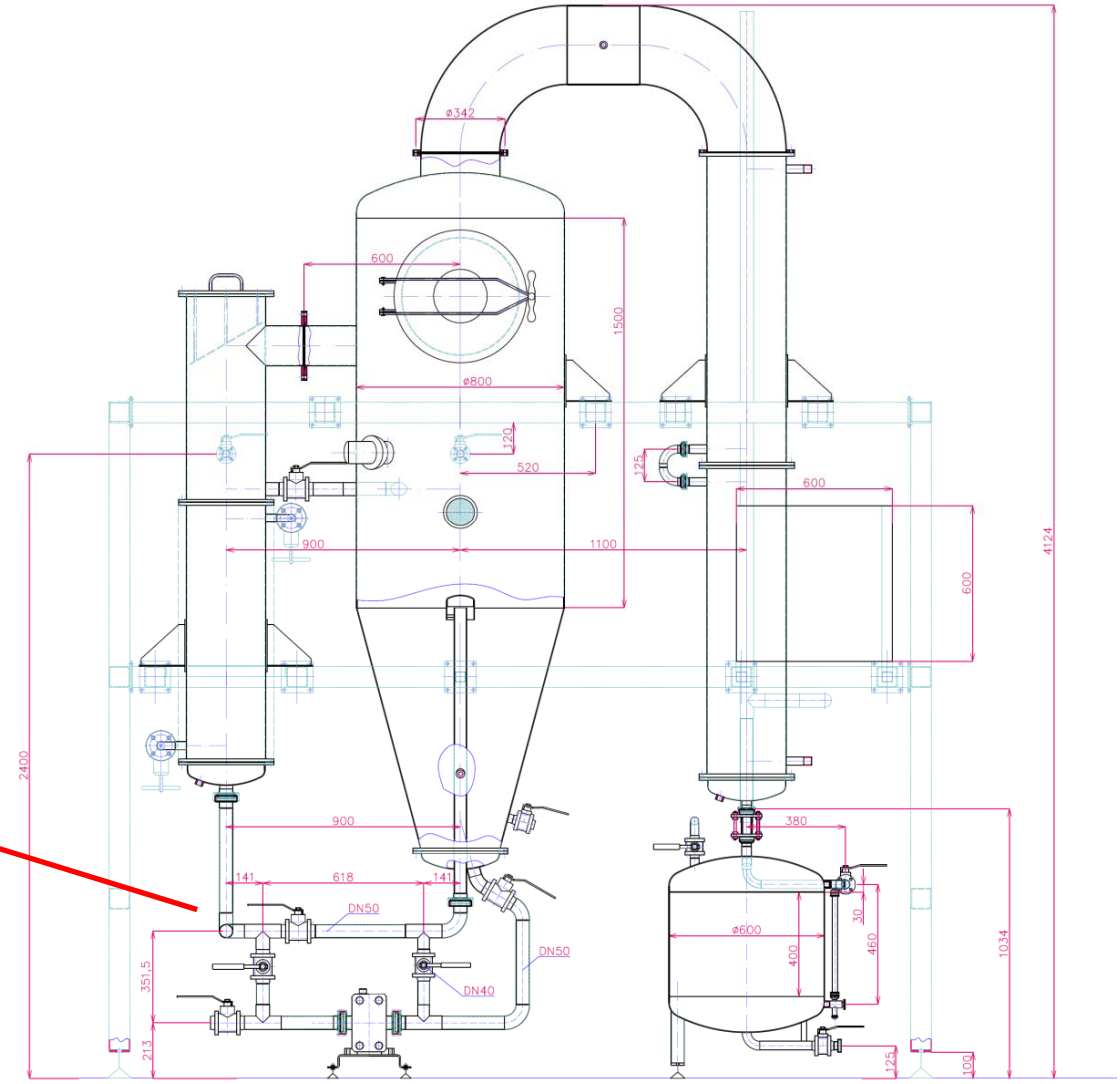
3-Pce Threaded Full Bore Ball valve
ETG-M3

Technical documentation

Experimental evaporator

Piping connection.

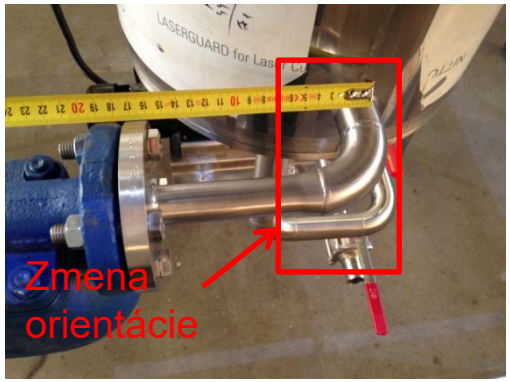




Technical documentation

Experimental evaporator

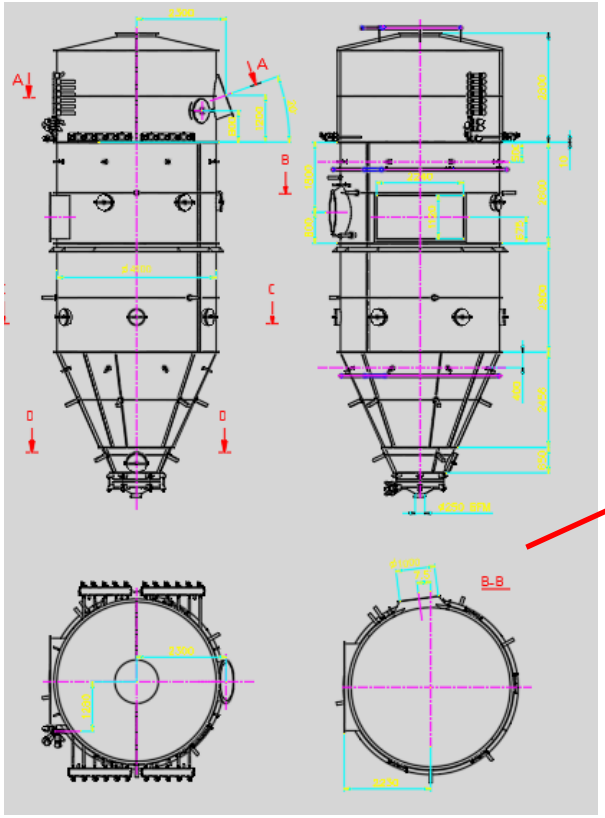
Drawings of the actual version/AB BUILD documentation/

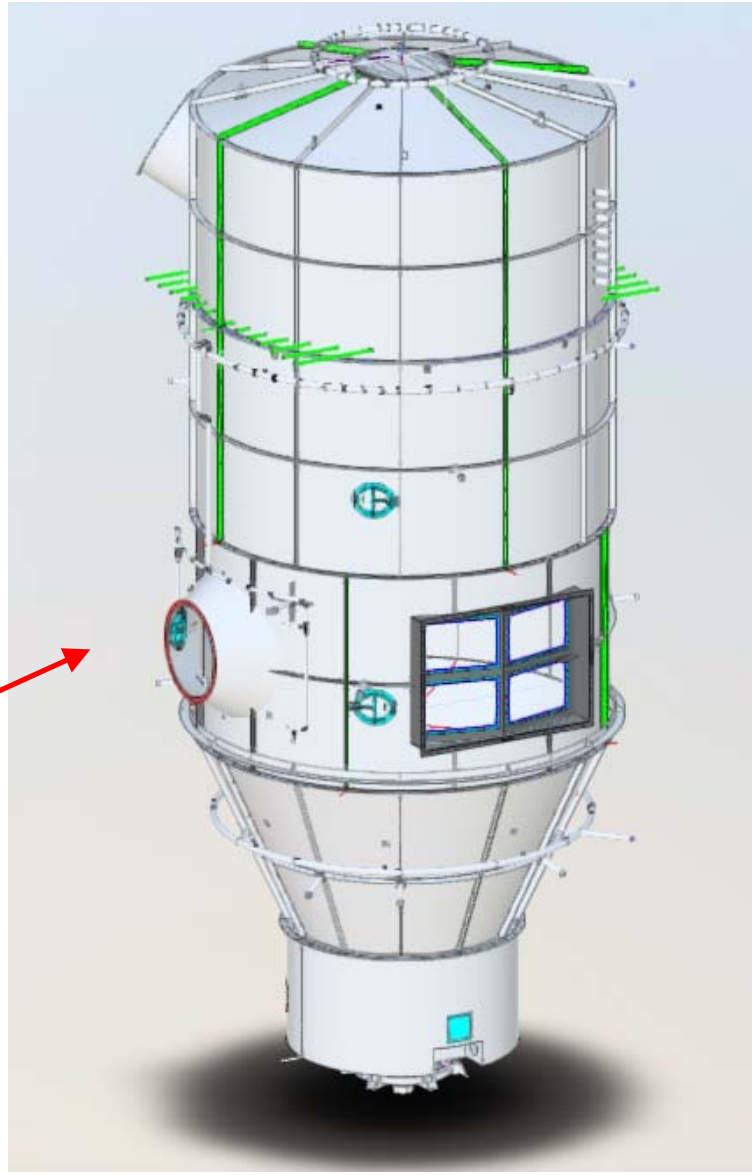


Technical documentation

Large capacity filter for milk powder.

The device serves to filter milk powder from the air.

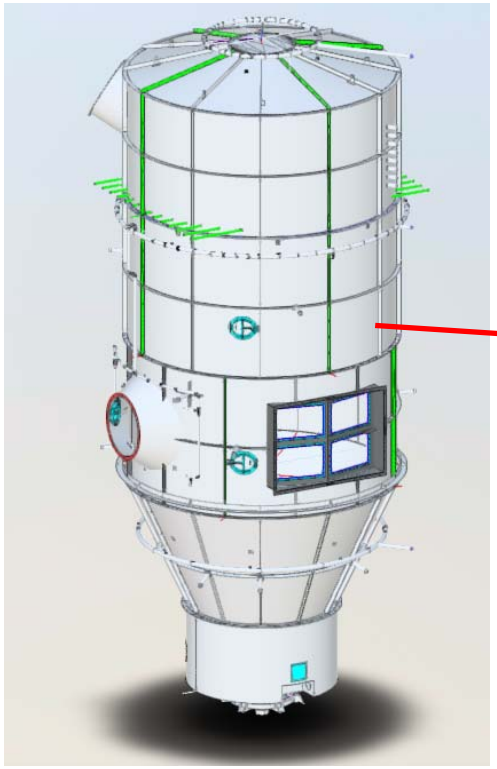


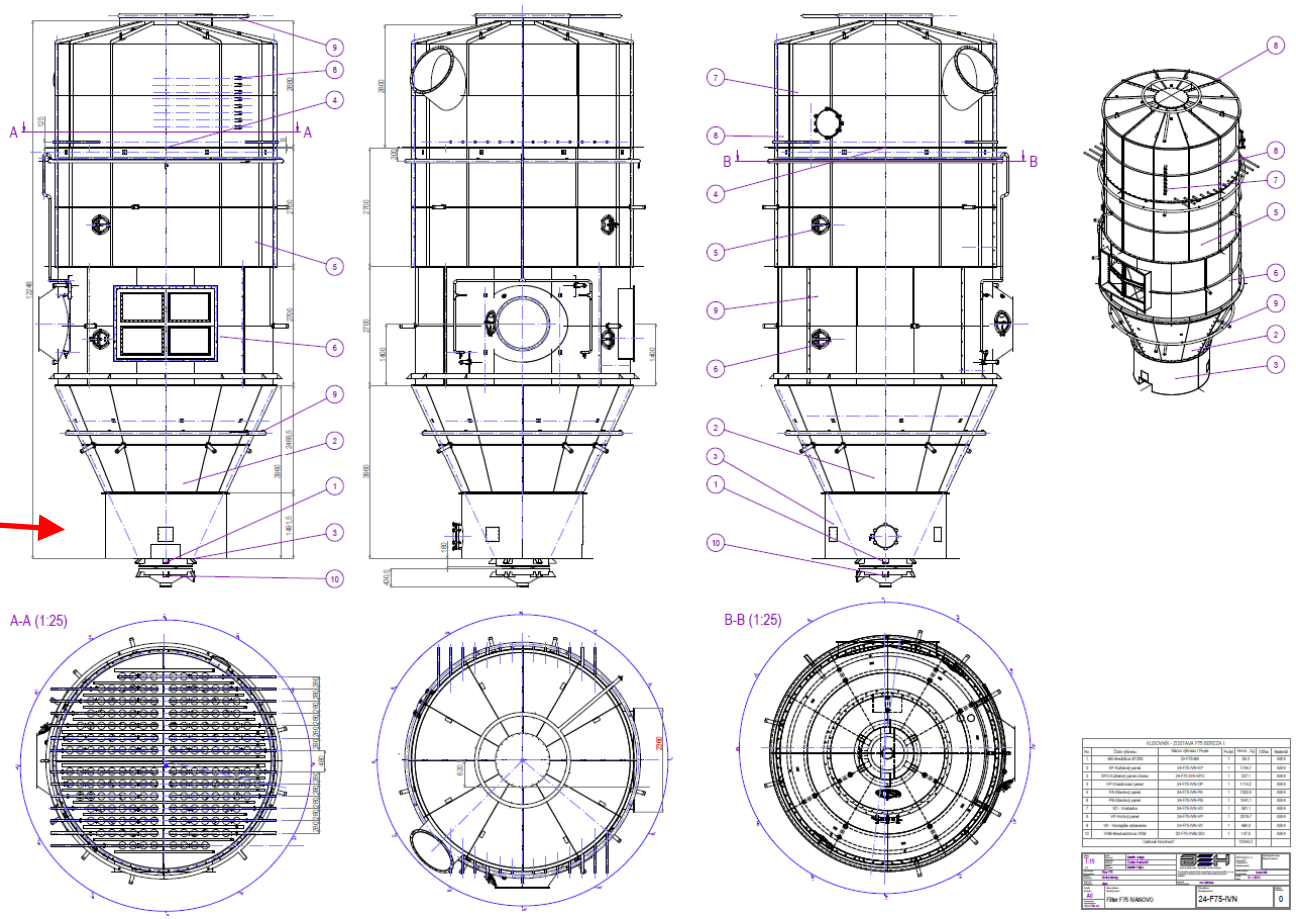


Technical documentation

Large capacity filter

A, Assembly drawing
B, Subassembly drawing
C, Production drawing

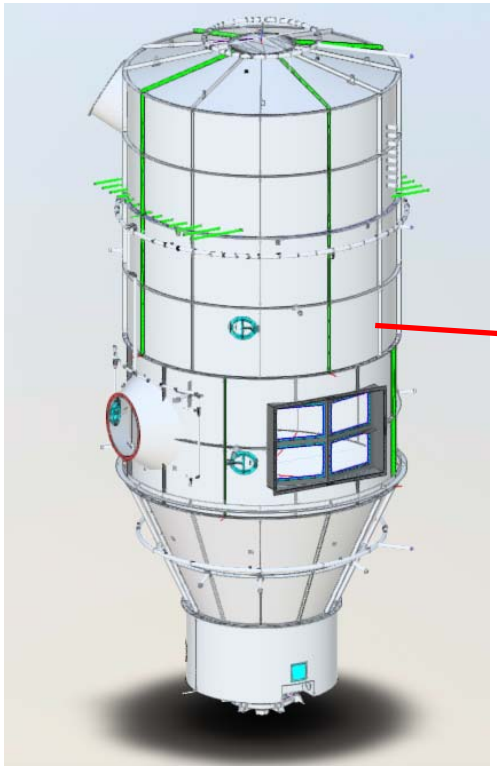


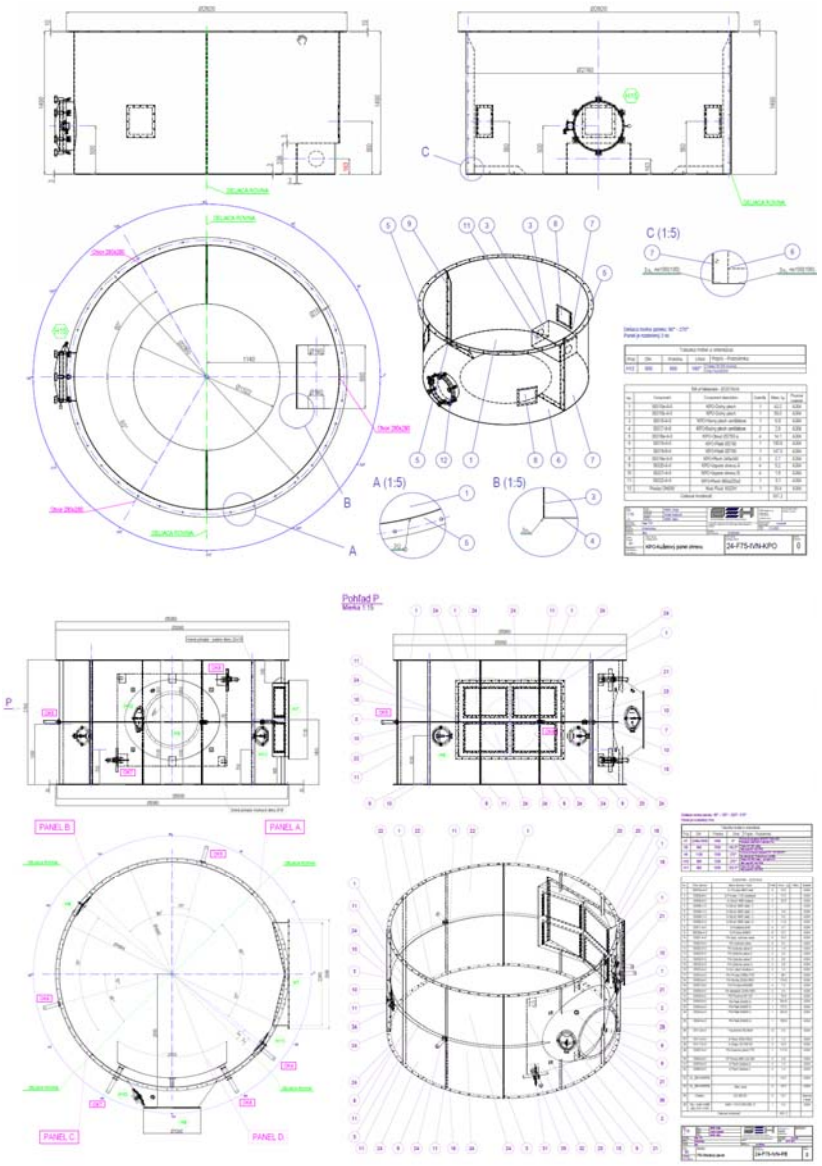


Technical documentation

Large capacity filter

A, Assembly drawing
B, Subassembly drawing
C, Production drawing

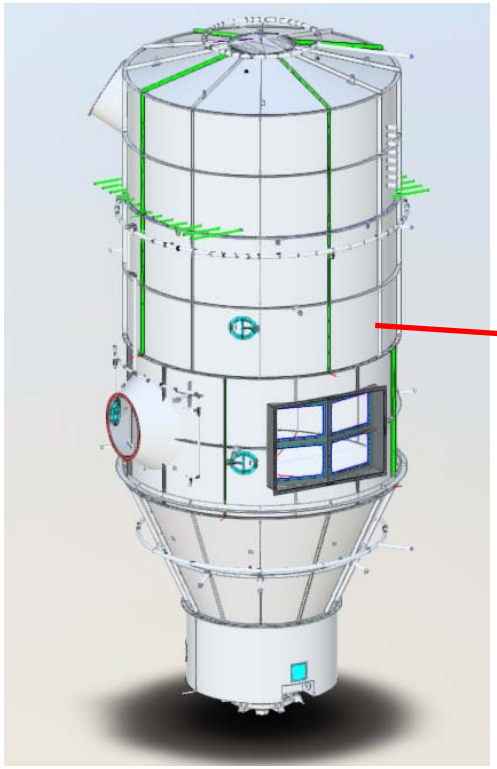


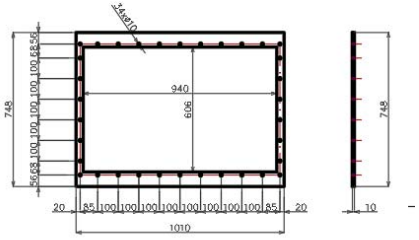


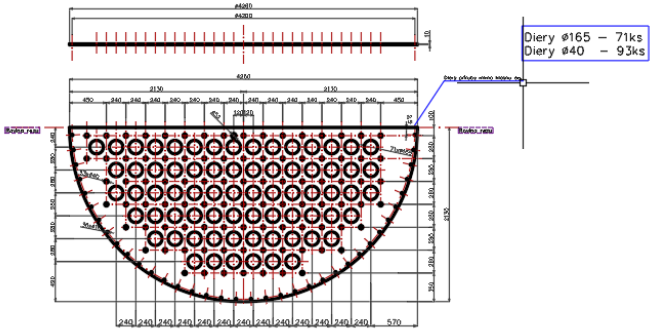
Technical documentation

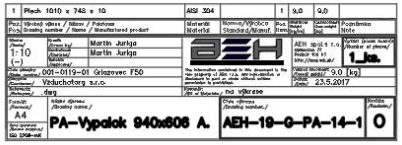
Large capacity filter

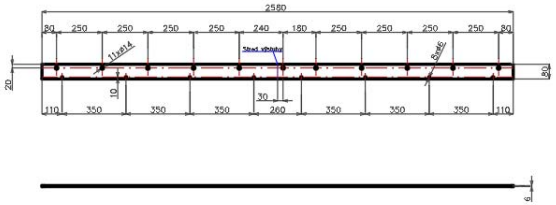
A, Assembly drawing
B, Subassembly drawing
C, Production drawing

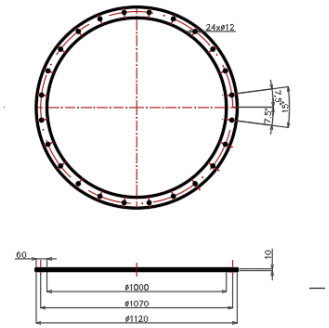


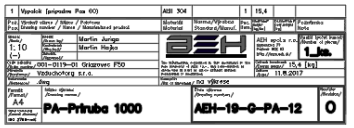












Technical documentation

To translate a technical idea into an understandable language for others

- Education / Understand the laws of nature, Know norms and standards, master 2D/3D drawing software, know the basics of production technology /
- Interest, talent, diligence / time-consuming and often frustrating work /
- Experience /increases with each completed project, by studying competitive solutions and ideas/
- Communication skills / today's unbeaten knowledge in the case of working in an international team/
- Professionalism / Skorates: I know that I know nothing. In engineering perspective it's: I know what I know and I know what I don't know/
- Ability to work in a team