

Design of Process Equipment

# Production of drawing documentation

Lecture

doc. Ing. Martin Juriga, PhD.  
Bratislava, February 2024

# Choice of appropriate design software

CAD - Computer Aided Design

CAM – Computer Aided Manufacturing

CAE - Computer Aided Engineering

CAD

MIT – 1959, SKETCHPAD ... 2D basic drawing concept, similar to AutoCAD today.

80 years - AutoCAD, 2D drawing - a popular system designed for personal computers /PC/.

1990-2000 PC boom, availability. New CAD solutions.

~ 2000, orientation towards 3D modeling prevails

CAM

– connection to fully automated production.

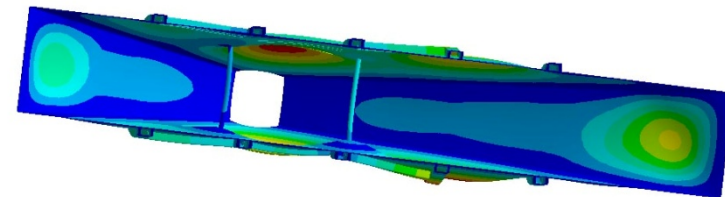
CAE

Finite Element Analysis (FEA), Computational Fluid Dynamics (CFD), Multibody dynamics (MBD) optimization



Total Deformation  
Type: Total Deformation  
Unit: mm  
Time: 1  
6. 9. 2010 7:55

6,1642 Max  
5,4782  
4,7943  
4,1094  
3,4245  
2,7396  
2,0547  
1,3698  
0,68491  
0 Min



# Choice of appropriate design software

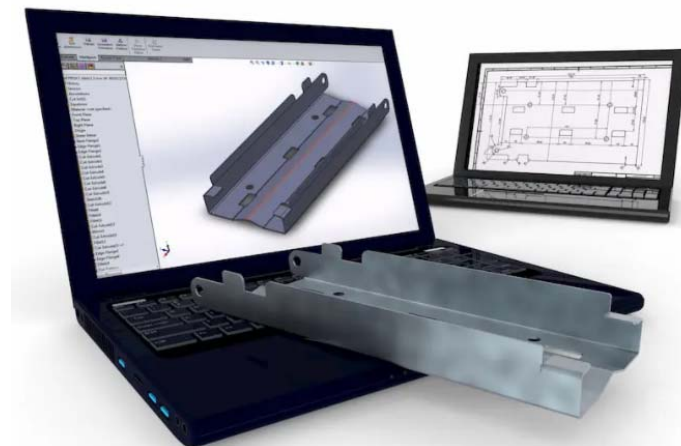
The present.

From simple 2D programs for drawing / often free e.g. LibreCAD / up to sophisticated 3D systems with direct implementation of CAE and CAM.

The right choice of suitable CAD software: What is the primary goal?

Comprehensively assess what I really need?

- the price
- annual fees /maintenance/
- availability / e.g. localization /
- support / SK, EU ... /
- competence
- the possibility of training, further education
- the price of a trained employee
- usability of all functions
- connection to suppliers, partners
- other.

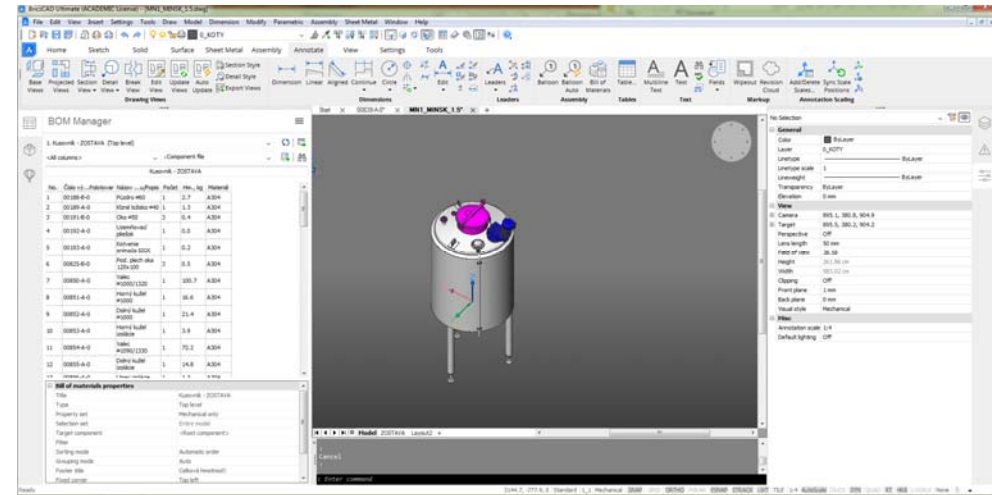
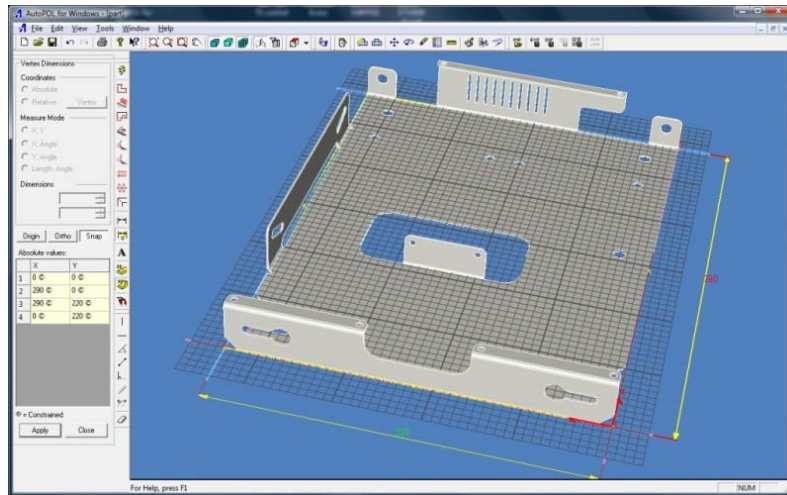
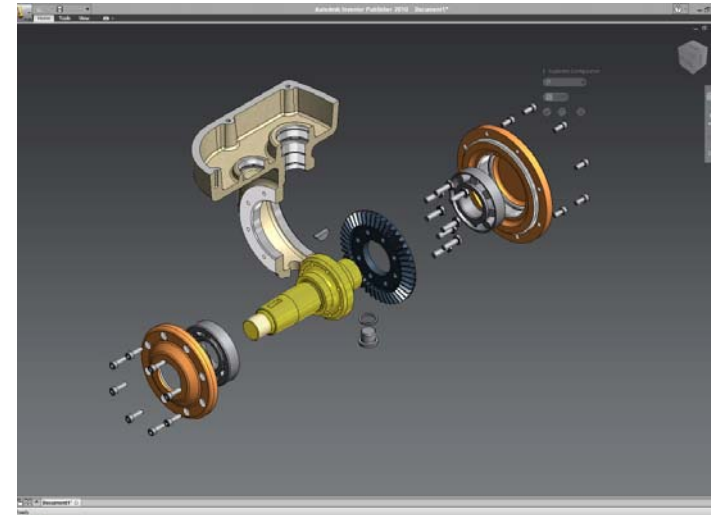


# Choice of appropriate design software

2D – Simple 2D drawing / e.g. AutoCAD LT, BricsCAD LT/

3D - solution  
 AutoCAD, BricsCAD, etc.

(3D modeler)  
 Autodesk Inventor, SolidEdge, SolidWorks  
 Catia, etc.



# Choice of appropriate design software

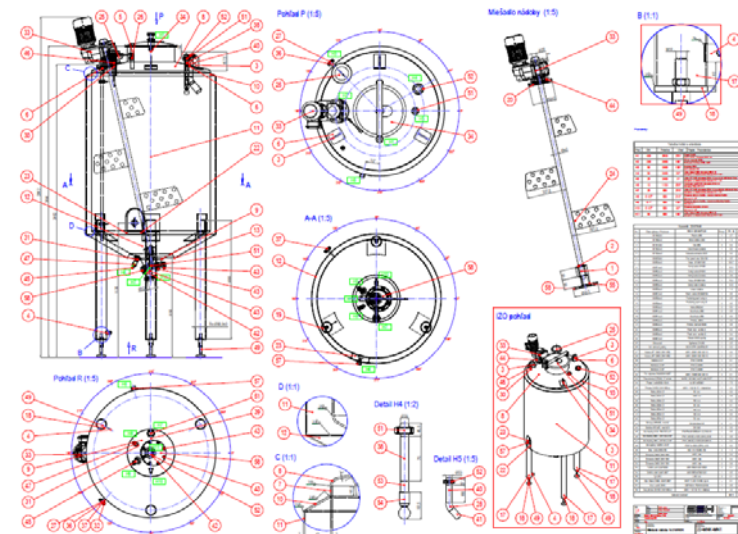
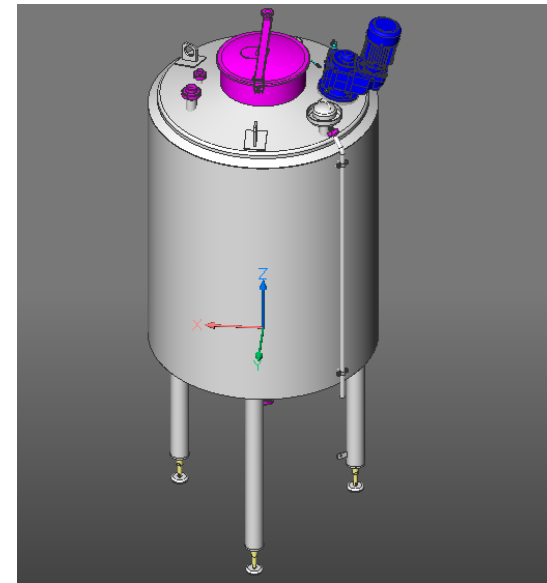
## 2D/3D solutions

### Advantages of 3D

- \* "digital prototype". In the case of a 3D solution. / FEM, CFD .../
- \* Compatibility with dwg / reading 2D documents /
- \* 3D to 2D ... Drawing generation
- \* Calculation of parts / e.g. Shaft /
- \* Visualization
- \* Automatic BOM
- \* FEM simulations ... Check, test and optimize. \* Data management.
- \* Unfold function/ \* Efficiency / where yes ~ where not /

### Disadvantages of 3D

- \* Price + Maintenance
- \* Constructor skills
- \* Drawing creation functions are under the control of the program /necessity of setting/. Certain limitations
- \* From batch to assembly



## Software solution on Institute of Process Engineering

2D/3D solutions:

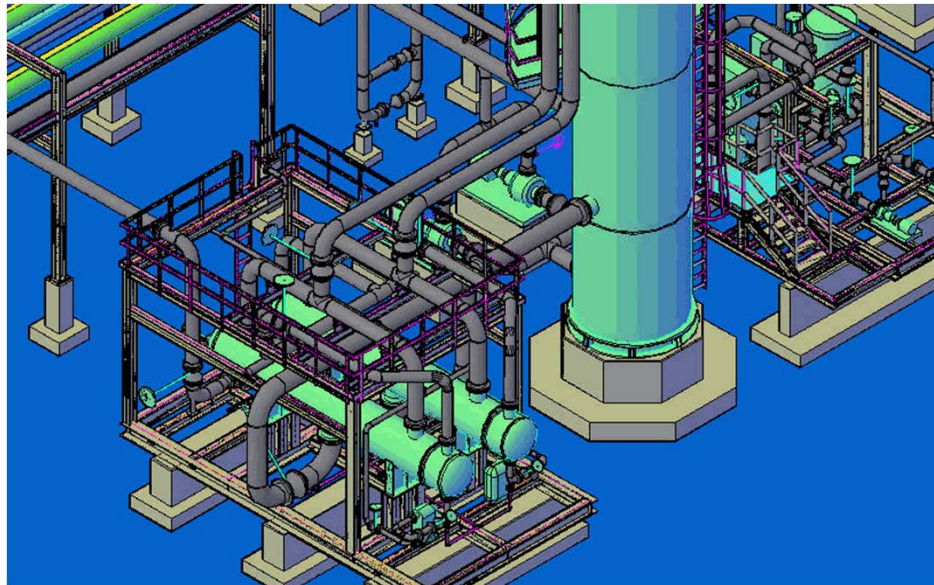
AutoCAD

BricsCAD

Piping solution:

Intergraph CADWorx Professional

Intergraph CADWorx P&ID Professional



**AUTODESK**



**BRICSCAD**



**HEXAGON**  
PPM

# Software solution on Institute of Process Engineering

What kind of drawings/drawing documentation/ will you encounter in practice?

Diagrams

Schemes / P&ID, PFD /

Construction drawings. - Production drawing (single part drawing) - Assembly drawing

Assembly/Service drawings

Layout drawings

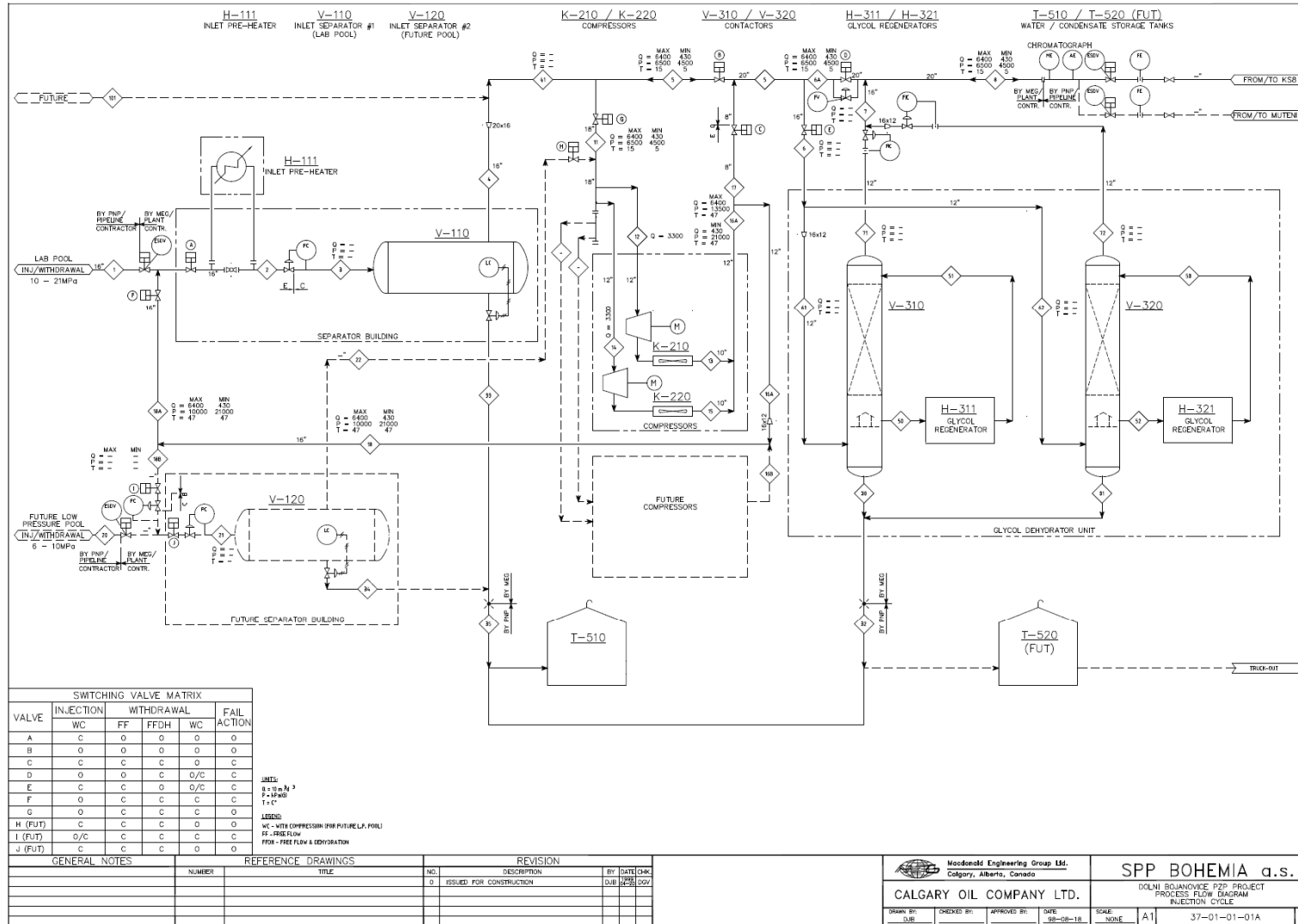
3D models.

Visualizations

Specifics? What should be on the drawing?

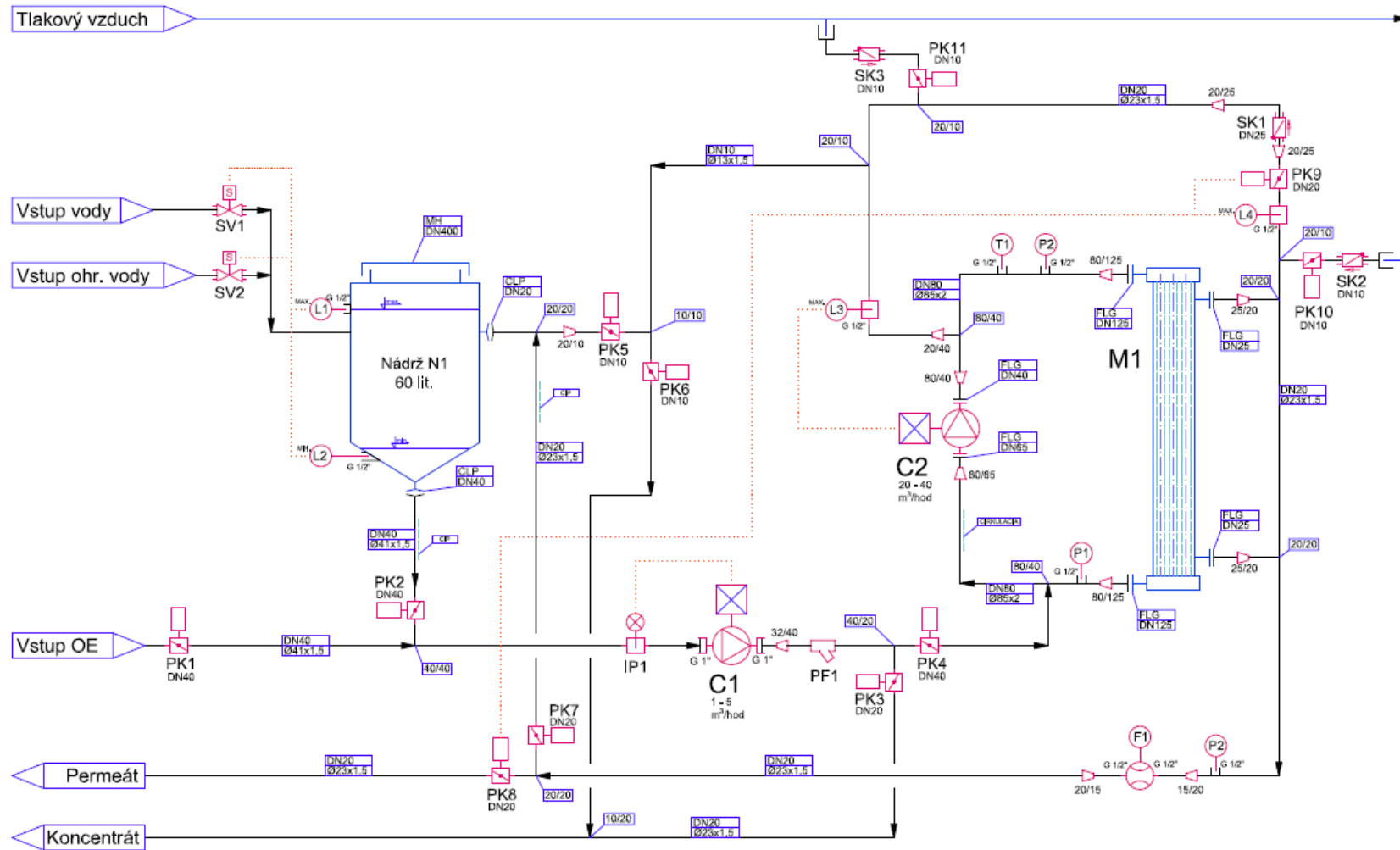


# Examples of technical drawings

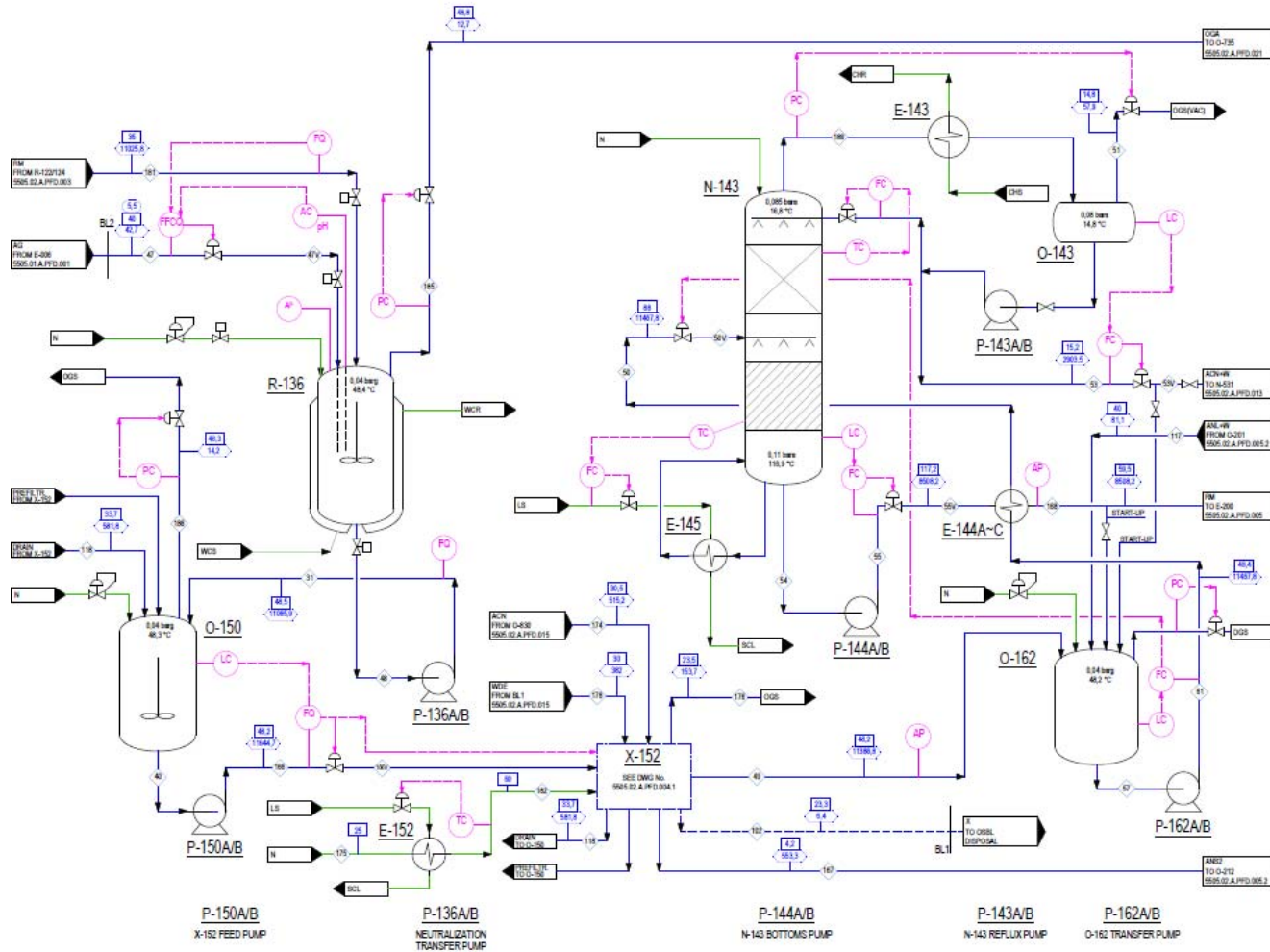




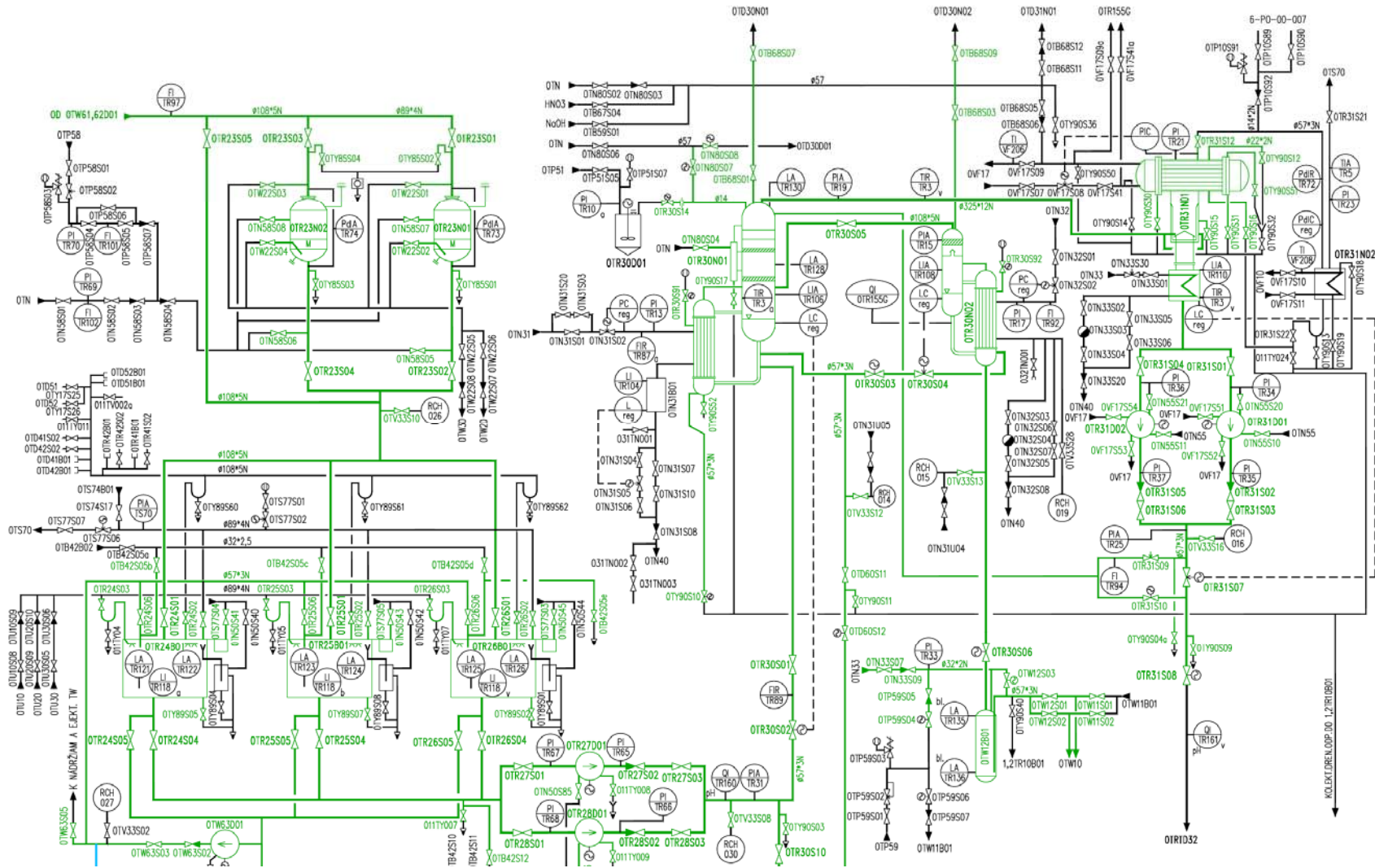
# Examples of technical drawings



# Examples of technical drawings



# Examples of technical drawings



# Examples of technical drawings

KUSOVNIK			
Položka	Množ.	Špecifikácia ; TDP	Materiál
1	2	Dno typ B 168.3 x 8.0 ; STN EN 10253-2	P265GH
2	1	Rura bezsvova 168.3 x 8.0 ; STN EN 10216-2-TC2	P265GH
3	2	Nohy podľa passportu	P265GH

POZNAMKY / REMARKS	
1	Hmotnosť zariadenia bude upravená dodávateľom. / Exact weight will be specified by manufacturer
2	Pre účely dopravy a montáže všetky rezy zaslepiť. / Nozzles blinded for transportation
3	Zariadenie vybaví evakuačným pre uzemnením. / Device to be equipped with earthing straps
4	Izolácia aparátu nie je súčasťou dodávky. / Insulation is not part of delivery
5	Zariadenie vybaví príchytkami a klemami pre odčísť. / Device to be equipped with support collars for insulation
6	TS / PS - napríklad pracovná teplota / Isk, pre ktorú je zariadenie skonstruované podľa urbenia výrobcu
7	Zariadenie vybaví závesnými okrami pre montáž po dodaní. / Device to be equipped with lifting lugs
8	Zariadenie je antisejpn výrobkom podľa § 4 ods. 1 zákona č. 56/2018 Z. z. v znení neskorších predpisov
9	Pre náhly a výhružbu zariadenia platí VZ 0315 Z. z., vč. kategória v zariadení zariadení
10	Pre uvedenie do prevádzky a prevádzku platí vyhláška č. 509/2009 Z. z., vč. skupina v zariadení zariadení
11	Prílohy z materiálu P265GH

Technical drawing showing a reactor base with dimensions: Ø168,3x7,1, Ø114,3x5,0, Ø88,9x4,0, Ø20x1,5, 150, 8, 400, 1550, 800, 10, 110, 2575, 300, 50, 125, 175, 300, 350, 250, 550.

VÝŠKA A PPOBEMA / HEIGHTS AND CONNECTIONS												
Obj. / Mark	EN	FN	Učenie / Service	Pr. dia. / Nom. diam.	Chrom. / Orient	Vol. / Diam. [mm]	Výška / Elev. [mm]	Zároveň na hrub. / Lead on the rough (N)				
								F.	F.	F.	M.	
40	8.1	86	18	nozna - ZASLEPIŤ			11 828 195-1					
42	8.2	100	18	výška pásu P265GH R262-4			11 828 195-1					
43	8.3	86	18	výška pásu z R262-4			11 828 195-1					
44	8.4	100	18	výška pásu z R262-4			11 828 195-1					
45	8.5	100	18	nozna - ZASLEPIŤ			11 828 195-1					
46	8.6	100	18	nozna - ZASLEPIŤ			11 828 195-1					
47	8.7	100	18	výška pásu z R262-4			11 828 195-1					
48												
49	8.9	25	18	odhad hmotnosti z R262-4			11 828 195-1					
50	8.10	80	18	prípojenie tlakovanej sietejy M20x1,5								
51	8.11	-	18	základňa pre hľadanie jadra								
52												
53												

PRACOVNÉ A NAHRNÉVY PODMIEŤKY / OPERATING AND DESIGN CONDITIONS											
Pracovná teplota / Oper. temp.	Pracovná atmosféra / Process fluid	Úroveň / Density	Skup. dia. / Nom. diam.	Pr. dia. / Nom. diam.	Pr. dia. / Nom. diam.	Pr. dia. / Nom. diam.	Pr. dia. / Nom. diam.	Pr. dia. / Nom. diam.	Pr. dia. / Nom. diam.	Pr. dia. / Nom. diam.	Pr. dia. / Nom. diam.
°C		kg/m³	mm	mm	mm	mm	mm	mm	mm	mm	mm
37	1	VODNÁ PÁRA		VODA	0	200	0	8	56	206	
38											
39											
40											

TECHNICKÁ DOKUMENTÁCIA / TECHNICAL DOCUMENTATION				KONŠTRUKČNÉ MATERIÁLY / MATERIALS OF CONSTRUCTION			
21	-	-	-	25	-	-	-
22	Podrobná dokumentácia kompletného systému skonstruovaného v súlade s požiadavkami.	26	Prílohy zariadenia / Equipment	27	Prílohy zariadenia / Equipment	28	Prílohy zariadenia / Equipment
23	Učenie / Service / Operation manual	29	Prílohy zariadenia / Equipment	30	Prílohy zariadenia / Equipment	31	Prílohy zariadenia / Equipment
24	Spôsob výroby / Production method	32	Prílohy zariadenia / Equipment	33	Prílohy zariadenia / Equipment	34	Prílohy zariadenia / Equipment
25	Prílohy zariadenia / Equipment	35	Prílohy zariadenia / Equipment	36	Prílohy zariadenia / Equipment	37	Prílohy zariadenia / Equipment
26	Prílohy zariadenia / Equipment	38	Prílohy zariadenia / Equipment	39	Prílohy zariadenia / Equipment	40	Prílohy zariadenia / Equipment
27	Prílohy zariadenia / Equipment	41	Prílohy zariadenia / Equipment	42	Prílohy zariadenia / Equipment	43	Prílohy zariadenia / Equipment
28	Prílohy zariadenia / Equipment	44	Prílohy zariadenia / Equipment	45	Prílohy zariadenia / Equipment	46	Prílohy zariadenia / Equipment

TECHNICKÉ PODMIEŤKY / TECHNICAL CONDITIONS				HRNÝŠŤA A PLOCHY / SURFACES AND SURFACES			
5	Werkstoff / Material	6	Werkstoff / Material	13	Werkstoff / Material	14	Werkstoff / Material
6	Spezifikácia / Specification	7	Spezifikácia / Specification	15	Spezifikácia / Specification	16	Spezifikácia / Specification
7	Umgebung / Environment	8	Umgebung / Environment	17	Umgebung / Environment	18	Umgebung / Environment
8	Druck / Pressure	9	Druck / Pressure	19	Druck / Pressure	20	Druck / Pressure
9	Korozijná odolnosť / Corrosion resistance	10	Korozijná odolnosť / Corrosion resistance	21	Korozijná odolnosť / Corrosion resistance	22	Korozijná odolnosť / Corrosion resistance
10	Skúška napätím / Tension test	11	Skúška napätím / Tension test	23	Skúška napätím / Tension test	24	Skúška napätím / Tension test
11	Prílohy zariadenia / Equipment	12	Prílohy zariadenia / Equipment	25	Prílohy zariadenia / Equipment	26	Prílohy zariadenia / Equipment
12	Prílohy zariadenia / Equipment	13	Prílohy zariadenia / Equipment	27	Prílohy zariadenia / Equipment	28	Prílohy zariadenia / Equipment

ORIENTAČNÉ ÚDAJE / BASIC DATA			
1	Názov - typ / Name - type	2	Prílohy zariadenia / Equipment
2	Dodávateľ / Supplier	3	Prílohy zariadenia / Equipment
3	Prílohy zariadenia / Equipment	4	Prílohy zariadenia / Equipment

TABUĽKA REVÍZIÍ / REVISION TABLE			
1	Revízia / Revision	2	Revízia / Revision
2	Revízia / Revision	3	Revízia / Revision
3	Revízia / Revision	4	Revízia / Revision

Príloha / Annex	Dátum / Date	Popis zmeny / Description	Príloha / Annex	Dátum / Date	Popis zmeny / Description	Príloha / Annex
1			4			
2			5			
3			6			

Príloha / Annex	Príloha / Annex	Príloha / Annex	Príloha / Annex	Príloha / Annex
1	2	3	4	5
6	7	8	9	10
11	12	13	14	15

Príloha / Annex		Príloha / Annex		Príloha / Annex	
1	2	3	4	5	6
7	8	9	10	11	12
13	14	15	16	17	18

Príloha / Annex		Príloha / Annex		Príloha / Annex	
1	2	3	4	5	6
7	8	9	10	11	12
13	14	15	16	17	18

Príloha / Annex		Príloha / Annex		Príloha / Annex	
1	2	3	4	5	6
7	8	9	10	11	12
13	14	15	16	17	18

Príloha / Annex		Príloha / Annex		Príloha / Annex	
1	2	3	4	5	6
7	8	9	10	11	12
13	14	15	16	17	18

Príloha / Annex		Príloha / Annex		Príloha / Annex	
1	2	3	4	5	6
7	8	9	10	11	12
13	14	15	16	17	18

Príloha / Annex		Príloha / Annex		Príloha / Annex	
1	2	3	4	5	6
7	8	9	10	11	12
13	14	15	16	17	18

Príloha / Annex		Príloha / Annex		Príloha / Annex	
1	2	3	4	5	6
7	8	9	10	11	12
13	14	15	16	17	18

Príloha / Annex		Príloha / Annex		Príloha / Annex	
1	2	3	4	5	6
7	8	9	10	11	12
13	14	15	16	17	18

Príloha / Annex		Príloha / Annex		Príloha / Annex	
1	2	3	4	5	6
7	8	9	10	11	12
13	14	15	16	17	18

Príloha / Annex		Príloha / Annex		Príloha / Annex	
1	2	3	4	5	6
7	8	9	10	11	12
13	14	15	16	17	18

Príloha / Annex		Príloha / Annex		Príloha / Annex	
1	2	3	4	5	6
7	8	9	10	11	12
13	14	15	16	17	18

Príloha / Annex		Príloha / Annex		Príloha / Annex	
1	2	3	4	5	6
7	8	9	10	11	12
13	14	15	16	17	18

Príloha / Annex		Príloha / Annex		Príloha / Annex	
1	2	3	4	5	6
7	8	9	10	11	12
13	14	15	16	17	18

Príloha / Annex		Príloha / Annex		Príloha / Annex	
1	2	3	4	5	6
7	8	9	10	11	12
13	14	15	16	17	18

Príloha / Annex		Príloha / Annex		Príloha / Annex	
1	2	3	4	5	6
7	8	9	10	11	12
13	14	15	16	17	18

Príloha / Annex		Príloha / Annex		Príloha / Annex	
1	2	3	4	5	6
7	8	9	10	11	12
13	14	15	16	17	18

Príloha / Annex		Príloha / Annex		Príloha / Annex	
1	2	3	4	5	6
7	8	9	10	11	12
13	14	15	16	17	18

Príloha / Annex		Príloha / Annex		Príloha / Annex	
1	2	3	4	5	6
7	8	9	10	11	12
13	14	15	16	17	18

Príloha / Annex		Príloha / Annex		Príloha / Annex	
1	2	3	4	5	6
7	8	9	10	11	12
13	14	15	16	17	18

Príloha / Annex		Príloha / Annex		Príloha / Annex	
1	2	3	4	5	6
7	8	9	10	11	12
13	14	15	16	17	18

Príloha / Annex		Príloha / Annex		Príloha / Annex	
1	2	3	4	5	6
7	8	9	10	11	12
13	14	15	16	17	18

Príloha / Annex		Príloha / Annex		Príloha / Annex	
1	2	3	4	5	6
7	8	9	10	11	12
13	14	15	16	17	18

Príloha / Annex		Príloha / Annex		Príloha / Annex	
1	2	3	4	5	6
7	8	9	10	11	12
13	14	15	16	17	18

Príloha / Annex		Príloha / Annex		Príloha / Annex	
1	2	3	4	5	6
7	8	9	10	11	12
13	14	15	16	17	18

Príloha / Annex		Príloha / Annex		Príloha / Annex	
1	2	3	4	5	6
7	8	9	10	11	12
13	14	15	16	17	18

Príloha / Annex		Príloha / Annex		Príloha / Annex	
1	2	3	4	5	6
7	8	9	10	11	12
13	14	15	16	17	18

Príloha / Annex		Príloha / Annex		Príloha / Annex	
1	2	3	4	5	6
7	8	9	10	11	12
13	14	15	16	17	18

Príloha / Annex		Príloha / Annex		Príloha / Annex	
1	2	3	4	5	6
7	8	9	10	11	12
13	14	15	16	17	18

Príloha / Annex		Príloha / Annex		Príloha / Annex	
1	2	3	4	5	6
7	8	9	10	11	12
13	14	15	16	17	18

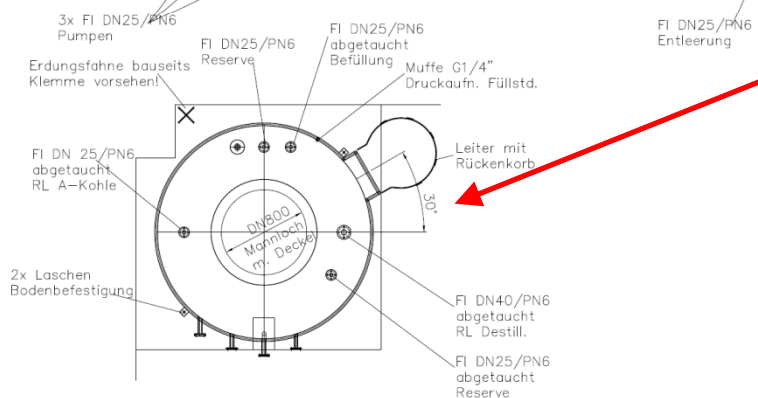
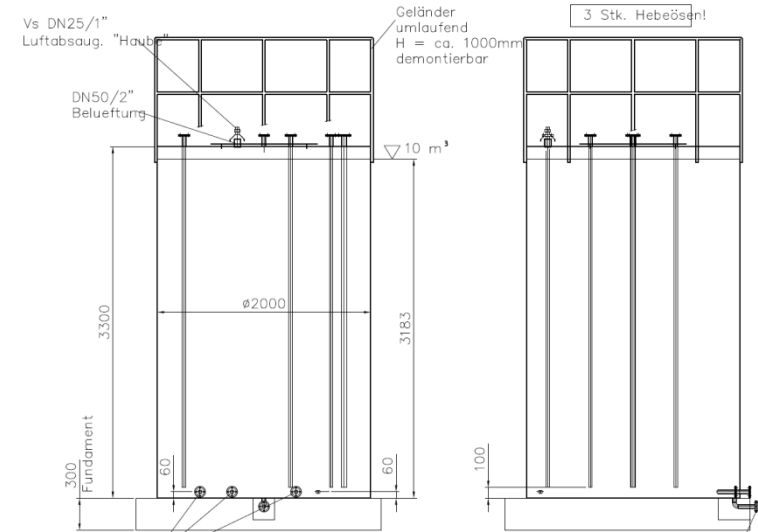
  

Príloha / Annex		Príloha / Annex		Príloha / Annex	
1	2	3	4	5	6
7	8	9	10	11	12
13	14	15	16	17	18

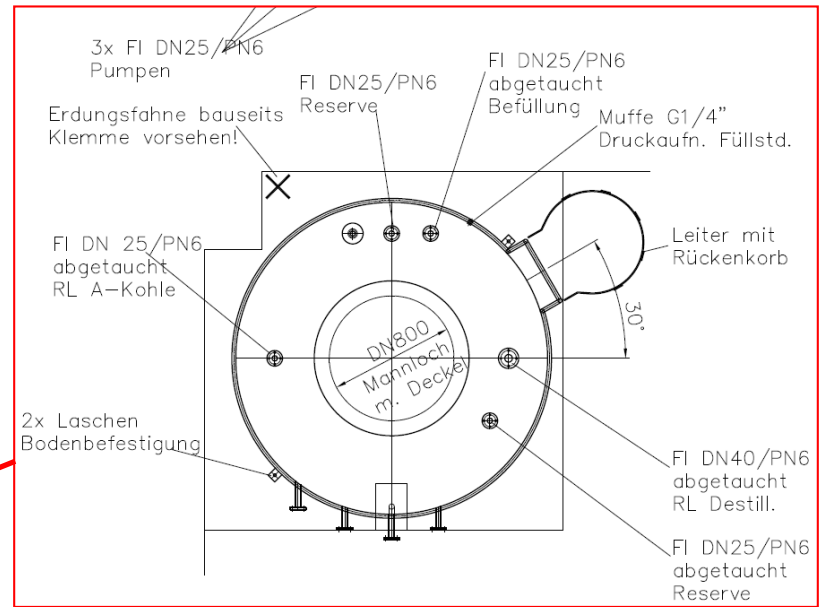
Príloha / Annex		Príloha / Annex		Príloha / Annex	
1	2	3	4	5	6
7	8				

# Examples of technical drawings

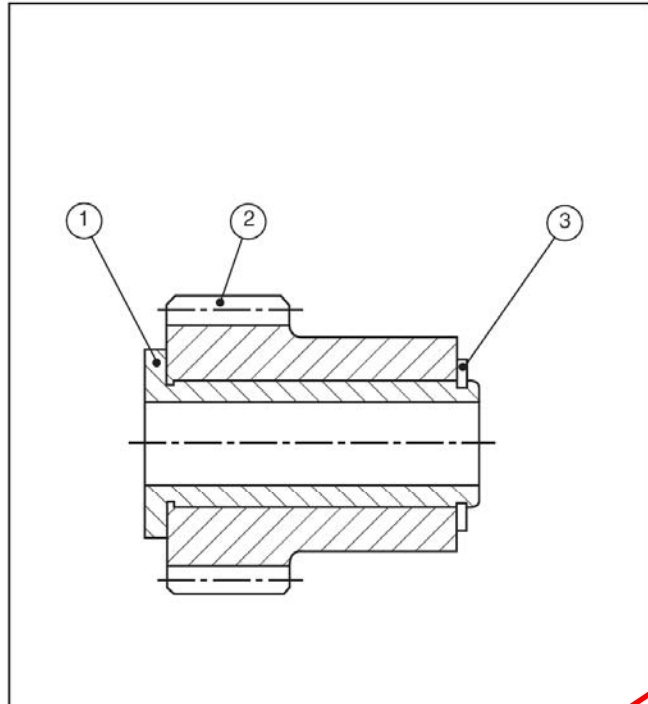


FI DN25/PN6 ... Flansch n. DIN 2631  
 FI DN40/PN6 ... Flansch n. DIN 2631  
 Vs DN25/1" ... Verschr. DIN 2993 konisch dichtend  
 Füllvolumen: 10m<sup>3</sup>  
 Medium: Trichlorethylen (Dichte 1,47 kg/m<sup>3</sup>)  
 Werkstoff: 1.4301

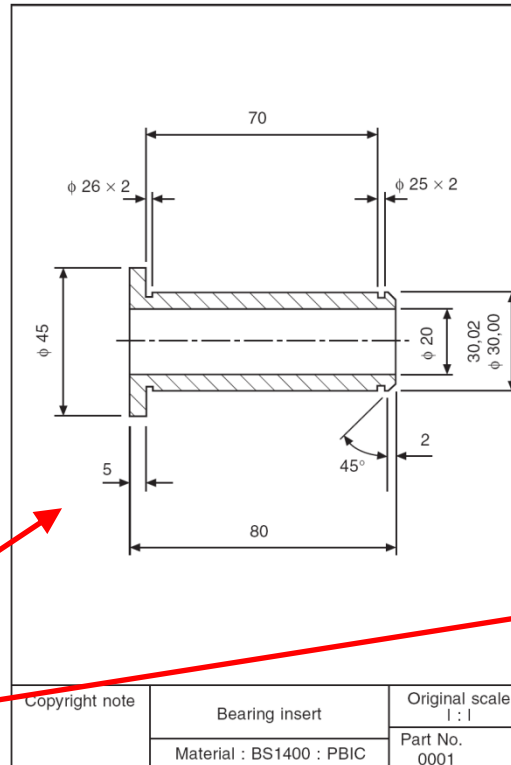
MICROPOROUS  
 PRODUCTS  
 GMBH  
 Trichlorethylen-  
 Lagertank (1  
 ...)



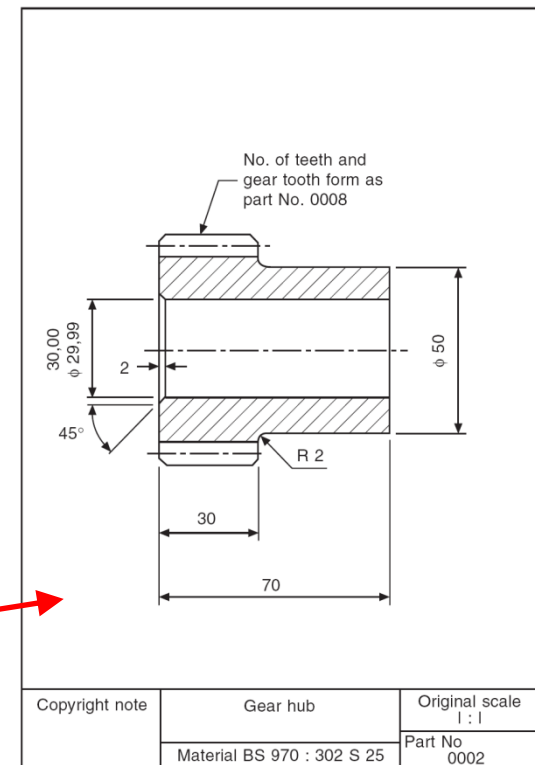
# Examples of technical drawings



Item No.	Title	No. off	Part No.
1	Bearing insert	1	0001
2	Gear hub	1	0002
3	Retaining ring	1	0003
Copyright note	Assembly of gear and bearing	Original Scale 1:1	
	Material ———	Part No. 0004	



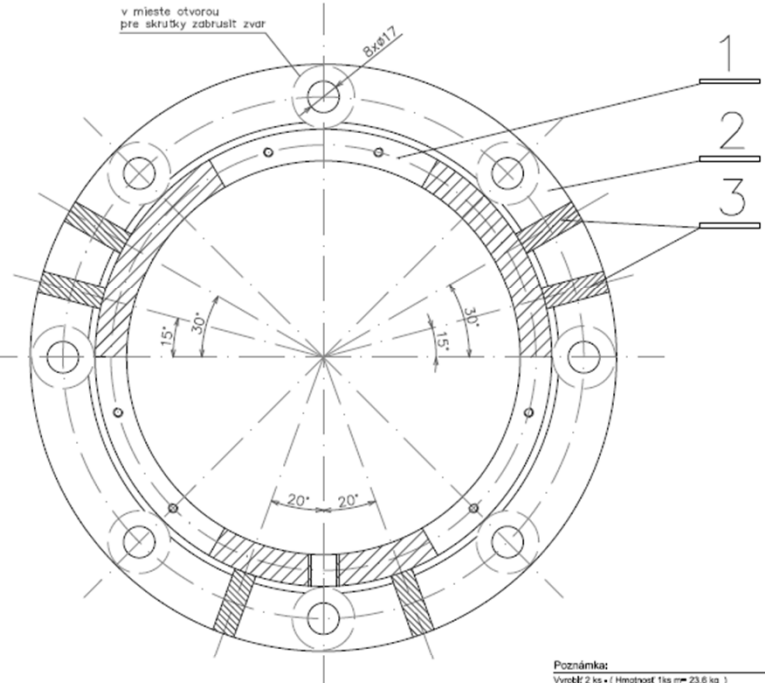
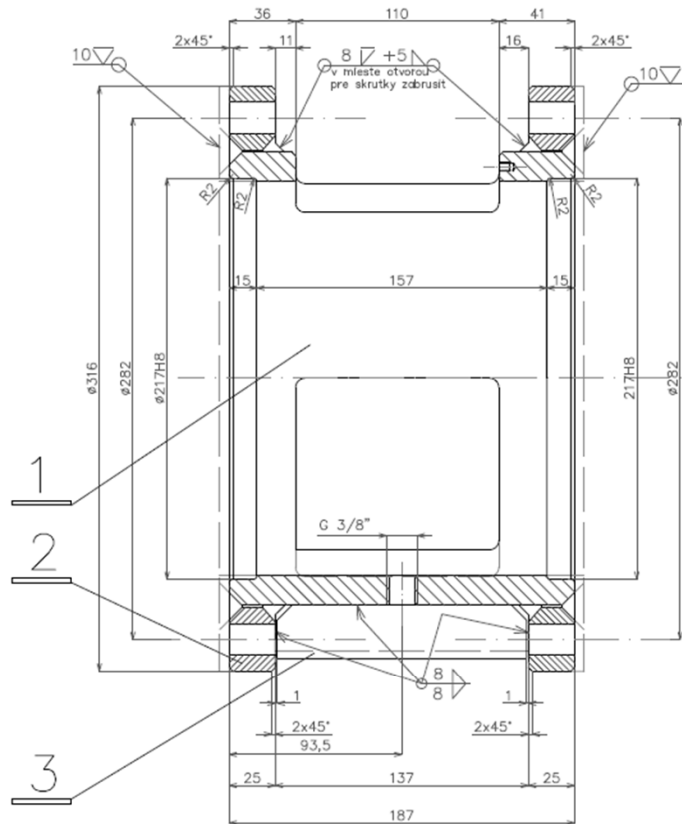
Copyright note	Bearing insert	Original scale 1:1
	Material : BS1400 : PBIC	Part No. 0001



Copyright note	Gear hub	Original scale 1:1
	Material BS 970 : 302 S 25	Part No. 0002



# Examples of technical drawings



Poznámka:  
 Vyrobit: 2 ks ( Hmotnosť 1ks = 23,6 kg )  
 Kusy sú rovnaké  
 LAVA (BD130-R-38zA) a PRAVA (BD130-R-38zB)  
 Materiál označený \* - bez prídavku na opracovanie

----- Prídavok na opracovanie

Poz.	Číslo výkresu / Palotovar	Materiál	Norma	Ks	Hmotnosť [kg]	Hmotnosť [kg]	TDP
3	Rebro BD130-R-38-3	11 416		12	0,35	4,2	
2	Krúžok 30 B. BD130-R-38-2	11 416		2	8,0	16,0	
1	Rurka 245x16 BD130-R-38-1	tr. 11/12		2	13,5	27,0	

Merka	Kresil:	Juriga	Zmena:	Datum:	Príloha:	A	Číslo kópie:
1:2	Kontroloval:	Madar				B	
	Schválil:	Madar				C	

Datum: 26.9.2004	Číslová hmotnosť: 47,2 kg	Poznámka: vyrobiť 2 ks	Kusovník:
Referencie (.dwg): bd1300_r.dwg	Názov: Prepojenie	Číslo výkresu: BD130-R-38zAB	



# Examples of technical drawings

The drawing illustrates a mechanical assembly with the following components and features:

- Main View:** A front view showing a rectangular frame with a central opening. It includes various dimensions and callouts such as 1, 2, 3, 7, 8, 9, 10, 11, 12, 13, 14, 15, and 16.
- Side View:** A vertical view showing the profile of the assembly, with callouts C, D, and E.
- View A(1:1):** A circular view showing a curved profile with callouts 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, and 14. It includes labels like 'SELIACKA ROVINA' and 'L 17'. A note indicates 'Sklenený povrch / transparentný / sklenený na 10°'.
- View B(1:1):** A detailed inset of a corner joint with a chamfered edge.
- View C(1:1):** A detailed inset showing a complex internal mechanism or joint.
- View D(1:1):** A detailed inset of a vertical edge with a chamfered corner.
- View E(1:1):** A detailed inset of a horizontal edge with a chamfered corner.

**Technical Tables:**

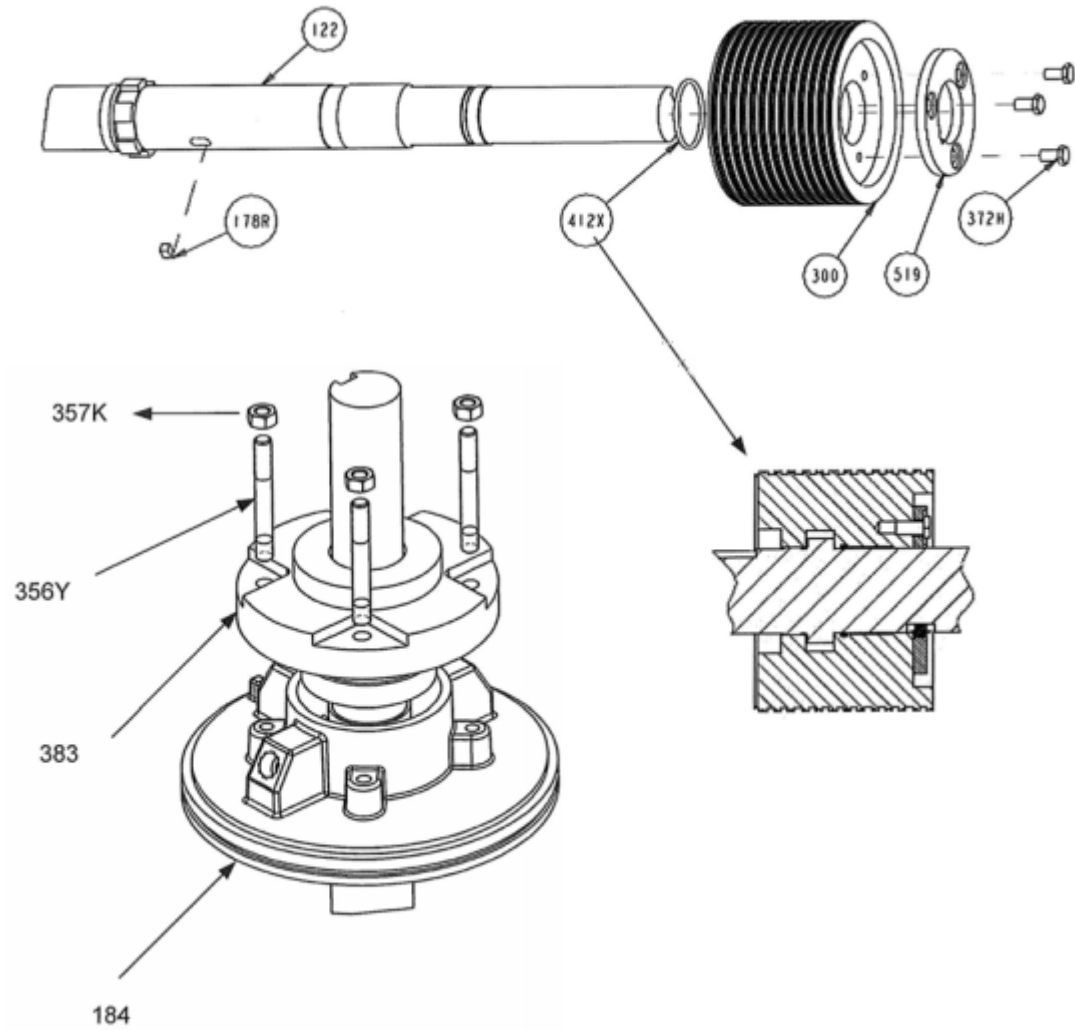
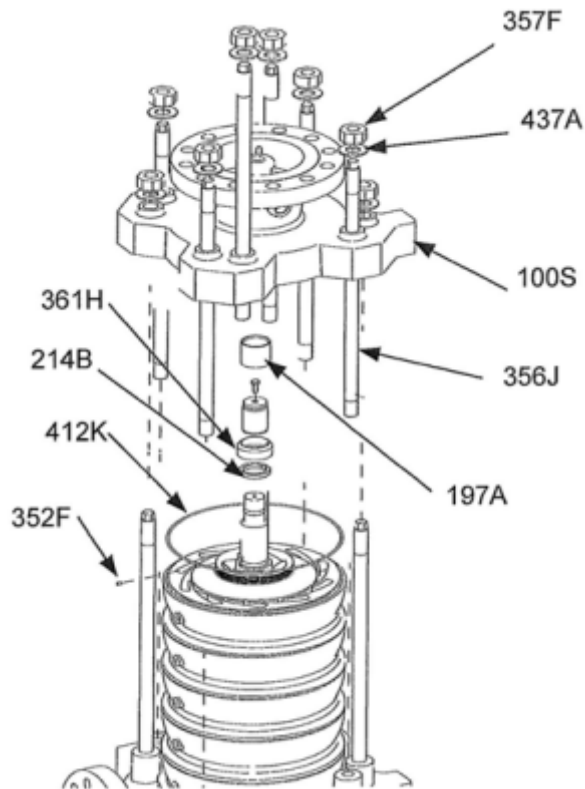
**Table 1: Tabuľka nábojov (30° 30')**

Typ	Ø	Príloha	Úhol	Príloha - Dĺžka
17	50x130	210	30°	170x130x130
18	48	20	31°	170x130x130

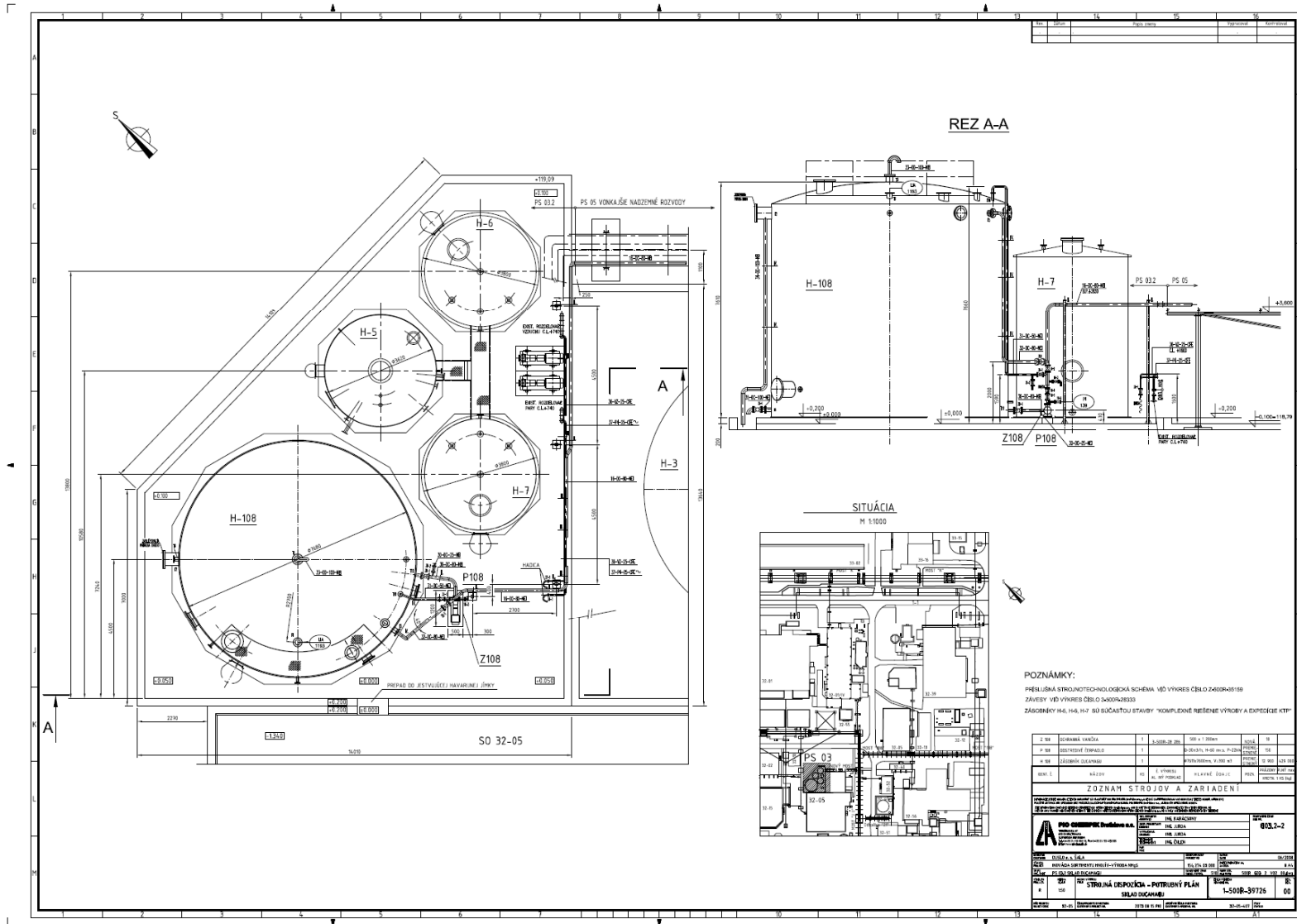
**Table 2: Bill of Materials (BOM)**

№	Opisovka	Opisovka množstva	Špecif.	Množ. v	Opisovka
1	170x130x130	1	170x130x130	1	170x130x130
2	170x130x130	1	170x130x130	1	170x130x130
3	170x130x130	1	170x130x130	1	170x130x130
4	170x130x130	1	170x130x130	1	170x130x130
5	170x130x130	1	170x130x130	1	170x130x130
6	170x130x130	1	170x130x130	1	170x130x130
7	170x130x130	1	170x130x130	1	170x130x130
8	170x130x130	1	170x130x130	1	170x130x130
9	170x130x130	1	170x130x130	1	170x130x130
10	170x130x130	1	170x130x130	1	170x130x130
11	170x130x130	1	170x130x130	1	170x130x130
12	170x130x130	1	170x130x130	1	170x130x130
13	170x130x130	1	170x130x130	1	170x130x130
14	170x130x130	1	170x130x130	1	170x130x130
15	170x130x130	1	170x130x130	1	170x130x130
16	170x130x130	1	170x130x130	1	170x130x130
17	170x130x130	1	170x130x130	1	170x130x130
18	170x130x130	1	170x130x130	1	170x130x130
19	170x130x130	1	170x130x130	1	170x130x130
20	170x130x130	1	170x130x130	1	170x130x130
21	170x130x130	1	170x130x130	1	170x130x130
22	170x130x130	1	170x130x130	1	170x130x130
23	170x130x130	1	170x130x130	1	170x130x130
24	170x130x130	1	170x130x130	1	170x130x130
25	170x130x130	1	170x130x130	1	170x130x130
26	170x130x130	1	170x130x130	1	170x130x130
27	170x130x130	1	170x130x130	1	170x130x130
28	170x130x130	1	170x130x130	1	170x130x130
29	170x130x130	1	170x130x130	1	170x130x130
30	170x130x130	1	170x130x130	1	170x130x130

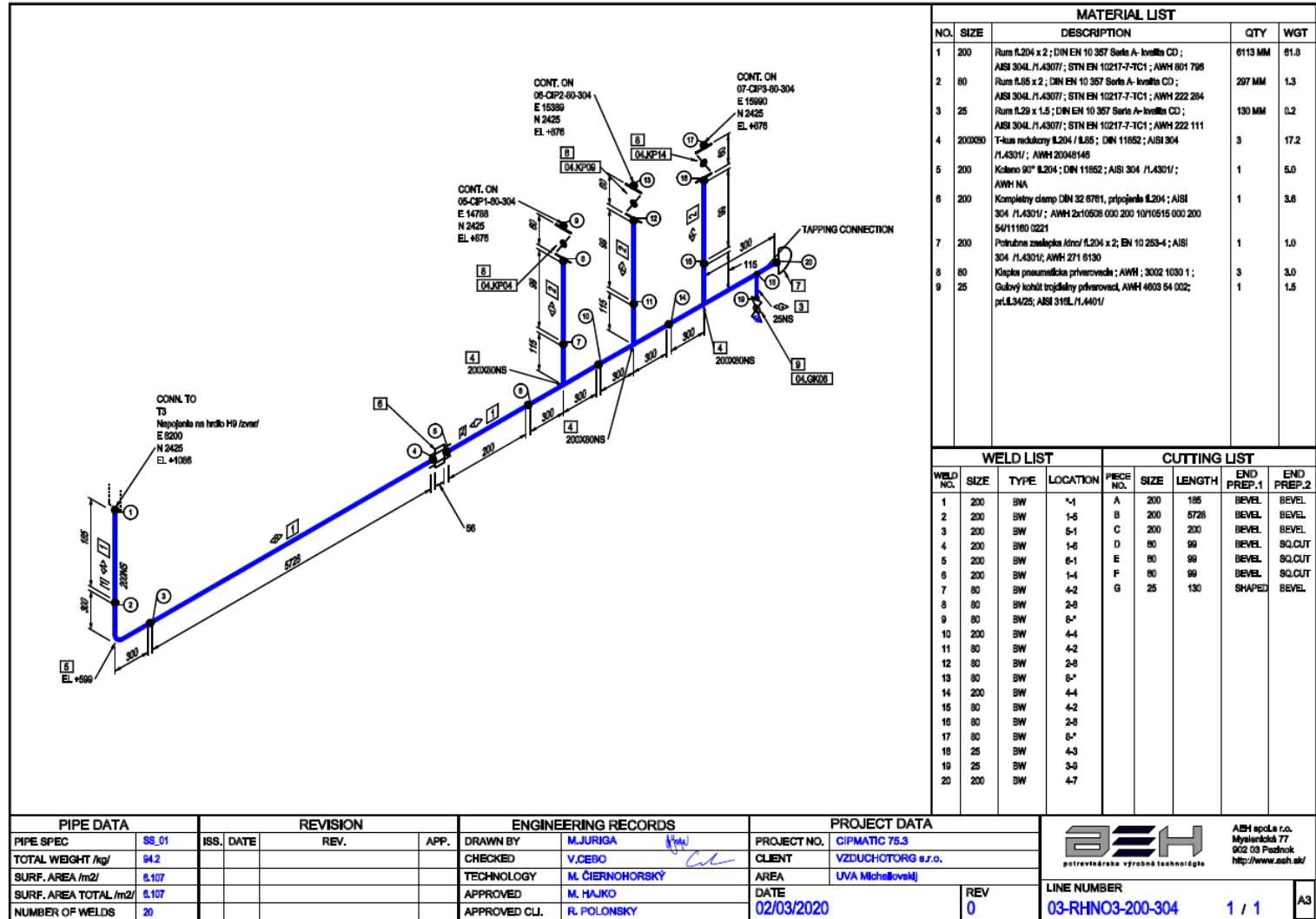
# Examples of technical drawings



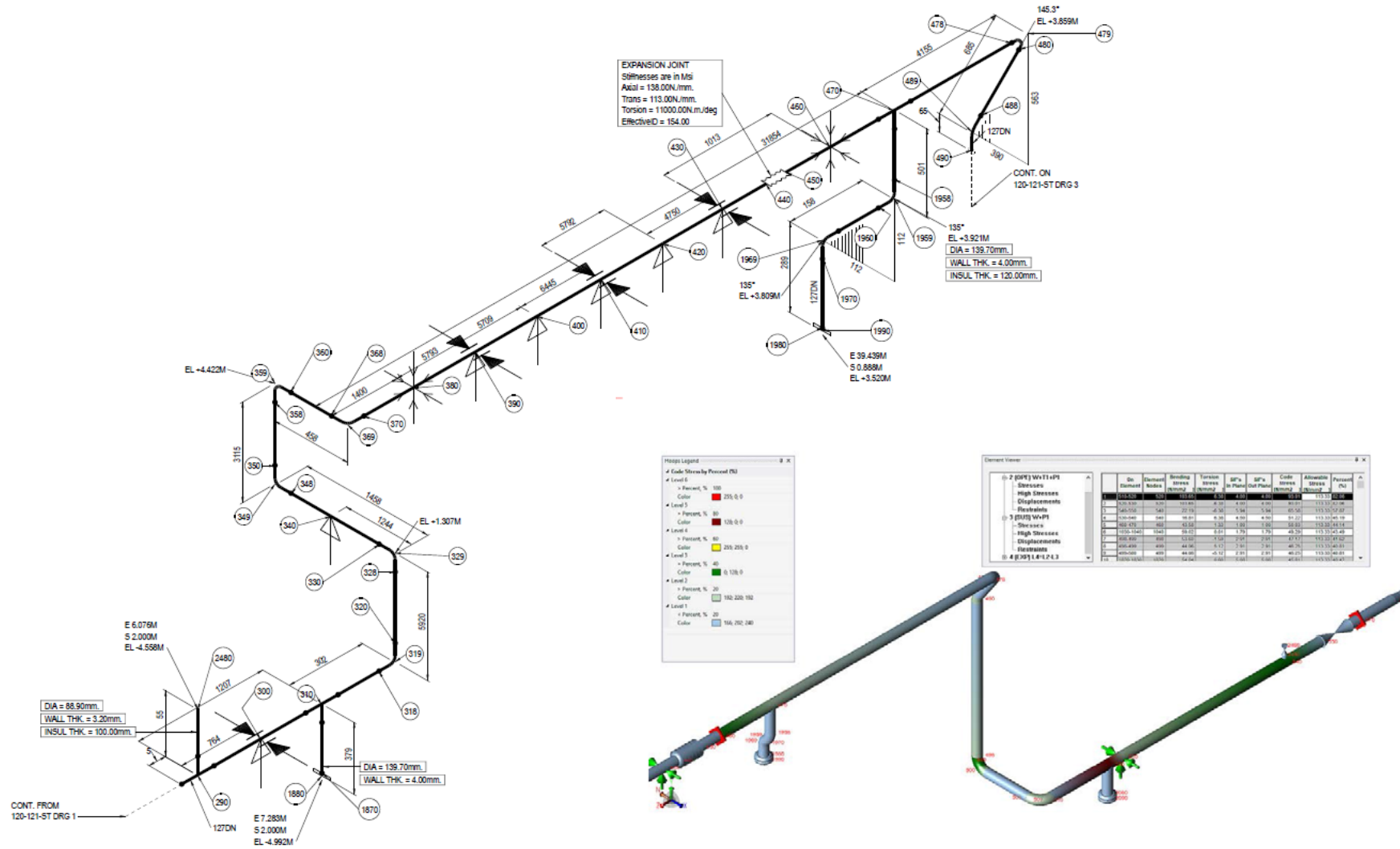
# Examples of technical drawings



# Examples of technical drawings



# Examples of technical drawings



# Examples of technical drawings

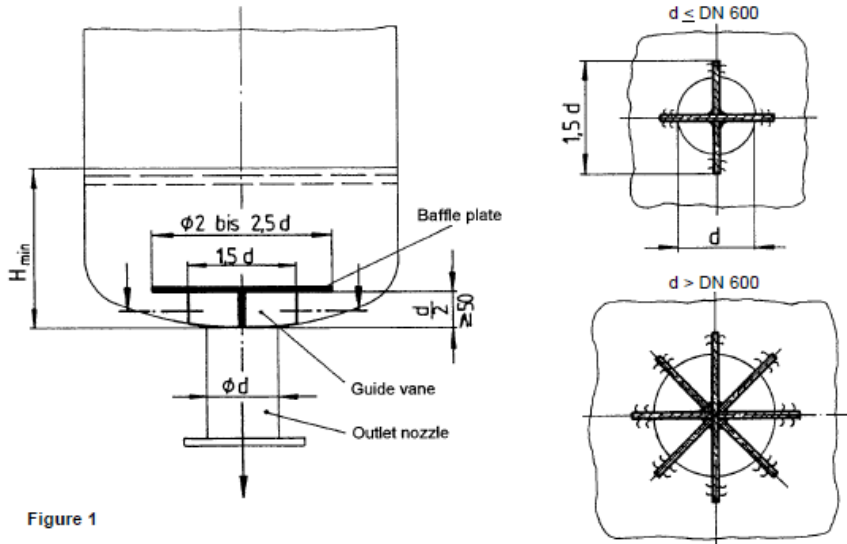


Figure 1

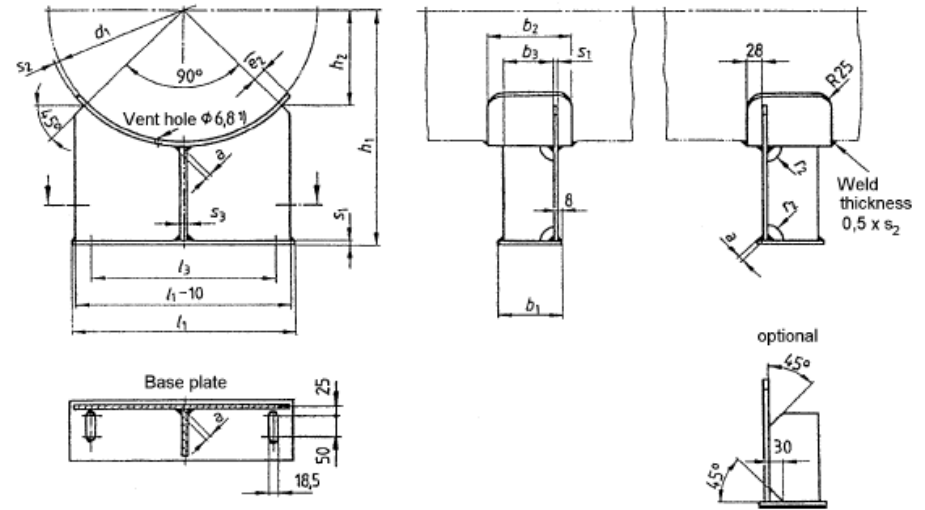
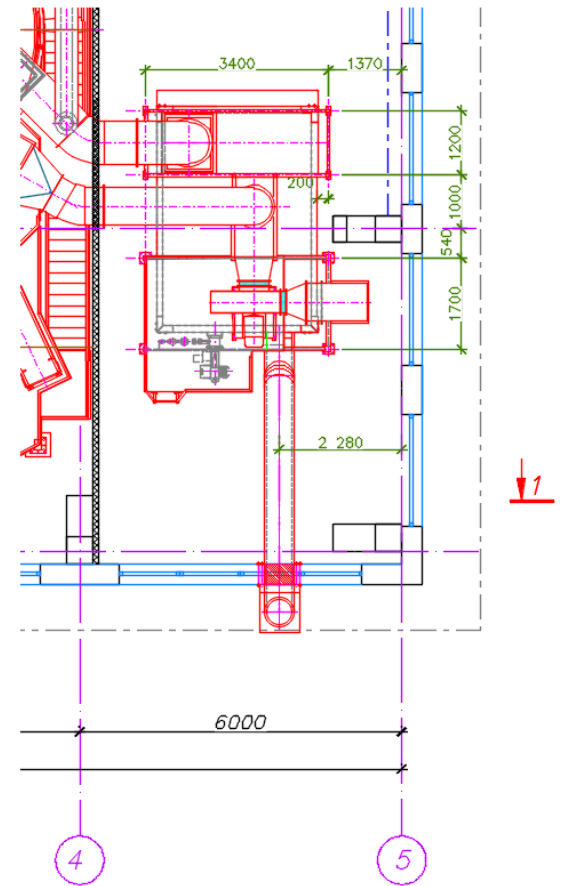
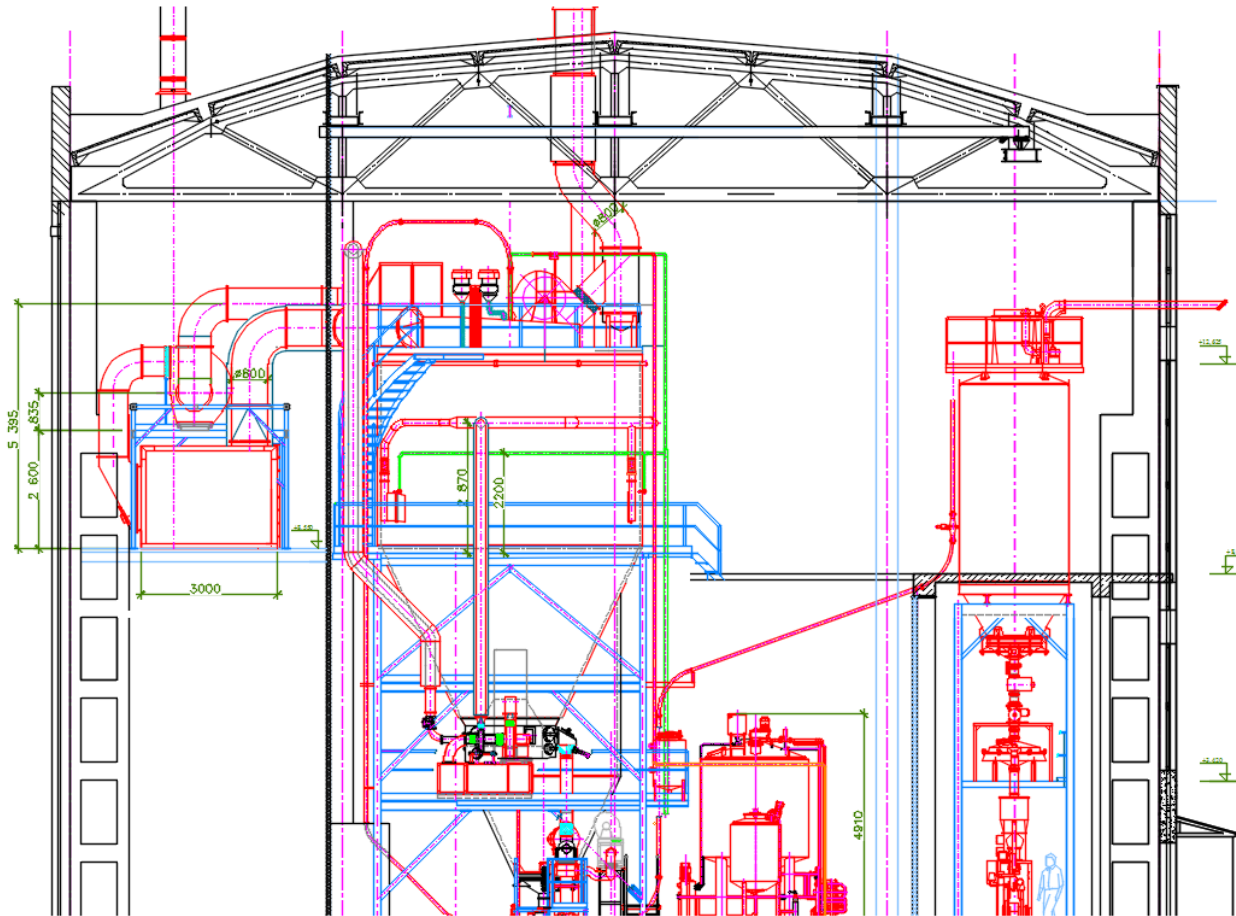


Figure 1

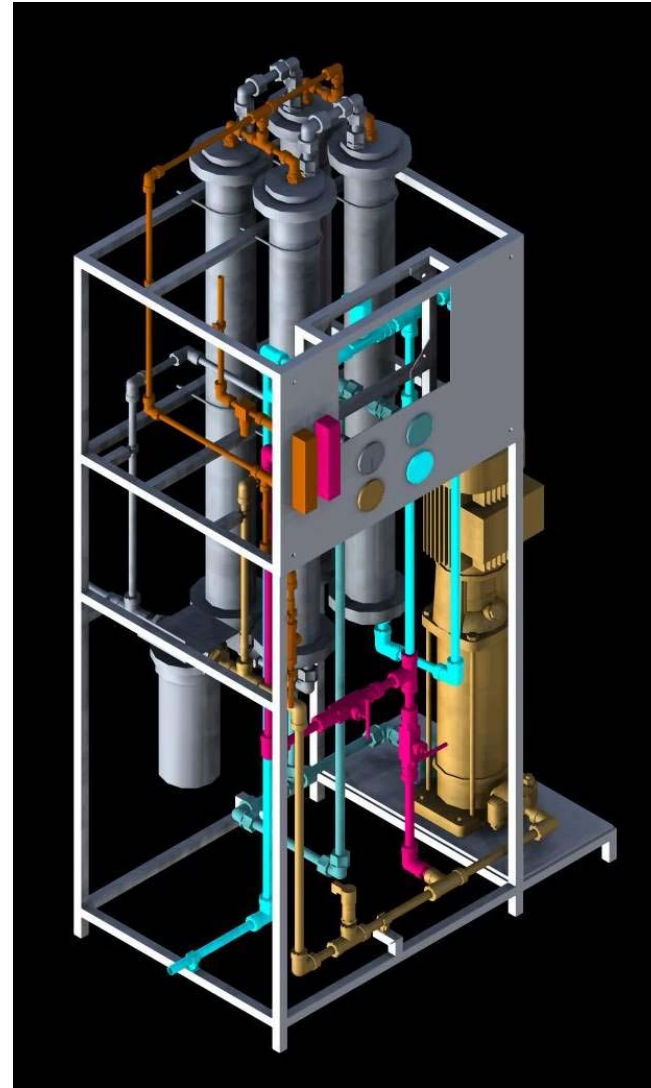
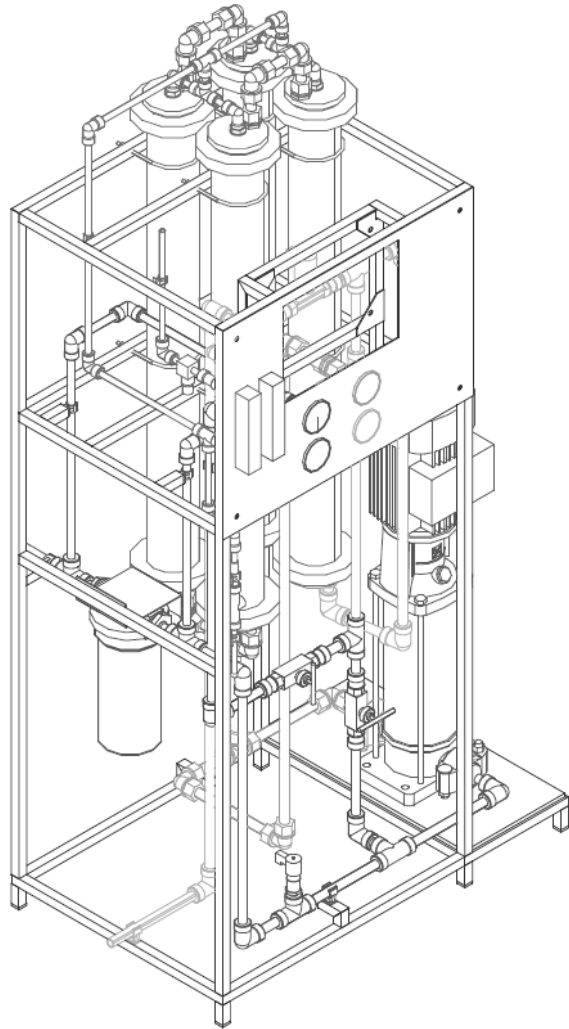
Table 2

Outside diameter	Height	Base plate			Saddle plate				Rib		Height	Fixing screws		Radii	Fillet welds a min.	Weight per saddle support kg
		$l_1$	$b_1$	$s_1$	$b_2$	$e_2$	$s_2$	Arc length	$b_3$	$s_3$		Thread	Distance $l_3$			
168	285	180						187			64		120			6,0
219	310	200						227			82		150			6,5
273	335	240						269			101		190			8,0
324	360	280	120	8	160	25	6	309	96	8	119	M16	230	30	3	9,0
358	380	300						334			130		250			10,0
406	405	350						374			148		300			11,0
508	455	420						454			184		350			13,0

# Examples of technical drawings



## Examples of technical drawings





# Examples of technical drawings

