

# Potrubné systémy

# PIPING SYSTEMS

Prednáška

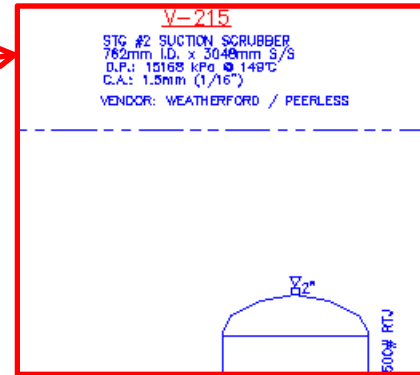
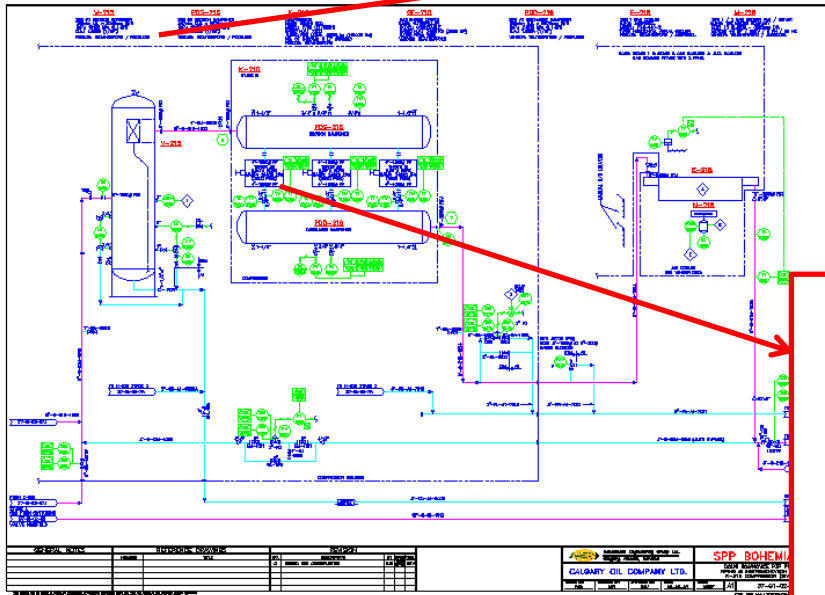
Vypracoval: Ing. Martin Juriga, PhD.

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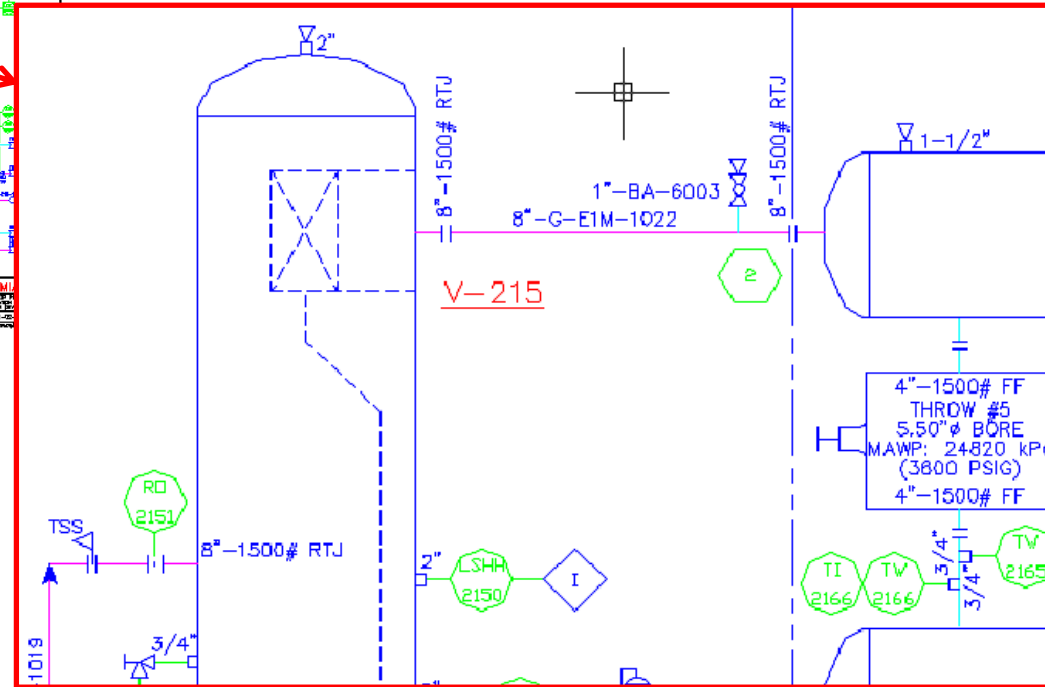
Bratislava, jún 2013

# Potrubný systém.

P&ID

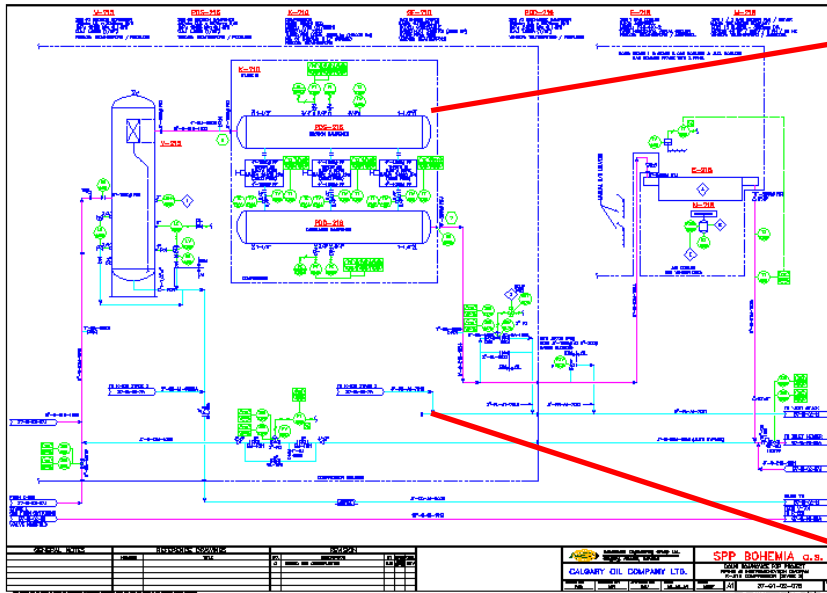


Procesný návrh  
 Konštrukčný návrh



# Potrubný systém. Procesný návrh

P&ID



Procesný návrh pre potrubia

Výpočet tlakových strát potrubia

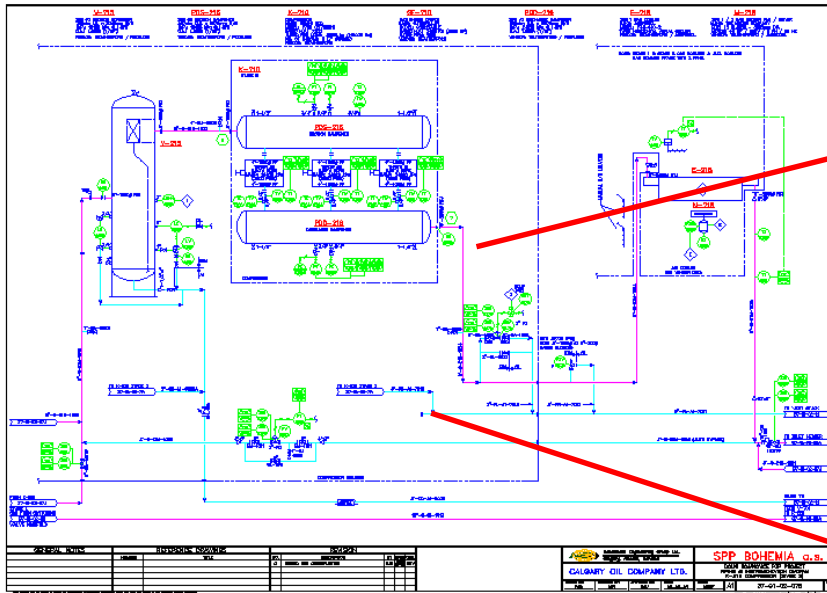
Návrh a optimalizácia nosných armatúr :  
-regulačné ventily  
-poistné ventily atď.

Návrh a optimalizácia zdrojov energie v  
potrubných systémoch (čerpadlá,  
kompresory, atď.)

Energetické aspekty dopravy v  
potrubíach ( straty energie do okolia  
atď. )

# Potrubný systém. Konštrukčný návrh

P&ID



Konštrukčný návrh potrubia

Návrh a optimalizácia potrubnej triedy

Výpočet hrúbok stien pre jednotlivé potrubné komponenty vzhľadom na zvolenú výpočtovú normu ( Európa: EN 13 480, USA: Power Piping 31.1, Process Piping 31.3 )

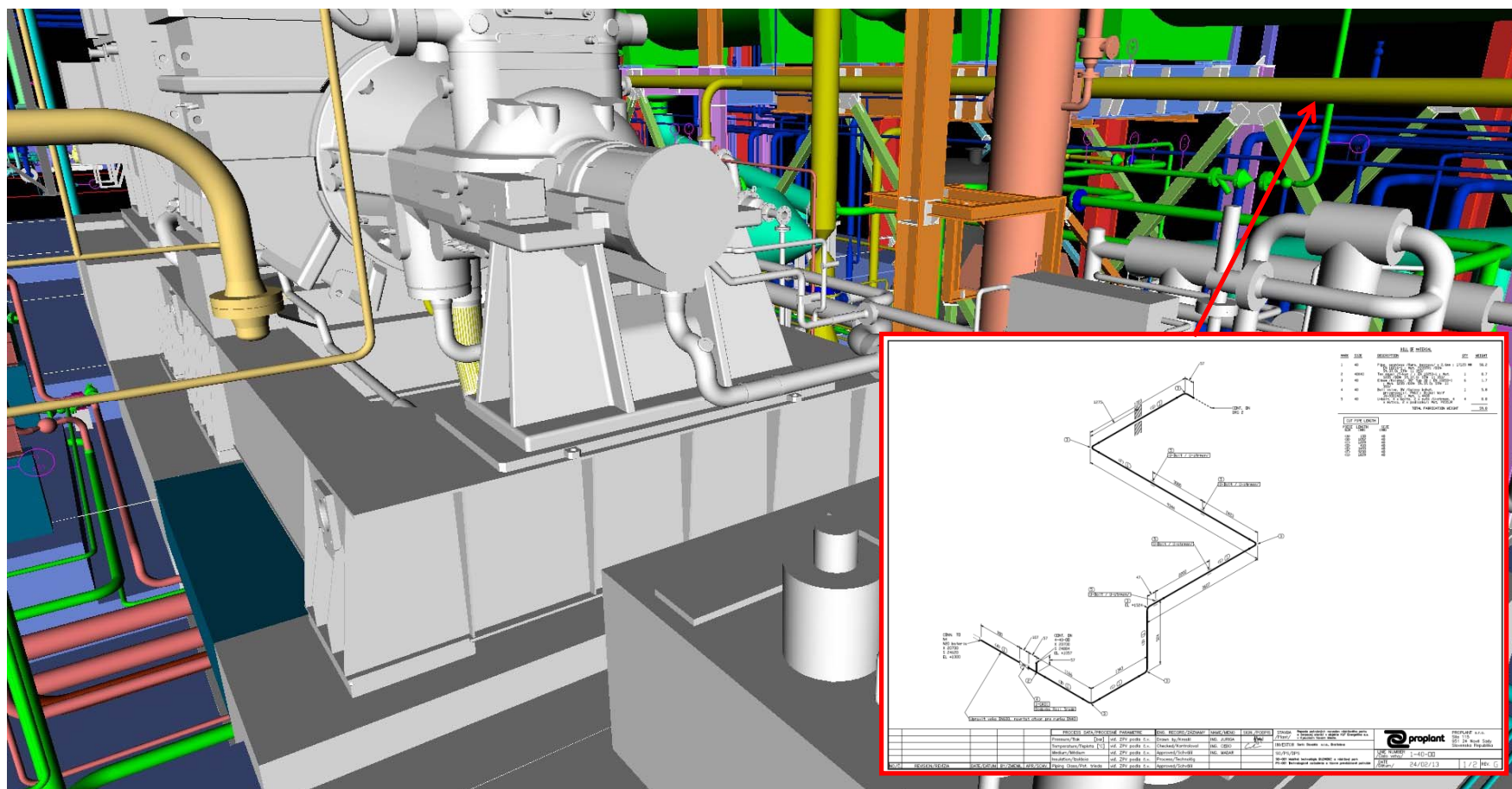
Kompletný konštrukčný návrh – 3D model ( zostavné, výrobné výkresy )

Pevnostný návrh potrubí, určenie napätostných polí, reakcií do uložení, kontrola síl na hrdlá aparátov.

Riešenie dynamických úloh v potrubniach ( vodný ráz, vibrácie atď. ...)

# Potrubný systém. Konštrukčný návrh

3D model a výkresové výstupy



## Potrubný systém. Pevnostný návrh potrubia

veľká pozornosť predovšetkým  
potrubia II. a III. Kategórie. ( ↑↑ vysoká  
teplota, ↑↑ vysoký tlak)

-pevnostný výpočet (EN, ASME, BS, ... )

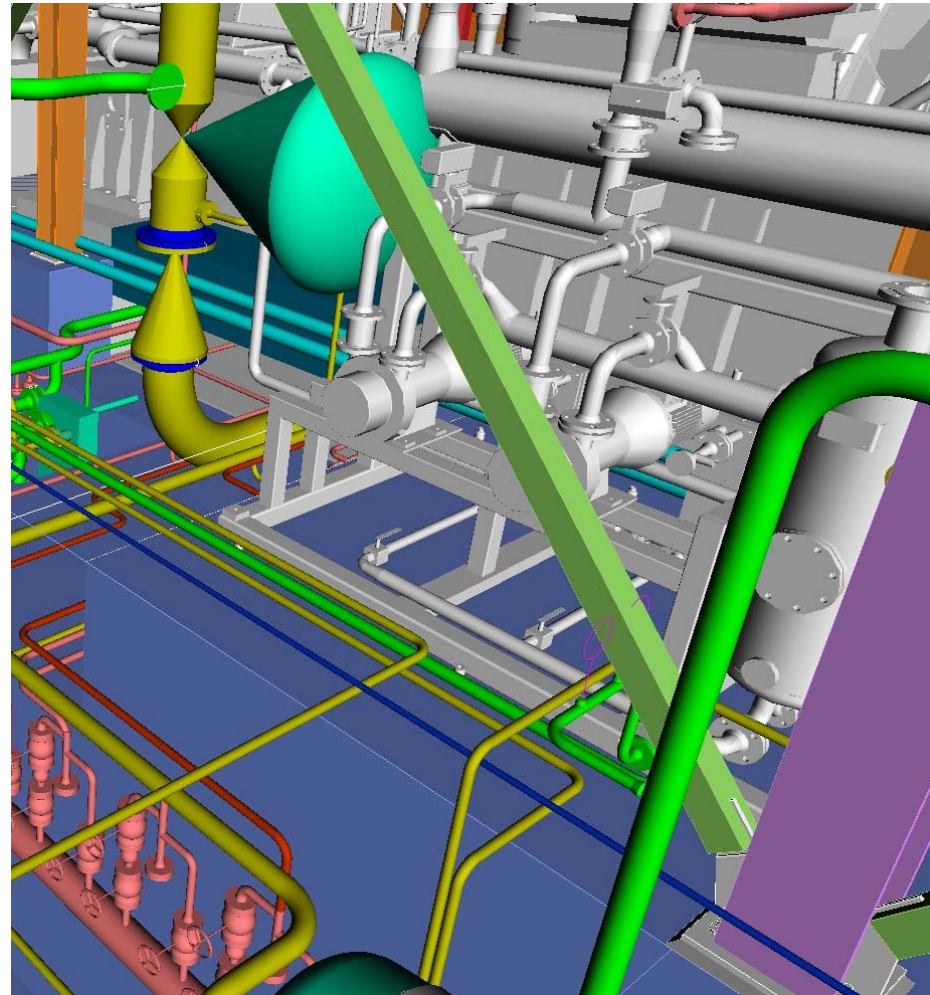
- optimalizácia

-návrh vhodných kompenzačných  
prvkov

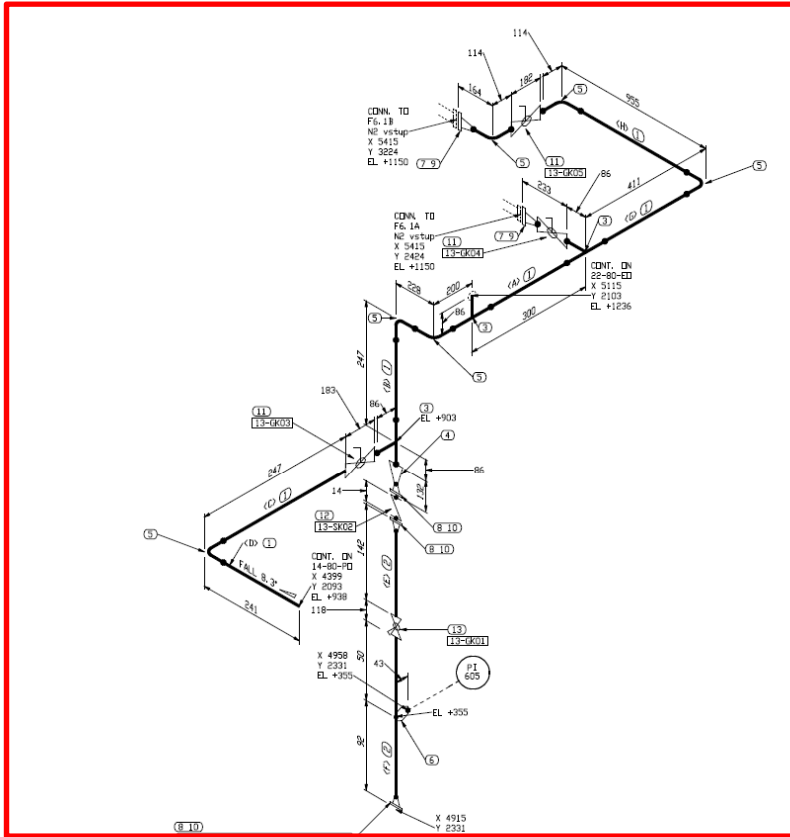
- presný návrh umiestnenia a uchytenia  
potrubia

- analýza vplyvu na pripájané aparáty ( hrdlá )

-podrobná analýza možných  
zaťažujúcich stavov



# Izometrický výkres.



BILL OF MATERIAL			
MAN	SIZE	DESCRIPTION	QTY WEIGHT
1	80	Pipe, stainless /Rura, nerezová/ x 3.6mm i EN 10253-1, Met. registro /IDN	1372 MM 10.4
2	40	Pipe, stainless /Rura, nerezová/ x 2.6mm i EN 10253-1, Met. registro /IDN	200 MM 0.6
3	80/80	Tea, steel /Telo, ocel / EN 10253-1, Met. registro /IDN	3 5.6
4	80/40	Reducer, concentric /Redukcia koncentrická, ocel i EN 10253-1, Met. registro /IDN	1 0.6
5	80	Elbow, 90deg /Úhlový kĺbov, 90°, ocel i EN 10253-1, Met. registro /IDN	6 7.4
6	40/15	Weldolet /Dobocky / Príprava / Met. registro /IDN	1 0.1
7	80	Flange, weldneck /Príruba, kĺbová / ocel i EN 10253-1, Met. registro /IDN	2 7.4
8	40	Flange, weldneck /Príruba, kĺbová / ocel i EN 10253-1, Met. registro /IDN	3 5.7
9	80	Gasket /Tesnenie / PN16 i EN 1514-1 Form 16 i EN 1514-1	2 0.2
10	40	Gasket /Tesnenie / PN16 i EN 1514-1 Form 16 i EN 1514-1	3 0.3
11	80	Ball valve, BW /Gulový kĺbov, prípravový / PN16 i Šperaco Ref. 797	3 36.3
12	40	Check valve /ŠC /Otvára kľapka, prípravový / PN16 i Šperaco Ref. 365, šperaco i Met. 33 316 + viton	1 0.7
13	40	Ball valve, BW /Gulový kĺbov, prípravový / PN16 i Šperaco Ref. 797	1 2.8
TOTAL FABRICATION WEIGHT			77.7

CUT PIPE LENGTH	
PIECE LENGTH	NUM
128	1
129	1
130	1
131	1
132	1
133	1
134	1
135	1
136	1
137	1
138	1

S čoho sa skladá potrubný systém ?

Jednotlivé položky potrubnej triedy ...

PROCESS DATA / PROCESNÉ PARAMETRE				ENG. RECORD / ZÁZNAMY	NAME / MENO	SIGN. / PODPIS	STAVBA / Plant /	Repara potrubných rozvadzov nádobného parní a tepelnej izolácie v objektu KÚP Energetika a.s. v Kysuckom Novom Meste.	PROPLANT s.r.o. Šiba 115 951 24 Nové Sady Slovenska Republika
Pressure / Tlak [bar]	vid. ZPV podľa č.v.	Drawn by / Kreslil	ING. JURISA			INVESTOR	Soleo Slovakia s.r.o., Bratislava	LINE NUMBER / Číslo vetvy / 13-80-PO	
Temperature / Teplota [°C]	vid. ZPV podľa č.v.	Checked / Kontroloval	ING. CEBJO			SO / PS / DPS		DATE / Dátum / 24/02/13	
Medium / Médium	vid. ZPV podľa č.v.	Approved / Schválil	ING. MADAR			PS-001	Metodická technológia BLDNED a nádržový parník	1 / 1	
Insulation / Izolácia	vid. ZPV podľa č.v.	Process / Technológ						REV. G	
Piping Class / Pot. trieda	vid. ZPV podľa č.v.	Approved / Schválil							

# Izometrický výkres.

## ZOZNAM MATERIÁLU

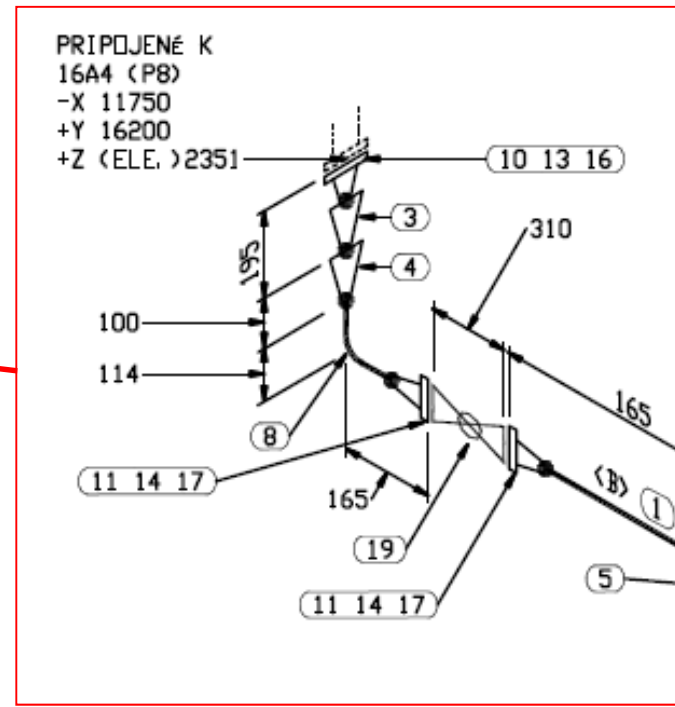
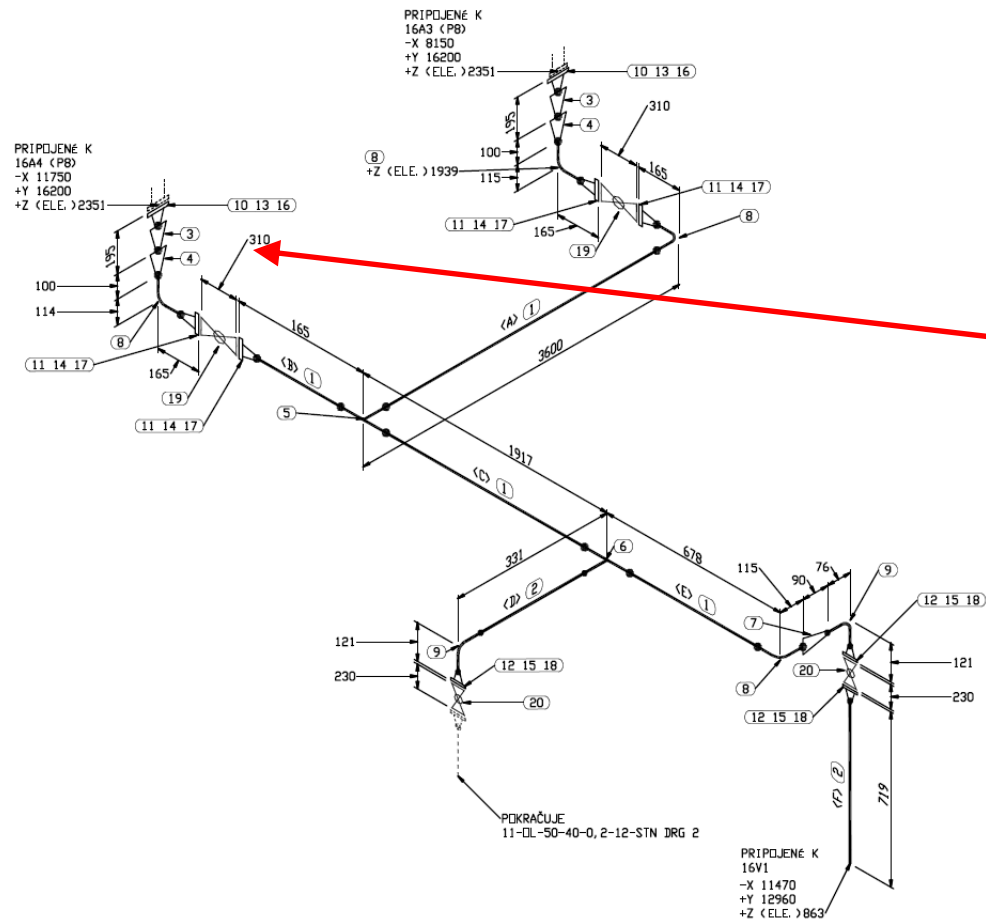
<u>OZN.</u>	<u>DN/ROZ.</u>	<u>POPIS</u>	<u>QTY</u>	<u>HMDTN.</u>
1	80	Rúrka, Hrúbka steny 3.6	5652 MM	42.8
2	50	Rúrka, Hrúbka steny 3.2	853 MM	3.9
3	150X100	Reducia, centrická časť 1 DIN2616	2	4.6
4	100X80	Reducia, centrická časť 1 DIN2616	2	1.9
5	80X80	T-kus, štandard časť 1 DIN2615	1	1.9
6	80X50	T-kus, redukcia časť 1 DIN2615	1	1.9
7	80X50	Reducia, centrická časť 1 DIN2616	1	0.6
8	80	90° Koleno DIN2606, časť 1, typ 3, R=1,5D	4	4.9
9	50	90° Koleno DIN2606, časť 1, typ 3, R=1,5D	2	1.0
10	150	Príruba krkovaná, RFWN PN16 DIN 2633	2	15.5
11	80	Príruba krkovaná, RFWN PN16 DIN 2633	4	14.8
12	50	Príruba krkovaná, RFWN PN16 DIN 2633	3	7.6
13	150	Tesnenie, 3mm, DN16	2	2.0
14	80	Tesnenie, 3mm, DN16	4	4.0
15	50	Tesnenie, 3mm, DN16	3	3.0
16	20X110	(8) ks - Komplet (Skrutka, matica, podložka) pre PN16	2	2.0
17	16X65	(8) ks - Komplet (Skrutka, matica, podložka) pre PN16	4	4.9
18	16X60	(4) ks - Komplet (Skrutka, matica, podložka) pre PN16	3	1.8
19	80	Gulový kohút, PN 16 Prírubový, ZEUS Typ K91.1 (Armatury Group)	2	85.0
20	50	Gulový kohút, PN 16 Prírubový, ZEUS Typ K91.1 (Armatury Group)	2	42.6
CELKOVÁ HMDTNOSŤ				yyyyyyyy 246.2 yyyyyyyy

### PRESNÁ DLŽKA RORKY

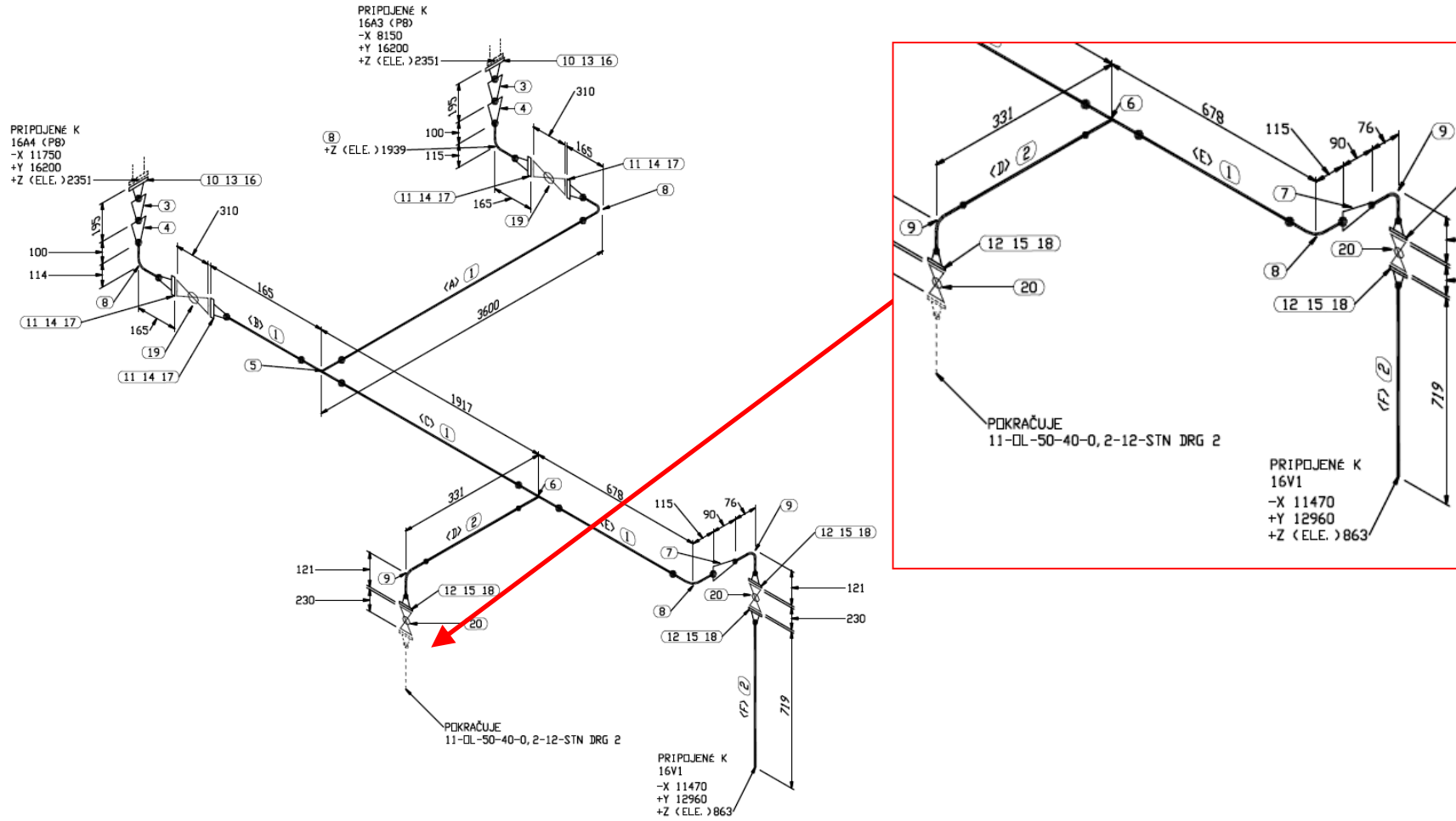
PIECE NUM	LENGTH (MM)	SIZE (MM)
<A>	3400	80
<B>	29	80
<C>	1745	80
<D>	179	50
<E>	478	80
<F>	674	50



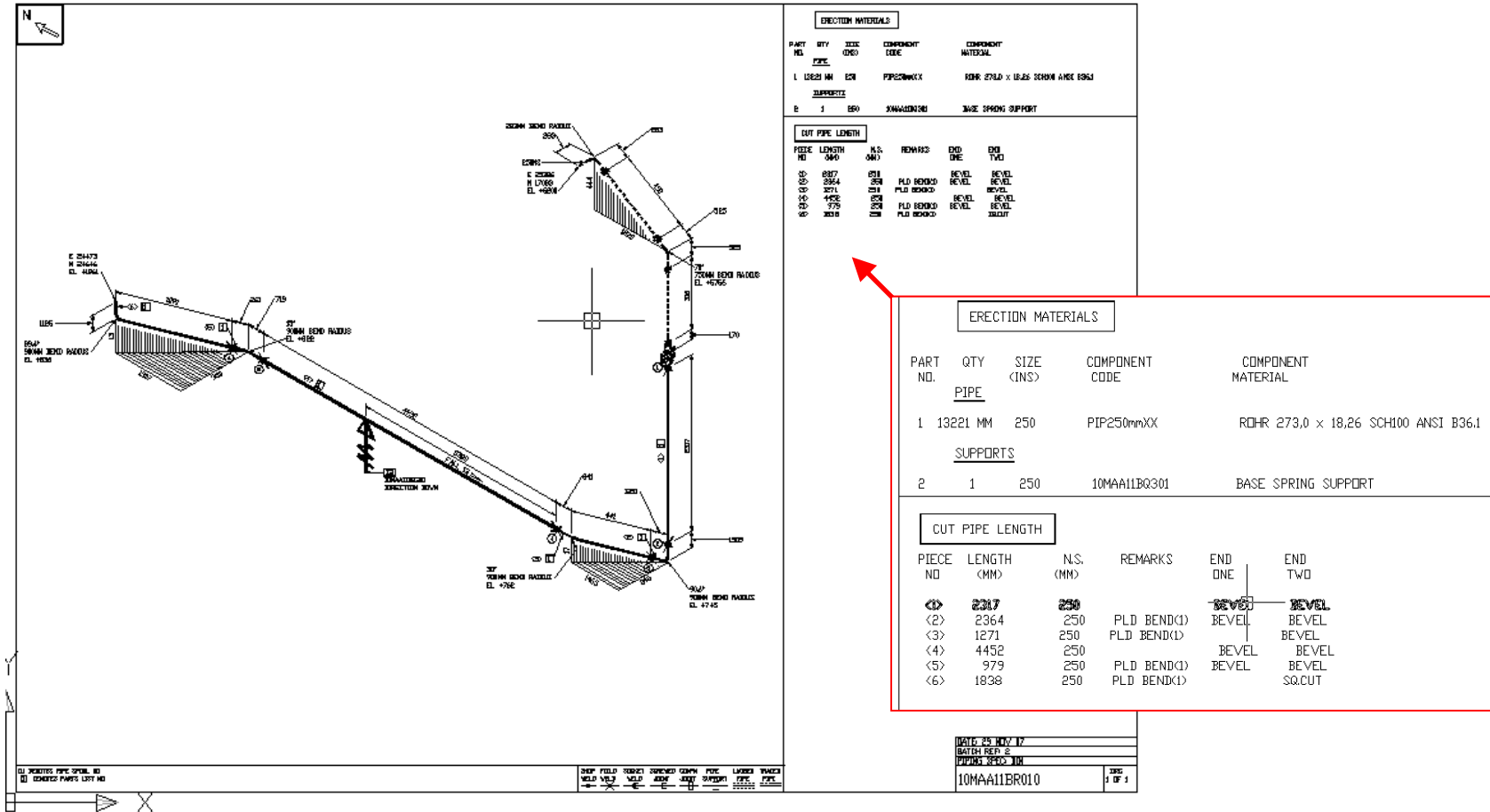
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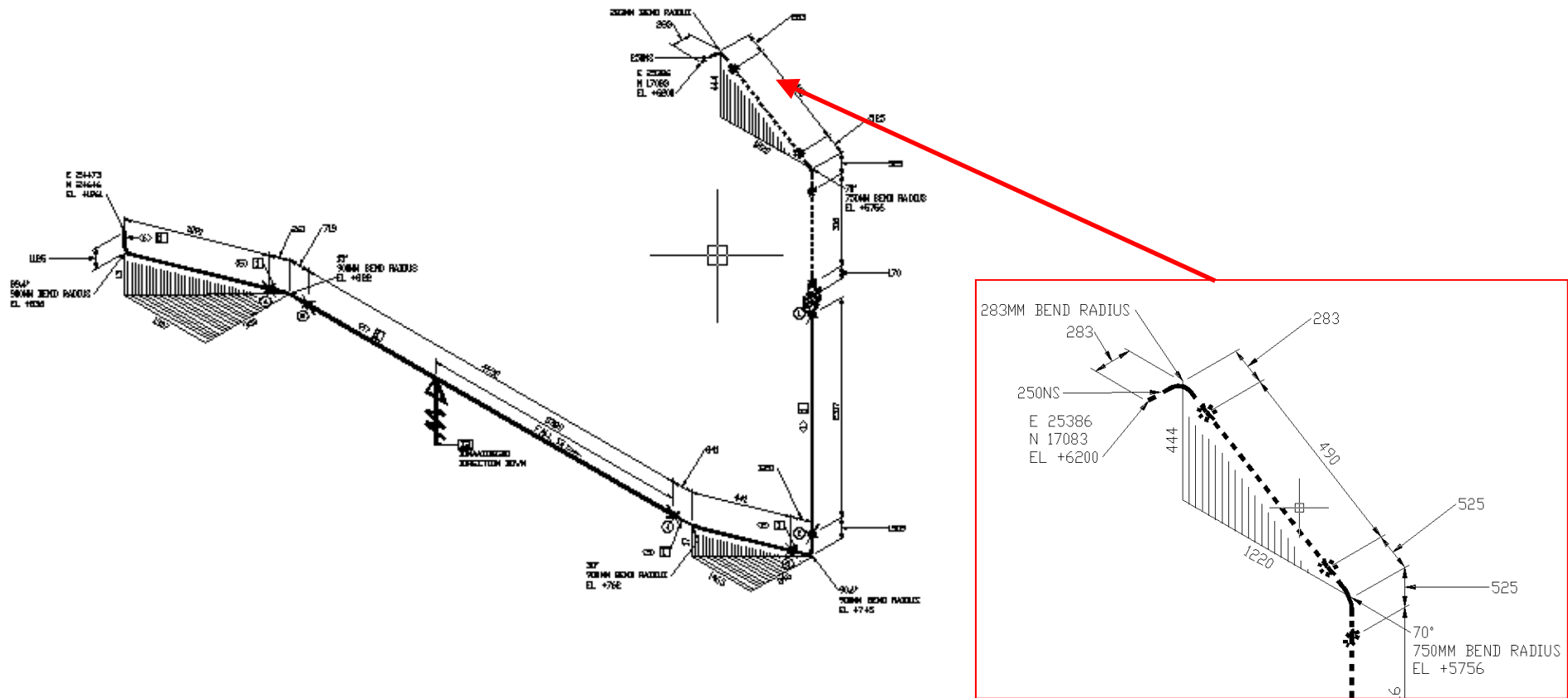
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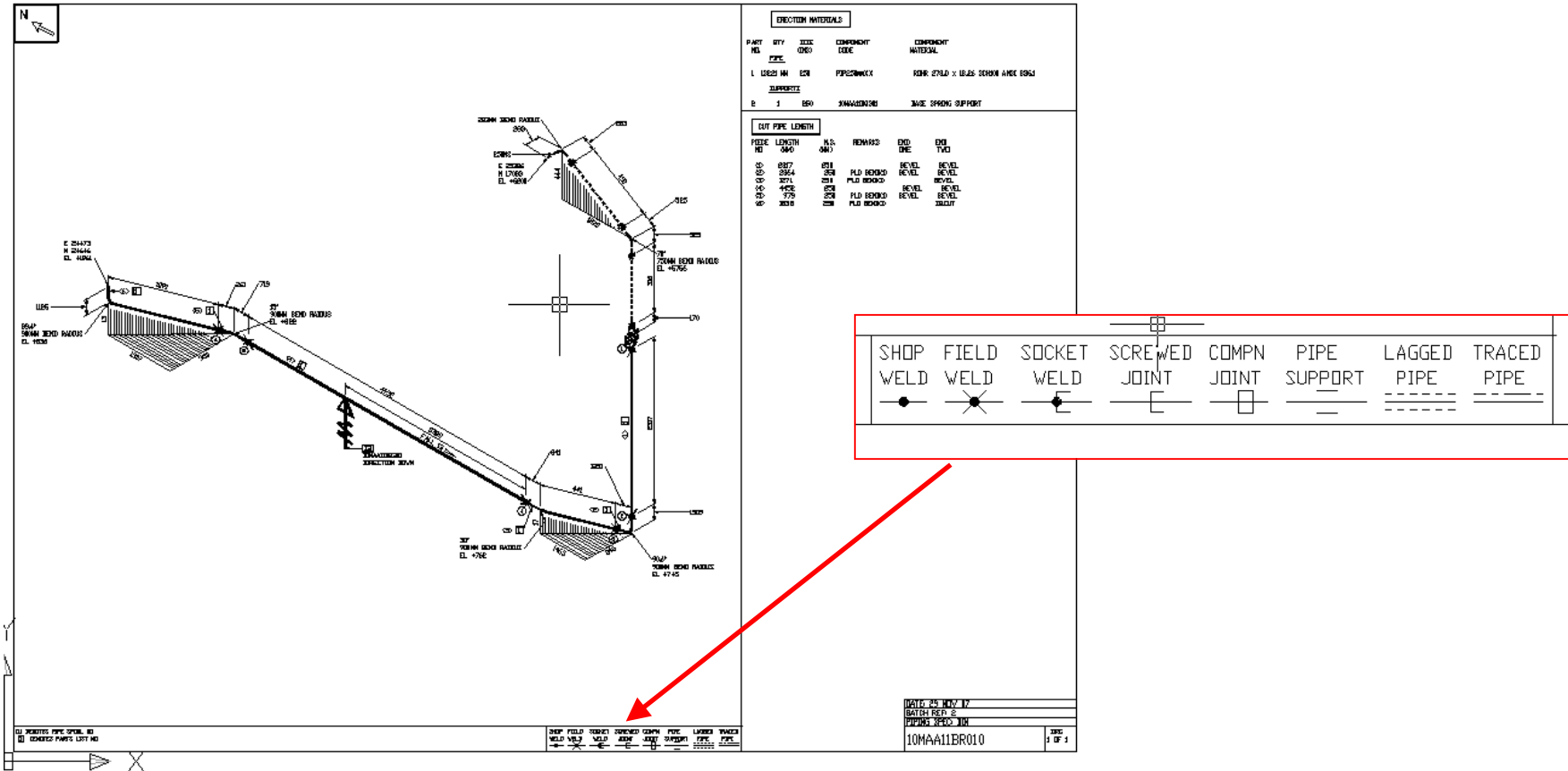
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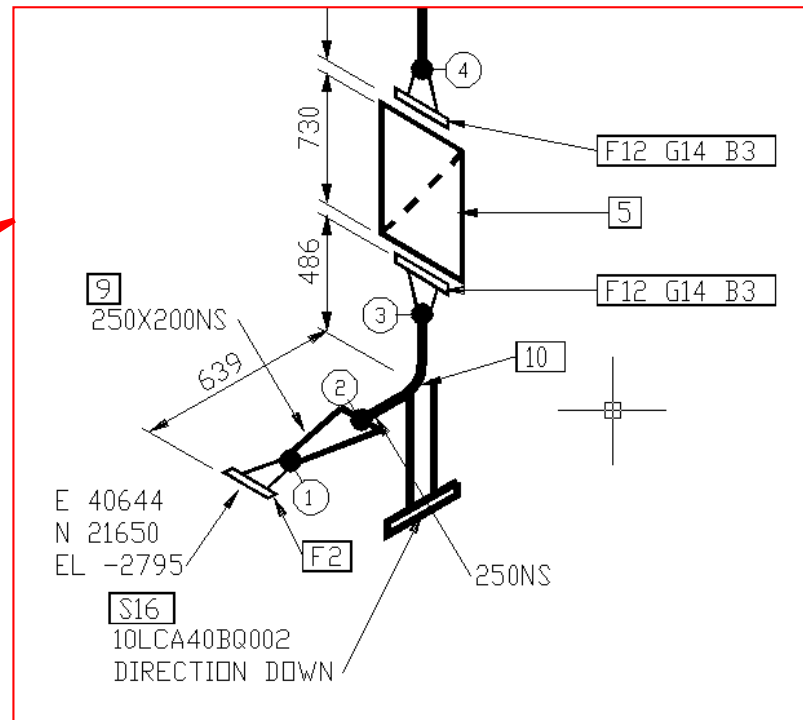
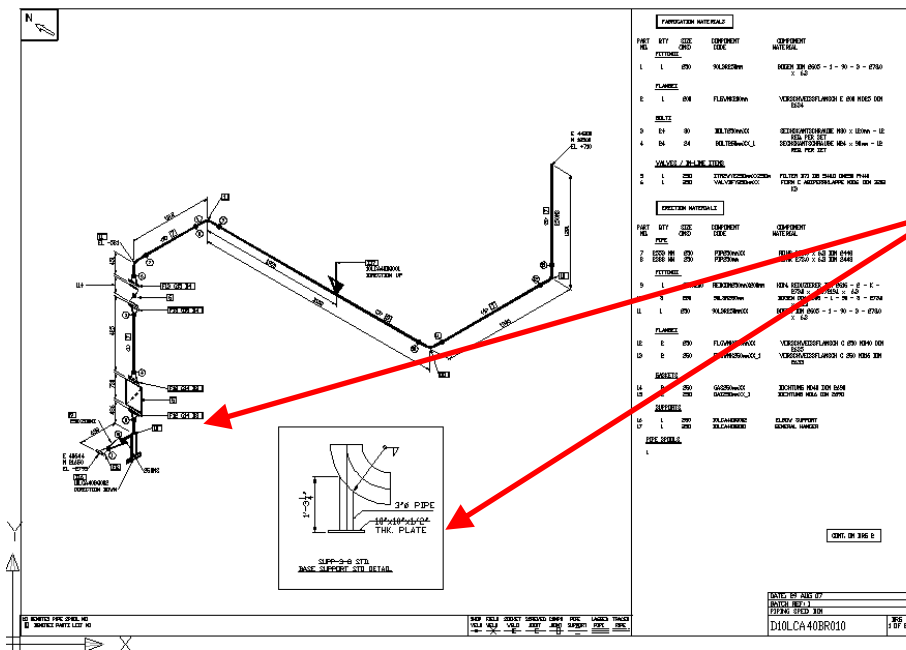
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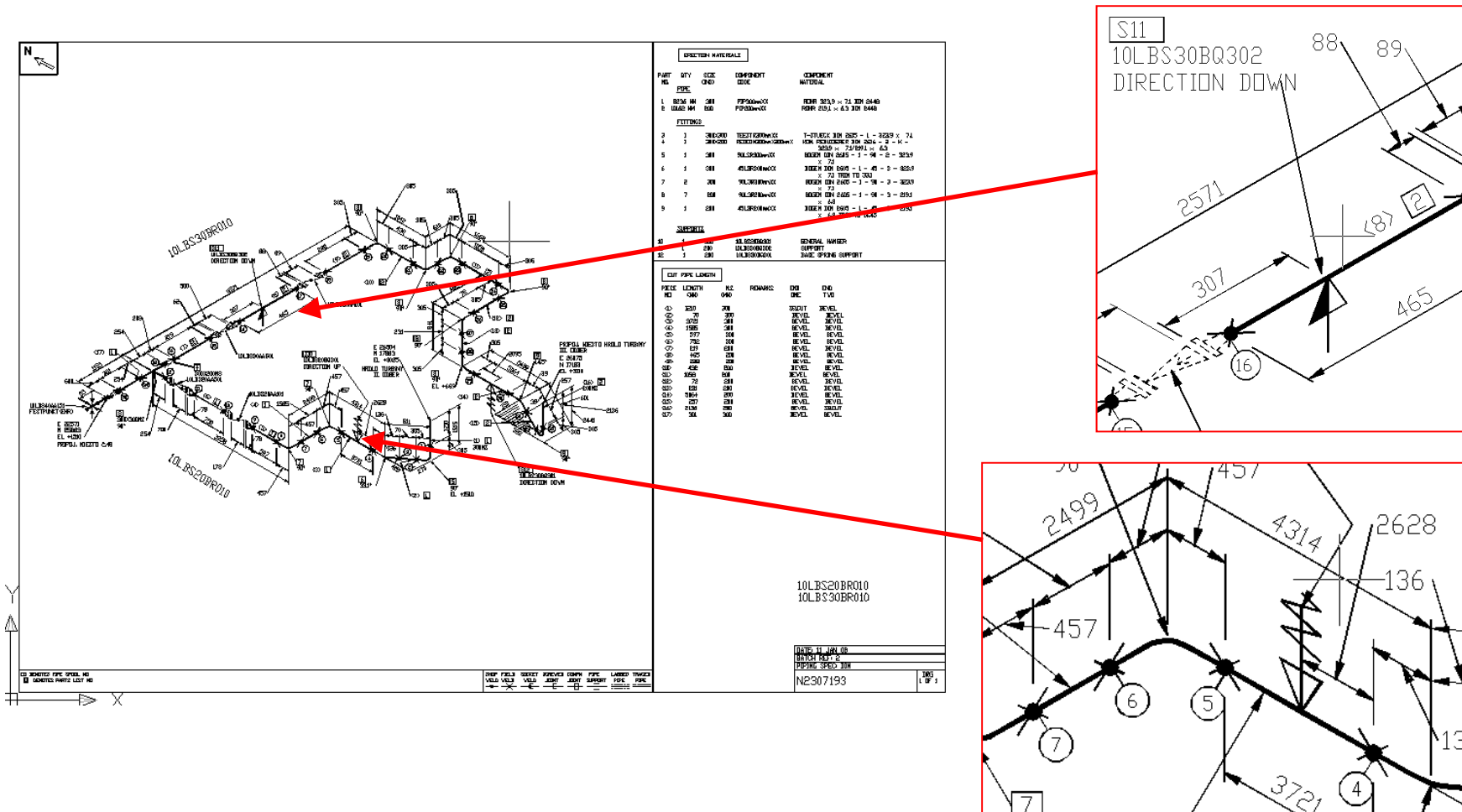
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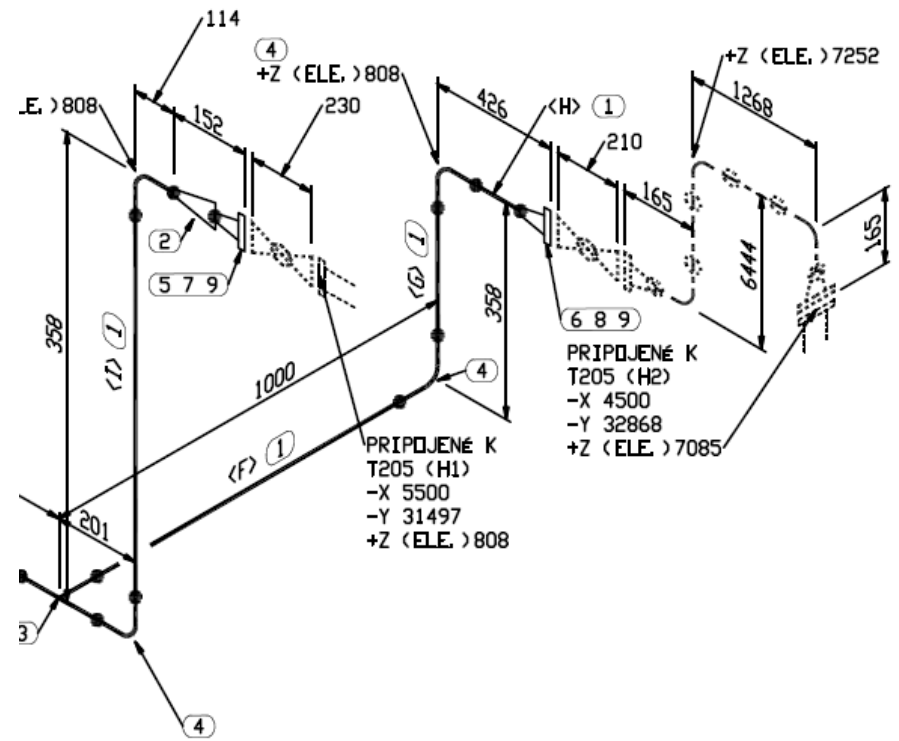
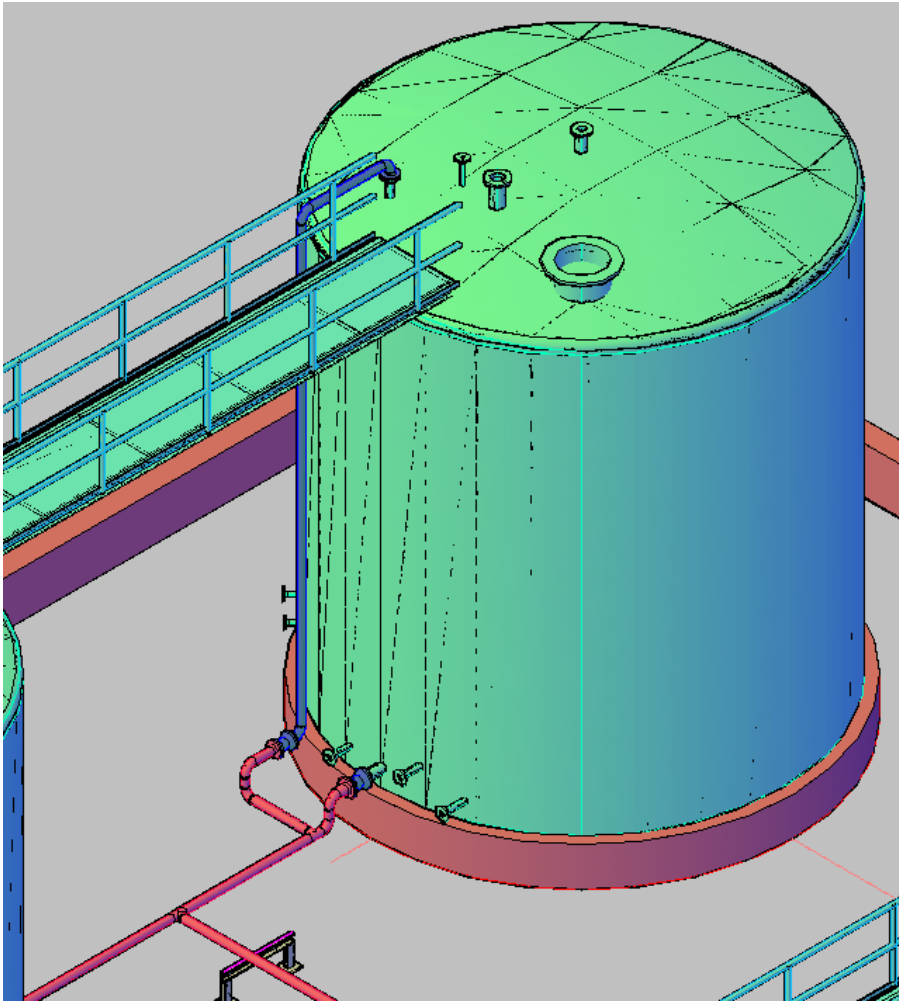
# Izometrický výkres.



# Izometrický výkres.

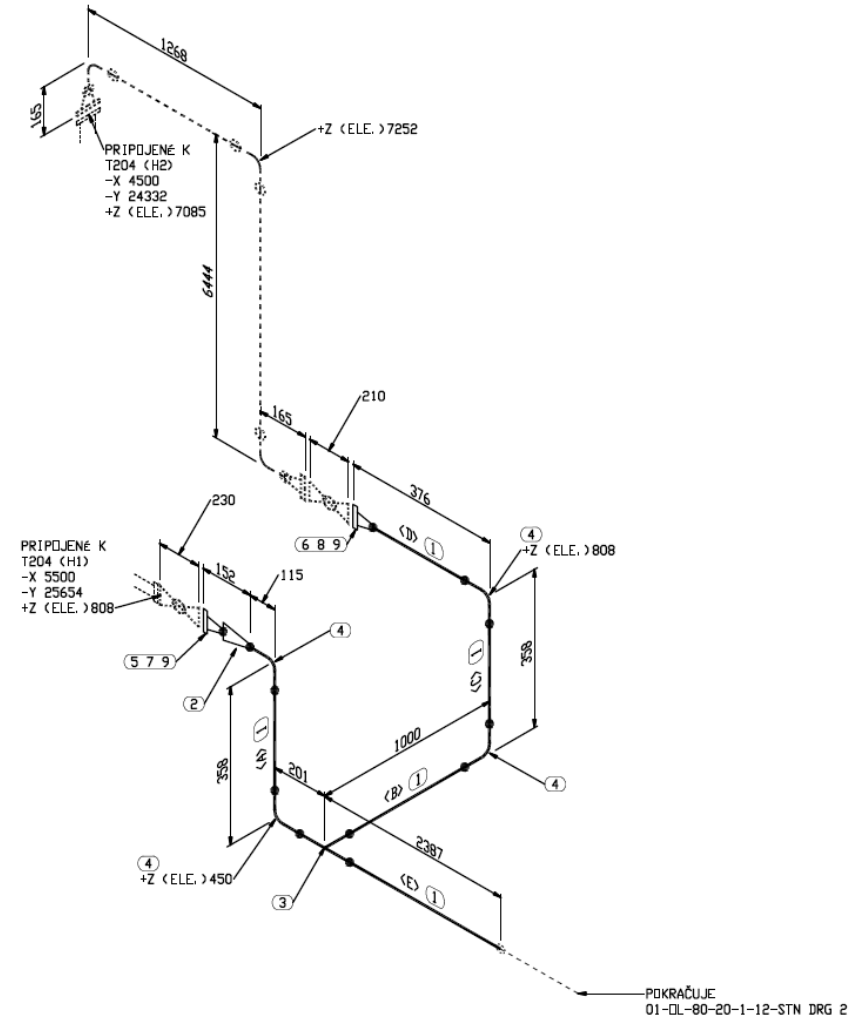
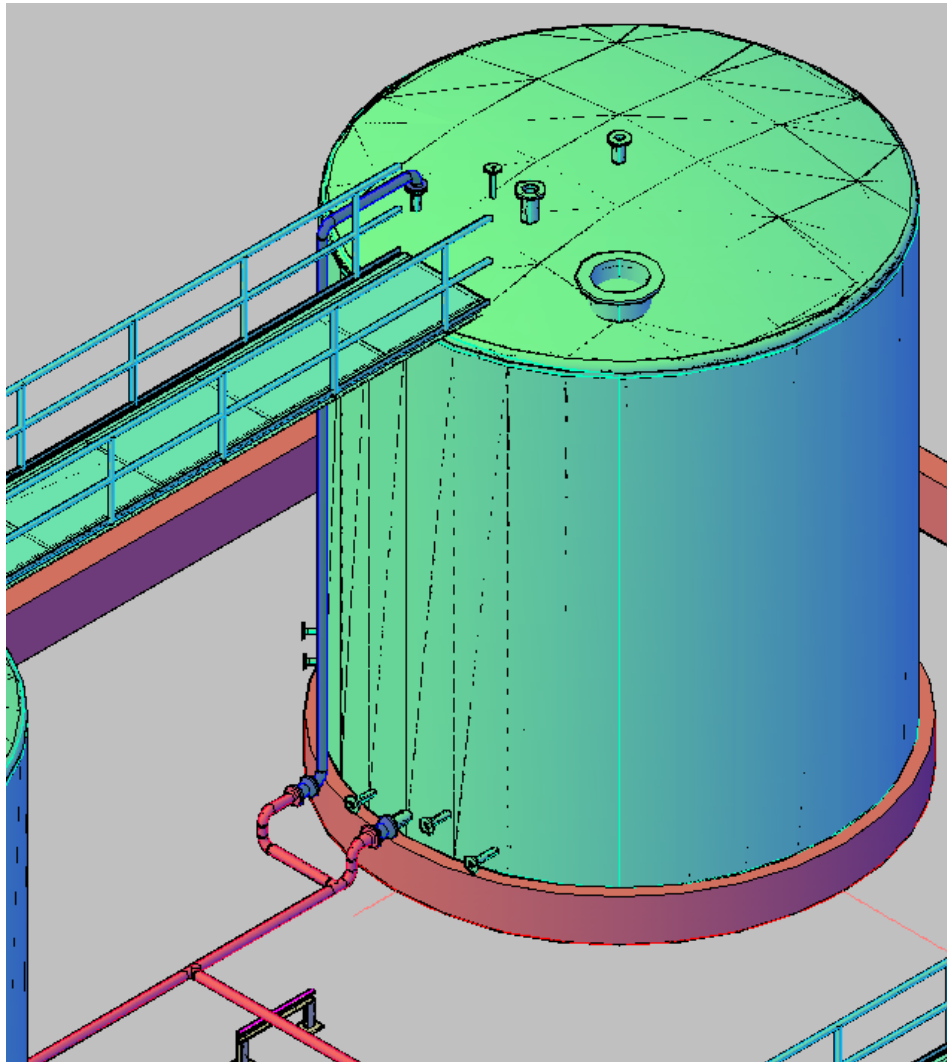


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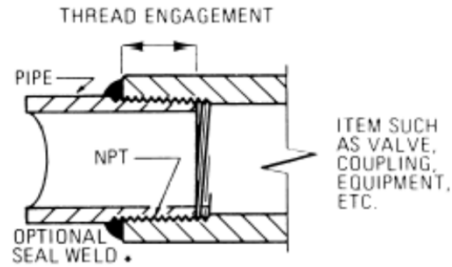




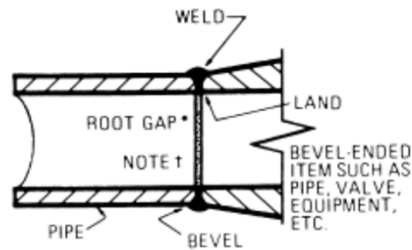
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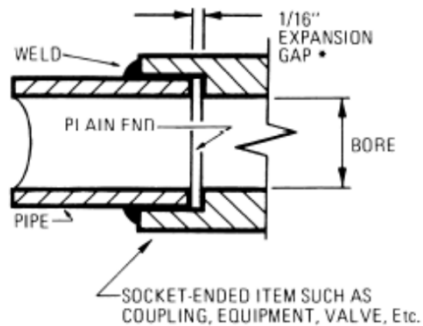
# Potrubný systém. Základné spôsoby spájania potrubí.



Screwed Piping S  
(prípade THD Thread)

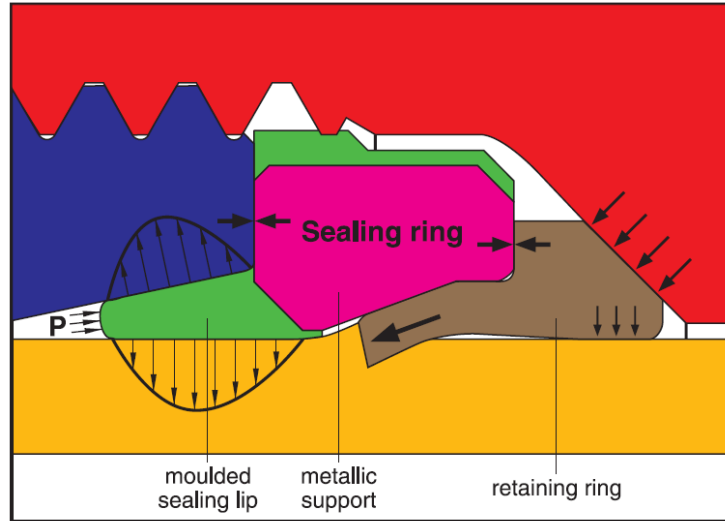
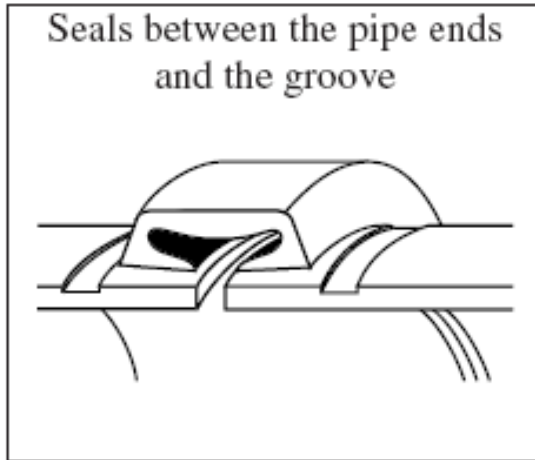


Butt-Welded Piping BW



Socket-Welded Piping  
SW

# Potrubný systém. Základné spôsoby spájania potrubí.

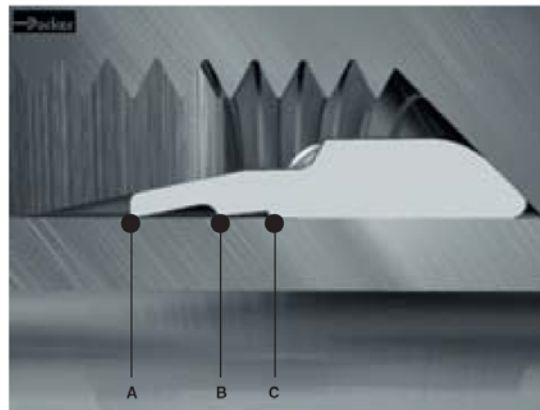


The metallic support of the sealing ring acts just like an integrated pre-assembly tool.

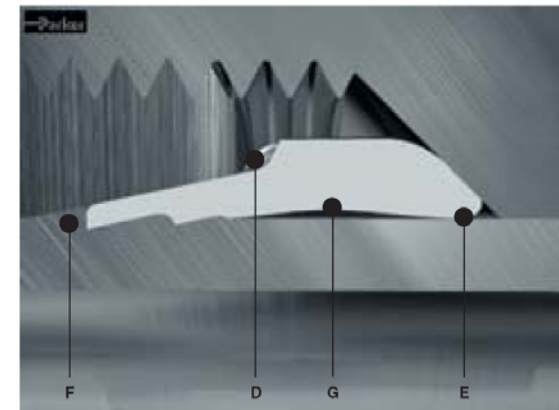
Ostatné typ spájania.

- pružný člen
- tvarový spoj

Victaulic  
 Parker  
 Swagelock atď.

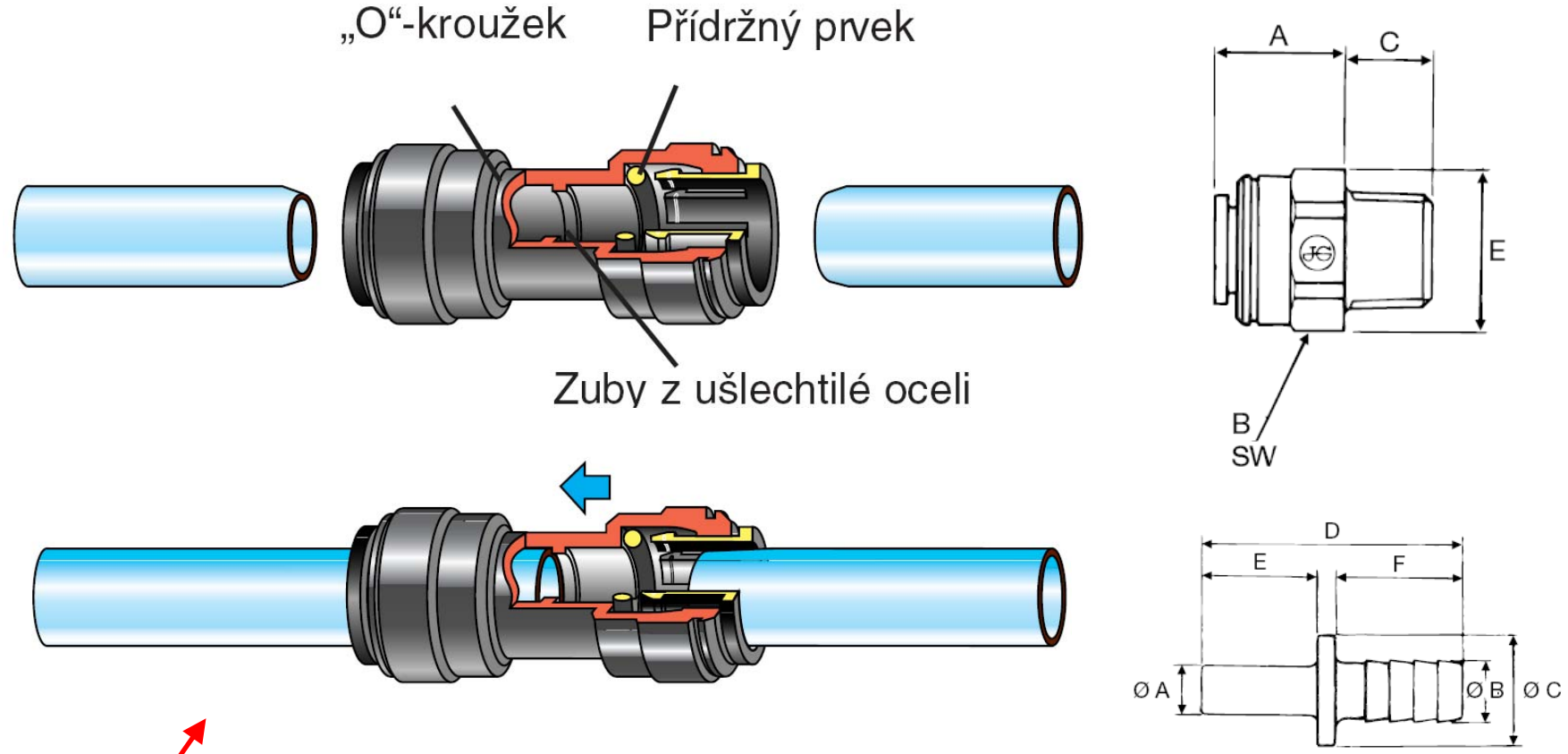


Before tightening the nut



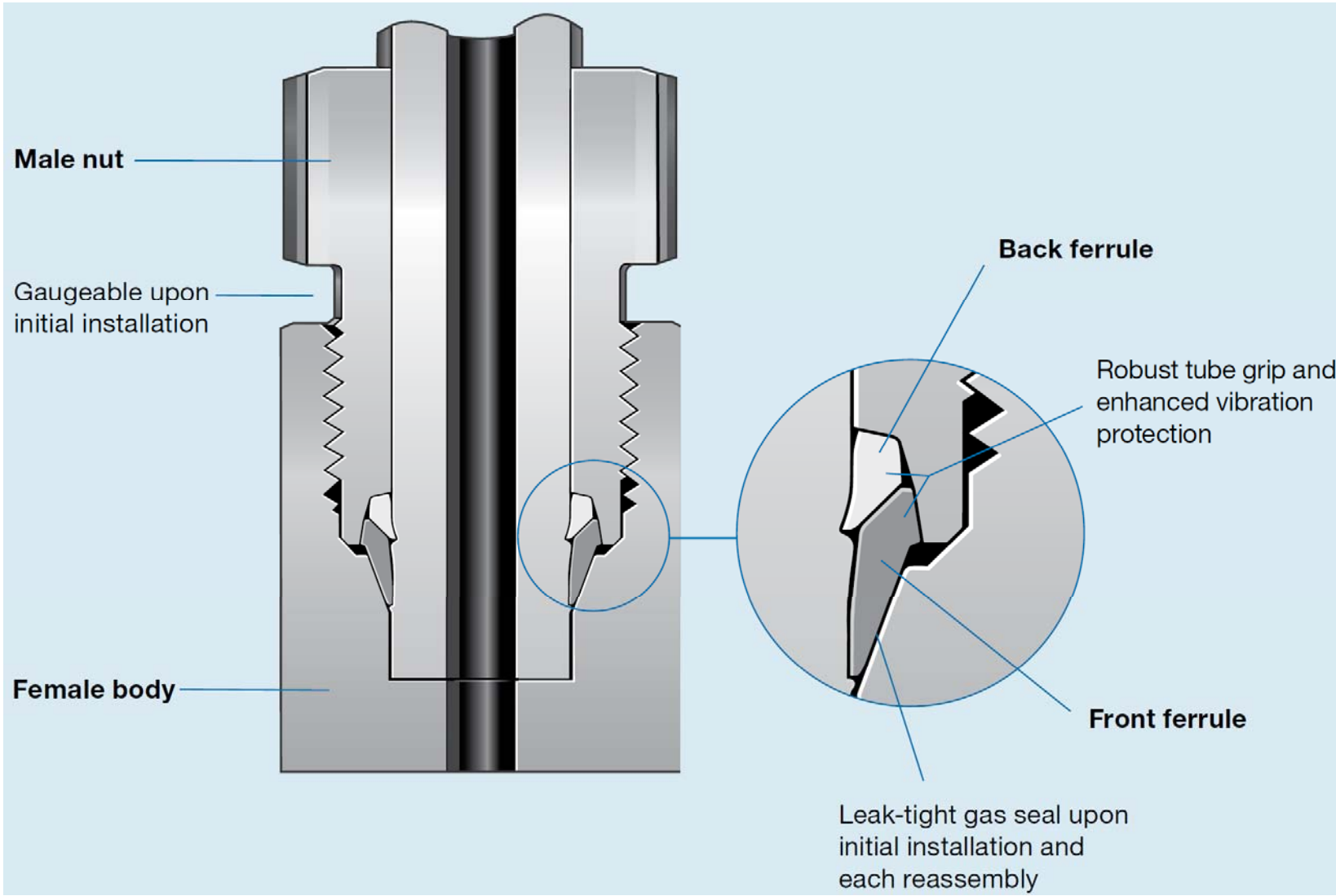
After tightening the nut

# John Guest



Patentovaný spôsob spájanie potrubí. / spojka, rúra/  
Systém spájanie s ostatnými spojeniami

# Swagelok

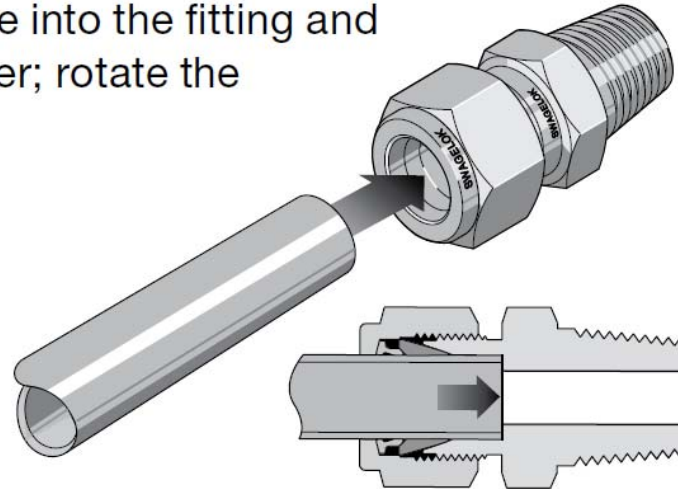


# Swagelok

Fully insert the tube into the fitting and against the shoulder; rotate the nut finger-tight.

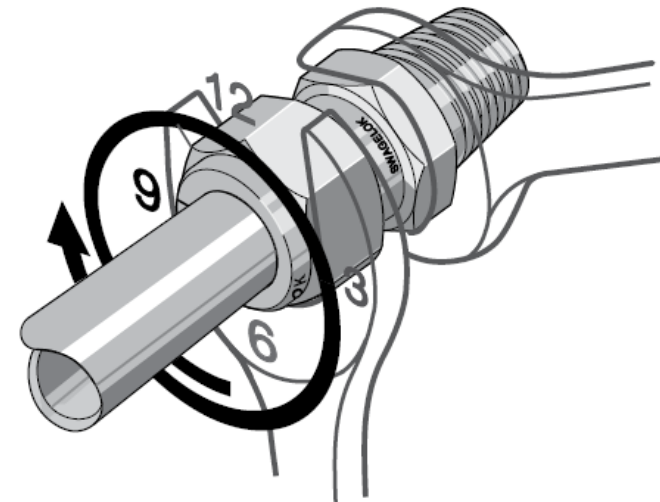
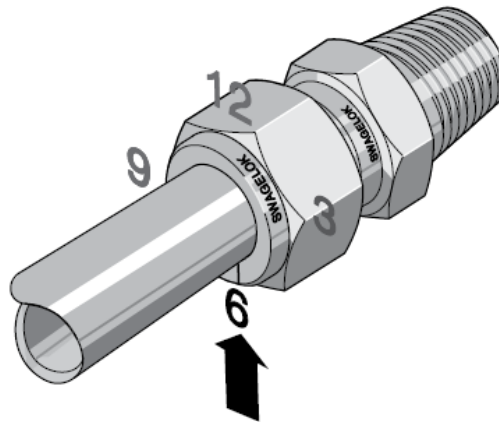
**High-pressure applications and high safety-factor systems:**

*Further tighten the nut until the tube will not turn by hand or move axially in the fitting.*



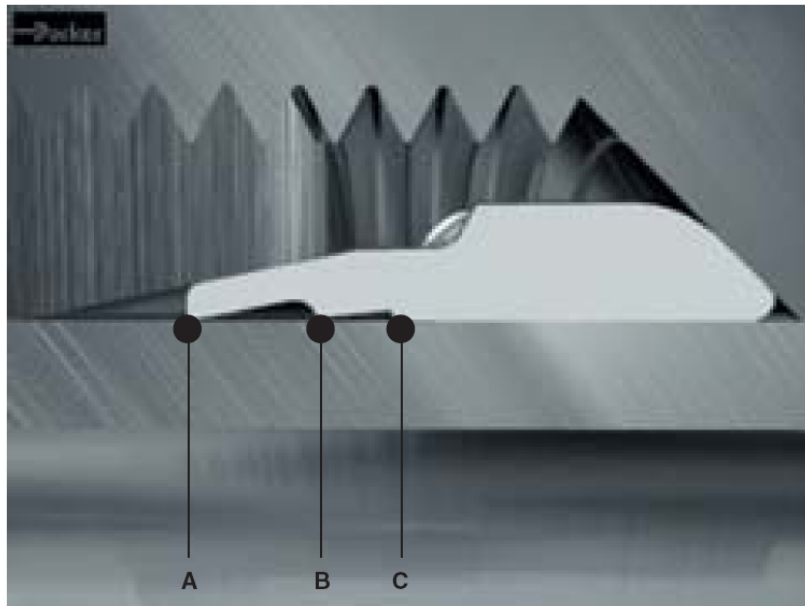
While holding the fitting body steady, tighten the nut one and one-quarter turns to the 9 o'clock position.

Mark the nut at the 6 o'clock position.

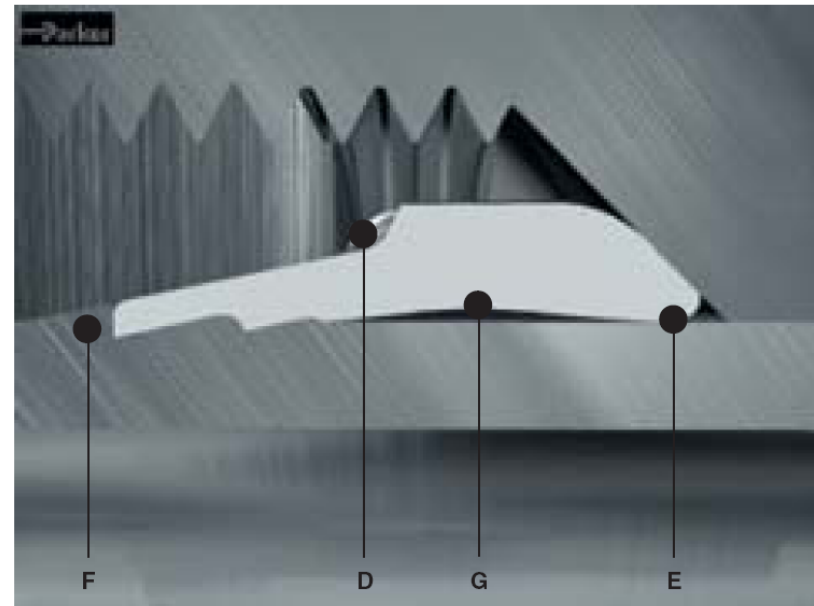


# Parker

**High pressure** – Due to the application of even better materials combined with the special processing of individual components, EO-PSR can be used in applications of up to 800 bar (S series) and 500 bar (L series).



Before tiahnenina the nut

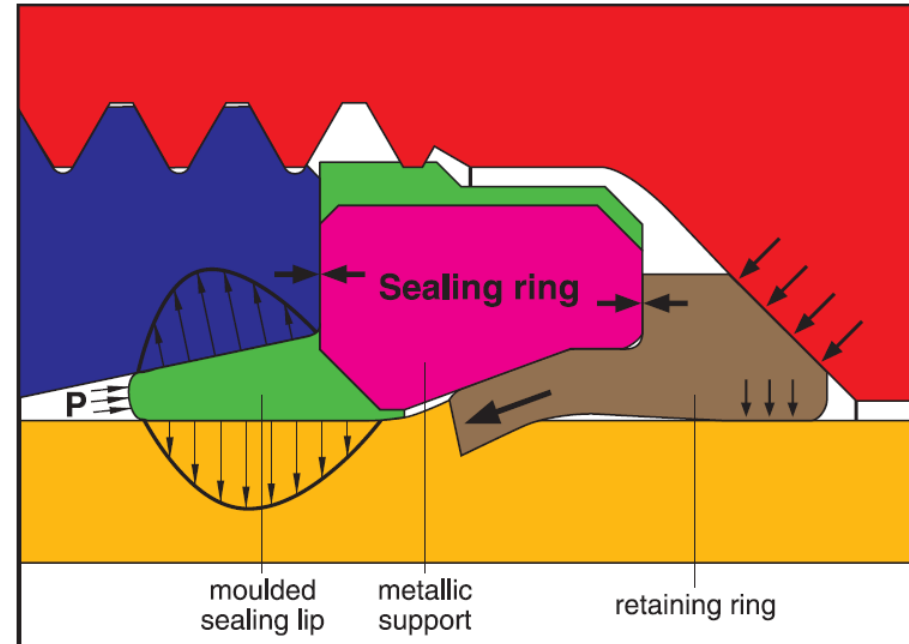


After tiahnenina the nut

# Parker



EO-2: Safe dry – clean – leakfree



The metallic support of the sealing ring acts just like an integrated pre-assembly tool.

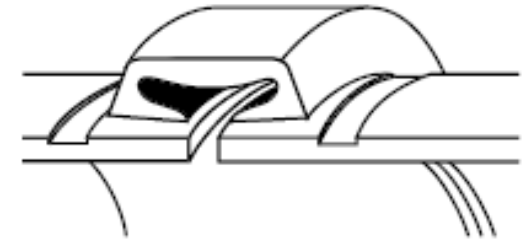
**Increased pressure** – Due to the application of even better materials combined with the special processing of individual components, EO-2 can be used in applications of up to 800 bar (S series) and 500 bar (L series).



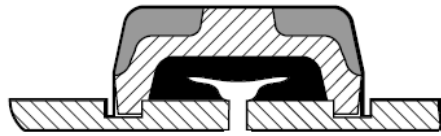
# Victaulic



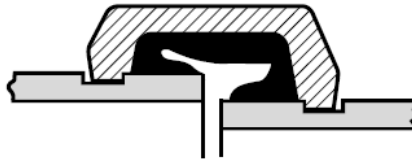
Seals between the pipe ends  
and the groove



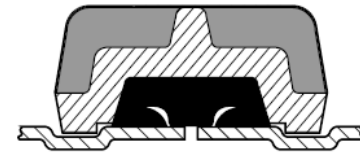
# Victaulic



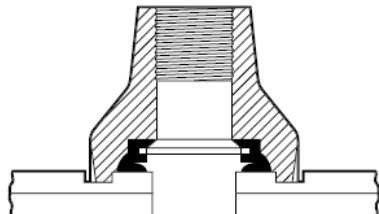
Standard



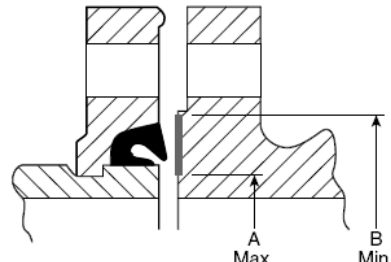
Reducing



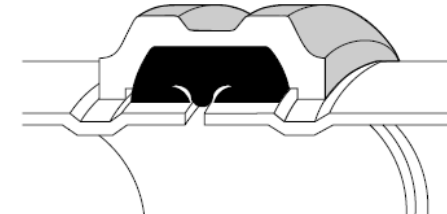
FlushSeal®



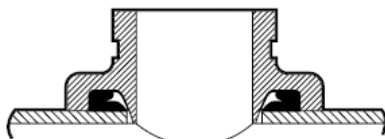
Outlet



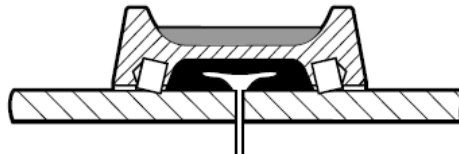
Vic-Flange®



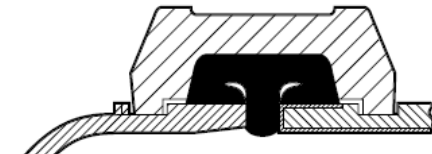
Grooved Copper Tubing with FlushSeal Gasket



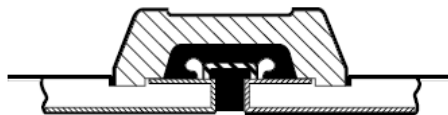
Mechanical-T®



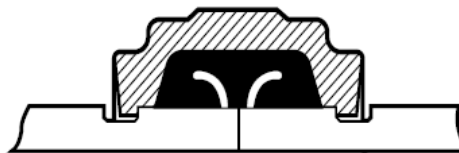
Plain End



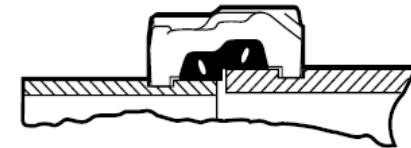
EndSeal®



EndSeal® Fire-R™



AWWA FlushSeal®



IPS to AWWA Transition

# Potrubný systém. Rúra

Wall thickness = mm Weight –kg/m (Plain end mass)

Pipe Size (Inches)	Pipe OD (mm)	5S	10S	10	20	30	STD	40S	40	XS	80S	80	XXS
3/8	17.10		1.65 <b>0.64</b>				2.31 <b>0.84</b>	2.31 <b>0.86</b>	2.31 <b>0.84</b>	3.20 <b>1.10</b>	3.20 <b>1.12</b>	3.20 <b>1.10</b>	
1/2	21.30	1.65 <b>0.82</b>	2.11 <b>1.01</b>				2.77 <b>1.27</b>	2.77 <b>1.30</b>	2.77 <b>1.27</b>	3.73 <b>1.62</b>	3.73 <b>1.65</b>	3.73 <b>1.62</b>	7.47 <b>1.95</b>
3/4	26.70	1.65 <b>1.04</b>	2.11 <b>1.31</b>				2.87 <b>1.69</b>	2.87 <b>1.71</b>	2.87 <b>1.69</b>	3.91 <b>2.20</b>	3.91 <b>2.24</b>	3.91 <b>2.20</b>	7.82 <b>3.64</b>
1	33.40	1.65 <b>1.33</b>	2.77 <b>2.13</b>				3.38 <b>2.50</b>	3.38 <b>2.55</b>	3.38 <b>2.50</b>	4.55 <b>3.24</b>	4.55 <b>3.29</b>	4.55 <b>3.24</b>	9.09 <b>5.45</b>
1 1/4	42.20	1.65 <b>1.68</b>	2.77 <b>2.76</b>				3.56 <b>3.39</b>	3.56 <b>3.46</b>	3.56 <b>3.39</b>	4.85 <b>4.47</b>	4.85 <b>4.56</b>	4.85 <b>4.47</b>	9.70 <b>7.77</b>
1 1/2	48.30	1.65 <b>1.95</b>	2.77 <b>3.17</b>				3.68 <b>4.05</b>	3.68 <b>4.13</b>	3.68 <b>4.05</b>	5.08 <b>5.41</b>	5.08 <b>5.51</b>	5.08 <b>5.41</b>	10.15 <b>9.56</b>
2	60.30	1.65 <b>2.44</b>	2.77 <b>4.01</b>				3.91 <b>5.44</b>	3.91 <b>5.54</b>	3.91 <b>5.44</b>	5.54 <b>7.48</b>	5.54 <b>7.63</b>	5.54 <b>7.48</b>	11.07 <b>13.44</b>
2 1/2	73.00	2.11 <b>3.77</b>	3.05 <b>5.36</b>				5.16 <b>8.63</b>	5.16 <b>8.81</b>	5.16 <b>8.63</b>	7.01 <b>11.41</b>	7.01 <b>11.64</b>	7.01 <b>11.41</b>	14.02 <b>20.39</b>
3	88.90	2.11 <b>4.60</b>	3.05 <b>5.59</b>				5.49 <b>11.29</b>	5.49 <b>11.52</b>	5.49 <b>11.29</b>	7.62 <b>15.27</b>	7.62 <b>15.59</b>	7.62 <b>15.27</b>	15.24 <b>27.68</b>
3 1/2	101.6	2.11 <b>5.29</b>	3.05 <b>7.99</b>				5.74 <b>13.57</b>	5.74 <b>13.84</b>	5.74 <b>13.57</b>	8.08 <b>18.63</b>	8.08 <b>19.01</b>	8.08 <b>18.63</b>	
4	114.3	2.11 <b>5.96</b>	3.05 <b>8.52</b>				6.02 <b>16.07</b>	6.02 <b>16.40</b>	6.02 <b>16.07</b>	8.56 <b>22.32</b>	8.56 <b>22.77</b>	8.56 <b>22.32</b>	17.12 <b>41.03</b>
5	141.3	2.77 <b>9.67</b>	3.40 <b>11.82</b>				6.55 <b>21.77</b>	6.55 <b>22.20</b>	6.55 <b>21.77</b>	9.53 <b>30.97</b>	9.53 <b>31.59</b>	9.53 <b>30.97</b>	19.05 <b>57.43</b>
6	168.3	2.77 <b>11.55</b>	3.40 <b>14.13</b>				7.11 <b>28.26</b>	7.11 <b>28.83</b>	7.11 <b>28.26</b>	10.97 <b>42.56</b>	10.97 <b>43.42</b>	10.97 <b>42.56</b>	21.95 <b>79.22</b>
8	219.1	2.77 <b>15.09</b>	3.76 <b>20.37</b>		6.35 <b>33.31</b>	7.04 <b>36.81</b>	8.18 <b>42.55</b>	8.18 <b>43.39</b>	8.18 <b>42.55</b>	12.70 <b>64.64</b>	12.70 <b>65.95</b>	12.70 <b>64.64</b>	22.23 <b>107.92</b>
10	273.1	3.40 <b>23.08</b>	4.19 <b>28.34</b>		6.35 <b>41.77</b>	7.80 <b>51.03</b>	9.27 <b>60.31</b>	9.27 <b>61.52</b>	9.27 <b>60.31</b>	12.70 <b>81.55</b>	12.70 <b>83.19</b>	15.90 <b>96.01</b>	25.40 <b>155.15</b>
12	323.9	3.96 <b>31.89</b>	4.57 <b>36.73</b>		6.35 <b>49.73</b>	8.35 <b>65.20</b>	9.53 <b>73.88</b>	9.27 <b>75.32</b>	10.31 <b>79.73</b>	12.70 <b>97.46</b>	12.70 <b>99.43</b>	17.48 <b>132.08</b>	25.40 <b>186.97</b>
14	355.6	3.96 <b>35.06</b>	4.78 <b>42.14</b>		6.35 <b>54.69</b>	7.92 <b>67.90</b>	9.53 <b>81.33</b>	9.53 <b>93.27</b>	11.13 <b>94.55</b>	12.70 <b>107.39</b>		19.05 <b>158.10</b>	
16	406.4	4.19 <b>42.41</b>	4.78 <b>48.26</b>		6.35 <b>62.64</b>	7.92 <b>77.83</b>	9.53 <b>93.27</b>	9.53 <b>81.33</b>	12.70 <b>123.30</b>	12.70 <b>123.30</b>		21.44 <b>203.53</b>	
18	457.0	4.19 <b>47.77</b>	4.78 <b>54.36</b>		6.35 <b>70.57</b>	7.92 <b>87.71</b>	11.13 <b>122.38</b>	9.53 <b>105.16</b>	14.27 <b>155.80</b>	12.70 <b>139.15</b>		23.38 <b>254.55</b>	
20	508.0	4.78 <b>60.46</b>	5.54 <b>70.00</b>		6.35 <b>78.55</b>	9.35 <b>117.15</b>	12.70 <b>155.12</b>	9.53 <b>117.15</b>	15.09 <b>183.42</b>	12.70 <b>155.12</b>		25.19 <b>311.17</b>	
22	559.0	4.78 <b>66.57</b>	5.54 <b>77.06</b>		6.35 <b>86.54</b>	9.35 <b>129.13</b>	12.70 <b>171.09</b>	9.53 <b>129.13</b>		12.70 <b>171.09</b>		28.58 <b>373.83</b>	
24	610.0	5.54 <b>84.16</b>	6.35 <b>96.37</b>		6.35 <b>94.53</b>	9.35 <b>141.12</b>	14.27 <b>209.64</b>	9.53 <b>141.12</b>	17.48 <b>255.41</b>	12.70 <b>187.06</b>		30.96 <b>442.08</b>	

Schedule

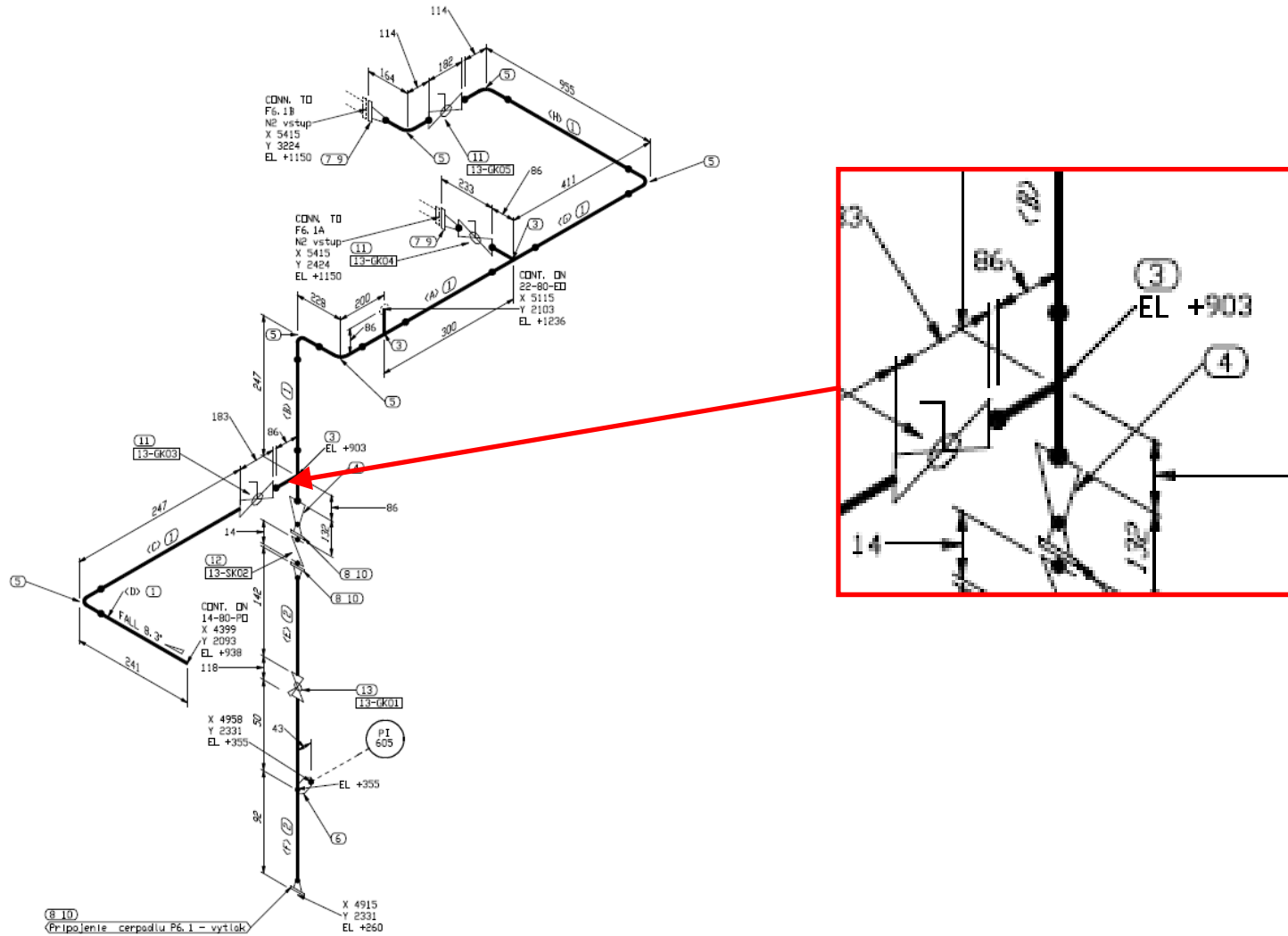
Rozsah. Platí aj pre ostatné potrubné komponenty : T-kus, koleno ... Atd'. )

STD- standard

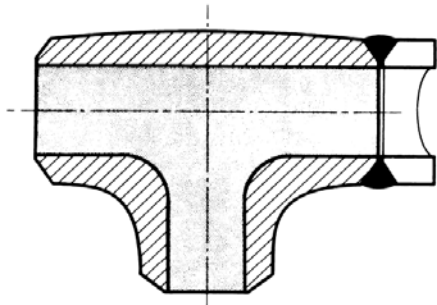
XS- extra strong

XXS – extra extra strong

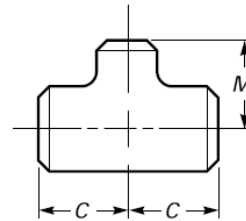
# Potrubný systém. T-kus, Kríž /Tee, Cross/



# Potrubný systém. T-kus, Kríž / Tee, Cross/



ASME B16.9-2001



FACTORY-MADE WROUGHT BUTTWELDING FITTINGS

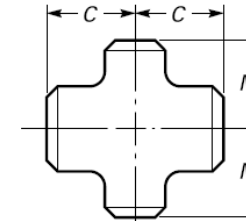
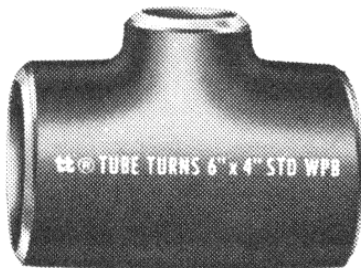
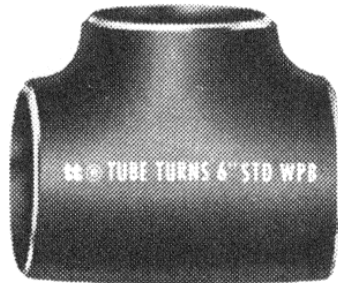
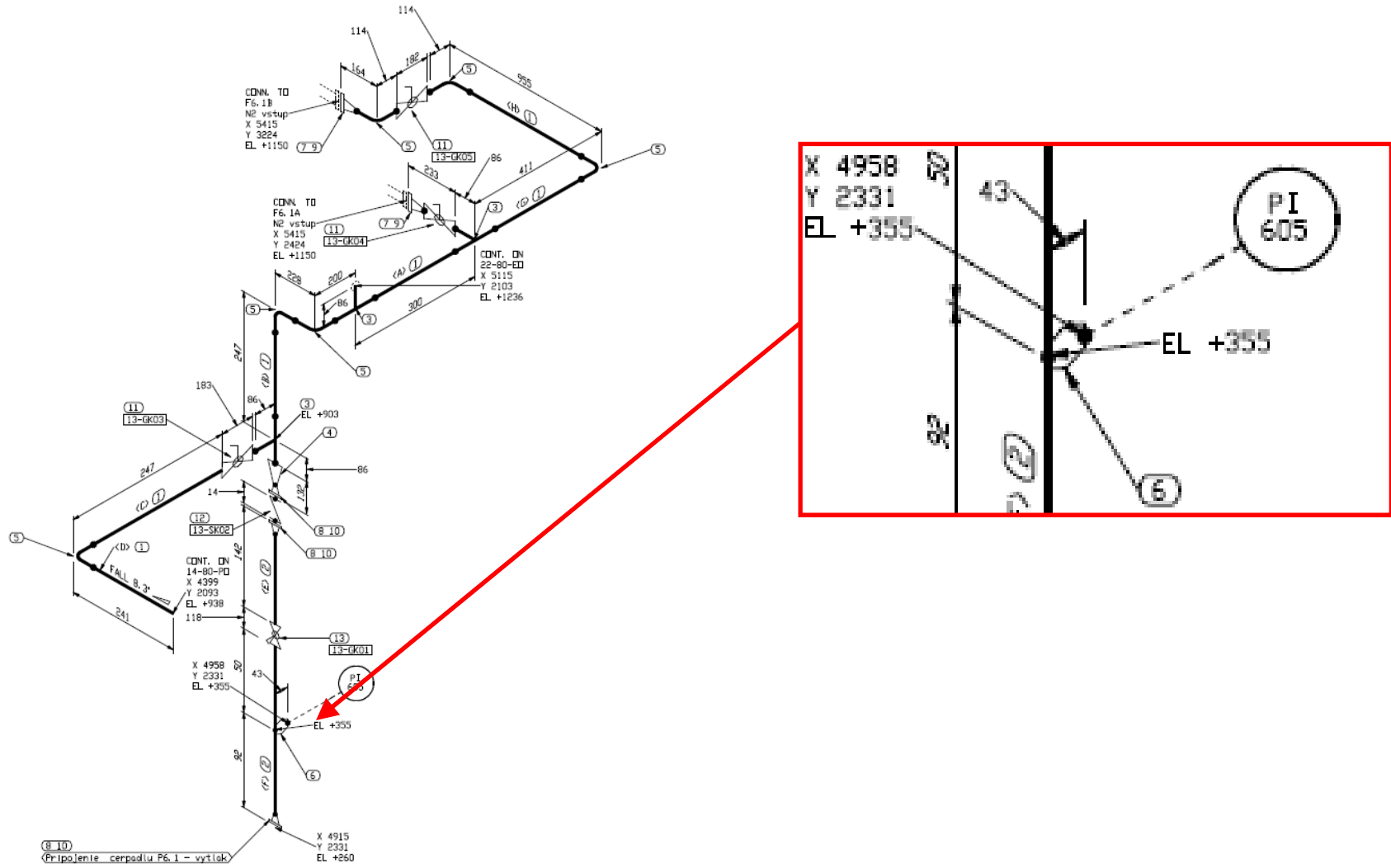


TABLE 9 DIMENSIONS OF REDUCING OUTLET TEES AND REDUCING OUTLET CROSSES

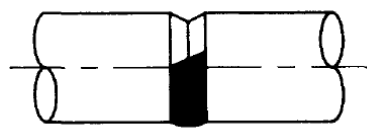


Nominal Pipe Size (NPS)	DN	Outside Diameter at Bevel		Center-to-End	
		Run	Outlet	Run, C	Outlet, M [Note (1)]
$\frac{1}{2} \times \frac{1}{2} \times \frac{3}{8}$	15 x 15 x 10	21.3	17.3	25	25
$\frac{1}{2} \times \frac{1}{2} \times \frac{1}{4}$	15 x 15 x 8	21.3	13.7	25	25
$\frac{3}{4} \times \frac{3}{4} \times \frac{1}{2}$	20 x 20 x 15	26.7	21.3	29	29
$\frac{3}{4} \times \frac{3}{4} \times \frac{3}{8}$	20 x 20 x 10	26.7	17.3	29	29
$1 \times 1 \times \frac{3}{4}$	25 x 25 x 20	33.4	26.7	38	38
$1 \times 1 \times \frac{1}{2}$	25 x 25 x 15	33.4	21.3	38	38
$1\frac{1}{4} \times 1\frac{1}{4} \times 1$	32 x 32 x 25	42.2	33.4	48	48
$1\frac{1}{4} \times 1\frac{1}{4} \times \frac{3}{4}$	32 x 32 x 20	42.2	26.7	48	48
$1\frac{1}{4} \times 1\frac{1}{4} \times \frac{1}{2}$	32 x 32 x 15	42.2	21.3	48	48
$1\frac{1}{2} \times 1\frac{1}{2} \times 1\frac{1}{4}$	40 x 40 x 32	48.3	42.2	57	57
$1\frac{1}{2} \times 1\frac{1}{2} \times 1$	40 x 40 x 25	48.3	33.4	57	57
$1\frac{1}{2} \times 1\frac{1}{2} \times \frac{3}{4}$	40 x 40 x 20	48.3	26.7	57	57
$1\frac{1}{2} \times 1\frac{1}{2} \times \frac{1}{2}$	40 x 40 x 15	48.3	21.3	57	57
$2 \times 2 \times 1\frac{1}{2}$	50 x 50 x 40	60.3	48.3	64	60
$2 \times 2 \times 1\frac{1}{4}$	50 x 50 x 32	60.3	42.2	64	57
$2 \times 2 \times 1$	50 x 50 x 25	60.3	33.4	64	51
$2 \times 2 \times \frac{3}{4}$	50 x 50 x 20	60.3	26.7	64	44

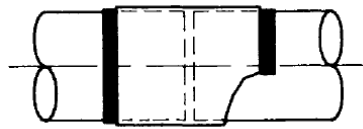
# Potrubný systém. Odbočky /Outlet, Olet/



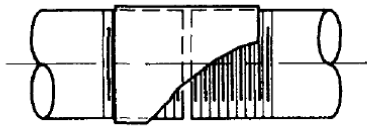
# Potrubný systém. Odbočky /Outlet, Olet/



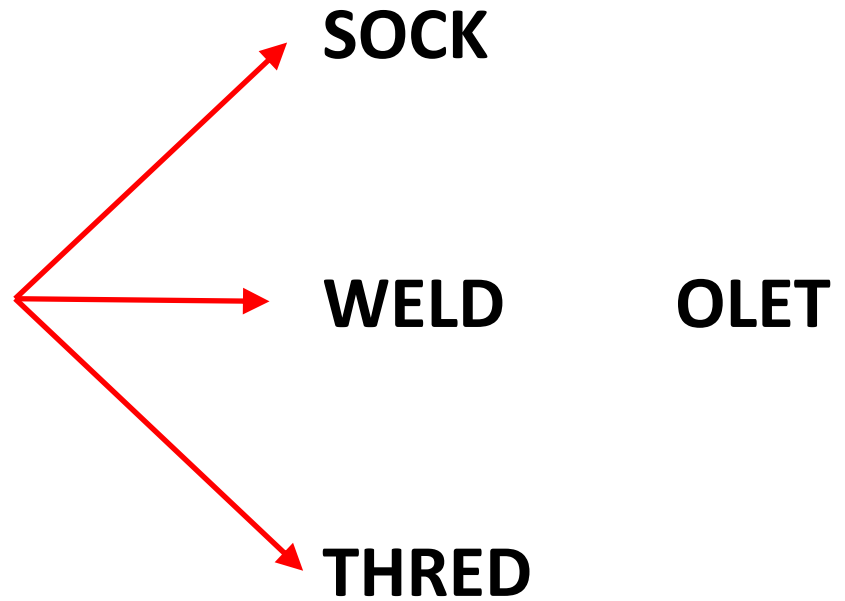
BUTT WELDED



SOCKET WELDED

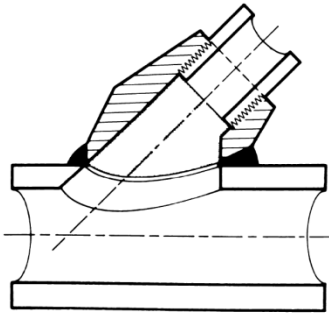


SCREWED

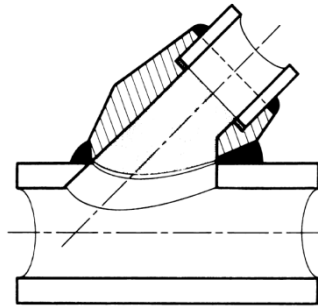


# Potrubný systém. Odbočky /Outlet, Olet/

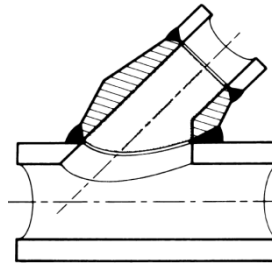
THREAD



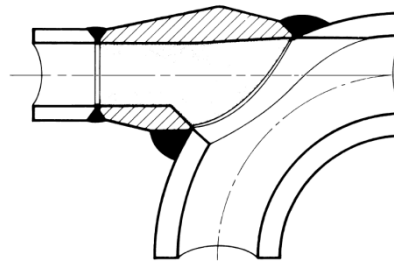
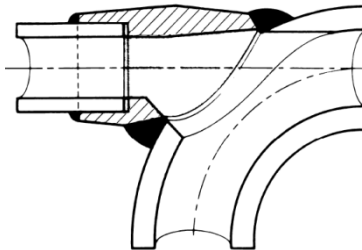
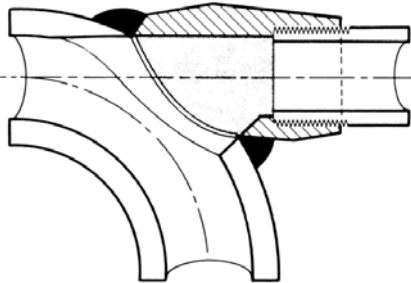
SOCKET



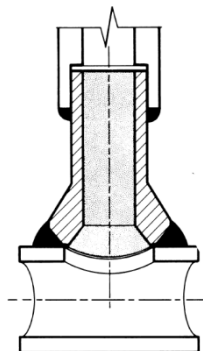
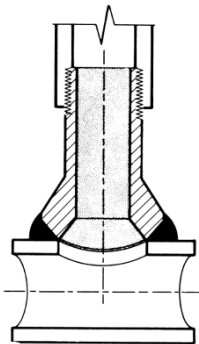
WELD



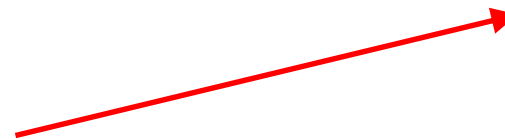
LATROLET



ELBOLET

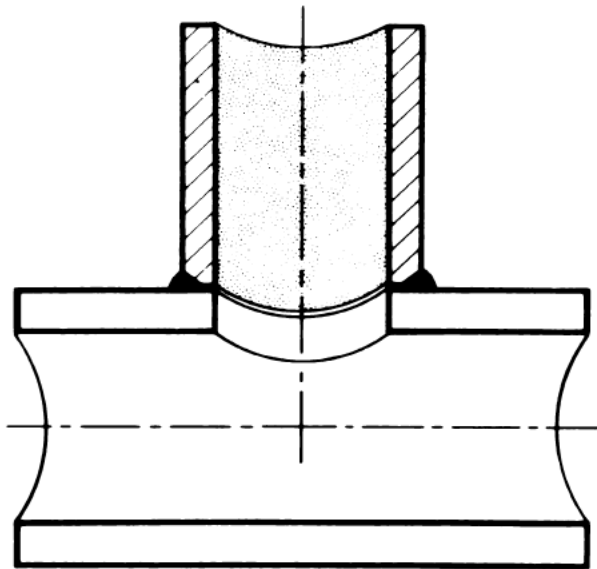


NIPOLET

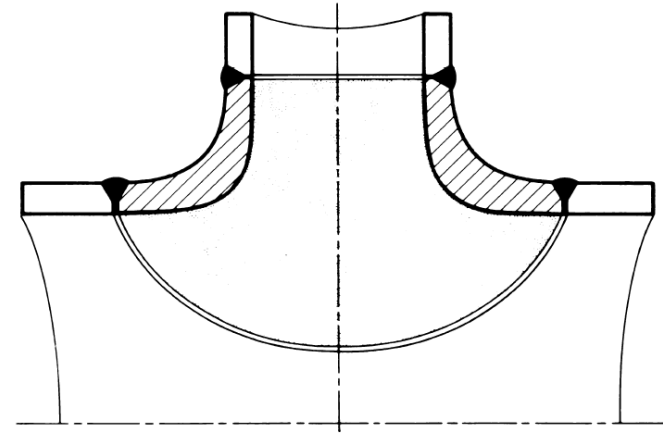




## Potrubný systém. Odbočky /Outlet, Olet/



STUB-IN



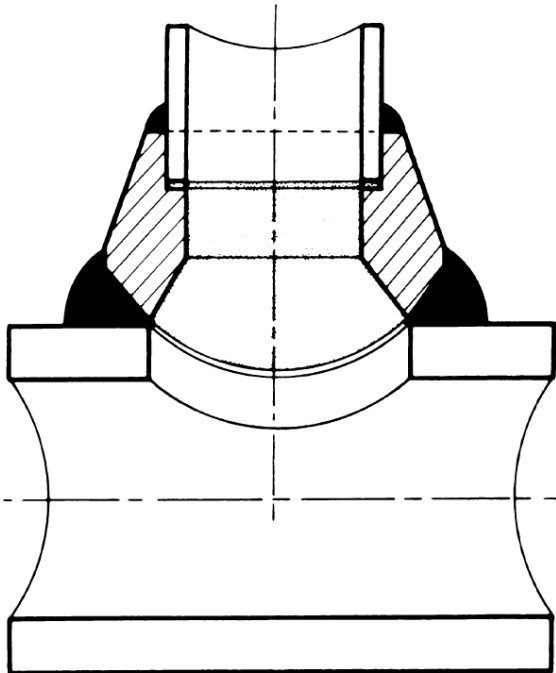
SWEEPOLET



WELDOLET

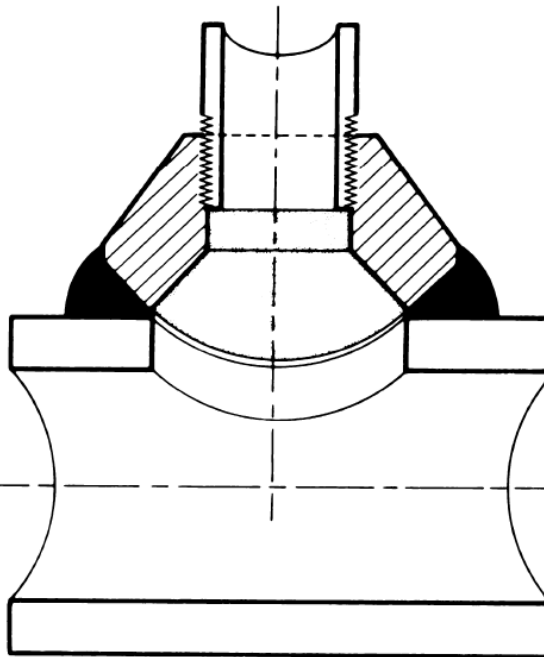
## Potrubný systém. Odbočky /Outlet, Olet/

THREAD



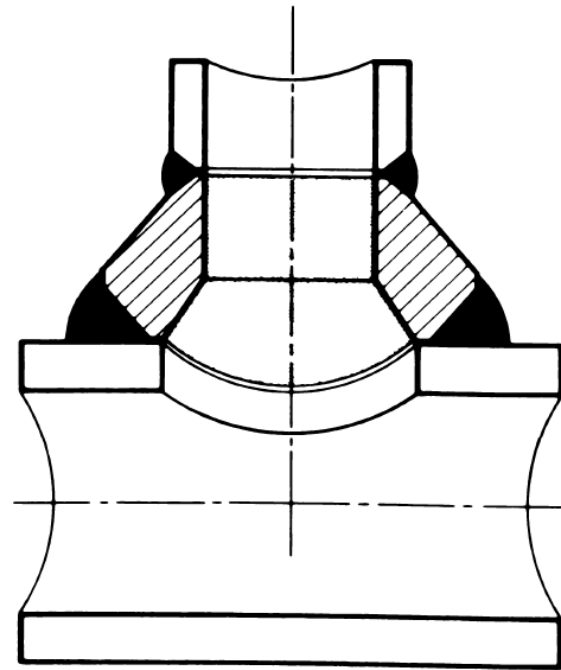
THREADOLET

SOCKET



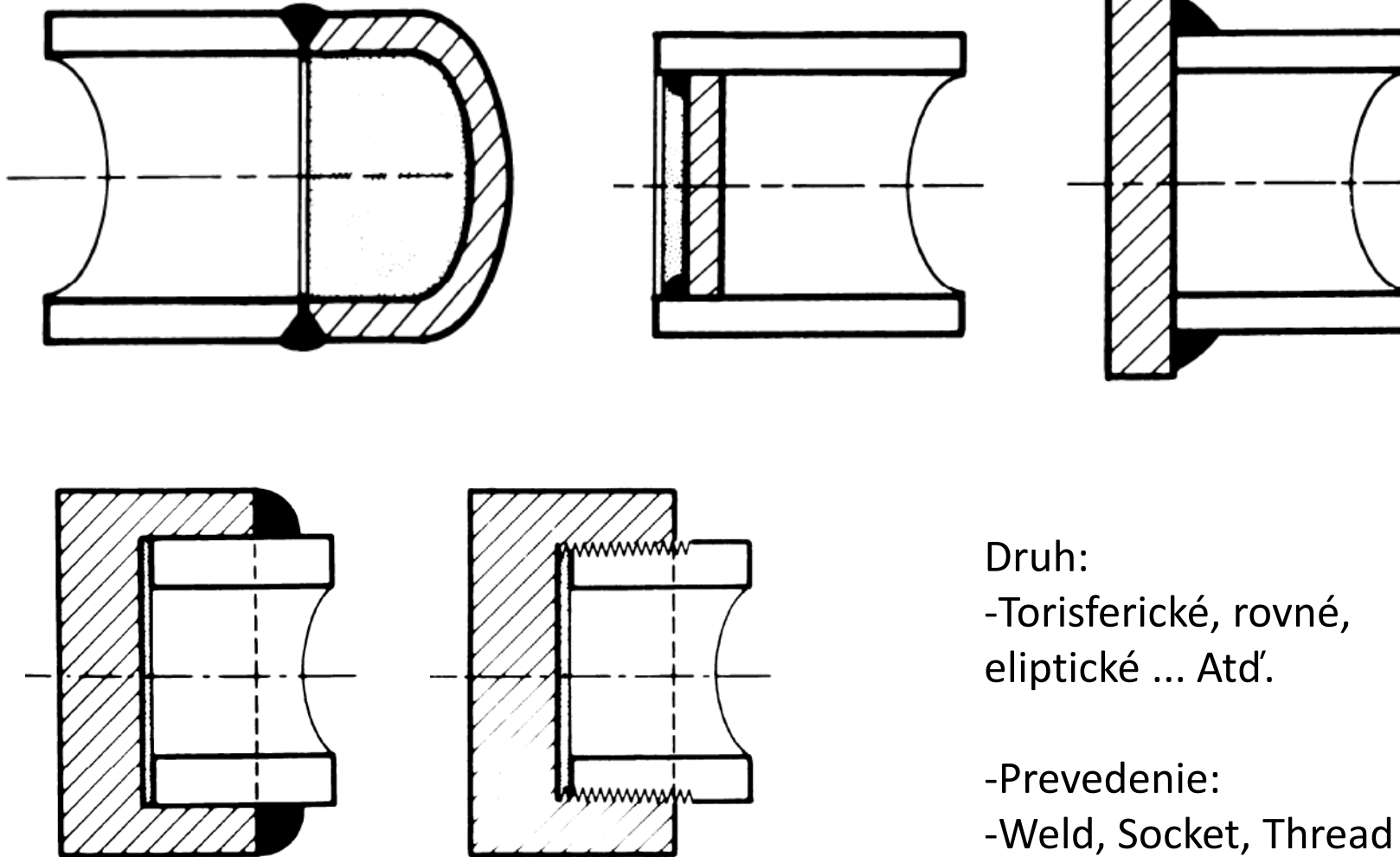
SOCKOLET

WELD



WELDOLET

## Potrubný systém. Uzáver /Cap/



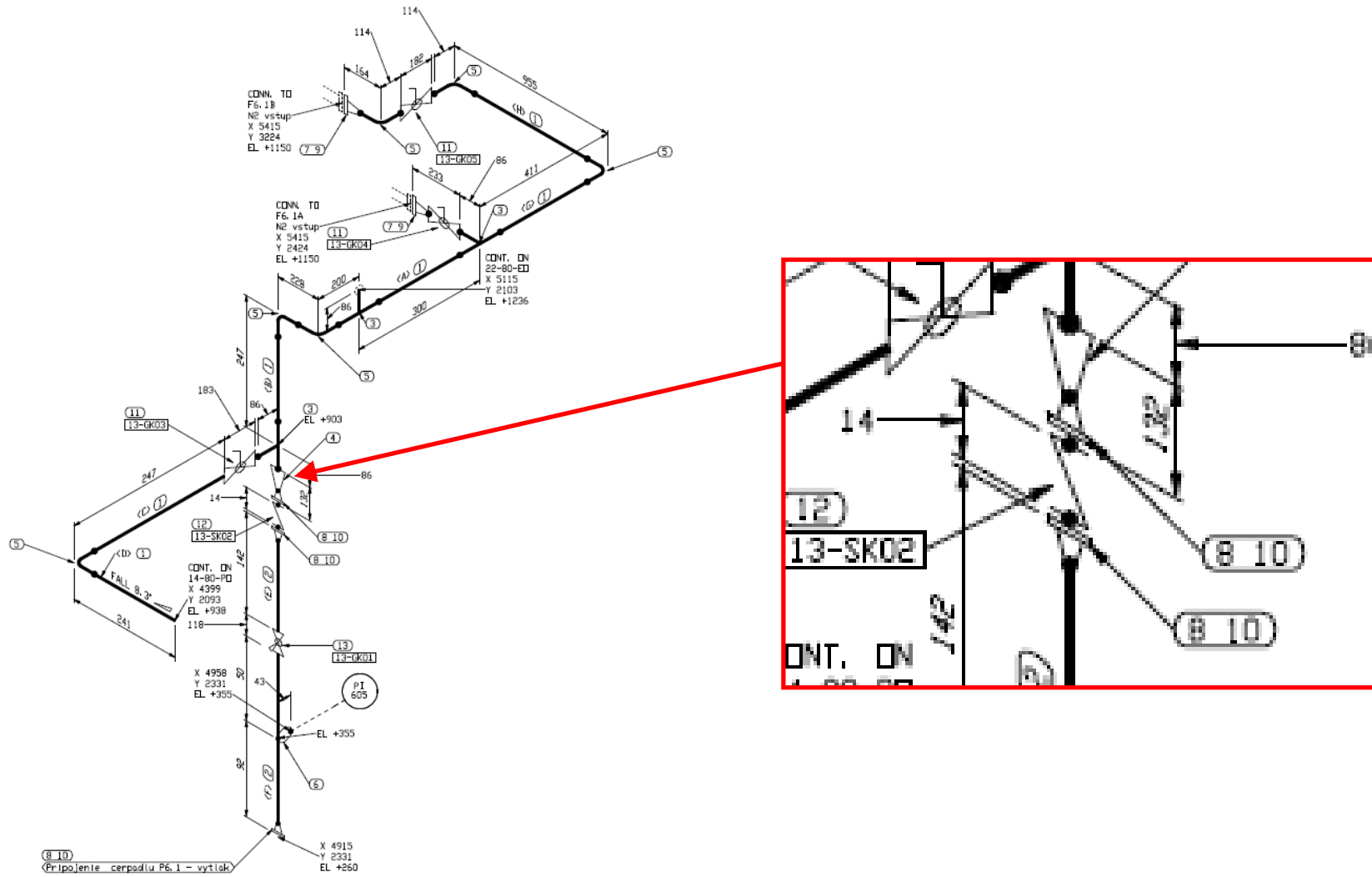
Druh:

-Torisferické, rovné,  
eliptické ... Atd'.

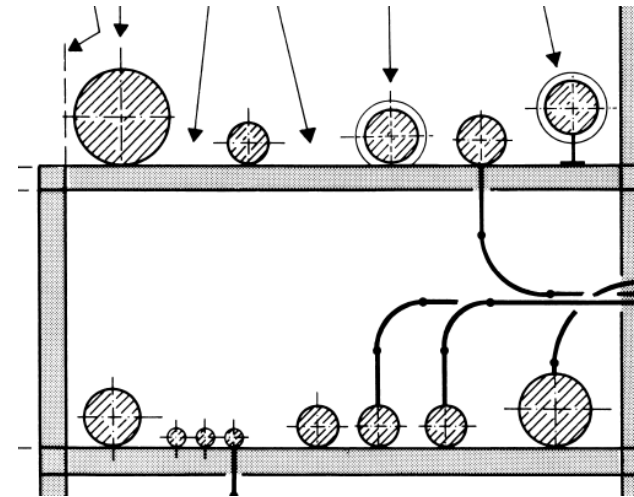
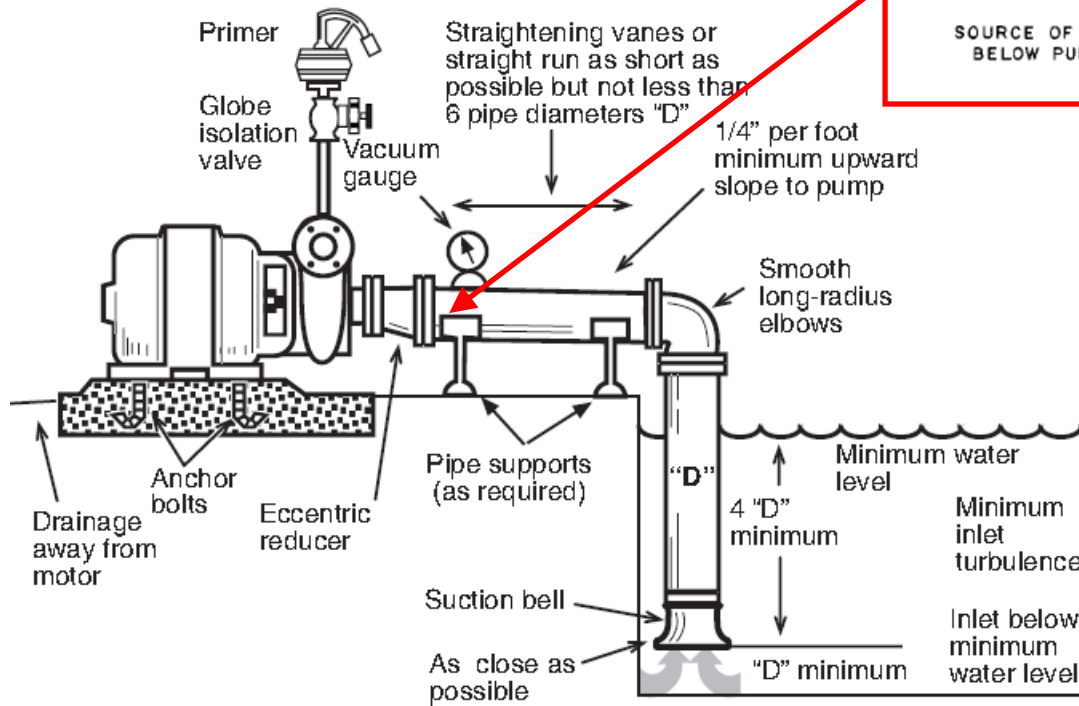
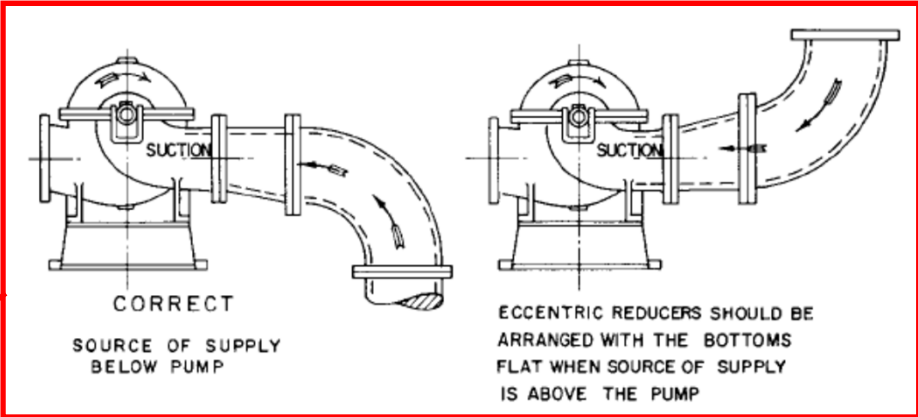
-Prevedenie:

-Weld, Socket, Thread

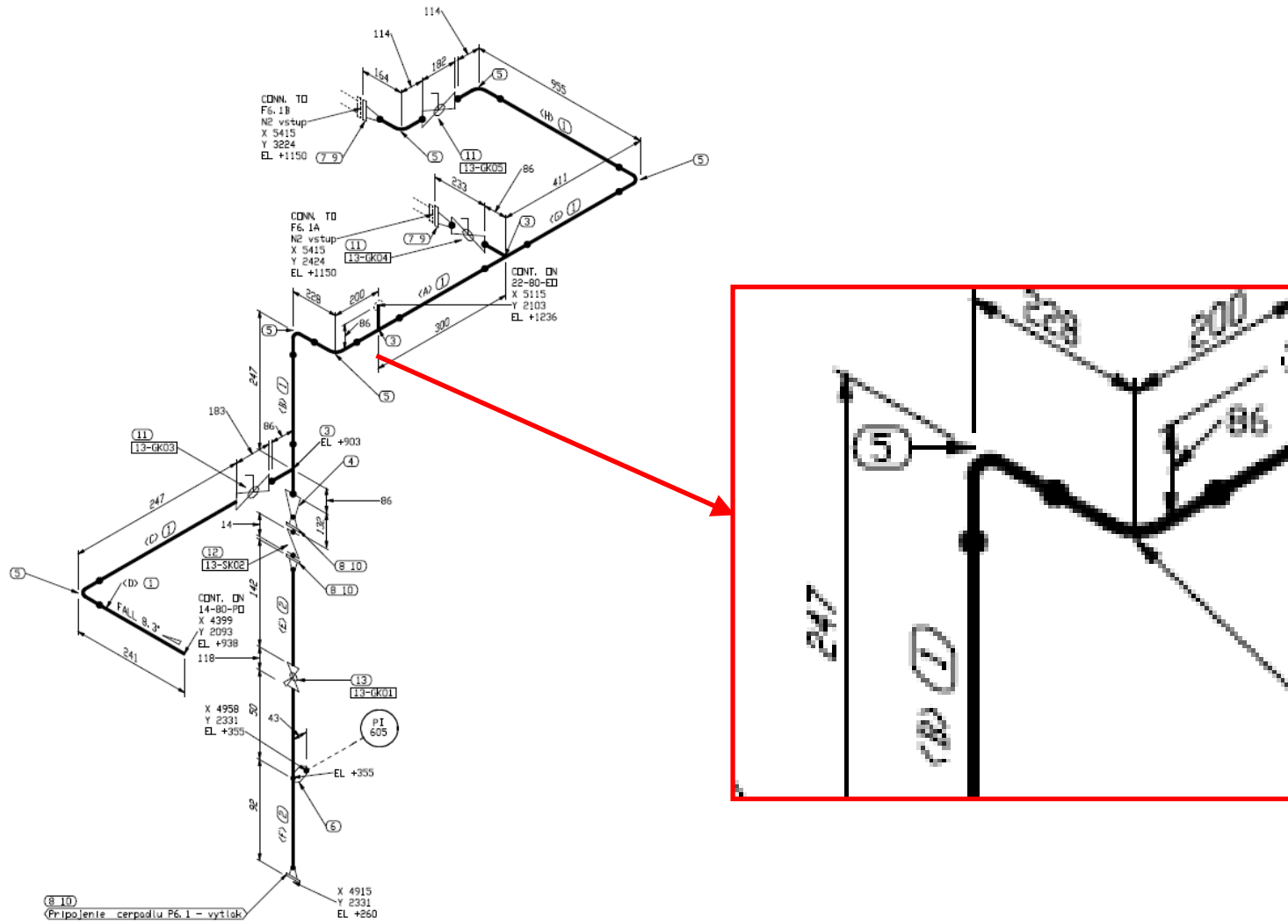
# Potrubný systém. Reducia /Reducer CON, ECC/



# Potrubný systém. Reducia /Reducer CON, ECC/

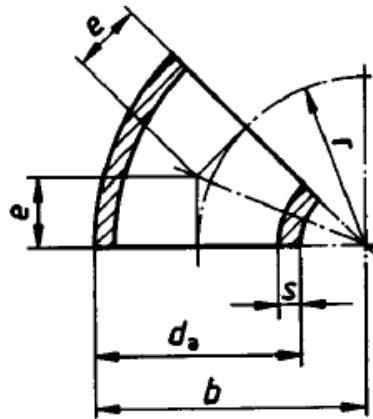


# Potrubný systém. Koleno /Elbow, R=1D, R=1,5D/

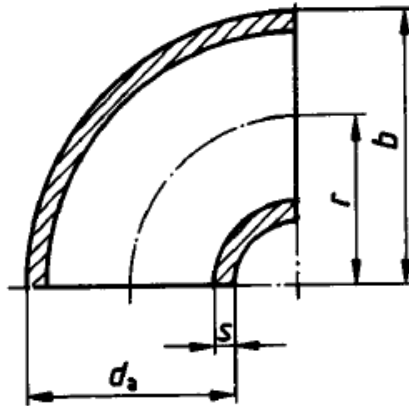


# Potrubný systém. Koleno /Elbow, R=1D, R=1,5D/

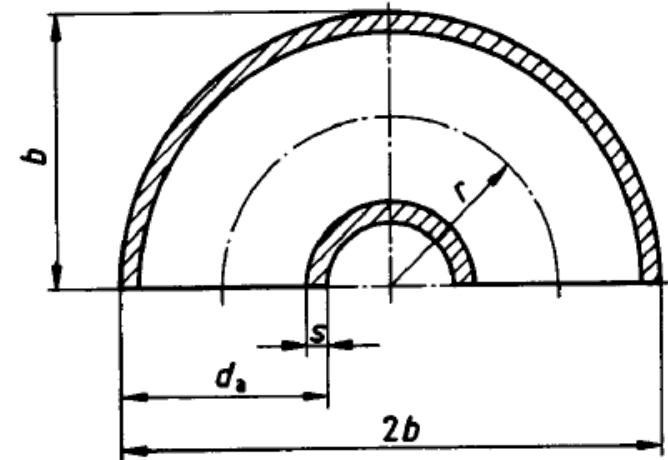
45° elbow



90° elbow



180° bend

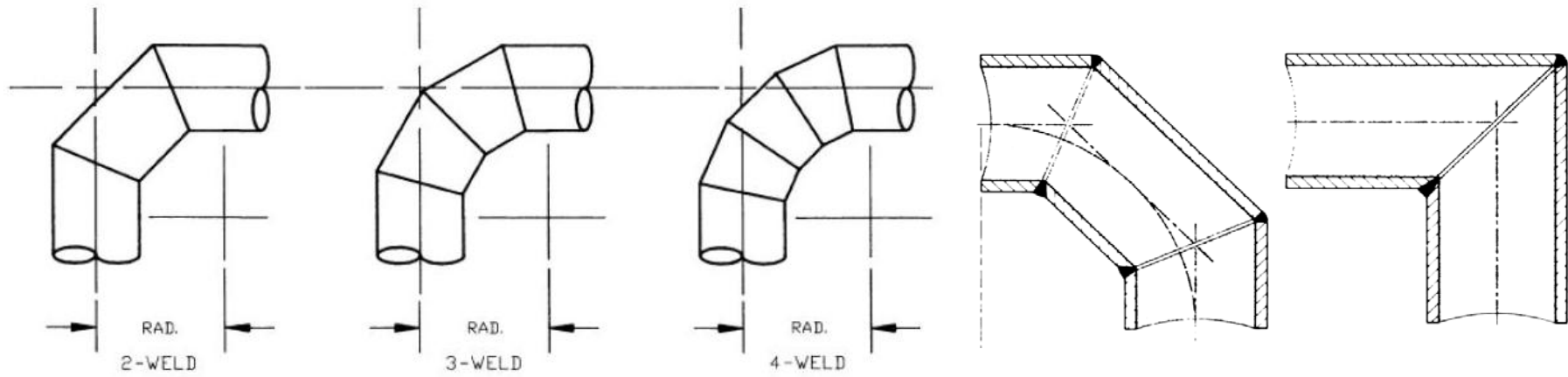


- $r$  is to be calculated as follows:
- type 2:  $r \approx 1,0 \cdot d_a$
  - type 3:  $r \approx 1,5 \cdot d_a$
  - type 5:  $r \approx 2,5 \cdot d_a$
  - type 10:  $r \approx 5,0 \cdot d_a$
  - type 20:  $r \approx 10,0 \cdot d_a$

Steel butt-welding pipe fittings  
 Elbows and bends with reduced pressure factor

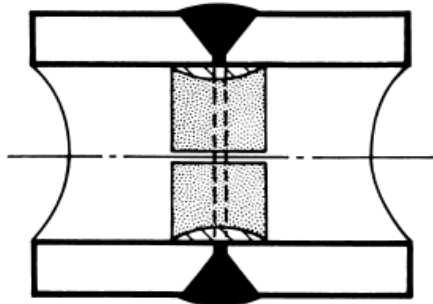
**DIN**  
**2605**  
 Part 1

# Potrubný systém. Seg. Koleno /Mitter Elbow/

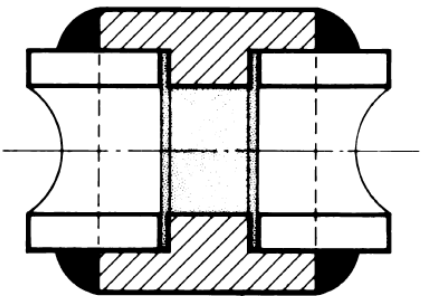




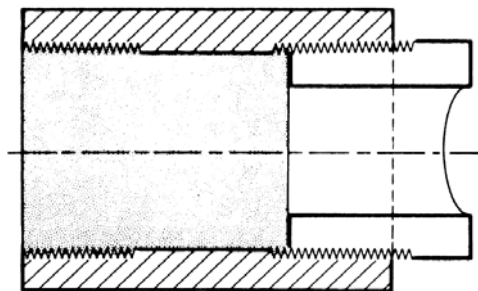
## Potrubný systém. Spojky, /Coupling, Connector/



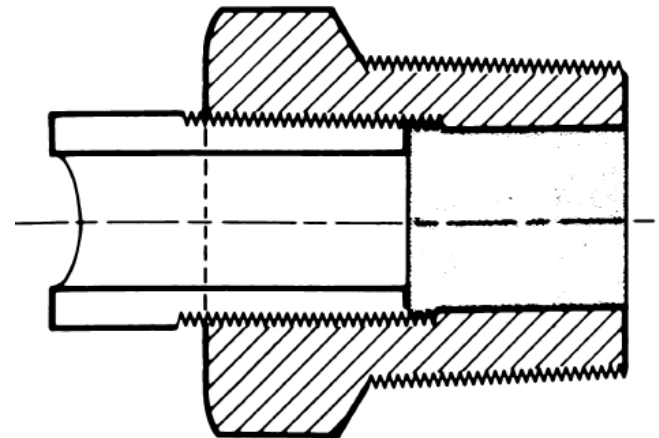
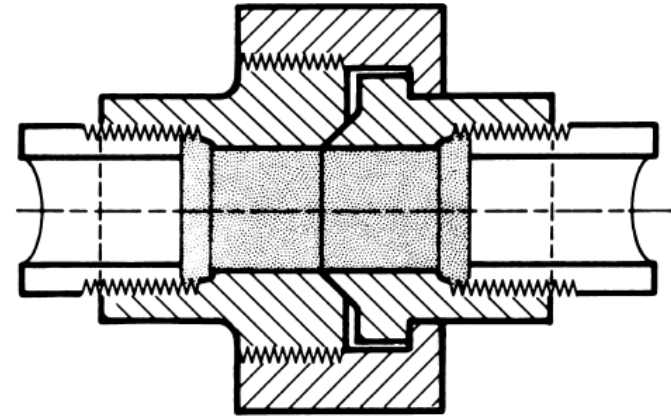
Butt-Welded  
Piping BW



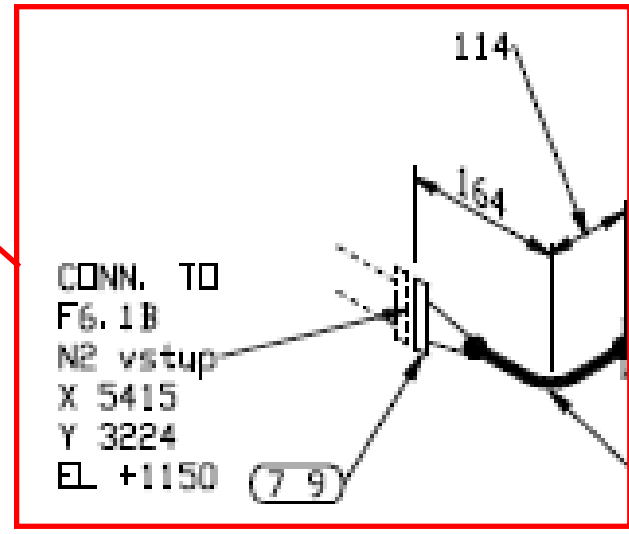
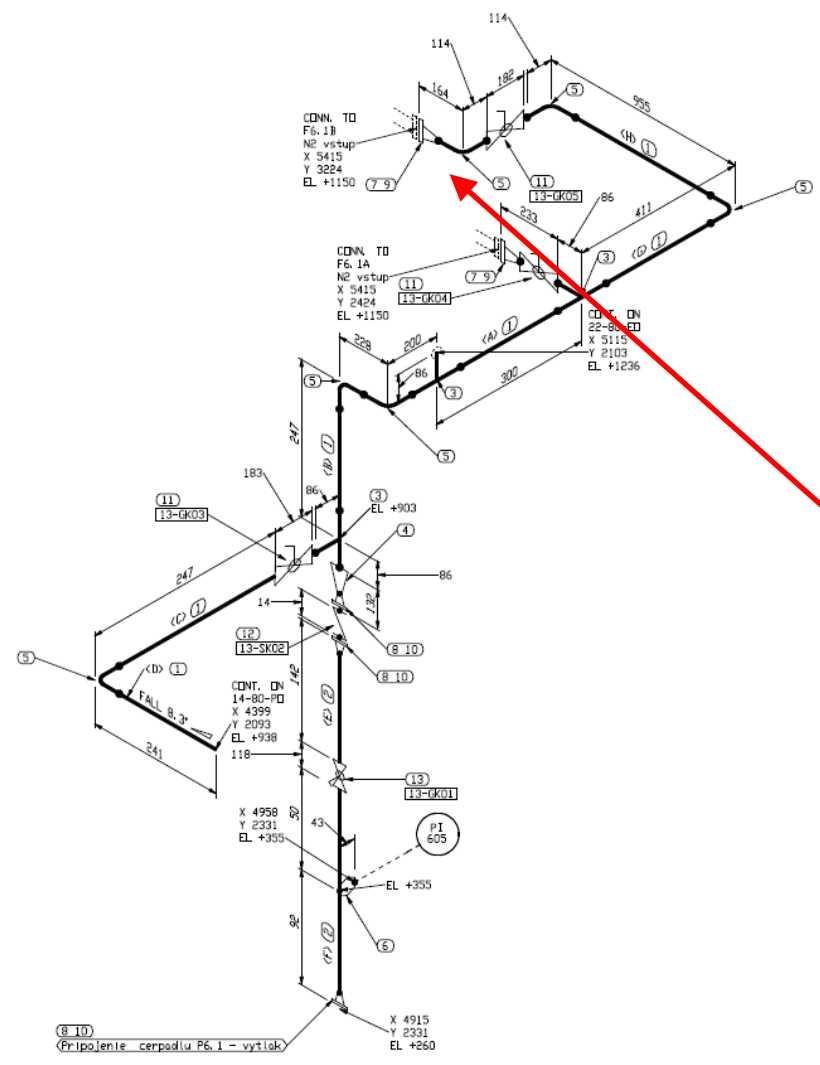
Socket-Welded  
Piping SW



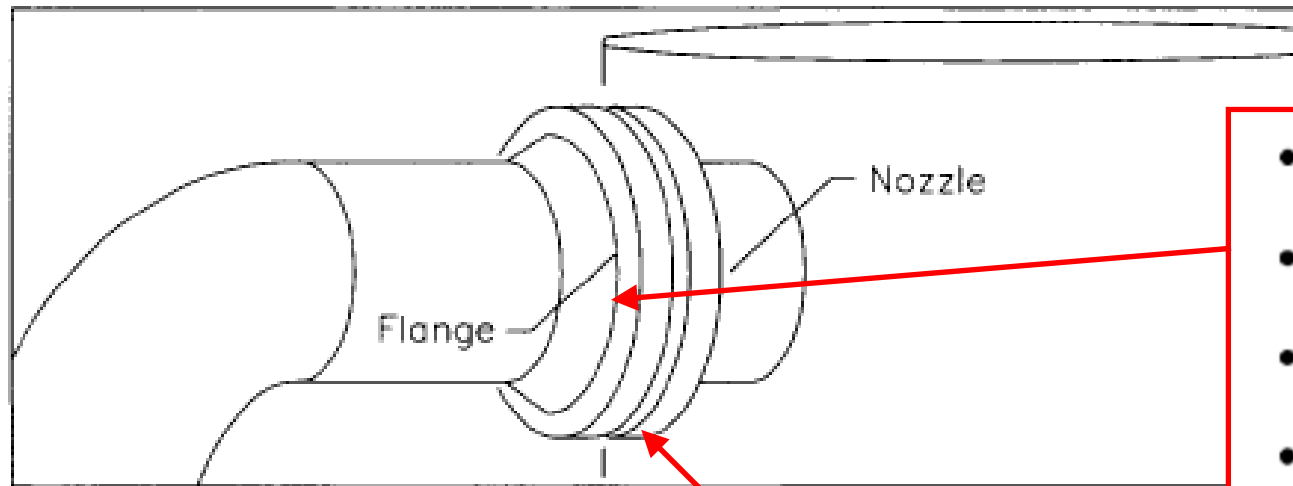
Screwed Piping S  
( THD Thread )



# Potrubný systém. Príruba /Flange/



## Potrubný systém. Príruba /Flange/

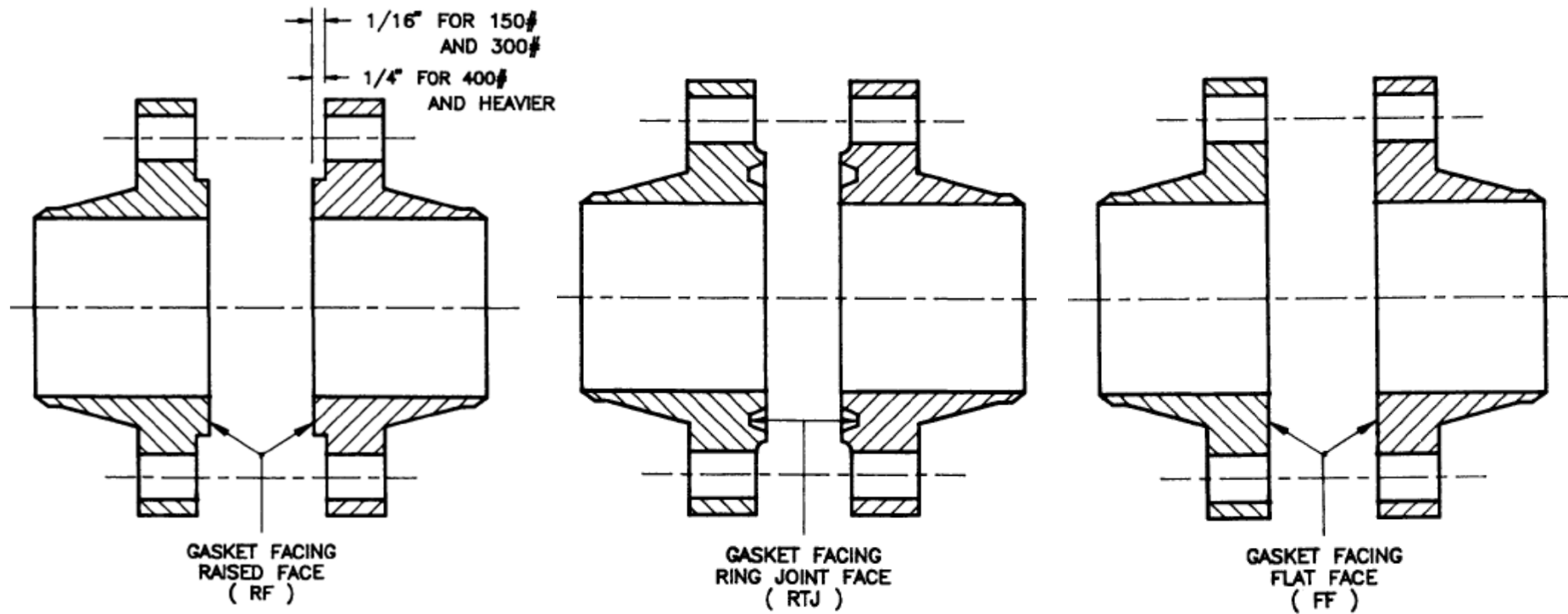


- Typ
- Rozmer
- Rating
- Tesniaca plocha

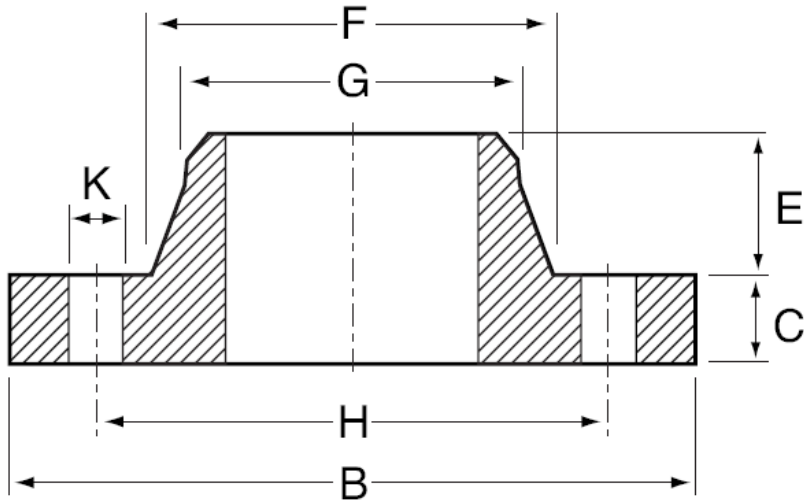
- flat face
- raised face
- ring-type joint

- weld neck
- threaded
- socket weld
- slip-on
- lap-joint
- reducing
- blind
- orifice

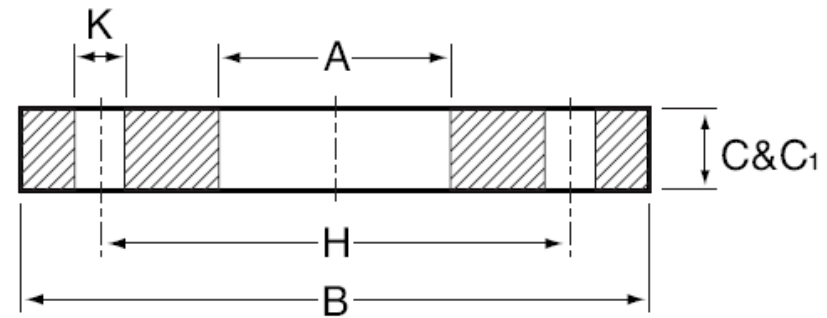
# Potrubný systém. Príruba /Flange/



## Potrubný systém. Príruba /Flange/



**WELDING NECK**

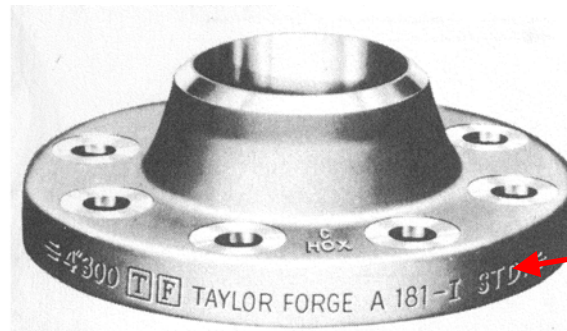
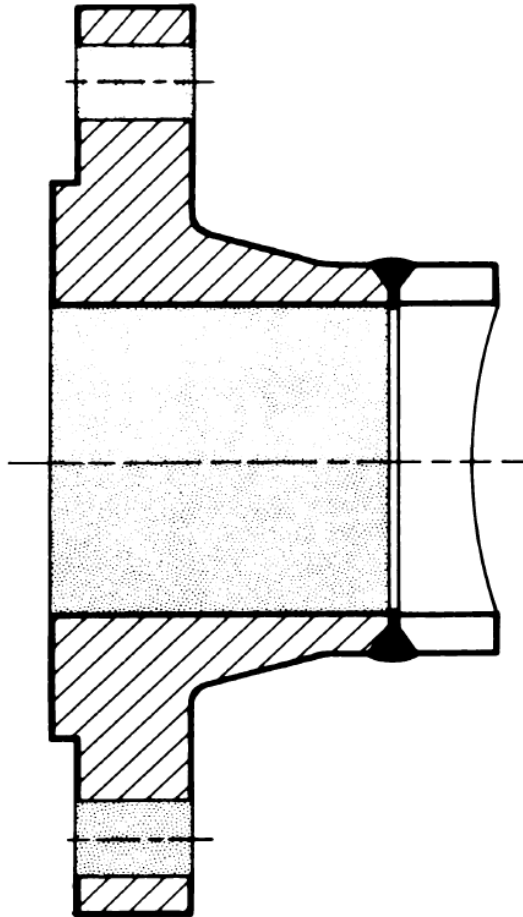


**PLATE SLIP-ON WELDING**

Hlavné rozmery:

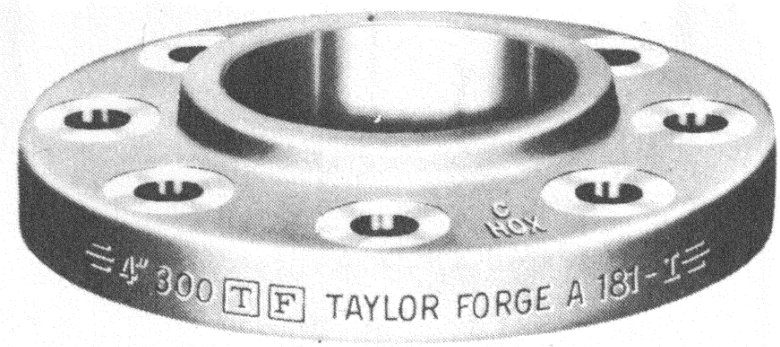
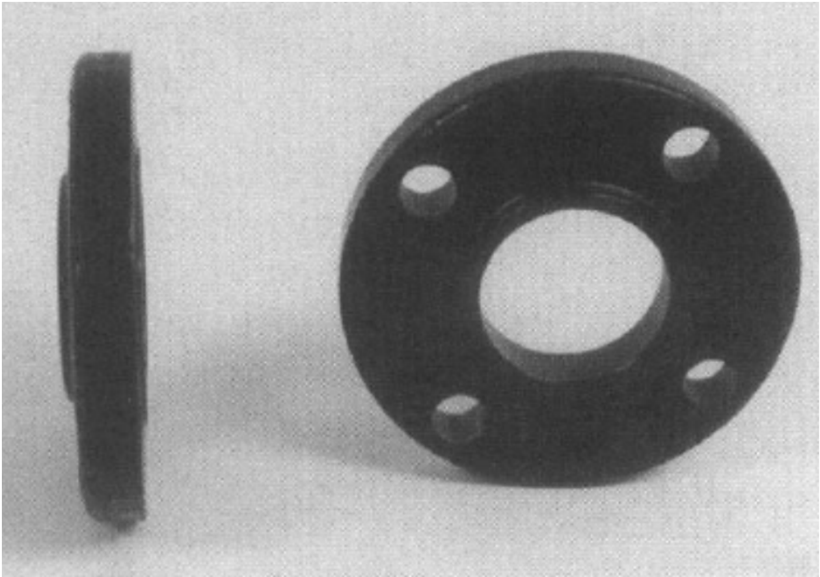
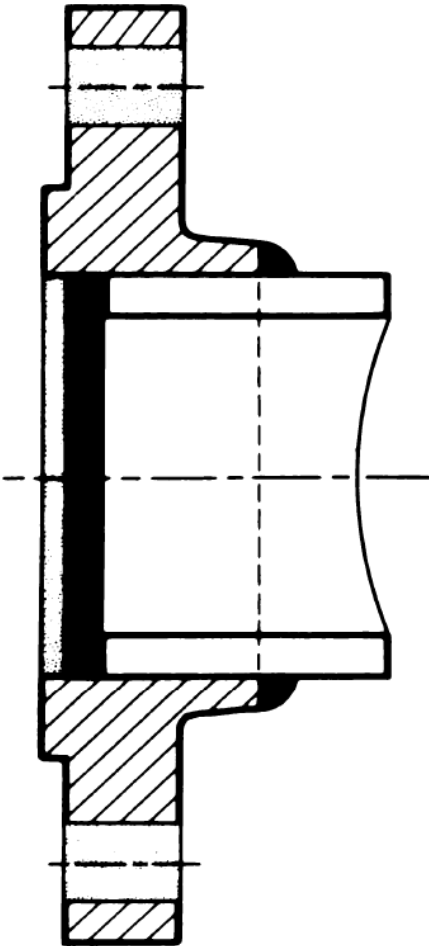
- Rozstupová kružnica
- Počet a priemer pre skrutky
- Pripojovací rozmer

## Potrubný systém. Krková príruha /Flange Welding Neck/

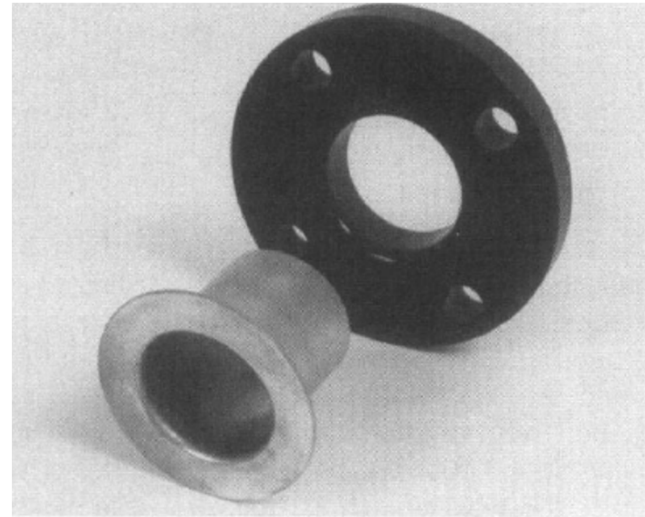
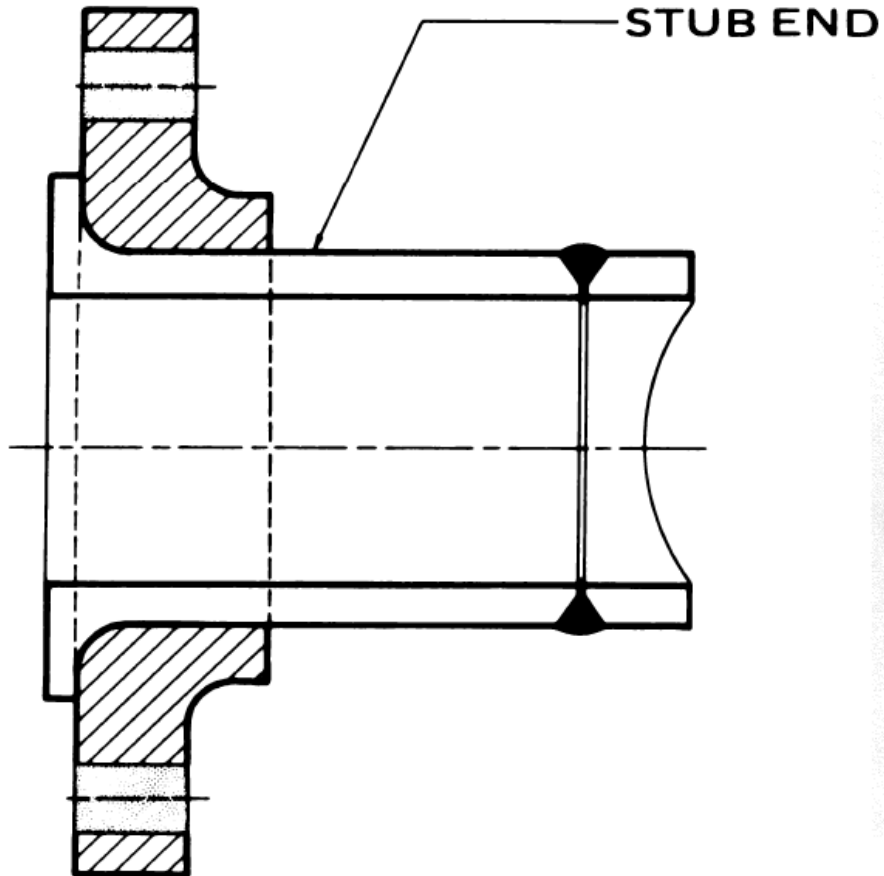


Identifikácia

# Potrubný systém. "Plochá" príruha /Slip-on flange/

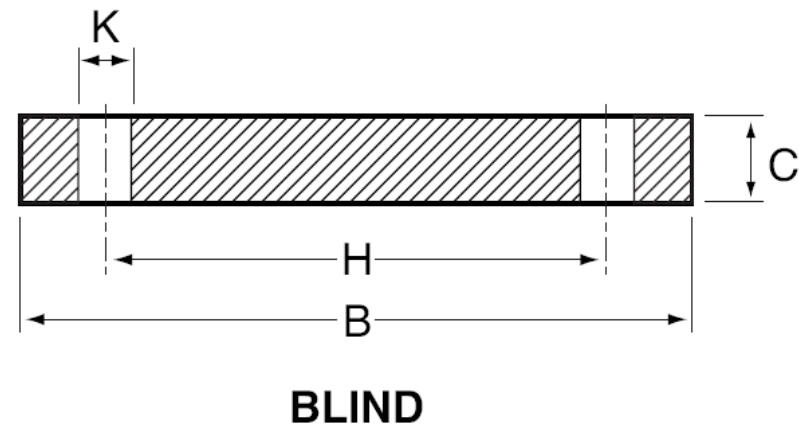
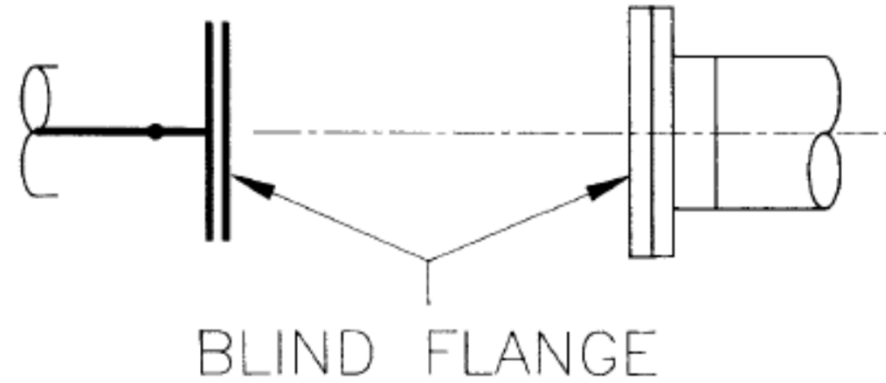


# Potrubný systém. Otočná príruha /Lap-joint flange/

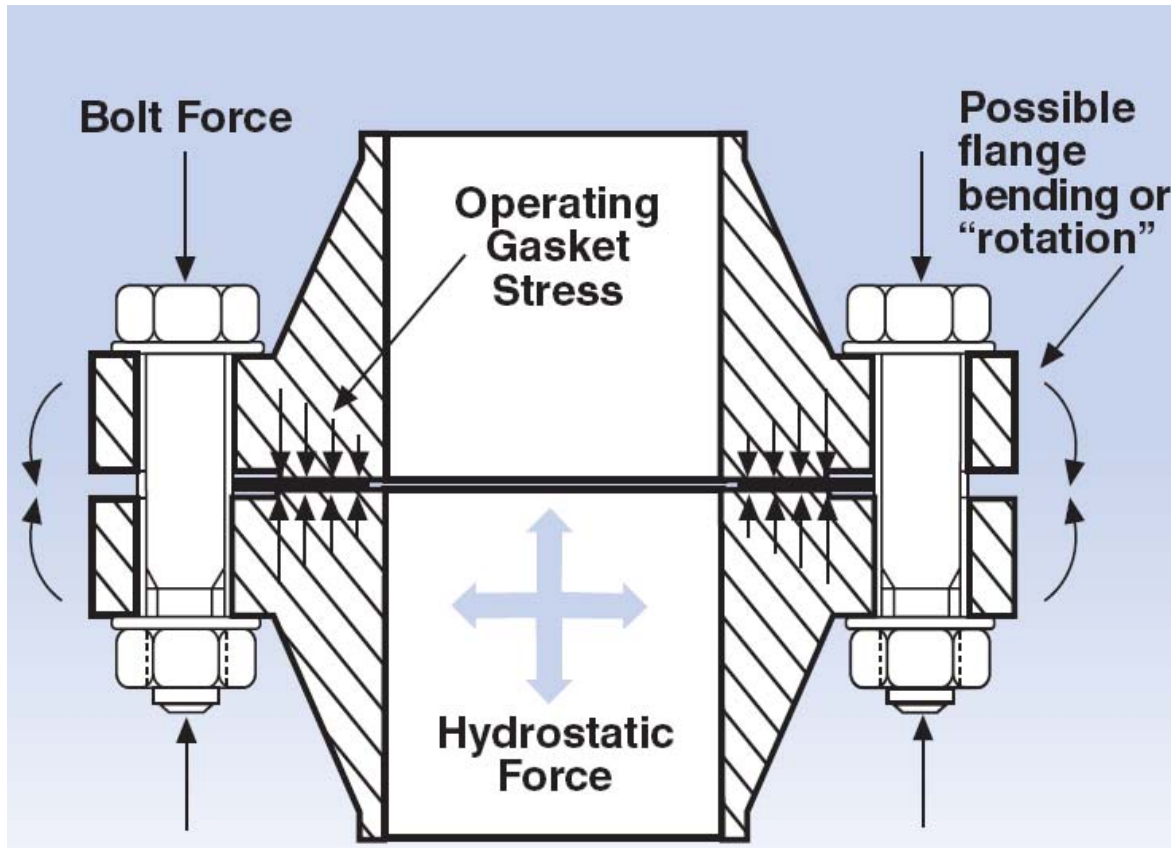




# Potrubný systém. Zaslepovacia príruha /Blind flange/



## Potrubný systém. Tesnenie, /Gasket /

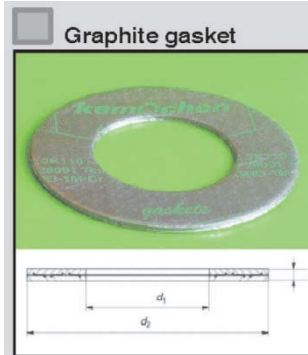
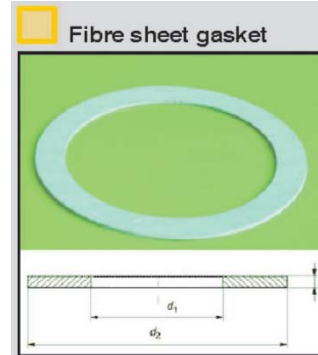
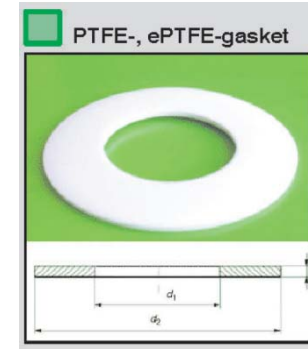
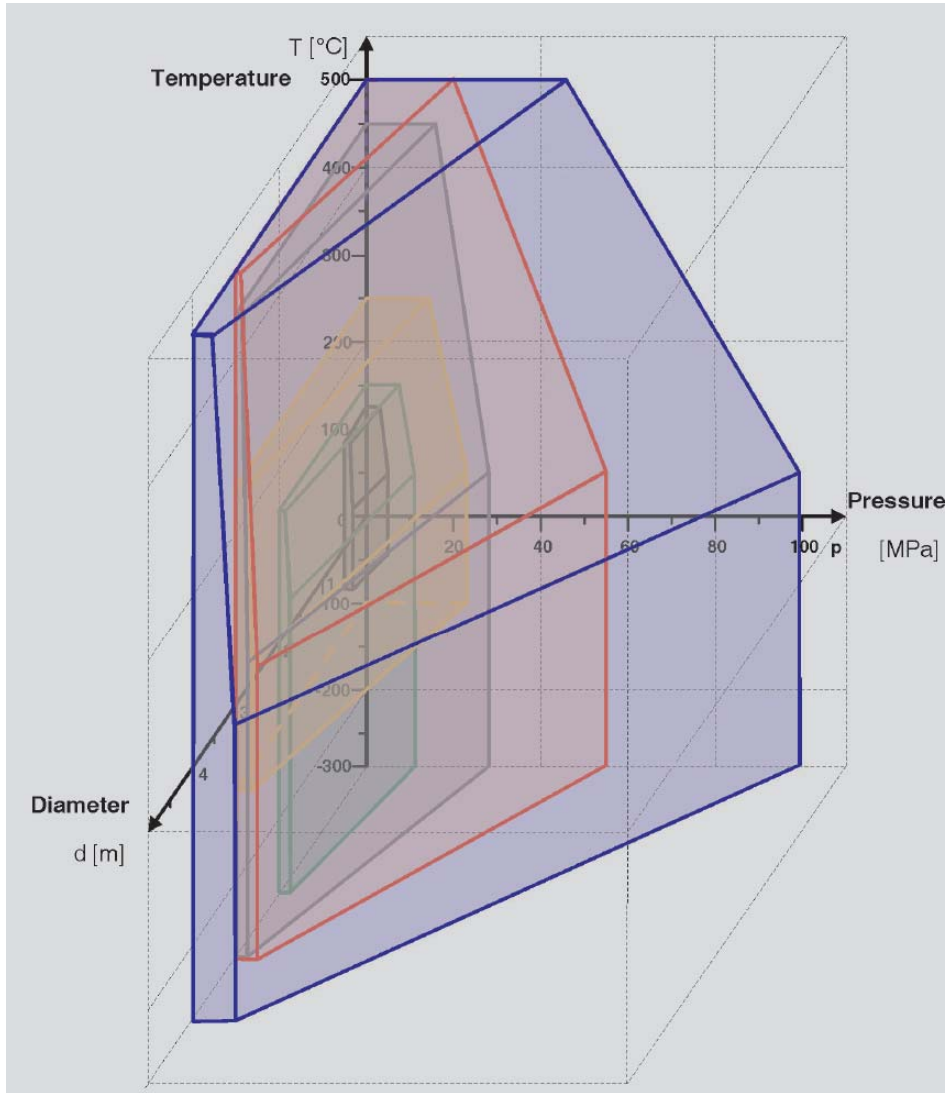


Tesnenie je komponent zabezpečujúci tesnosť dvoch plôch, pomocou uskladnenej energie medzi nimi.

Materiály pre tesnenia rozdeľujeme:

Nekovové /Non-metallic types/  
Semi kovové /Semi-metallic types/  
Kovové /Metallic types/

# Potrubný systém. Tesnenie, /Gasket /



# Potrubný systém. Skrutkový spoj /Bolt /

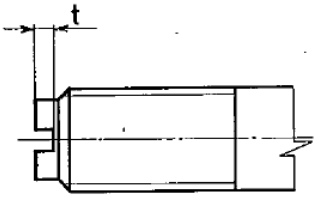
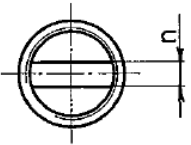
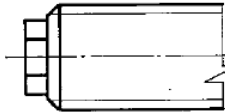
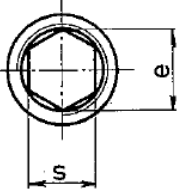
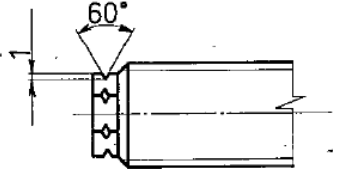
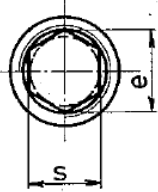

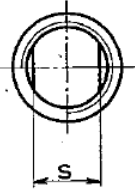
Sub-clause number	Mechanical and physical property	Property class											
		3.6	4.6	4.8	5.6	5.8	6.8	8.8 <sup>1)</sup>		9.8 <sup>2)</sup>	10.9	12.9	
								<i>d</i> ≤ 16mm <sup>3)</sup>	<i>d</i> > 16mm <sup>3)</sup>				
5.1 und 5.2	Tensile strength R <sub>m</sub> in N/mm <sup>2</sup> 4), 5)	nominal value	300	400		500		600	800	800	900	1000	1200
		min.	330	400	420	500	520	600	800	830	900	1040	1220
5.3	Vickers hardness HV F ≥ 98 N	min.	95	120	130	155	160	190	250	255	290	320	385
		max.	220 <sup>6)</sup>					250	320	335	360	380	435
5.4	Brinell hardness HB F = 30 D <sup>2</sup>	min.	90	114	124	147	152	181	238	242	276	304	366
		max.	209 <sup>6)</sup>					238	304	318	342	361	414
5.5	Rockwell hardness HR	min. HRB	52	67	71	79	82	89	—	—	—	—	—
		HRC	—	—	—	—	—	—	22	23	28	32	39
		HRB	95 <sup>6)</sup>					99,5	—	—	—	—	—
		max. HRC	—					—	32	34	37	39	44
5.6	Surface hardness HV 0,3	max.	—					7)					
5.7	lower yield stress R <sub>eL</sub> <sup>8)</sup> in N/mm <sup>2</sup>	nominal value	180	240	320	300	400	480	—	—	—	—	—
		min.	190	240	340	300	420	480	—	—	—	—	—
5.8	Stress at 0,2% non-proportional elongation R <sub>p0,2</sub> <sup>9)</sup> in N/mm <sup>2</sup>	nominal value	—					—	640	640	720	900	1080
		min.	—					—	640	660	720	940	1100
5.9	Stress under proofing load S <sub>p</sub>	S <sub>p</sub> / R <sub>eL</sub> or S <sub>p</sub> / R <sub>p0,2</sub>	0,94	0,94	0,91	0,93	0,9	0,92	0,91	0,91	0,9	0,88	0,88
		N/mm <sup>2</sup>	180	225	310	280	380	440	580	600	650	830	970
5.10	Breaking torque, M <sub>b</sub> Nm min.		—					see ISO 898-7					
5.11	Percent elongation after fracture A in %	min.	25	22	—	20	—	—	12	12	10	9	8
5.12	Reduction area after fracture Z	% min.	—					52		48	48	44	
5.13	Strength under wedge loading <sup>5)</sup>		The values for full size bolts and screws (not studs) shall not be smaller than the minimum values for tensile strength shown in 5.2										
5.14	Impact strength, KU in J	J min.	—		25	—		30	30	25	20	15	
5.15	Head soudness		no fracture										
5.16	Minimum height of non-decarburized thread zone, E		—					1/2 H <sub>t</sub>		2/3 H <sub>t</sub>	3/4 H <sub>t</sub>		
	Maximum depth of complete decarburization, G	mm	—					0,015					
5.17	Hardness after retempering		—					Reduction of hardness 20 HV max.					
5.18	Surface integrity		In accordance with ISO 6157-1 or ISO 6157-3 as appropriate										

Skrutkový spoj

Výber vhodného materiálu  
Mechanické vlastnosti

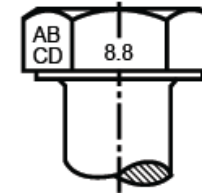
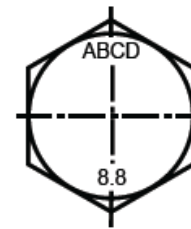
-Vysoké teploty  
-Nízke teploty  
-Korózne prostredie

# Potrubný systém. Skrutkový spoj /Bolt /

Materiál	Doplňková číslice za číslom normy	Tvar konce šroubu	
12 050.6 12 056.6	13 1520.1		
15 320.5	13 1520.2		
15 320.5 <sup>1)</sup>	13 1520.3		
17 248.4	13 1520.4		

Skrutkový spoj

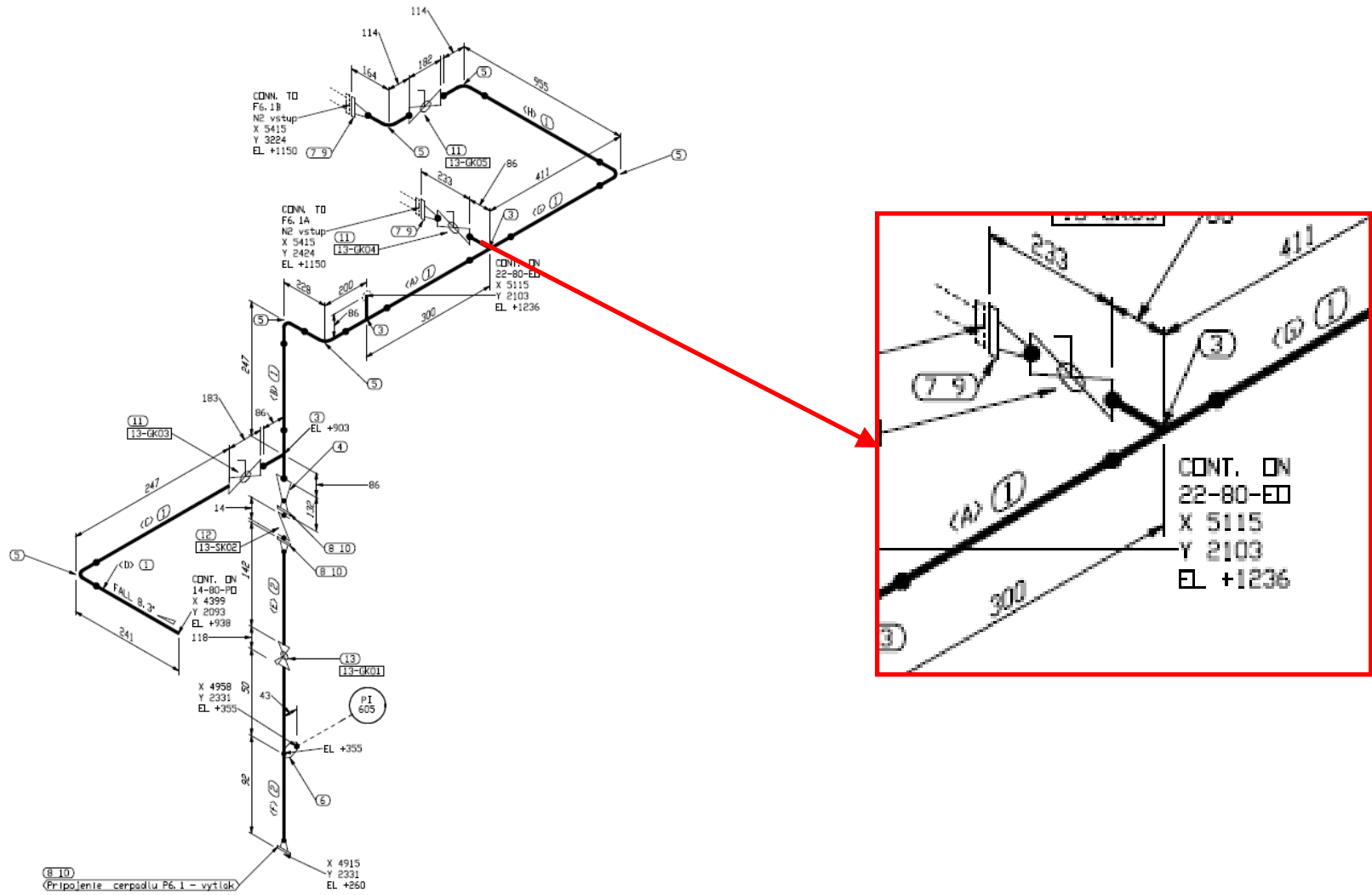
Identifikácia



Examples of marking on hexagon screws



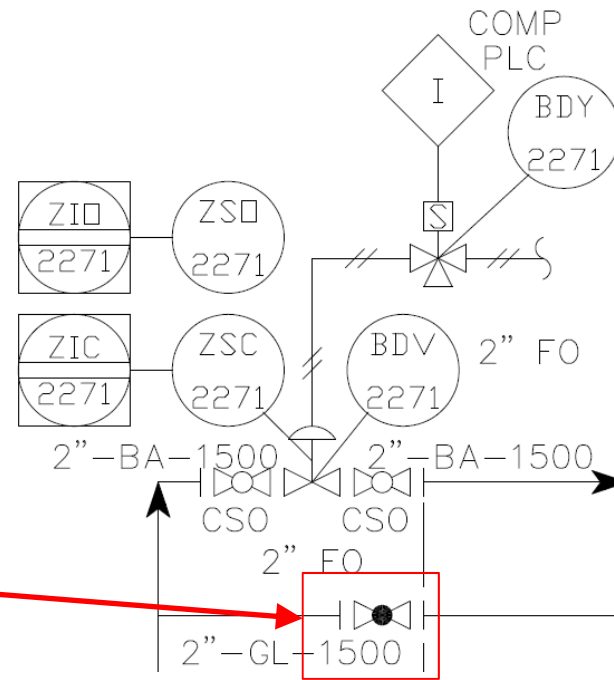
# Potrubný systém. Armatúry



## Potrubný systém. Armatúry

Čo ovplyvňuje správny výber armatúr ?

- funkcia
- materiálové prevedenie
- T/p
- bezpečnosť
- životnosť
- pripojenie
- prevádzkovanie
- hmotnosť
- údržba
- cena



Pre jednu pozíciu viacero alternatív  
Kompromis, nie cenový

# Potravný systém. Armatúry

Table 5: Loss coefficients  $\zeta$  for various types of valves and fittings (referred to the velocity of flow in the line connection nominal diameter DN)

Type of valve / fitting	Design	Loss coefficient $\zeta$ for DN =															Comment					
		15	20	25	32	40	50	65	80	100	125	150	200	250	300	400		500	600	800	1000	
Shut-off valves	Slide disc valves (d <sub>g</sub> = DN)	min	1	0.1	←																0.1	
		max		0.65	0.6	0.55	0.5	0.5	0.45	0.4	0.35	0.3	←									0.3
	Round-body gate valves (d <sub>g</sub> = DN)	min	2						0.25	0.24	0.23	0.22	0.21	0.19	0.18	0.17	0.16	0.15	0.13	0.12	0.11	0.11
		max							0.32	0.31	0.30	0.28	0.26	0.25	0.23	0.22	0.20	0.19	0.18	0.16	0.15	0.14
	Ball and plug valves (d <sub>g</sub> = DN)	min	3	0.10	0.10	0.09	0.09	0.08	0.08	0.07	0.07	0.06	0.05	0.05	0.04	0.03	0.03	0.02				
		max		0.15	←																	0.15
	Butterfly valves	PN 2.5 10	min	4					0.90	0.59	0.38	0.26	0.20	0.14	0.12	0.09	0.06	←				0.06
		max							1.20	1.00	0.80	0.70	0.62	0.56	0.50	0.42	0.40	0.37	0.33	0.33	0.33	0.30
	PN 16 25	min							2.04	1.80	1.55	1.30	1.08	0.84	0.75	0.56	0.48	0.40	←			0.40
		max							2.50*	2.30*	2.10*	1.90*	1.70*	1.50*	1.30	1.10	0.90	0.83	0.76	0.71	0.67*	0.63*
	Globe valves, forged	min	5			6.0	←		6.0	←												
		max				6.8	←		6.8	←												
	Globe valves, cast	min	6	3.0	←																	
		max		6.0	←																	3.0
	Compact valves	min	7	0.3	0.4	0.6	0.6	1.0	1.1	←												1.1
		max		0.3	0.9	1.9	←															6.0
	Angle valves	min	8	2.0	←																	2.0
		max		3.1	←																	6.6
	Y-valves	min	9	1.5	←																	1.5
max			2.6	←																	2.6	
Straight-through valves	min	10	0.6	←																	0.6	
	max		1.6	←																	1.6	
Diaphragm valves	min	11	0.8	←																	0.8	
	max		2.7	←																	2.7	
Non-return valves	Non-return valves, straight seat	min	12	3.0	←																3.0	
		max		6.0	←																6.0	
	Non-return valves, axial	min	13	3.2	←				3.2	3.7	5.0	7.3	4.3	←								4.3
		max		3.4	3.4	3.5	3.6	3.8	4.2	5.0	6.4	8.2	4.6	←								4.6
	Non-return valves, slanted seat	min	14	2.5	2.4	2.2	2.1	2.0	1.9	1.7	1.6	1.5	←									1.5
		max		3.0	←																	3.0
	Foot valves	min	15					1.0	0.9	0.8	0.7	0.6	0.5	0.4	0.4	0.4	0.4					0.4
		max						3.0	←													3.0
	Swing check valves	min	16	0.5	←			0.5	0.4	←												0.4
		max		3.0	←																	3.0
	Hydrostops	v = 4 m/s	17					0.9			3.0		3.0	2.5	2.5	1.2	2.2					
		v = 3 m/s						1.8		4.0		4.5	4.0	4.0	1.8	3.4						
v = 2 m/s							5.0		6.0		8.0	7.5	6.5	6.0	7.0							
Filters	18					2.8	←													2.8		
Strainers	19					1.0	←													1.0		

1) If the narrowest shut-off diameter d<sub>g</sub> is smaller than the line connection nominal diameter DN, the loss coefficient  $\zeta$  must be increased by (DN/d<sub>g</sub>)<sup>x</sup> with x = 5 to 6.  
2) When the valve is partially open, i.e. low flow velocities, the loss coefficients increase to the "max" values. With increasing flow velocities v (in m/s) the loss coefficients decrease roughly as  $\zeta \cdot 3/v$ .  
See Fig. 13 for designs.

Procesné parametre:

Tlaková strata  $\xi$

Pre regulačné armatúry  
Prietokový súčiniteľ Kv,  
Cv.

$$Kv = \frac{1}{100} \cdot Q \cdot \sqrt{\frac{\rho_1}{\Delta p}} \quad [m^3 \cdot h^{-1}]$$

kde

Q je objemový prietok [m<sup>3</sup> · h<sup>-1</sup>]  
ρ je objemová hmotnosť [kg · m<sup>-3</sup>]  
Δp je tlaková strata armatúry [MPa]

Prietokový súčiniteľ - charakteristický prietok danou armatúrou za presne definovaných podmienok pri menovitom Kv – m<sup>3</sup>/hod.  
Cv- US gal/min.

Handwheel rotation	Kv-value (m <sup>3</sup> /h)
0.5	1.1
1.0	2.2
1.5	3.2
2.0	4.3
2.5	5.4
3.0	6.45
3.4	7.2

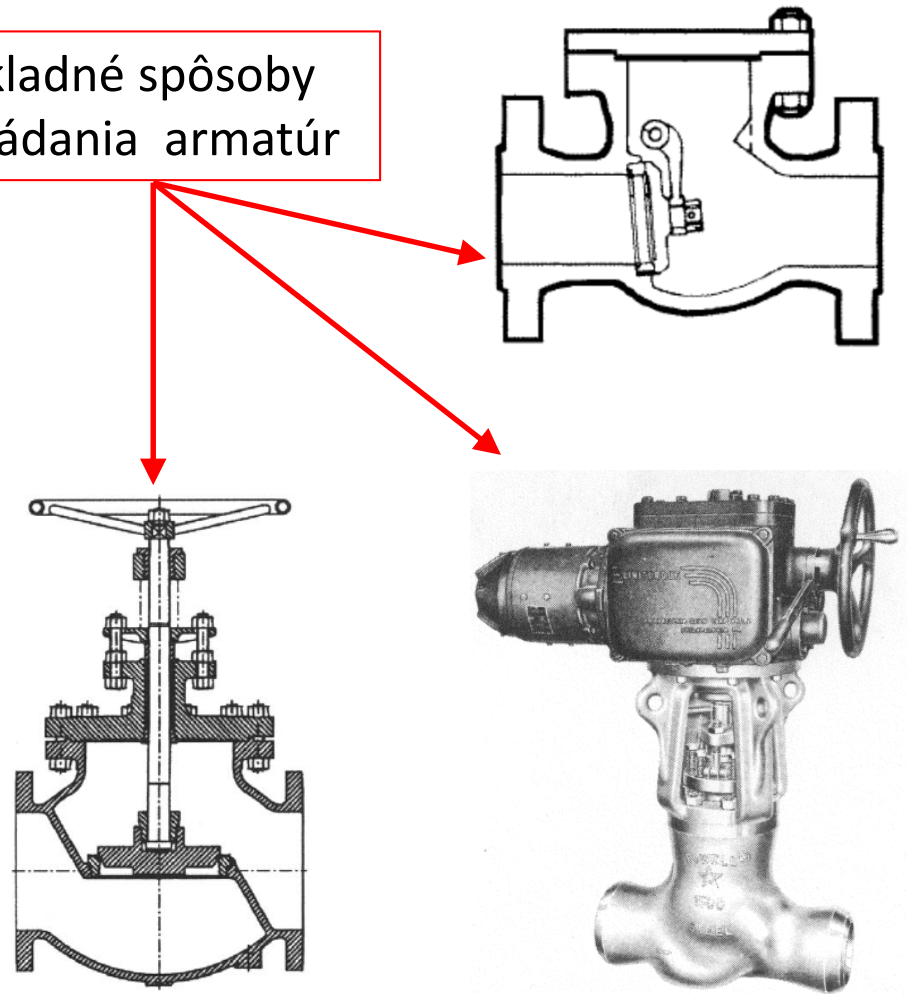


# Potrubný systém. Armatúry

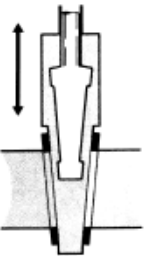
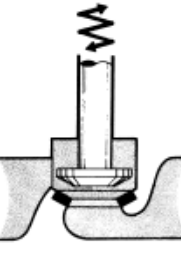
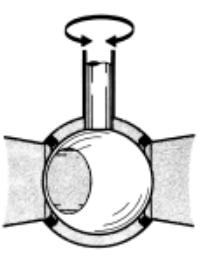
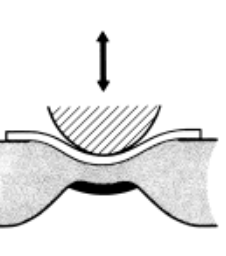
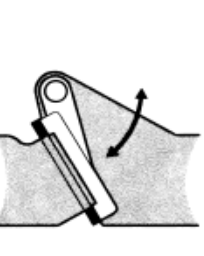
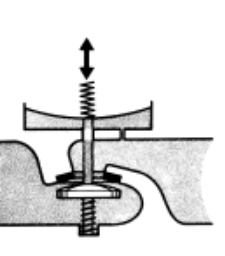
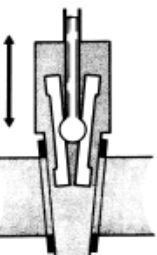

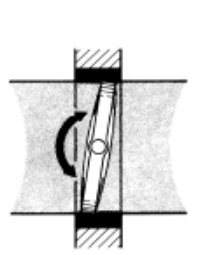
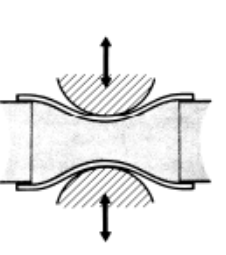
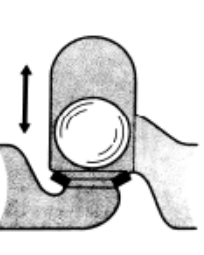
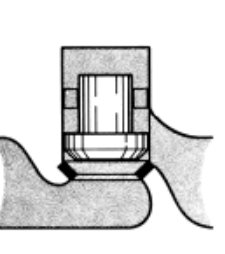
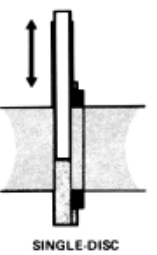
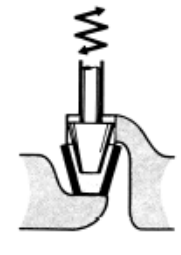
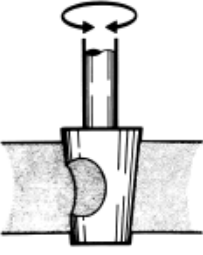
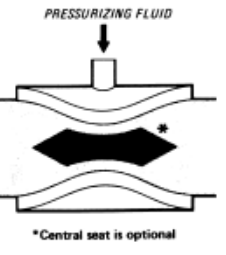
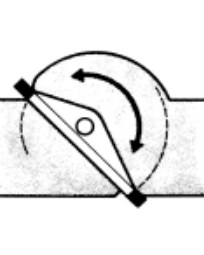

Základné funkcie  
armatúr

VALVE ACTION	EXPLANATION
ON/OFF	STOPPING OR STARTING FLOW
REGULATING	VARYING THE RATE OF FLOW
CHECKING	PERMITTING FLOW IN ONE DIRECTION ONLY
SWITCHING	SWITCHING FLOW ALONG DIFFERENT ROUTES
DISCHARGING	DISCHARGING FLUID FROM A SYSTEM

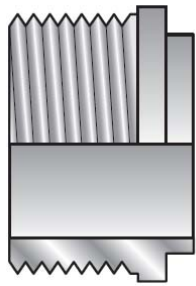
Základné spôsoby  
ovládania armatúr



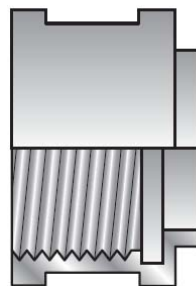
# Potrubný systém. Armatúry

OPERATED VALVES				SELF-OPERATED VALVES	
GATE	GLOBE	ROTARY	DIAPHRAGM	CHECK	REGULATING
 <p>SOLID-WEDGE GATE</p>	 <p>GLOBE</p>	 <p>ROTARY-BALL</p>	 <p>DIAPHRAGM (SAUNDERS TYPE)</p>	 <p>SWING CHECK</p>	 <p>PRESSURE REGULATOR</p>
 <p>SPLIT-WEDGE GATE</p>	 <p>ANGLE GLOBE</p>	 <p>BUTTERFLY</p>	 <p>PINCH</p>	 <p>BALL CHECK</p>	 <p>PISTON CHECK</p>
 <p>SINGLE-DISC SINGLE-SEAT GATE</p>	 <p>NEEDLE</p>	 <p>PLUG or COCK</p>	 <p>PRESSURIZING FLUID</p> <p>*Central seat is optional</p> <p>SQUEEZE</p>	 <p>TILTING DISC CHECK</p>	 <p>STOP CHECK</p>

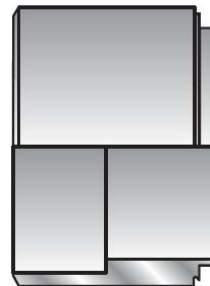
## Potrubný systém. Armatúry



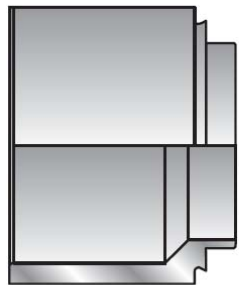
External threaded



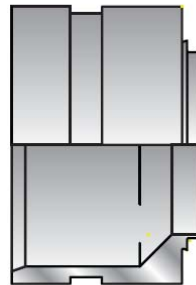
Internal threaded



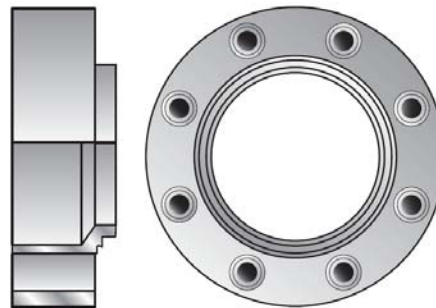
Soldering



Welding



Vitaulic



Compact flanges

Pripojenie,  
Pripojovací rozmer

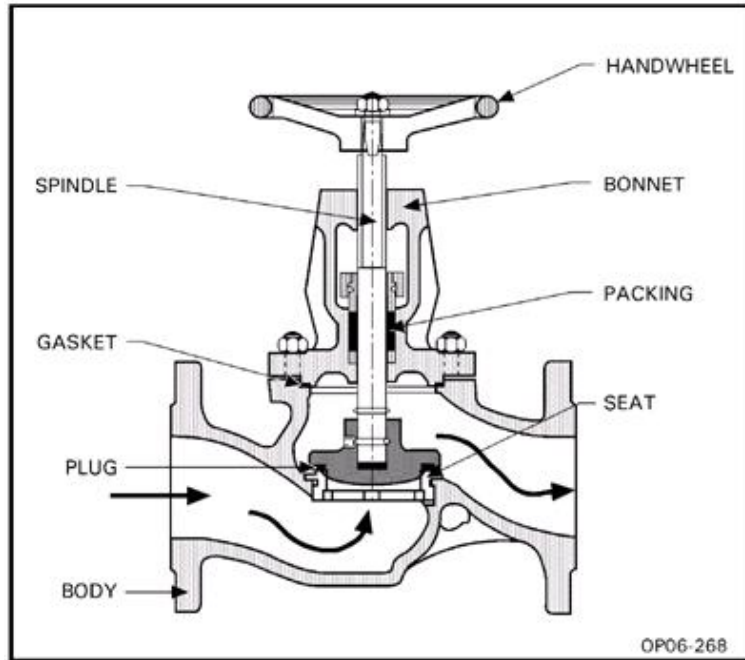
Príruba

Závit

Zvar

Ostatné pripojenia  
( Parker, Swagelock,  
Clamp, aseptický  
program ... )

## Armatúry. Globe Valve /Ventil/



### Funkcia:

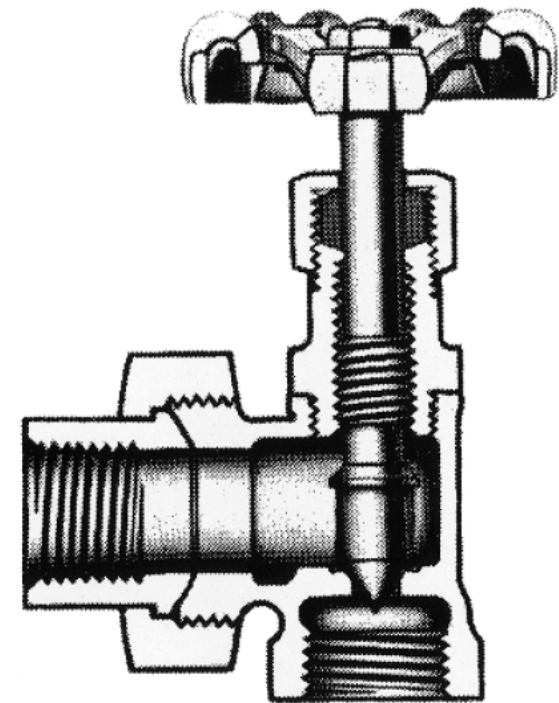
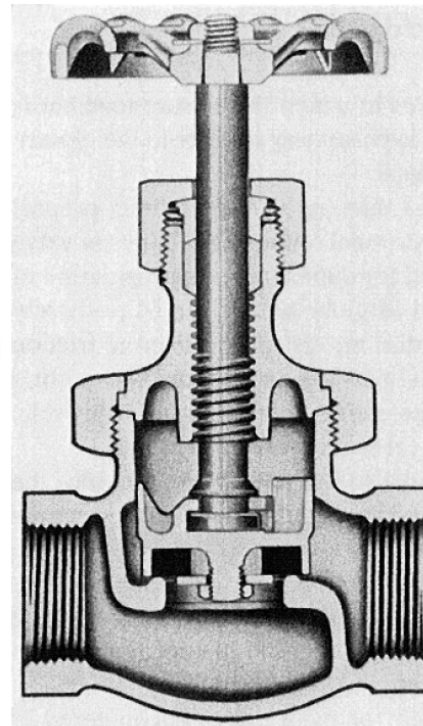
- Regulačná
- Uzatváracia
- Časté otváranie a zatváranie

### Použitie

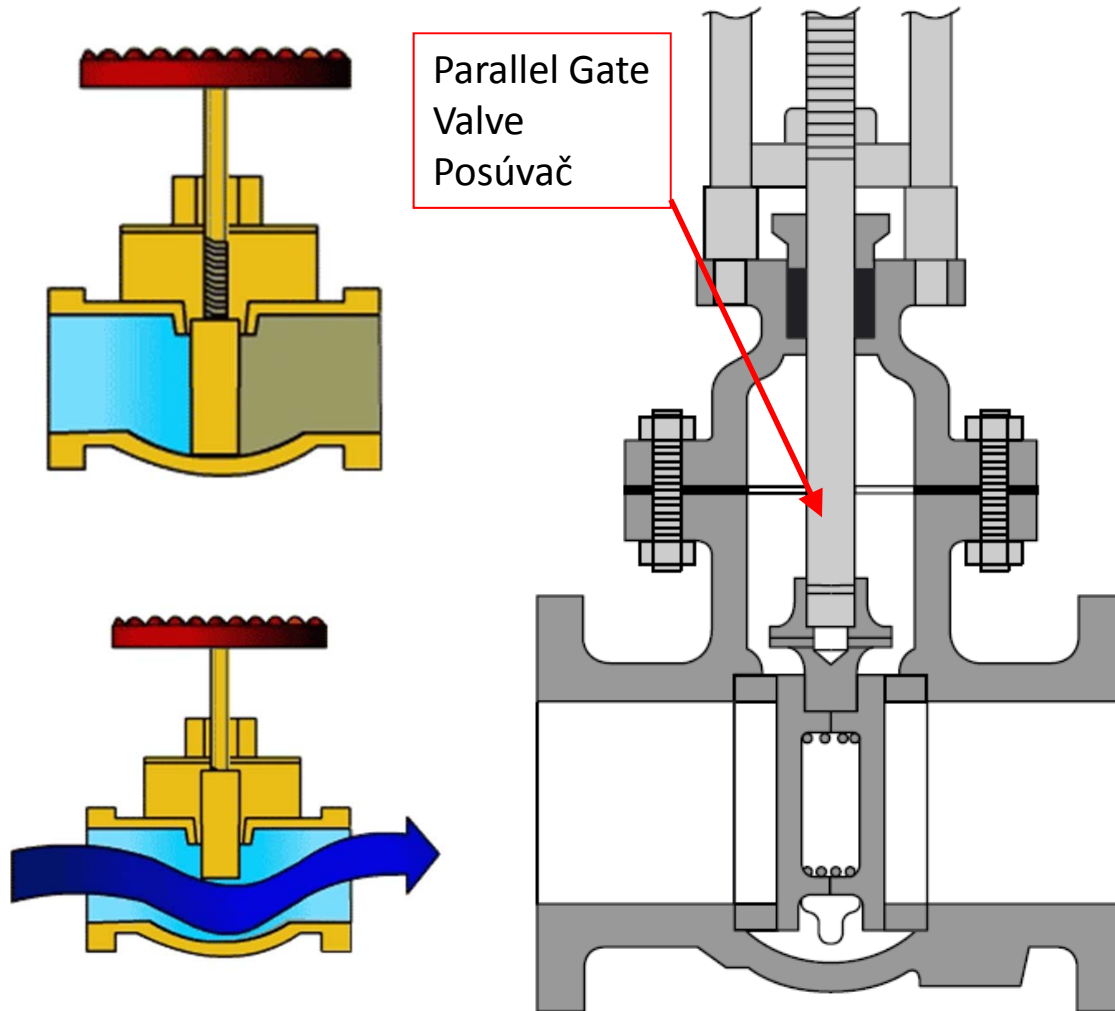
(g) a (l) bez častíc  
Vákuum

### Vzor /Valve Body Pattern/:

- Standard
- Angle
- Oblique „Y“



## Armatúry. Parallel Gate Valve /Posúvač/



### Výhody:

- ↓↓↓ tlaková strata pri 100 % otvorení.
- vhodné pre kaly pasty, suspenzie, a ťažko dopravovateľné materiály

### Nevýhody:

- nevhodné pre časté otváranie . Poškodenie tesnenia.
- Nevhodné pre regulácia. Efektívna regulácia začína pri 50% zatvorení
- pri ↑↑ rýchlostiach tendencia k vibráciám

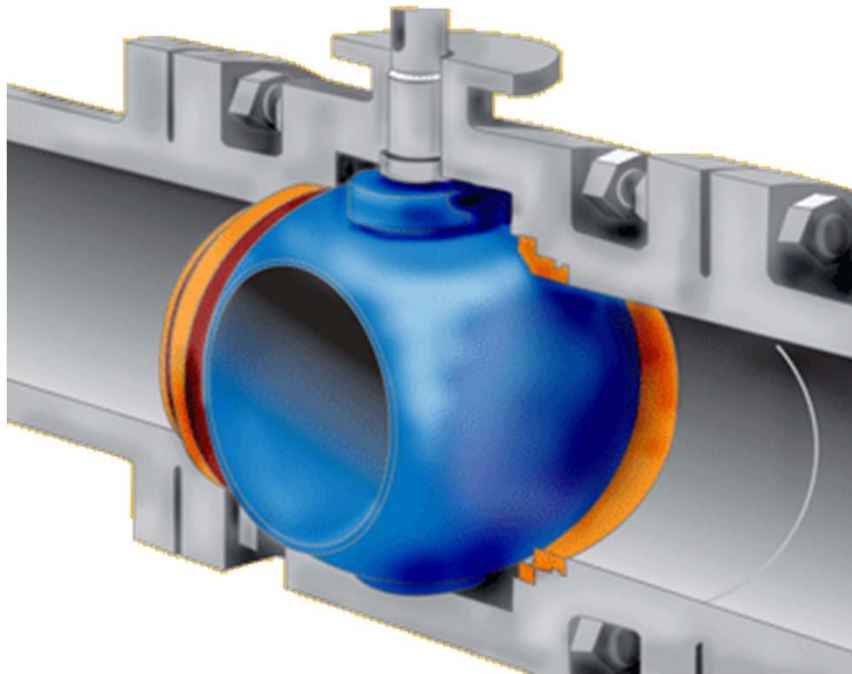
### Funkcia:

- Uzatváracia
- Regulačná, špeciálna konštrukcia

### Použitie

- (g),(l) . Aj suspenzie, kaly, pasty
- vákuum

## Armatúry. Ball Valve /Guľový kohút/



Otočná armatúra. Teleso v tvare gule s otvorom.

### Výhody:

- rýchle otváranie/zatváranie 90°-
- o vyšších tlakov
- nízka tlaková strata pri 100 % otvorení

### Nevýhody:

- zväčša pre ↓↓ teploty
- nevhodný pre regulácia.

### Funkcia:

- Uzatváracia, rozdeľovacia

### Použitie

-(g),(l), aj suspenzie .

## Armatúry. Ball Valve /Guľový kohút/



Prevedenie:

1-kus ( napr. prírubový/  
medziprírubvóný )

2- dielny

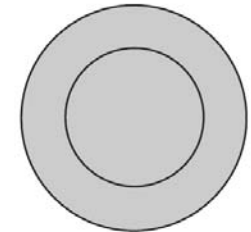
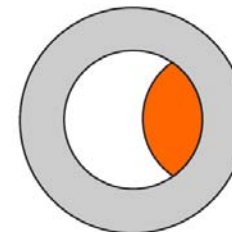
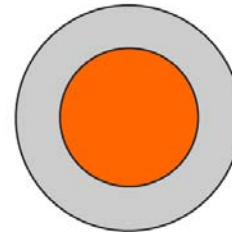
3- dielny



Valve fully open

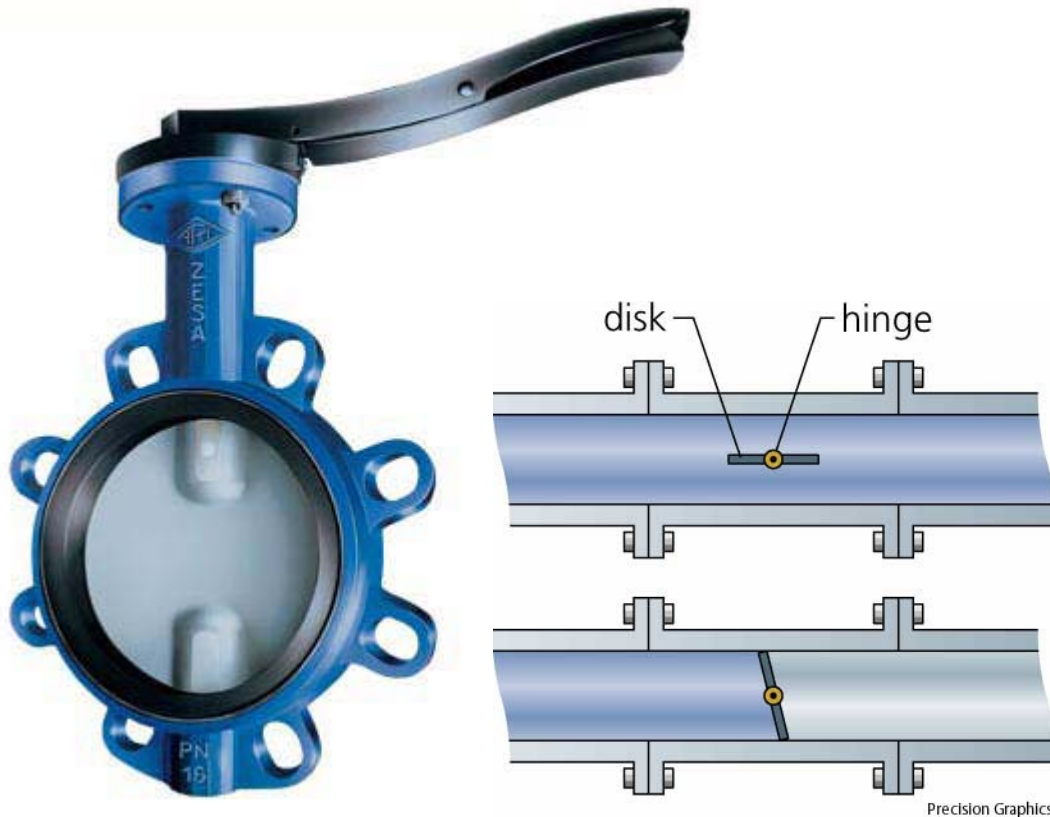
Valve ½ open

Valve fully closed



Fluid passes freely  
through the orifice

## Armatúry. Butterfly Valve /Klapka/



### Funkcia:

-Uzatváracia, regulačná

### Použitie

-(g),(l), prášky, kaly ....

Otočná armatúra. Otáčanie klapky v priereze potrubia.

### Výhody:

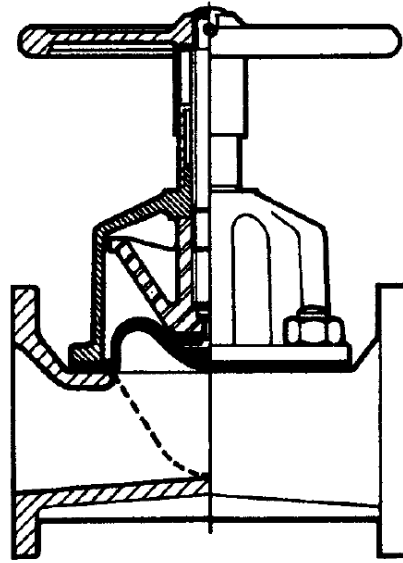
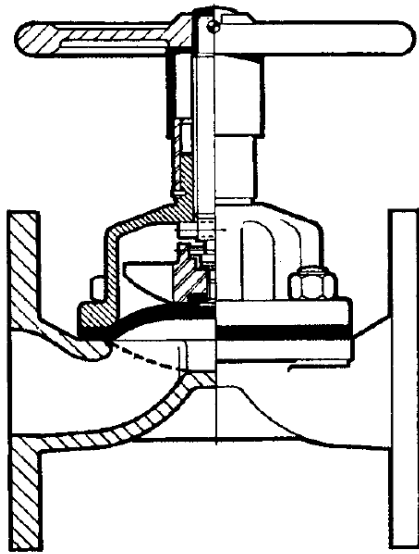
- jednoduchá, lacná
- nízka hmotnosť
- otváranie/zatváranie 90°
- nízka tlaková strata pri 100 % otvorení
- implementovaná manžeta
- vhodná aj na reguláciu

### Nevýhody:

- zväčša pre ↓↓ teploty/tlaky
- „pigging“, stredová časť



## Armatúry. Diaphragm valve /Membránový ventil/



Priamočiary pohyb. Stláčanie ohybného elementu membrány

### Výhody:

- pre extrémne korozívne a abrazívne materiály.
- nízka hmotnosť
- jednoduché
- vhodná aj na reguláciu

### Nevýhody:

- teplotné obmedzenia, ↓↓ teploty ( do 160 °C ) - membrána
- natlakovanie systému.

### Funkcia:

- Uzatváracia, regulačná

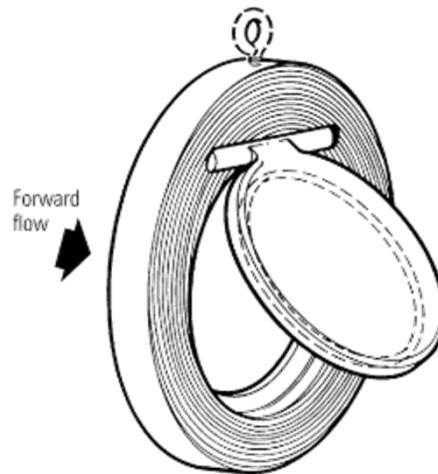
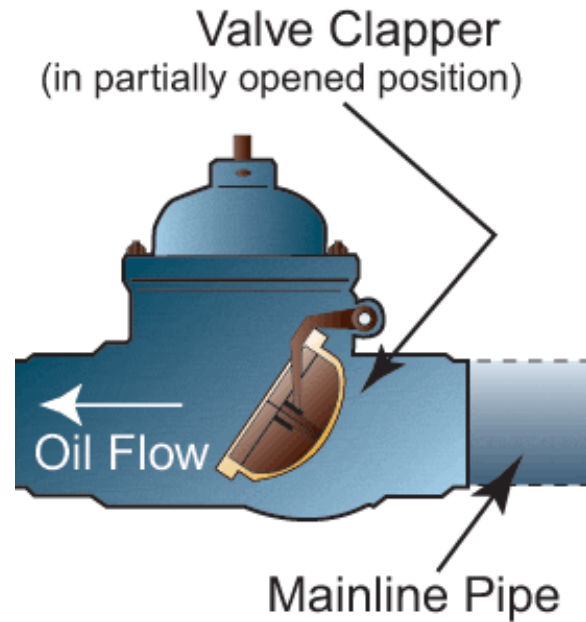
### Použitie

- (l),(g) + korozívne médiá.



Vnútoraná vložka

## Armatúry. Swing Check Valve / Spätná klapka/



Swing Check Valve  
Prúdom média je otáčaný uzatvárací prvok, pri spätnom toku je naopak je tlačný na dosadaciu plochu.

### Výhody:

- väčšia vzdialenosť pohybu uzatváracieho prvku.
- malá tendencia k zanášaniam

### Nevýhody:

- dodržať montážnu polohu



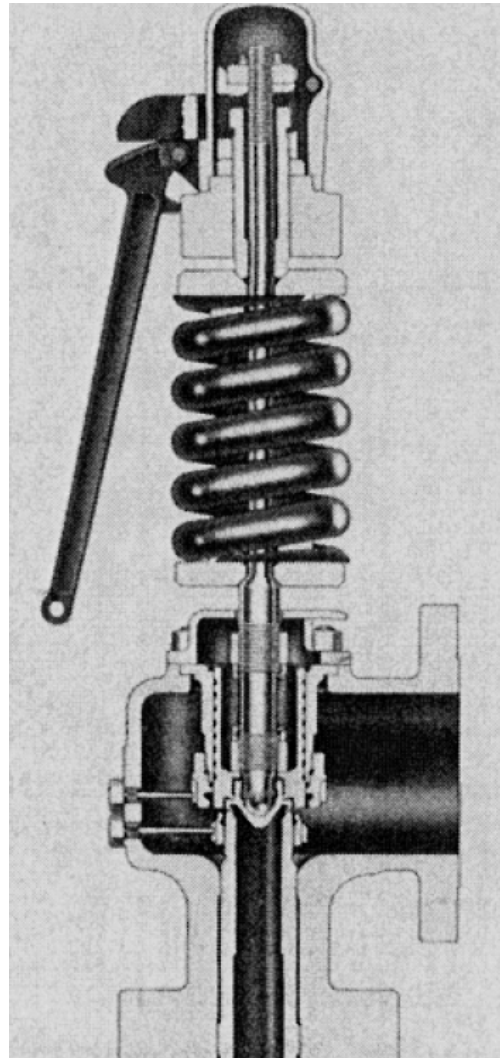
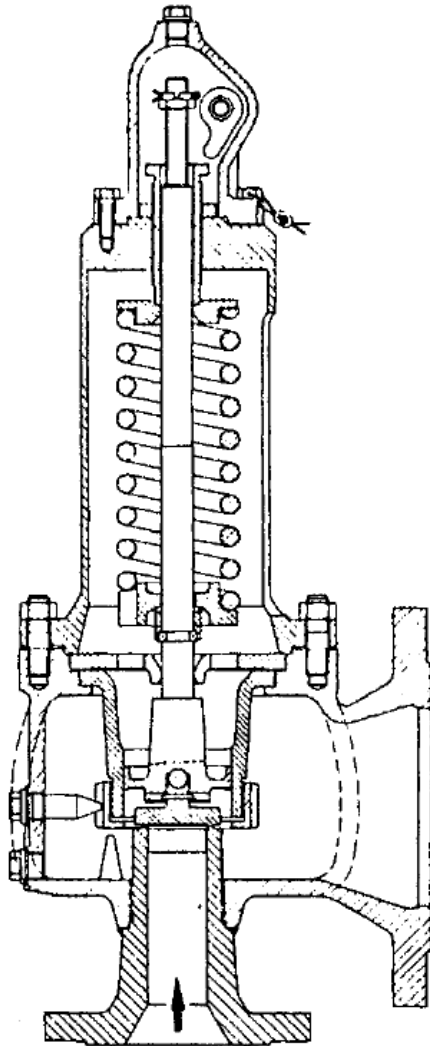
### Funkcia:

Zamedzenie spätného toku

### Použitie

- (l),(g)

## Armatúry. Pressure Relief Valve / Poistný ventil /



Pressure Relief Valve  
Automatická armatúra, pri prekročení dovoleného tlaku sa armatúra otvorí a zníži tlak.

### Rozdelenie:

- priamo ovládané PV
- ( tlak zväčša otvára cez pružinu, prípadne protiváhu )

- nepriamo ovládané PV (Ventil tkz. "pilot", ktorá ovláda kužeľeku hlavného ventilu.

### Funkcia:

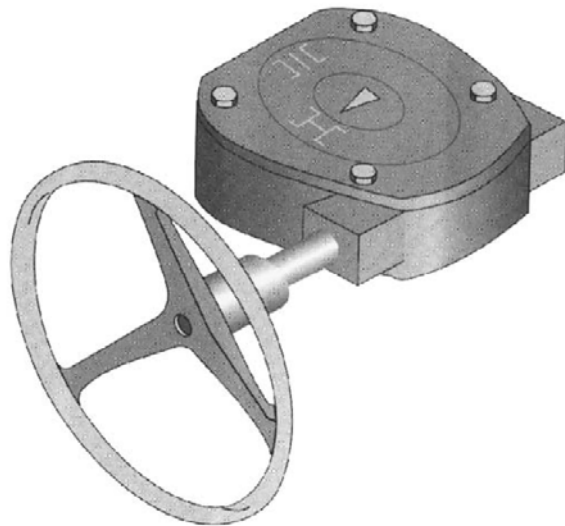
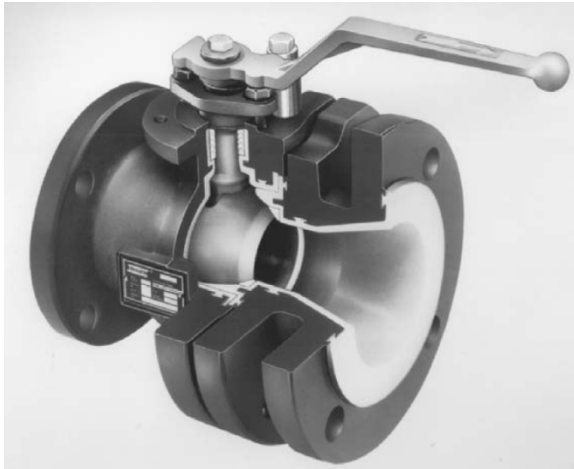
Poistná funkcia

### Použitie

(g), (l)



## Armatúry. Pohon / Actuator /

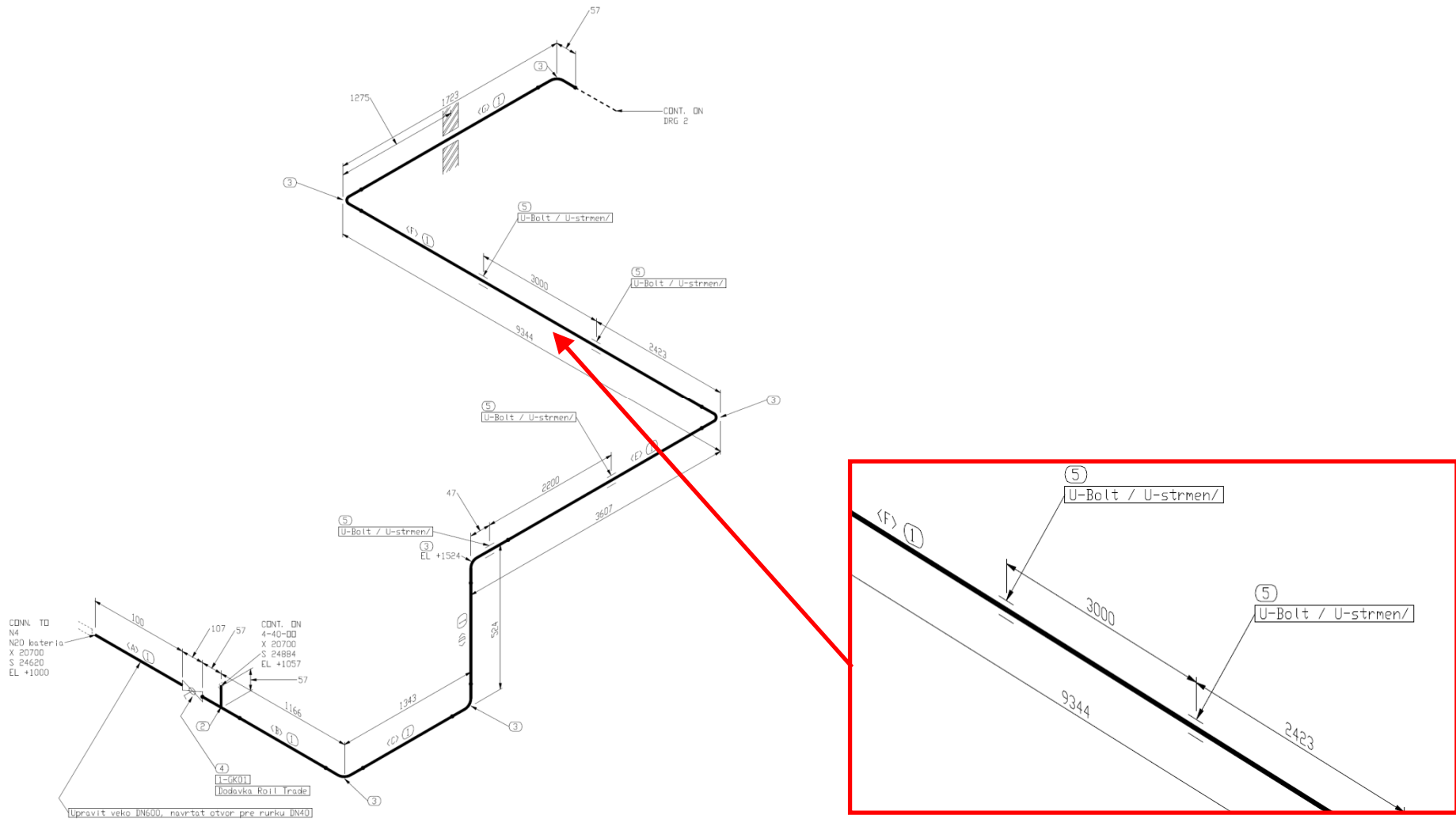


Základné rozdelenie

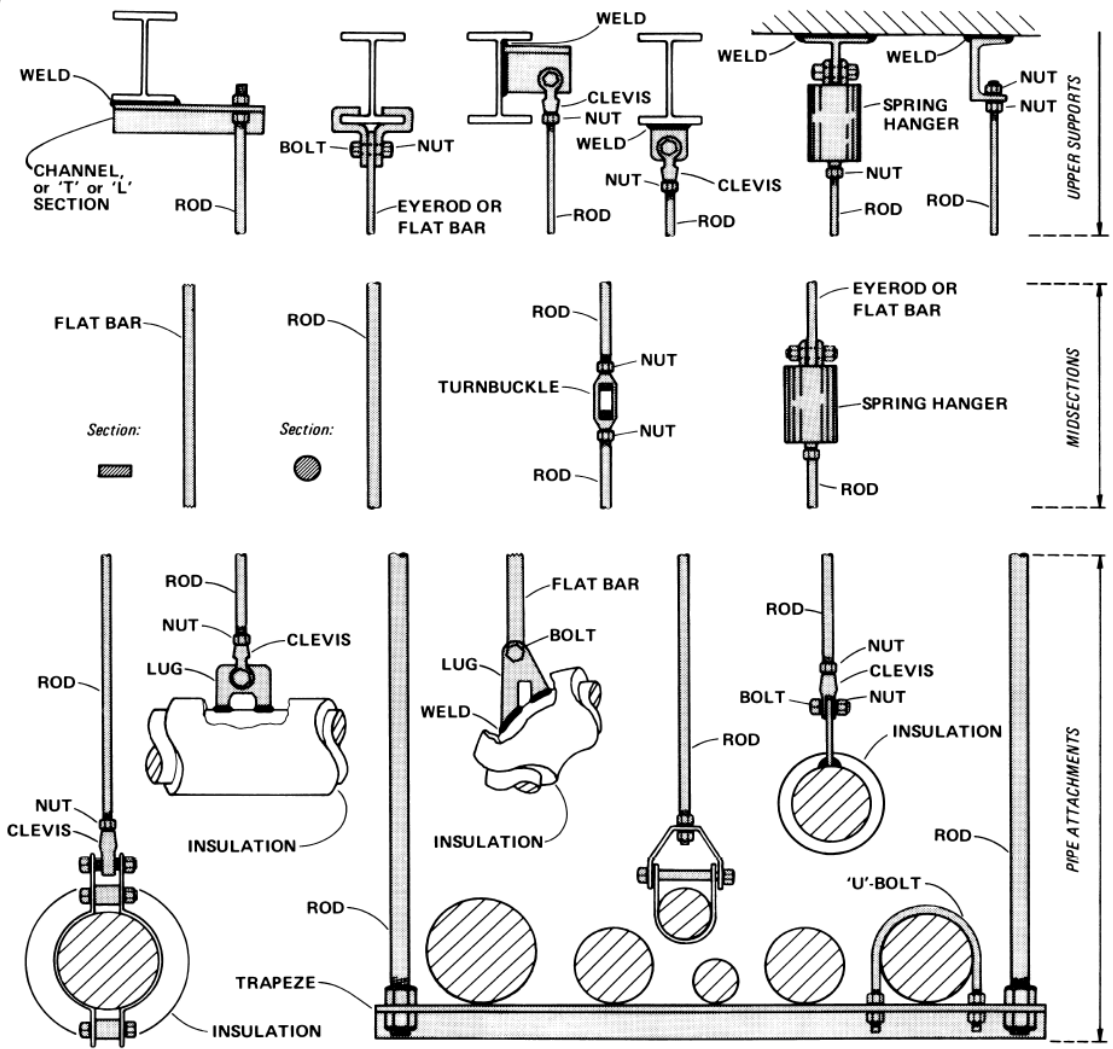
Manuálny pohon:  
Vyžaduje ľudskú silu a  
mechanický člen spojený s  
armatúrou ( napr. páka,  
rúčka, koleso )

Ovládaný pohon.  
Vyžaduje zdroj energie (  
napr. Elektrická energia,  
tlakový vzduch )  
mechanický člen spojený s  
armatúrou. Na ovládanie  
je nutný riadiaci systém .

# Kotvenie potrubia / Pipe Support /



# Kotvenie potrubia / Pipe Support /



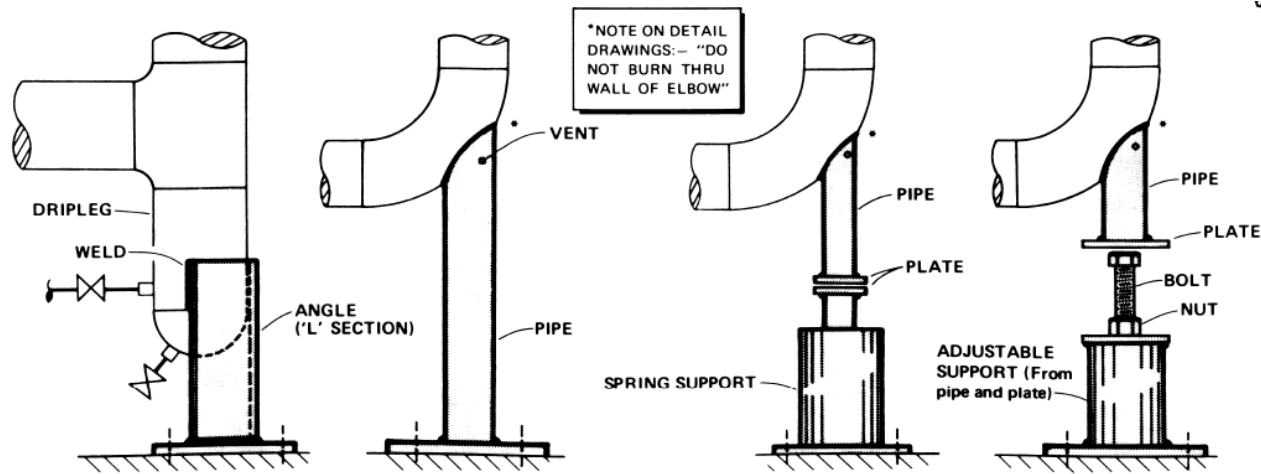
## Kotvenie potrubia

- zachytenie hmotnosti potrubia  
 (+ hmotnosť média, izolácia,  
 všetky ostatné zaťaženia )

Výpočtový model určí presné  
 miesto uchytenia ako aj  
 odobratý stupeň voľnosti

Podpery  
 Závesy  
 Pružné ( Pružinové závesy )

# Kotvenie potrubia / Pipe Support /



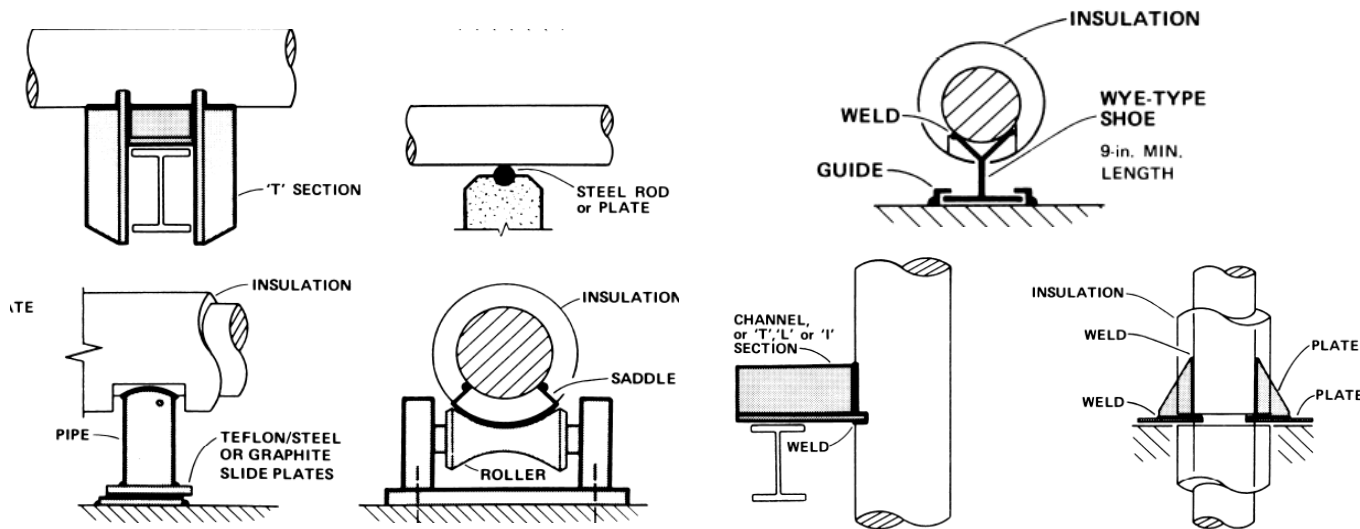
Podpera na kolene /Dummy Leg./

Podpera na kolene pružinovou podperou /Dummy leg with spring support /

Klzné uloženia

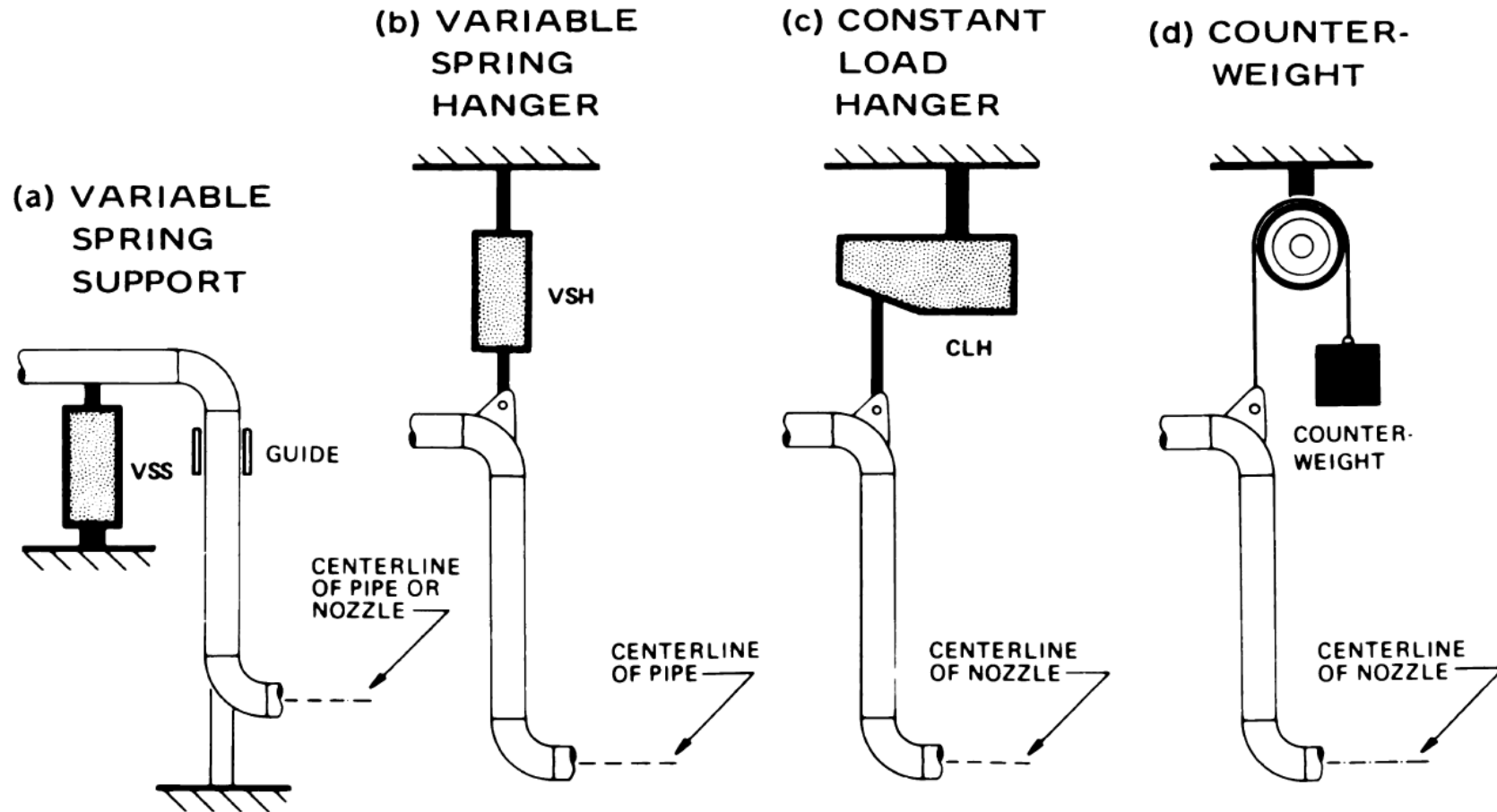
Medzera /Gap/

Vedenie /Guide/

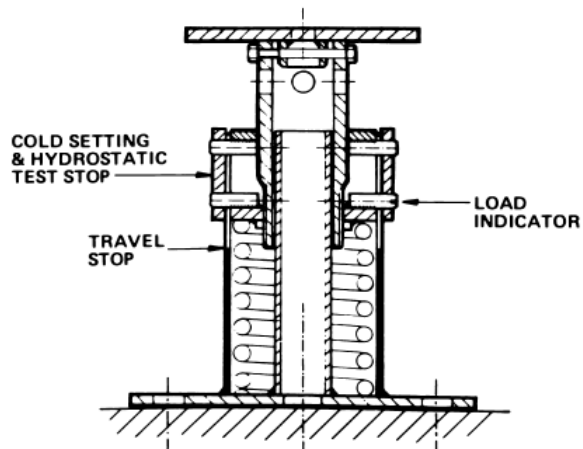
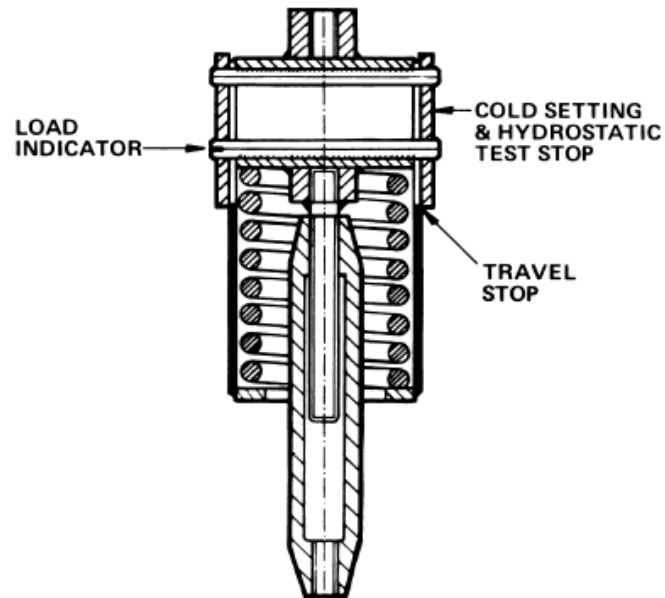
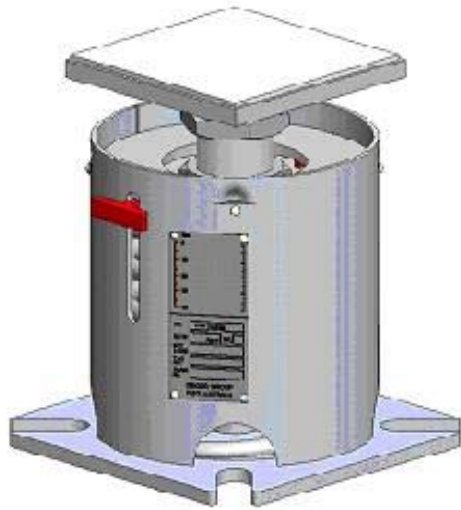




# Kotvenie potrubia / Pipe Support /



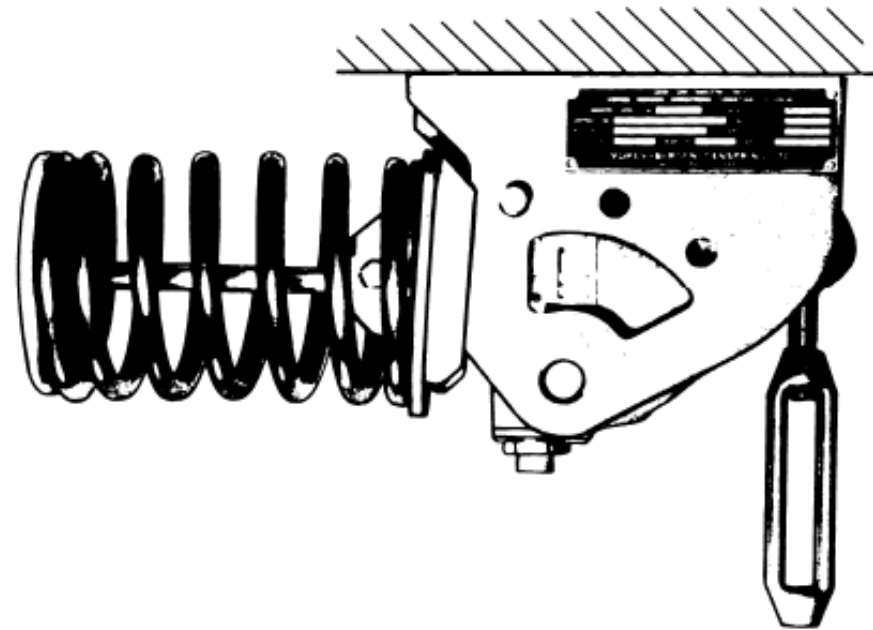
## Kotvenie potrubia / Pipe Support /



VSH - Variable Spring Hanger  
Pružinový záves / podpera

- Najbežnejší
- Obmedzenie, 25%-30% z rozsahu pružiny.

## Kotvenie potrubia / Pipe Support /



CSH – Constant Load Hanger  
Pružinový záves / podpera s konštantným zaťažením

- Drahý
- Veľký rozsah

# Kotvenie potrubia / Pipe Support /

