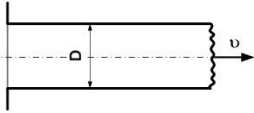
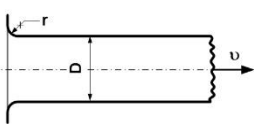
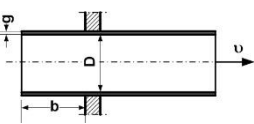
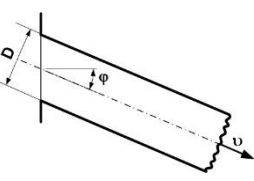
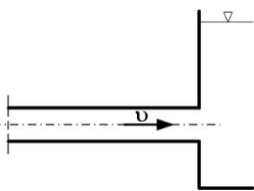
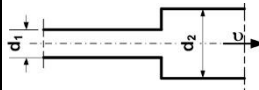
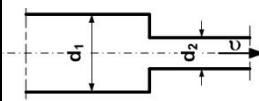
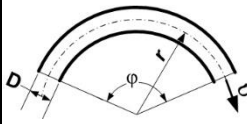
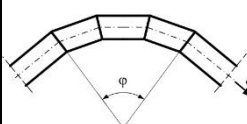
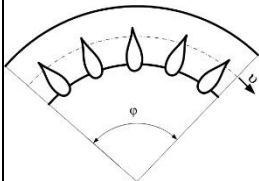
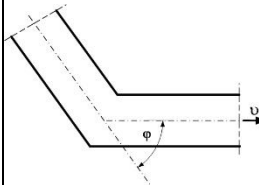
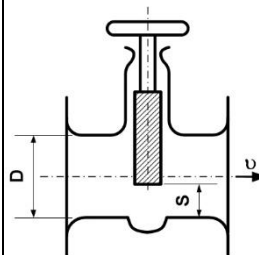
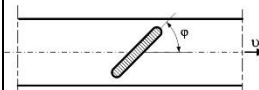
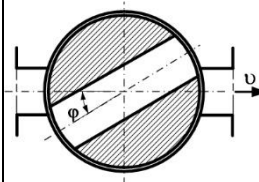
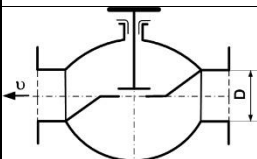
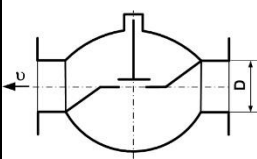
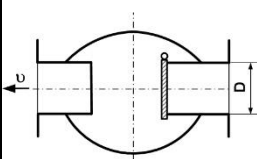
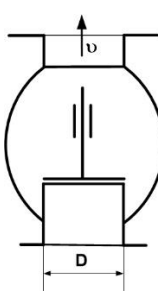


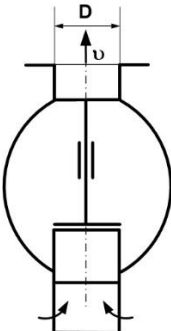
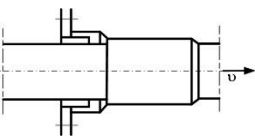
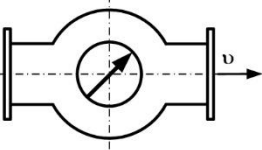
6. Współczynniki strat miejscowych dla wybranych przeszkód

Lp.	Nazwa przeszkody	Kształt	Współczynniki oporów miejscowych ζ																											
1.	Wlot o ostrych krawędziach		$\zeta = 0,5$																											
2.	Wlot prosty zaokrąglony		<table><tr><td>$\frac{r}{D}$</td><td>0</td><td>0,01</td><td>0,02</td><td>0,05</td><td>0,10</td><td>0,16</td><td>0,2</td></tr><tr><td>ζ</td><td>0,5</td><td>0,43</td><td>0,36</td><td>0,22</td><td>0,12</td><td>0,06</td><td>0,03</td></tr></table>	$\frac{r}{D}$	0	0,01	0,02	0,05	0,10	0,16	0,2	ζ	0,5	0,43	0,36	0,22	0,12	0,06	0,03											
$\frac{r}{D}$	0	0,01	0,02	0,05	0,10	0,16	0,2																							
ζ	0,5	0,43	0,36	0,22	0,12	0,06	0,03																							
3.	Wlot w rurę wsuniętą przez otwór w ścianie do wewnątrz zbiornika		$0,5 \leq \zeta = \zeta\left(\frac{b}{D}, \frac{g}{D}\right) \leq 1,0$																											
4.	Wlot do rury pod kątem		$\zeta = 0,5 + 0,3 \cdot \sin\varphi + 0,2 \cdot \sin^2\varphi$ <table><tr><td>φ</td><td>°</td><td>10</td><td>20</td><td>30</td><td>45</td><td>60</td><td>70</td><td>80</td></tr><tr><td></td><td>rad</td><td>$\frac{\pi}{18}$</td><td>$\frac{\pi}{9}$</td><td>$\frac{\pi}{6}$</td><td>$\frac{\pi}{4}$</td><td>$\frac{\pi}{3}$</td><td>$\frac{7\pi}{18}$</td><td>$\frac{4\pi}{9}$</td></tr><tr><td>ζ</td><td></td><td>0,558</td><td>0,626</td><td>0,700</td><td>0,812</td><td>0,910</td><td>0,959</td><td>0,990</td></tr></table>	φ	°	10	20	30	45	60	70	80		rad	$\frac{\pi}{18}$	$\frac{\pi}{9}$	$\frac{\pi}{6}$	$\frac{\pi}{4}$	$\frac{\pi}{3}$	$\frac{7\pi}{18}$	$\frac{4\pi}{9}$	ζ		0,558	0,626	0,700	0,812	0,910	0,959	0,990
φ	°	10	20	30	45	60	70	80																						
	rad	$\frac{\pi}{18}$	$\frac{\pi}{9}$	$\frac{\pi}{6}$	$\frac{\pi}{4}$	$\frac{\pi}{3}$	$\frac{7\pi}{18}$	$\frac{4\pi}{9}$																						
ζ		0,558	0,626	0,700	0,812	0,910	0,959	0,990																						
5.	Wlot z przewodu do zbiornika		$\zeta = 1$ v - prędkość w przewodzie (przed przeszkodą)																											

6.	Nagłe zwiększenie przekroju, $Re \geq 3500$		$\zeta = \left[\left(\frac{d_2}{d_1} \right)^2 - 1 \right]^2$ <table><tr><td>$\left(\frac{d_2}{d_1} \right)^2$</td><td>1,2</td><td>1,4</td><td>1,6</td><td>1,8</td><td>2,0</td><td>2,5</td></tr><tr><td>ζ</td><td>0,04</td><td>0,16</td><td>0,36</td><td>,64</td><td>1,0</td><td>2,25</td></tr><tr><td>$\left(\frac{d_2}{d_1} \right)^2$</td><td>3,0</td><td>3,5</td><td>4,0</td><td>5,0</td><td>6,0</td><td></td></tr><tr><td>ζ</td><td>4,0</td><td>6,25</td><td>9,0</td><td>16,0</td><td>25,0</td><td></td></tr></table>							$\left(\frac{d_2}{d_1} \right)^2$	1,2	1,4	1,6	1,8	2,0	2,5	ζ	0,04	0,16	0,36	,64	1,0	2,25	$\left(\frac{d_2}{d_1} \right)^2$	3,0	3,5	4,0	5,0	6,0		ζ	4,0	6,25	9,0	16,0	25,0																											
$\left(\frac{d_2}{d_1} \right)^2$	1,2	1,4	1,6	1,8	2,0	2,5																																																									
ζ	0,04	0,16	0,36	,64	1,0	2,25																																																									
$\left(\frac{d_2}{d_1} \right)^2$	3,0	3,5	4,0	5,0	6,0																																																										
ζ	4,0	6,25	9,0	16,0	25,0																																																										
7.	Nagłe zmniejszenie przekroju		$\zeta = 0,5 \left[1 - \left(\frac{d_2}{d_1} \right)^2 \right]$ <table><tr><td>$\left(\frac{d_2}{d_1} \right)^2$</td><td>0,01</td><td>0,1</td><td>0,2</td><td>0,25</td><td>0,3</td><td>0,4</td><td>0,6</td><td>0,8</td></tr><tr><td>ζ</td><td>0,50</td><td>0,45</td><td>0,40</td><td>0,38</td><td>0,35</td><td>0,30</td><td>0,20</td><td>0,10</td></tr></table>							$\left(\frac{d_2}{d_1} \right)^2$	0,01	0,1	0,2	0,25	0,3	0,4	0,6	0,8	ζ	0,50	0,45	0,40	0,38	0,35	0,30	0,20	0,10																																				
$\left(\frac{d_2}{d_1} \right)^2$	0,01	0,1	0,2	0,25	0,3	0,4	0,6	0,8																																																							
ζ	0,50	0,45	0,40	0,38	0,35	0,30	0,20	0,10																																																							
8.	Kolana gięte		<table><tr><td rowspan="3">ϕ $\frac{r}{D}$</td><td></td><td colspan="4">Gładkie</td><td>Chropowate</td></tr><tr><td>°</td><td>15</td><td>45</td><td>60</td><td>90</td><td>90</td></tr><tr><td>rad</td><td>$\frac{5\pi}{6}$</td><td>$\frac{\pi}{4}$</td><td>$\frac{\pi}{3}$</td><td>$\frac{\pi}{2}$</td><td>$\frac{\pi}{2}$</td></tr><tr><td>1</td><td></td><td>0,03</td><td>0,14</td><td>0,19</td><td>0,21</td><td>0,51</td></tr><tr><td>2</td><td></td><td>0,03</td><td>0,09</td><td>0,12</td><td>0,14</td><td>0,30</td></tr><tr><td>4</td><td></td><td>0,03</td><td>0,08</td><td>0,10</td><td>0,11</td><td>0,23</td></tr><tr><td>6</td><td></td><td>0,03</td><td>0,075</td><td>0,09</td><td>0,09</td><td>0,18</td></tr><tr><td>10</td><td></td><td>0,03</td><td>0,07</td><td>0,07</td><td>0,11</td><td>0,20</td></tr></table>	ϕ $\frac{r}{D}$		Gładkie				Chropowate	°	15	45	60	90	90	rad	$\frac{5\pi}{6}$	$\frac{\pi}{4}$	$\frac{\pi}{3}$	$\frac{\pi}{2}$	$\frac{\pi}{2}$	1		0,03	0,14	0,19	0,21	0,51	2		0,03	0,09	0,12	0,14	0,30	4		0,03	0,08	0,10	0,11	0,23	6		0,03	0,075	0,09	0,09	0,18	10		0,03	0,07	0,07	0,11	0,20						
ϕ $\frac{r}{D}$		Gładkie				Chropowate																																																									
	°	15	45		60	90	90																																																								
	rad	$\frac{5\pi}{6}$	$\frac{\pi}{4}$	$\frac{\pi}{3}$	$\frac{\pi}{2}$	$\frac{\pi}{2}$																																																									
1		0,03	0,14	0,19	0,21	0,51																																																									
2		0,03	0,09	0,12	0,14	0,30																																																									
4		0,03	0,08	0,10	0,11	0,23																																																									
6		0,03	0,075	0,09	0,09	0,18																																																									
10		0,03	0,07	0,07	0,11	0,20																																																									
9.	Kolana segmentowe		<table><tr><td rowspan="2">ϕ</td><td>°</td><td>15</td><td>30</td><td>45</td><td>60</td><td>90</td></tr><tr><td>rad</td><td>$\frac{5\pi}{6}$</td><td>$\frac{\pi}{6}$</td><td>$\frac{\pi}{4}$</td><td>$\frac{\pi}{3}$</td><td>$\frac{\pi}{2}$</td></tr><tr><td colspan="2">S</td><td>1</td><td>2</td><td>2</td><td>3</td><td>3</td></tr><tr><td colspan="2">ζ</td><td>0,06</td><td>0,10</td><td>0,15</td><td>0,20</td><td>0,25</td></tr></table>	ϕ	°	15	30	45	60	90	rad	$\frac{5\pi}{6}$	$\frac{\pi}{6}$	$\frac{\pi}{4}$	$\frac{\pi}{3}$	$\frac{\pi}{2}$	S		1	2	2	3	3	ζ		0,06	0,10	0,15	0,20	0,25	S - liczba segmentów																																
ϕ	°	15	30		45	60	90																																																								
	rad	$\frac{5\pi}{6}$	$\frac{\pi}{6}$	$\frac{\pi}{4}$	$\frac{\pi}{3}$	$\frac{\pi}{2}$																																																									
S		1	2	2	3	3																																																									
ζ		0,06	0,10	0,15	0,20	0,25																																																									

10.	Kolana półfaliste		$\varphi = \frac{\pi}{2} \text{ rad}, \quad \zeta = 0,4$																														
11.	Załamanie przewodu		$\zeta = \zeta(\varphi)$ <table><tr><td>φ</td><td>°</td><td>20</td><td>40</td><td>60</td><td>80</td><td>90</td><td>100</td><td>120</td><td>140</td></tr><tr><td></td><td>rad</td><td>$\frac{\pi}{9}$</td><td>$\frac{2\pi}{9}$</td><td>$\frac{\pi}{3}$</td><td>$\frac{4\pi}{9}$</td><td>$\frac{\pi}{2}$</td><td>$\frac{5\pi}{9}$</td><td>$\frac{2\pi}{3}$</td><td>$\frac{8\pi}{9}$</td></tr><tr><td>ζ</td><td></td><td>0,04</td><td>0,14</td><td>0,36</td><td>0,74</td><td>0,98</td><td>1,26</td><td>2,43</td><td>2,85</td></tr></table>	φ	°	20	40	60	80	90	100	120	140		rad	$\frac{\pi}{9}$	$\frac{2\pi}{9}$	$\frac{\pi}{3}$	$\frac{4\pi}{9}$	$\frac{\pi}{2}$	$\frac{5\pi}{9}$	$\frac{2\pi}{3}$	$\frac{8\pi}{9}$	ζ		0,04	0,14	0,36	0,74	0,98	1,26	2,43	2,85
φ	°	20	40	60	80	90	100	120	140																								
	rad	$\frac{\pi}{9}$	$\frac{2\pi}{9}$	$\frac{\pi}{3}$	$\frac{4\pi}{9}$	$\frac{\pi}{2}$	$\frac{5\pi}{9}$	$\frac{2\pi}{3}$	$\frac{8\pi}{9}$																								
ζ		0,04	0,14	0,36	0,74	0,98	1,26	2,43	2,85																								
12.	Zawór zasuwowy równoprzelotowy		$\zeta = \zeta\left(\frac{S}{D}\right)$ <table><tr><td>$\frac{S}{D}$</td><td>0,25</td><td>0,3</td><td>0,4</td><td>0,5</td><td>0,6</td><td>0,7</td><td>0,8</td><td>0,9</td><td>1,0</td></tr><tr><td>ζ</td><td>30</td><td>22</td><td>12</td><td>5,3</td><td>2,8</td><td>1,5</td><td>0,8</td><td>0,3</td><td>0,15</td></tr></table>	$\frac{S}{D}$	0,25	0,3	0,4	0,5	0,6	0,7	0,8	0,9	1,0	ζ	30	22	12	5,3	2,8	1,5	0,8	0,3	0,15										
$\frac{S}{D}$	0,25	0,3	0,4	0,5	0,6	0,7	0,8	0,9	1,0																								
ζ	30	22	12	5,3	2,8	1,5	0,8	0,3	0,15																								
13.	Zawór motylkowy (klapowy, dławicowy)		$\zeta = \zeta(\varphi)$ <table><tr><td>φ</td><td>°</td><td>10</td><td>20</td><td>30</td><td>40</td><td>50</td><td>60</td><td>70</td><td>90</td></tr><tr><td></td><td>rad</td><td>$\frac{\pi}{18}$</td><td>$\frac{\pi}{9}$</td><td>$\frac{\pi}{6}$</td><td>$\frac{2\pi}{9}$</td><td>$\frac{5\pi}{18}$</td><td>$\frac{\pi}{3}$</td><td>$\frac{7\pi}{18}$</td><td>$\frac{\pi}{2}$</td></tr><tr><td>ζ</td><td></td><td>0,52</td><td>1,54</td><td>3,91</td><td>10,8</td><td>32,6</td><td>118</td><td>751</td><td>∞</td></tr></table>	φ	°	10	20	30	40	50	60	70	90		rad	$\frac{\pi}{18}$	$\frac{\pi}{9}$	$\frac{\pi}{6}$	$\frac{2\pi}{9}$	$\frac{5\pi}{18}$	$\frac{\pi}{3}$	$\frac{7\pi}{18}$	$\frac{\pi}{2}$	ζ		0,52	1,54	3,91	10,8	32,6	118	751	∞
φ	°	10	20	30	40	50	60	70	90																								
	rad	$\frac{\pi}{18}$	$\frac{\pi}{9}$	$\frac{\pi}{6}$	$\frac{2\pi}{9}$	$\frac{5\pi}{18}$	$\frac{\pi}{3}$	$\frac{7\pi}{18}$	$\frac{\pi}{2}$																								
ζ		0,52	1,54	3,91	10,8	32,6	118	751	∞																								
14.	Zawór kurkowy (kurek gazowy)		$\zeta = \zeta(\varphi)$ <table><tr><td>φ</td><td>°</td><td>10</td><td>20</td><td>30</td><td>40</td><td>50</td><td>55</td><td>67</td></tr><tr><td></td><td>rad</td><td>$\frac{\pi}{18}$</td><td>$\frac{\pi}{9}$</td><td>$\frac{\pi}{6}$</td><td>$\frac{2\pi}{9}$</td><td>$\frac{5\pi}{18}$</td><td>0,96</td><td>1,17</td></tr></table>	φ	°	10	20	30	40	50	55	67		rad	$\frac{\pi}{18}$	$\frac{\pi}{9}$	$\frac{\pi}{6}$	$\frac{2\pi}{9}$	$\frac{5\pi}{18}$	0,96	1,17												
φ	°	10	20	30	40	50	55	67																									
	rad	$\frac{\pi}{18}$	$\frac{\pi}{9}$	$\frac{\pi}{6}$	$\frac{2\pi}{9}$	$\frac{5\pi}{18}$	0,96	1,17																									

			ζ	0,31	1,84	6,15	20,7	95	275	∞	
15.	Zawór grzybkowy normalny		$\zeta = \zeta(D)$								
			D mm	20	40	80	100	150	200	250	300
			ζ	8,0	4,9	4,0	4,1	4,4	4,7	5,1	5,4
16.	Zawór zwrotny grzybkowy normalny		$\zeta = \zeta(D)$								
			D mm	25	32	40	50	80	100	150	200
			ζ	4,5	4,8	5,3	6,0	7,4	4,6	6,0	4,5
17.	Zawór zwrotny klapowy		$\zeta = \zeta(D)$								
			D mm	25	32	40	50	80	100	150	200
			ζ	1,9	1,6	1,5	1,4	1,3	1,2	0,9	0,8
18.	Zawór zwrotny grzybkowy osiowy		$\zeta = \zeta(D) = 2,2 \div 2,5$								
19.	Zawór zwrotny z koszem		$\zeta = \zeta(D)$								
			D mm	40	70	100	200	300	500		

			ζ	12	8,5	7,0	4,7	3,7	2,5
20.	Kosz bez zaworu zwrotnego		$\zeta = 0,9 \div 6$ w zależności od konstrukcji kosza						
21.	Kompensator dławicowy		$\zeta \cong 0,2$						
22.	Wodomierz		<p>Tłoczkowy $\zeta = 12$</p> <p>Płytkowy $\zeta = 8$</p> <p>Skrętowy $\zeta = 6$</p>						