

CALCULATION OF Kv FLOW COEFFICIENTS

Sizing of control valves and pressure regulators can be performed through calculation of flow coefficient, analysis of flow characteristic curves, nomographs or other empirical methods. The IEC 60534-2-1 is typically used for such tasks, most commonly for control valve sizing.

This section provides a simplified method for sizing which is based on the valve flow coefficient. This method is sufficiently accurate for most simple industrial applications.

In cases where:

- Flow rate and/or upstream pressure varies significantly - high turndown ratios.
- Safety valve set pressure is too close to PRV set pressure.
- Critical applications where events such as high noise emissions, erosion, cavitation or flashing may occur.

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Kv: Flow rate coefficient which represents the quantity of water, expressed in m³ at a temperature between 5 and 40 °C, that flows through the valve at a specified travel H with a differential pressure of 1 bar, in a one-hour period. Unit is m³/h.

Cv: Flow rate coefficient, similar to Kv, but in imperial units. The relationship is given by $Kv = 0,865 \cdot Cv$. Unit is gpm.

Kvs: Flow coefficient Kv value of the valve at rated stroke H_{100} . This value is indicated and published on the valve IS – Information sheet. Unit is m³/h.

Kv₁₀₀: Actual Kv flow coefficient of the valve at rated stroke H_{100} . This value may deviate ±10 % from the indicated Kvs.

Pressure drop	MEDIUM		
	Liquids	Saturated steam	Gases
$p_2 > \frac{p_1}{2}$	$Kv = \dot{V}_L \sqrt{\frac{\rho_L}{\Delta p \cdot 1000}}$	$Kv = \frac{\dot{m}_s}{22,4 \cdot \sqrt{\Delta p \cdot p_2}}$	$Kv = \frac{\dot{V}_G}{514} \sqrt{\frac{\rho_G \cdot T}{\Delta p \cdot p_2}}$
$p_2 < \frac{p_1}{2}$		$Kv = \frac{\dot{m}_s}{11,2 \cdot p_1}$	$Kv = \frac{\dot{V}_G}{257 \cdot p_1} \sqrt{\rho_G \cdot T}$

Kv – Flow coefficient [m³/h]

p₁ – Upstream absolute pressure [bar]

p₂ – Downstream absolute pressure [bar]

Δp – Pressure drop (p₁-p₂) [bar]

Ṃ_L – Volumetric flow rate of liquid [m³/h]

Ṃ_G – Volumetric flow rate of gas at 0 °C and 1013 mbar [Nm³/h]

ṁ_s – Mass flow rate of steam [kg/h]

ρ_L – Density of liquid [kg/m³]

ρ_G – Density of gas [kg/m³]

T – Absolute temperature (T = 273 + t [°C]) [K]

The formulas shown in the previous table allow Kv calculation in accordance with the type of fluid and its operating conditions. The valve Kvs can be retrieved from its respective IS – Information sheet.

Control valves: If realistic operating conditions have been considered, as a rule, the calculated Kv should be around 70% to 80% of the selected valve Kvs, hence $Kvs \geq 1,3 \cdot Kv$.

Pressure regulators: In theory the ideal pressure regulator working range is between 10% to 70% of its rated Kvs value. Thus, if realistic operating conditions have been considered the calculated Kv should be at a maximum of 70% of the selected regulator's Kvs, hence $Kvs \geq 1,3 \cdot Kv$.

VALVE SEAT LEAKAGE

ADCAtrol valve sealing	Leakage class acc. to IEC 60534-4	Maximum seat leakage
Metal to metal *	III	$\leq 0,1\%$ of Kvs
Metal to metal Pressure balanced trim	IV	$\leq 0,01\%$ of Kvs
Metal to metal (lapped)	V	$1,8 \cdot 10^{-5} \cdot \Delta p \cdot D$ (l/h) $10,8 \cdot 10^{-6} \cdot D$ (Nm ³ /h)
Soft sealing	VI	$0,3 \cdot \Delta p \cdot f_L$

D – seat diameter in mm. Δp – differential pressure in bar. f_L – leakage rate factor.

Refer to Table 3 in IEC 60534-4 section 5.5 for further details.

* Uncommon.

PIPE SIZING AND FLOW VELOCITY

Pipelines should be calculated considering flowrates and pressure drops, and various known methodologies are known and may be used for this matter. To simplify and especially in cases where pipe lengths are small, sizing can be performed based exclusively on flow and velocity.

The values shown in the following table refer to recommended flow velocities in accordance with the type of fluid.

RECOMMENDED FLOW VELOCITIES [m/s]	
Flash and exhaust steam	15 to 25
Saturated steam	20 to 30
Superheated steam	35 to 65
Feedwater suction	0,5 to 1
Feedwater pressure	1,5 to 3,5
Drinking and service water	1 to 2
Compressed air and most other gases	15 to 20

The pipe inner diameter D in mm is given by

$$D = 18,8 \sqrt{\frac{\dot{V}}{u}}$$

where $\dot{V}$ is the volumetric flow rate in m³/h and u is the pipe flow velocity in m/s.

MASS FLOW RATES OF SATURATED STEAM IN PIPES ACC. TO DIN 2448

p _m [bar]	u [m/s]	FLOW RATE [kg/h]													
		DN 15	DN 20	DN 25	DN 32	DN 40	DN 50	DN 65	DN 80	DN 100	DN 125	DN 150	DN 200	DN 250	DN 300
0,4	15	10	17	28	48	64	103	171	236	397	600	878	1476	2346	3319
	25	17	29	47	80	107	171	285	393	662	1000	1464	2459	3911	5532
	40	28	46	75	128	171	274	456	628	1058	1601	2342	3935	6257	8851
0,6	15	12	20	33	56	76	121	202	278	468	708	1036	1741	2769	3917
	25	20	34	55	94	126	202	336	463	781	1181	1727	2902	4615	6528
	40	33	54	89	151	202	324	538	741	1249	1889	2764	4644	7384	10445
0,8	15	13	22	35	60	81	130	216	297	501	757	1108	1862	2960	4187
	25	22	36	59	101	135	216	360	495	835	1262	1846	3103	4934	6979
	40	35	58	95	161	216	346	575	792	1335	2019	2954	4964	7894	11166
1	15	14	24	39	67	89	143	238	327	552	835	1221	2052	3263	4615
	25	24	40	65	111	149	238	396	546	920	1391	2035	3420	5438	7692
	40	38	64	104	178	238	381	634	873	1472	2226	3256	5471	8700	12307
1,5	15	18	29	48	82	110	176	293	404	681	1030	1507	2532	4026	5694
	25	30	49	80	137	184	294	489	673	1135	1716	2511	4219	6710	9491
	40	47	79	129	219	294	470	783	1078/	1816	2746	4018	6751	10735	15185
2	15	21	35	57	97	131	209	347	478	806	1219	1784	2998	4767	6743
	25	35	58	95	162	218	348	579	797	1344	2032	2973	4996	7945	11238
	40	56	93	152	259	348	557	927	1276	2150	3252	4757	7994	12711	17980
2,5	15	24	40	66	112	151	241	401	553	931	1409	2061	3463	5506	7789
	25	41	67	110	187	251	402	669	921	1552	2348	3435	5771	9177	12982
	40	65	108	176	300	402	643	1070	1474	2484	3756	5495	9234	14684	20770
3	15	28	46	75	127	171	273	454	626	1055	1595	2333	3921	6235	8820
	25	46	76	125	212	285	455	757	1043	1758	2658	3889	6535	10392	14699
	40	73	122	199	339	455	728	1212	1669	2813	4253	6223	10456	16627	23519
4	15	34	56	92	157	211	337	560	771	1300	1966	2876	4833	7685	10871
	25	57	94	154	261	351	561	934	1286	2167	3277	4794	8055	12809	18119
	40	90	150	246	418	561	898	1494	2057	3467	5243	7670	12888	20495	28990
5	15	40	67	109	186	250	400	665	916	1544	2334	3415	5738	9125	12907
	25	67	111	182	310	417	666	1109	1527	2573	3890	5692	9564	15208	21512
	40	107	178	292	496	667	1066	1774	2443	4116	6224	9107	15302	24333	34420
6	15	47	77	127	216	289	463	770	1061	1788	2703	3955	6646	10568	14948
	25	78	129	211	359	482	772	1284	1768	2979	4505	6592	11076	17613	24913
	40	124	206	338	575	772	1235	2054	2829	4767	7208	10546	17722	28180	39861
7	15	53	88	144	244	328	525	873	1202	2026	3064	4482	7532	11977	16941
	25	88	146	239	407	547	875	1455	2004	3377	5106	7470	12553	19961	28235
	40	141	234	383	652	875	1399	2328	3206	5402	8170	11953	20084	31937	45176
8	15	59	98	160	273	366	586	975	1342	2261	3420	5003	8407	13369	18911
	25	98	163	267	455	610	976	1624	2237	3769	5700	8339	14012	22282	31518
	40	157	261	427	727	977	1562	2599	3579	6031	9120	13342	22420	35651	50429
9	15	65	109	178	302	406	649	1080	1487	2506	3790	5545	9318	14816	20958
	25	109	181	296	504	676	1082	1800	2479	4177	6317	9242	15529	24694	34930
	40	174	289	474	806	1082	1731	2880	3966	6683	10107	14787	24847	39510	55888
10	15	72	119	195	331	445	711	1184	1630	2747	4154	6078	10212	16239	22971
	25	119	198	324	552	741	1186	1973	2717	4578/	6923	10129	17021	27066	38285
	40	191	317	519	884	1186	1897	3157	4347	7325	11077	16207	27233	43305	61255
12	15	84	139	228	388	521	834	1388	1911	3220	4869	7124	11971	19036	26926
	25	140	232	380	647	869	1390	2313	3185	5367	8115	11873	19951	31726	44877
	40	224	372	608	1036	1390	2224	3700	5095	8587	12985	18998	31922	50761	71803
14	15	96	160	261	444	596	954	1587	2186	3683	5570	8150	13694	21776	30802
	25	160	266	435	740	994	1590	2645	3643	6139	9284	13583	22823	36293	51336
	40	256	425	696	1185	1591	2544	4233	5829	9823	14854	21732	36517	58068	82138
16	15	108	180	294	501	673	1076	1791	2466	4156	6284	9194	15450	24567	34751
	25	181	300	491	835	1122	1794	2985	4110	6926	10474	15324	25749	40945	57918
	40	289	480	785	1337	1794	2870	4775	6576	11082	16758	24518	41199	65513	92668
18	15	121	201	328	559	750	1199	1995	2748	4631	7003	10245	17215	27375	38722
	25	201	334	547	931	1250	1999	3326	4580	7718	11671	17075	28692	45625	64537
	40	322	535	875	1489	2000	3198	5321	7328	12348	18673	27320	45907	73000	103259
20	15	134	222	363	617	829	1326	2205	3037	5118	7740	11324	19027	30256	42798
	25	223	369	604	1029	1381	2209	3676	5062	8530	12899	18873	31712	50427	71330
	40	356	591	967	1646	2210	3535	5881	8099	13648	20639	30196	50740	80684	114128

p_m – gauge pressure. u – flow velocity.

PROPERTIES OF SATURATED STEAM

p_m [bar]	p [bar]	t_s [°C]	v [m³/kg]	h_f [kcal/kg]	h_f [kJ/kg]	h_{fg} [kcal/kg]	h_{fg} [kJ/kg]	h_g [kcal/kg]	h_g [kJ/kg]
0	1,013	100,0	1,673	100,1	419,1	539,4	2258,4	639,5	2677,5
0,05	1,063	101,4	1,601	101,5	425,0	538,4	2254,2	639,9	2679,1
0,1	1,113	102,6	1,533	102,8	430,4	537,7	2251,2	640,5	2681,6
0,15	1,163	105,1	1,471	104,1	435,8	536,9	2247,9	641,0	2683,7
0,2	1,213	106,2	1,414	105,3	440,9	536,2	2245,0	641,5	2685,8
0,3	1,313	107,4	1,312	107,6	450,5	534,7	2238,7	642,3	2689,2
0,4	1,413	109,5	1,225	109,8	459,7	533,3	2232,8	643,1	2692,5
0,5	1,513	111,6	1,149	111,9	468,5	531,9	2227,0	643,8	2695,5
0,6	1,613	113,5	1,038	113,8	476,5	530,6	2221,5	644,4	2698,0
0,7	1,713	115,4	1,024	115,7	484,4	529,5	2216,9	645,2	2701,3
0,8	1,813	117,1	0,971	117,5	491,9	528,3	2211,9	645,8	2703,8
0,9	1,913	118,8	0,923	119,2	499,1	527,1	2206,9	646,3	2705,9
1	2,013	120,4	0,881	120,8	505,8	526,0	2202,3	646,8	2708,0
1,1	2,113	121,9	0,841	122,4	512,5	525,1	2198,5	647,5	2711,0
1,2	2,213	123,4	0,806	124,0	519,2	524,1	2194,3	648,1	2713,5
1,3	2,313	124,9	0,773	125,4	525,0	523,1	2190,1	648,5	2715,1
1,4	2,413	126,3	0,743	126,8	530,9	522,2	2186,3	649,0	2717,2
1,5	2,513	127,6	0,714	128,1	536,3	521,1	2181,7	649,2	2718,1
1,6	2,613	128,9	0,689	129,5	542,2	520,4	2178,8	649,9	2721,0
1,7	2,713	130,1	0,665	130,7	547,2	519,5	2175,0	650,2	2722,3
1,8	2,813	131,4	0,643	132,0	552,7	518,6	2171,3	650,6	2723,9
1,9	2,913	132,5	0,622	133,2	557,7	517,8	2167,9	651,0	2725,6
2	3,013	133,7	0,603	134,4	562,7	517,0	2164,6	651,4	2727,3
2,2	3,213	135,9	0,568	136,6	571,9	515,5	2158,3	652,1	2730,2
2,4	3,413	138,0	0,536	138,8	581,1	514,0	2152,0	652,8	2733,1
2,6	3,613	140,0	0,509	140,8	589,5	512,6	2146,2	653,4	2735,7
2,8	3,813	141,9	0,483	142,8	597,9	511,2	2140,3	654,0	2738,2
3	4,013	143,7	0,461	144,7	605,8	509,9	2134,8	654,6	2740,7
3,2	4,213	145,4	0,440	146,4	612,9	508,6	2129,4	655,0	2742,4
3,4	4,413	147,2	0,422	148,2	620,5	507,4	2124,4	655,6	2744,9
3,6	4,613	148,8	0,405	149,9	627,6	506,1	2118,9	656,0	2746,5
3,8	4,813	150,4	0,389	151,5	634,3	505,0	2114,3	656,5	2748,6
4	5,013	152,0	0,374	153,1	641,0	503,8	2109,3	656,9	2750,3
4,2	5,213	153,4	0,361	154,6	647,3	502,7	2104,7	657,3	2752,0
4,4	5,413	154,8	0,348	156,1	653,6	501,6	2100,1	657,7	2753,7
4,6	5,613	156,2	0,336	157,6	659,8	500,6	2095,9	658,2	2755,8
4,8	5,813	157,6	0,325	159,0	665,7	499,5	2091,3	658,5	2757,0
5	6,013	158,9	0,315	160,3	671,1	498,5	2087,1	658,8	2758,3
5,5	6,513	162,1	0,292	163,6	685,0	496,1	2077,1	659,7	2762,0
6	7,013	165,0	0,272	166,7	697,9	493,8	2067,4	660,5	2765,4
6,5	7,513	167,8	0,255	169,6	710,1	491,6	2058,2	661,2	2768,3
7	8,013	170,5	0,240	172,4	721,8	489,4	2049,0	661,8	2770,8
7,5	8,513	173,0	0,227	175,1	733,1	487,4	2040,6	662,5	2773,8
8	9,013	175,4	0,215	177,6	743,6	485,4	2032,3	663,0	2775,8
8,5	9,513	177,7	0,204	180,0	753,6	483,5	2024,3	663,5	2777,9
9	10,013	180,0	0,194	182,3	763,3	481,6	2016,4	663,9	2779,6
9,5	10,513	182,1	0,185	184,6	772,9	479,8	2008,8	664,4	2781,7
10	11,013	184,1	0,177	186,8	782,1	478,0	2001,3	664,8	2783,4
11	12,013	188,0	0,163	190,9	799,3	474,6	1987,1	665,5	2786,3
12	13,013	191,7	0,151	194,8	815,6	471,4	1973,7	666,2	2789,2
13	14,013	195,1	0,141	198,5	831,1	468,3	1960,7	666,8	2791,8
14	15,013	198,3	0,132	202,0	845,7	465,3	1948,1	667,3	2793,9
15	16,013	201,4	0,124	205,3	859,6	462,5	1936,4	667,8	2795,9
16	17,013	204,4	0,117	208,5	872,9	459,7	1924,7	668,2	2797,6
17	18,013	207,2	0,110	211,5	885,5	457,0	1913,4	668,5	2798,9
18	19,013	209,9	0,105	214,4	897,8	454,4	1902,5	668,8	2800,1
19	20,013	212,5	0,100	217,2	909,4	451,8	1891,6	669,0	2801,0
20	21,013	215,0	0,095	220,0	921,1	449,4	1881,5	669,4	2802,6
21	22,013	217,3	0,090	222,6	932,0	447,0	1871,5	669,6	2803,5
22	23,013	219,6	0,087	225,1	942,4	444,6	1861,5	669,7	2803,9
23	24,013	221,8	0,083	227,6	952,9	442,2	1851,4	669,8	2804,3
24	25,013	224,0	0,080	230,0	963,0	440,0	1842,2	670,0	2805,2
25	26,013	226,1	0,077	232,3	972,6	437,7	1832,6	670,0	2805,2

p_m – gauge pressure. p – absolute pressure. t_s – saturation temperature. v – specific volume. h_f – specific enthalpy of liquid. h_{fg} – specific enthalpy of vaporization (r). h_g – specific enthalpy of saturated steam.

PROPERTIES OF SUPERHEATED STEAM

p [bar]		Total temperature [°C]															
		200	220	240	260	280	300	320	340	360	380	400	420	440	460	480	500
1	v	2,172	2,266	2,359	2,453	2,546	2,639	2,732	2,824	2,917	3,010	3,102	3,195	3,288	3,380	3,473	3,565
	h	2875,4	2915,0	2954,6	2994,4	3034,4	3074,5	3114,8	3155,3	3196,0	3237,0	3278,2	3319,7	3361,4	3403,4	3445,6	3488,1
2	v	1,0804	1,1280	1,1753	1,2224	1,2693	1,3162	1,3629	1,4095	1,4561	1,5027	1,5492	1,5956	1,6421	1,6885	1,7349	1,7812
	h	2870,5	2910,8	2951,1	2991,4	3031,7	3072,1	3112,6	3153,3	3194,2	3235,4	3276,7	3318,3	3360,1	3402,1	3444,5	3487,0
3	v	0,7164	0,7486	0,7805	0,8123	0,8438	0,8753	0,9066	0,9379	0,9691	1,0003	1,0314	1,0625	1,0935	1,1245	1,1556	1,1865
	h	2865,5	2906,6	2947,5	2988,2	3028,9	3069,7	3110,5	3151,4	3192,4	3233,7	3275,2	3316,8	3358,8	3400,9	3443,3	3486,0
4	v	0,5343	0,5589	0,5831	0,6072	0,6311	0,6549	0,6785	0,7021	0,7256	0,7491	0,7725	0,7959	0,8192	0,8426	0,8659	0,8892
	h	2860,4	2902,3	2943,9	2985,1	3026,2	3067,2	3108,3	3149,4	3190,6	3232,1	3273,6	3315,4	3357,4	3399,7	3442,1	3484,9
5	v	0,4250	0,4450	0,4647	0,4841	0,5034	0,5226	0,5416	0,5606	0,5795	0,5984	0,6172	0,6359	0,6547	0,6734	0,6921	0,7108
	h	2855,1	2898,0	2940,1	2981,9	3023,4	3064,8	3106,1	3147,4	3188,8	3230,4	3272,1	3314,0	3356,1	3398,4	3441,0	3483,8
6	v	0,3520	0,3690	0,3857	0,4021	0,4183	0,4344	0,4504	0,4663	0,4821	0,4979	0,5136	0,5293	0,5450	0,5606	0,5762	0,5918
	h	2849,7	2893,5	2936,4	2978,7	3020,6	3062,3	3103,9	3145,4	3187,0	3228,7	3270,6	3312,6	3354,8	3397,2	3439,8	3482,7
7	v	0,2929	0,3147	0,3292	0,3435	0,3575	0,3714	0,3852	0,3989	0,4125	0,4261	0,4396	0,4531	0,4666	0,4801	0,4935	0,5069
	h	2844,2	2888,9	2932,5	2975,4	3017,7	3059,8	3101,6	3143,4	3185,2	3227,1	3269,0	3311,2	3353,4	3395,9	3439,6	3481,6
8	v	0,2608	0,2740	0,2869	0,1995	0,3119	0,3241	0,3363	0,3483	0,3603	0,3723	0,3842	0,3960	0,4078	0,4196	0,4314	0,4432
	h	2838,6	2884,2	2928,6	2972,1	3014,9	3057,3	3099,4	3141,4	3183,4	3225,4	3267,5	3309,7	3352,1	3394,7	3437,5	3480,5
9	v	0,2303	0,2423	0,2539	0,2653	0,2764	0,2874	0,2983	0,3090	0,3197	0,3304	0,3410	0,3516	0,3621	0,3726	0,3831	0,3936
	h	2832,7	2879,5	2924,6	2968,7	3012,0	3054,7	3097,1	3139,4	3181,6	3223,7	3266,0	3308,3	3350,8	3393,5	3436,3	3479,4
10	v	0,2059	0,2169	0,2276	0,2379	0,2480	0,2580	0,2678	0,2776	0,2873	0,2969	0,3065	0,3160	0,3256	0,3350	0,3445	0,3540
	h	2826,8	2874,6	2920,6	2965,2	3009,0	3052,1	3094,9	3137,4	3179,7	3222,0	3264,4	3306,9	3349,5	3392,2	3435,1	3478,3
11	v	0,1859	0,1961	0,2060	0,2155	0,2248	0,2339	0,2429	0,2518	0,2607	0,2695	0,2782	0,2870	0,2956	0,3043	0,3129	0,3215
	h	2820,7	2869,6	2916,4	2961,8	3006,0	3049,6	3092,6	3135,3	3177,9	3220,3	3262,9	3305,4	3348,1	3391,0	3434,0	3477,2
12	v	0,1692	0,1788	0,1879	0,1968	0,2054	0,2139	0,2222	0,2304	0,2386	0,2467	0,2547	0,2627	0,2707	0,2787	0,2866	0,2945
	h	2814,4	2864,5	2912,2	2958,2	3003,0	3046,9	3090,3	3133,2	3176,0	3218,7	3261,3	3304,0	3346,8	3389,7	3432,8	3476,1
13	v	0,1551	0,1641	0,1727	0,1810	0,1890	0,1969	0,2046	0,2123	0,2198	0,2273	0,2348	0,2422	0,2496	0,2570	0,2643	0,2716
	h	2808,0	2859,3	2908,0	2954,7	3000,0	3044,3	3088,0	3131,2	3174,1	3217,0	3259,2	3302,5	3345,4	3388,5	3431,6	3475,0
14	v	0,1429	0,1515	0,1596	0,1674	0,1749	0,1823	0,1896	0,1967	0,2038	0,2108	0,2177	0,2246	0,2315	0,2384	0,2452	0,2520
	h	2801,4	2854,0	2903,6	2951,0	2996,9	3041,6	3085,6	3129,1	3172,3	3215,3	3258,2	3301,1	3344,1	3387,2	3430,5	3473,9
15	v	0,1324	0,1406	0,1483	0,1556	0,1628	0,1697	0,1765	0,1832	0,1898	0,1964	0,2029	0,2094	0,2158	0,2223	0,2287	0,2350
	h	2794,7	2848,6	2899,2	2947,3	2993,7	3038,9	3083,3	3127,0	3170,4	3213,5	3256,6	3299,7	3342,8	3386,0	3429,3	3472,8
16	v	–	0,1310	0,1383	0,1453	0,1521	0,1587	0,1651	0,1714	0,1777	0,1838	0,1900	0,1961	0,2021	0,2082	0,2142	0,2202
	h	–	2843,1	2894,7	2943,6	2990,6	3036,2	3080,9	3124,9	3168,5	3211,8	3255,0	3298,2	3341,4	3384,7	3428,1	3471,7
18	v	–	0,1150	0,1217	0,1282	0,1343	0,1402	0,1460	0,1517	0,1573	0,1629	0,1684	0,1738	0,1793	0,1847	0,1900	0,1954
	h	–	2831,7	2885,4	2935,9	2984,1	3030,7	3076,1	3120,6	3164,7	3208,4	3251,9	3295,3	3338,7	3382,2	3425,8	3469,5
20	v	–	0,1021	0,1084	0,1144	0,1200	0,1255	0,1308	0,1360	0,1411	0,1461	0,1511	0,1561	0,1610	0,1659	0,1707	0,1756
	h	–	2819,9	2875,9	2928,1	2977,5	3025,0	3071,2	3116,3	3160,8	3204,9	3248,7	3292,4	3336,0	3379,7	3423,4	3467,3
22	v	–	0,09152	0,09752	0,10309	0,10837	0,11343	0,11833	0,12311	0,12780	0,13243	0,13700	0,14152	0,14602	0,15048	0,15492	0,15934
	h	–	2807,5	2866,0	2920,0	2970,8	3019,3	3066,2	3112,0	3156,9	3201,4	3245,5	3289,4	3333,3	3377,1	3421,1	3465,1
24	v	–	–	0,08839	0,09367	0,09863	0,10336	0,10793	0,11237	0,11672	0,12100	0,12522	0,12940	0,13355	0,13766	0,14175	0,14582
	h	–	–	2855,7	2911,6	2963,8	3013,4	3061,1	3107,5	3153,0	3197,8	3242,3	3286,5	3330,6	3374,6	3418,7	3462,9
26	v	–	–	0,08064	0,08567	0,09037	0,09483	0,09912	0,10328	0,10734	0,11133	0,11526	0,11914	0,12299	0,12681	0,13061	0,13438
	h	–	–	2845,2	2903,0	2956,7	3007,4	3056,0	3103,0	3149,0	3194,3	3239,0	3283,5	3327,8	3372,1	3416,3	3460,6
28	v	–	–	0,07397	0,07880	0,08328	0,08751	0,09156	0,09548	0,09929	0,10303	0,10671	0,11035	0,11395	0,11752	0,12106	0,12458
	h	–	–	2834,2	2894,2	2949,5	3001,3	3050,8	3098,5	3145,0	3190,7	3235,8	3280,5	3325,1	3369,5	3413,9	3458,4
30	v	–	–	0,06816	0,07283	0,07712	0,08116	0,08500	0,08871	0,09232	0,09584	0,09931	0,10273	0,10611	0,10946	0,11278	0,11608
	h	–	–	2822,9	2885,1	2942,0	2995,1	3045,4	3093,9	3140,9	3187,0	3232,5	3277,5	3322,3	3367,0	3411,6	3456,2
32	v	–	–	0,06305	0,06759	0,07173	0,07559	0,07926	0,08279	0,08621	0,08955	0,09283	0,09606	0,09925	0,10241	0,10554	0,10865
	h	–	–	2811,2	2875,8	2934,4	2988,7	3040,0	3089,2	3136,8	3183,4	3229,2	3274,5	3319,5	3364,4	3409,2	3454,0
34	v	–	–	–	0,06295	0,06695	0,07068	0,07419	0,07756	0,08082	0,08400	0,08711	0,09017	0,09319	0,09618	0,09915	0,10209
	h	–	–	–	2866,2	2926,6	2982,2	3034,5	3084,4	3132,7	3179,7	3225,9	3271,5	3316,8	3361,8	3406,8	3451,7
36	v	–	–	–	0,05880	0,06270	0,06630	0,06968	0,07291	0,07603	0,07906	0,08202	0,08494	0,08781	0,09065	0,09347	0,09626
	h	–	–	–	2856,3	2918,6	2975,6	3028,9	3079,6	3128,4	3175,9	3222,5	3268,4	3314,0	3359,2	3404,4	3449,5
38	v	–	–	–	0,05508	0,05888	0,06237	0,06564	0,06875	0,07174	0,07464	0,07747	0,08025	0,08300	0,08570	0,08838	0,09104
	h	–	–	–	2846,1	2910,4	2968,9	3023,3	3074,8	3124,2	3172,2	3219,1	3265,4	3311,2	3356,6	3402,0	3447,2
40	v	–	–	–	0,05172	0,05544	0,05883	0,06200	0,06499	0,06787	0,07066	0,07338	0,07604	0,07866	0,08125	0,08381	0,08634
	h	–	–	–	2835,6	2902,0	2962,0	3017,5	3069,8	3119,9	3168,4	3215,7	3262,3	3308,3	3354,0	3399,6	3445,0

p – absolute pressure. v – specific volume in m³/kg. h – specific enthalpy of superheated steam (total heat) in kJ/kg.

PROPERTIES OF SUPERHEATED STEAM (CONTINUED)

p [bar]		Total temperature [°C]												
		260	280	300	320	340	360	380	400	420	440	460	480	500
42	v	0,04865	0,05231	0,05562	0,05870	0,06160	0,06437	0,06706	0,06967	0,07222	0,07474	0,07722	0,07967	0,08209
	h	2824,8	2893,5	2955,0	3011,6	3064,8	3115,5	3164,5	3212,3	3259,2	3305,5	3351,4	3397,7	3442,7
44	v	0,04585	0,04946	0,05270	0,05569	0,05850	0,06119	0,06378	0,06630	0,06876	0,07117	0,07355	0,07590	0,07823
	h	2813,6	2884,7	2947,8	3005,7	3059,7	3111,1	3160,6	3208,8	3256,0	3302,6	3348,8	3394,7	3440,5
46	v	0,04328	0,04685	0,05003	0,05294	0,05568	0,05828	0,06079	0,06321	0,06559	0,06791	0,07020	0,07247	0,07470
	h	2802,0	2875,6	2940,5	2999,6	3054,6	3106,7	3156,7	3205,3	3252,9	3299,8	3346,2	3392,3	3438,2
48	v	–	0,04444	0,04757	0,05042	0,05309	0,05561	0,05604	0,06039	0,06268	0,06493	0,06714	0,06931	0,07147
	h	–	2866,4	2933,1	2993,4	3049,4	3102,2	3152,8	3201,8	3249,7	3296,9	3343,5	3389,8	3435,9
50	v	–	0,04222	0,04530	0,04810	0,05070	0,05316	0,05551	0,05779	0,06001	0,06218	0,06431	0,06642	0,06849
	h	–	2856,9	2925,5	2987,2	3044,1	3097,6	3148,8	3198,3	3246,6	3294,0	3340,9	3387,4	3433,7
55	v	–	0,03733	0,04034	0,04302	0,04549	0,04780	0,05001	0,05213	0,05419	0,05620	0,05817	0,06011	0,06202
	h	–	2831,8	2905,7	2971,0	3030,5	3085,9	3138,6	3189,3	3238,5	3286,7	3334,2	3381,2	3427,9
60	v	–	0,03317	0,03614	0,03874	0,04111	0,04330	0,04539	0,04738	0,04931	0,05118	0,05302	0,05482	0,05659
	h	–	2804,9	2885,0	2954,2	3016,5	3074,0	3128,3	3180,1	3230,3	3279,3	3327,4	3375,0	3422,2
70	v	–	–	0,02946	0,03198	0,03420	0,03623	0,03812	0,03992	0,04165	0,04331	0,04494	0,04653	0,04809
	h	–	–	2839,4	2918,3	2987,0	3049,1	3106,7	3161,2	3213,5	3264,2	3313,7	3362,4	3410,6
80	v	–	–	0,02426	0,02681	0,02896	0,03088	0,03265	0,03431	0,03589	0,03740	0,03887	0,04030	0,04170
	h	–	–	2786,8	2878,7	2955,3	3022,7	3084,2	3141,6	3196,2	3248,7	3299,7	3349,6	3398,8
90	v	–	–	–	0,02269	0,02484	0,02669	0,02837	0,02993	0,03140	0,03280	0,03415	0,03546	0,03674
	h	–	–	–	2834,3	2920,9	2994,8	3060,5	3121,2	3178,2	3232,7	3285,3	3336,5	3386,8
100	v	–	–	–	0,01926	0,02147	0,02331	0,02493	0,02641	0,02779	0,02911	0,03036	0,03158	0,03276
	h	–	–	–	2783,5	2883,4	2964,8	3035,7	3099,9	3159,7	3216,2	3270,5	3323,2	3374,6
110	v	–	–	–	0,01628	0,01864	0,02049	0,02208	0,02351	0,02483	0,02608	0,02726	0,02840	0,02950
	h	–	–	–	2723,5	2841,7	2932,8	3009,6	3077,8	3140,5	3199,4	3255,5	3309,6	3362,2
120	v	–	–	–	–	0,01619	0,01811	0,01969	0,02108	0,02236	0,02355	0,02467	0,02575	0,02679
	h	–	–	–	–	2794,7	2898,1	2982,0	3054,8	3120,7	3182,0	3240,0	3295,7	3349,6
130	v	–	–	–	–	0,01401	0,01604	0,01764	0,01902	0,02025	0,02140	0,02247	0,02350	0,02440
	h	–	–	–	–	2740,6	2860,2	2952,7	3030,7	3100,2	3164,1	3224,2	3281,6	3336,8
140	v	–	–	–	–	0,01200	0,01421	0,01586	0,01723	0,01844	0,01955	0,02059	0,02157	0,02251
	h	–	–	–	–	2675,7	2818,1	2921,4	3005,6	3079,0	3145,8	3208,1	3267,1	3323,8
150	v	–	–	–	–	–	0,01256	0,01428	0,01566	0,01686	0,01794	0,01895	0,01989	0,02080
	h	–	–	–	–	–	2770,8	2887,7	2979,1	3057,0	3126,9	3191,5	3252,4	3310,6
160	v	–	–	–	–	–	0,01104	0,01287	0,01427	0,01546	0,01653	0,01751	0,01842	0,01929
	h	–	–	–	–	–	2716,5	2851,1	2951,3	3034,2	3107,5	3174,5	3237,4	3297,1
180	v	–	–	–	–	–	0,008104	0,01040	0,01191	0,01311	0,01416	0,01510	0,01597	0,01678
	h	–	–	–	–	–	2569,1	2766,6	2890,3	2985,8	3066,9	3139,4	3206,5	3269,6
200	v	–	–	–	–	–	–	0,008246	0,009947	0,01120	0,01224	0,01315	0,01399	0,01477
	h	–	–	–	–	–	–	2660,2	2820,5	2932,9	3023,7	3102,7	3174,4	3241,1
250	v	–	–	–	–	–	–	–	0,006014	0,007580	0,008696	0,009609	0,01041	0,01113
	h	–	–	–	–	–	–	–	2582,0	2774,1	2901,7	3002,3	3088,5	3165,9

p – absolute pressure. v – specific volume in m³/kg. h – specific enthalpy of superheated steam (total heat) in kJ/kg.

PROPERTIES OF WATER

t [°C]	ρ [kg/m³]	v [dm³/kg]	Ca [kcal/kg °C]	λ [kcal/m h °C]	t [°C]	ρ [kg/m³]	v [dm³/kg]	Ca [kcal/kg °C]	λ [kcal/m h °C]
0	999,87	1,00013	–	–	70	977,81	1,02269	1,0002	0,57
4	999,99	1,00001	–	–	71	977,23	1,0233	–	–
6	999,97	1,00003	–	–	72	976,66	1,0239	–	–
8	999,89	1,00011	–	–	73	976,07	1,02452	–	–
10	999,75	1,00025	1	0,493	74	975,48	1,02514	–	–
12	999,55	1,00045	–	–	75	974,89	1,02576	1,0013	0,574
14	999,3	1,0007	–	–	76	974,29	1,02639	–	–
16	999	1,001	–	–	77	973,68	1,02703	–	–
18	998,65	1,00135	–	–	78	973,07	1,02768	–	–
20	998,2	1,0018	1	0,51	79	972,45	1,02833	–	–
22	997,83	1,00217	–	–	80	971,83	1,02899	1,0025	0,577
24	997,37	1,00264	–	–	81	971,21	1,02964	–	–
26	996,87	1,00314	–	–	82	970,57	1,03032	–	–
28	996,33	1,00368	–	–	83	969,94	1,03099	–	–
30	995,76	1,00426	1	0,526	84	969,3	1,03167	–	–
32	995,12	1,0049	–	–	85	968,65	1,03236	1,0037	0,58
34	994,49	1,00554	–	–	86	968	1,03306	–	–
36	993,74	1,0063	–	–	87	967,34	1,03376	–	–
38	993,02	1,00703	–	–	88	966,68	1,03447	–	–
40	992,24	1,00782	1	0,539	89	966,01	1,03519	–	–
41	991,86	1,00821	–	–	90	965,34	1,0359	1,0049	0,582
42	991,47	1,0086	–	–	91	964,67	1,03662	–	–
43	991,07	1,00901	–	–	92	963,99	1,03736	–	–
44	990,66	1,00943	–	–	93	963,3	1,0381	–	–
45	990,25	1,00985	–	–	94	962,61	1,03884	–	–
46	989,82	1,01028	–	–	95	961,92	1,03959	1,006	0,584
47	989,4	1,01071	–	–	96	961,22	1,04034	–	–
48	988,96	1,01116	–	–	97	960,51	1,04111	–	–
49	988,52	1,01161	–	–	98	959,81	1,04187	–	–
50	988,07	1,01207	1	0,551	99	959,09	1,04266	–	–
51	987,62	1,01254	–	–	100	958,38	1,04343	1,0061	0,586
52	987,15	1,01302	–	–	105	–	–	1,0071	0,588
53	986,69	1,01349	–	–	110	951	1,0515	1,0084	0,589
54	986,21	1,01398	–	–	115	–	–	1,0098	0,59
55	985,73	1,01448	1	0,556	120	943,1	1,0603	1,0114	0,591
56	985,25	1,01497	–	–	125	–	–	1,0132	0,591
57	984,75	1,01549	–	–	130	934,8	1,0697	1,0152	0,592
58	984,25	1,016	–	–	135	–	–	1,0175	0,592
59	983,75	1,01652	–	–	140	926,1	1,0798	1,02	0,592
60	983,24	1,01705	1	0,561	145	–	–	1,0228	0,591
61	982,72	1,01758	–	–	150	916,9	1,0906	1,0258	0,591
62	982,2	1,01812	–	–	160	907,4	1,1021	1,0328	0,589
63	981,67	1,01867	–	–	170	897,3	1,1144	1,0411	0,586
64	981,13	1,01923	–	–	180	886,9	1,1275	1,0507	0,582
65	980,59	1,01979	1	0,566	190	876	1,1415	1,0619	0,578
66	980,05	1,02036	–	–	200	864,7	1,1565	1,0746	0,572
67	979,5	1,02093	–	–	210	–	–	1,089	0,565
68	978,94	1,02151	–	–	220	–	–	1,1052	0,558
69	978,38	1,0221	–	–	230	–	–	1,1234	0,55

t – temperature. ρ – density. v – specific volume. Ca – actual specific heat capacity at t. λ – thermal conductivity at t.

Remark: To convert specific volume from cubic decimeters per kilogram (dm³/kg) to cubic meters per kilogram (m³/kg) divide values by 10³.

PROPERTIES OF GASES

Gas	Formula	ρ [kg/m ³]	t_f [°C]	t_b [°C]	ρ_b [kg/m ³]	v [m ³ /kg]	C_p [kcal/kg h °C]	λ [kcal/m h °C]
Acetone	C ₃ H ₆ O	2,591	-94,8	56,2	749	0,386	0,296	0,0083
Acetylene	C ₂ H ₂	1,162	-83,3	-83,6	613	0,861	0,386	0,0158
Ammonia	NH ₃	0,76	-77,9	-33,4	680	1,316	0,491	0,0187
Argon	Ar	1,782	189,2	-185,7	1820	0,561	0,125	0,014
Benzole	C ₆ H ₆	3,485	–	–	–	0,287	0,227	0,0076
Butane	C ₄ H ₁₀	2,593	-138,4	-0,5	602	0,386	0,382	0,0119
Carbon dioxide	CO ₂	1,964	-56,6	-78,2	1219	0,509	0,195	0,0122
Carbon disulphide	CS ₂	3,397	–	–	–	0,294	0,139	0,0058
Carbon monoxide	CO	1,25	-205	-191,6	801	0,8	0,248	0,0191
Chlorine	Cl ₂	3,164	-101	-34,6	1512	0,316	0,116	0,0073
Diethyl ether	C ₄ H ₁₀ O	3,307	–	–	–	0,302	0,345	0,0108
Dry air	–	1,293	-213	-192,3	875	0,773	0,24	0,0209
Ethane	C ₂ H ₆	1,342	-183,3	-88,6	546	0,745	0,394	0,0155
Ethyl alcohol	C ₂ H ₆ O	2,055	-114,2	78,3	747	0,487	0,364	0,0119
Ethylene	C ₂ H ₄	1,251	-169,5	-103,7	568	0,799	0,349	0,0144
Helium	He	0,179	-272,2	-268,9	125	5,599	1,25	0,1233
Hydrochloric acid	HCl	1,627	-111,2	-84,8	1135	0,615	0,19	0,0072
Hydrogen	H ₂	0,09	-259,1	-252,9	71	11,118	3,45	0,1508
Hydrogen sulphide	H ₂ S	1,52	-85,6	-60,4	957	0,658	0,237	0,0108
Methane	CH ₄	0,716	-182,5	-161,5	415	1,397	0,517	0,0263
Methyl alcohol	CH ₄ O	1,429	-97,6	64,7	737	0,7	0,32	0,012
Nitrogen	N ₂	1,25	-209,9	-195,8	810	0,8	0,247	0,0205
Oxygen	O ₂	1,428	-218,4	-183	1131	0,7	0,218	0,0208
Propane	C ₃ H ₈	1,968	-187,7	-42,1	585	0,508	0,37	0,013
Propylene	C ₃ H ₆	1,877	-185	-47,8	686	0,533	0,34	–
Sulfur dioxide	SO ₂	2,858	–	–	–	0,35	0,14	0,0072

ρ – density. t_f – melting temperature. t_b – boiling temperature. ρ_b – density of liquid at t_b . v – specific volume. C_p – specific heat capacity at constant pressure. λ – thermal conductivity of substance.

Remark: Values are referenced to 0 °C and 1013,25 mbar.

DENSITY OF DRY AIR [kg/m³]

t [°C]	GAUGE PRESSURE [bar]										
	0	0,5	1	1,5	2	2,5	3	3,5	4	4,5	5
0	1,293	1,931	2,569	3,207	3,845	4,483	5,121	5,759	6,397	7,036	7,674
10	1,247	1,863	2,478	3,094	3,709	4,325	4,941	5,556	6,172	6,787	7,403
20	1,205	1,799	2,394	2,988	3,583	4,177	4,772	5,367	5,961	6,556	7,150
30	1,165	1,740	2,315	2,890	3,465	4,040	4,615	5,189	5,764	6,339	6,914
40	1,128	1,684	2,241	2,798	3,354	3,911	4,467	5,024	5,580	6,137	6,693
50	1,093	1,632	2,172	2,711	3,250	3,790	4,329	4,868	5,408	5,947	6,486
60	1,060	1,583	2,106	2,630	3,153	3,676	4,199	4,722	5,245	5,768	6,292
70	1,029	1,537	2,045	2,553	3,061	3,569	4,077	4,585	5,092	5,600	6,108
80	1,000	1,494	1,987	2,481	2,974	3,468	3,961	4,455	4,948	5,442	5,935
90	0,973	1,453	1,932	2,412	2,892	3,372	3,852	4,332	4,812	5,292	5,772
100	0,947	1,414	1,881	2,348	2,815	3,282	3,749	4,216	4,683	5,150	5,617
110	0,922	1,377	1,832	2,286	2,741	3,196	3,651	4,106	4,561	5,016	5,471
120	0,898	1,342	1,785	2,228	2,672	3,115	3,558	4,002	4,445	4,888	5,331
130	0,876	1,308	1,741	2,173	2,605	3,038	3,470	3,902	4,335	4,767	5,199
140	0,855	1,277	1,699	2,120	2,542	2,964	3,386	3,808	4,230	4,651	5,073
150	0,835	1,247	1,658	2,070	2,482	2,894	3,306	3,718	4,130	4,542	4,953
160	0,815	1,218	1,620	2,023	2,425	2,827	3,230	3,632	4,034	4,437	4,839
170	0,797	1,190	1,584	1,977	2,370	2,763	3,157	3,550	3,943	4,337	4,730
180	0,779	1,164	1,549	1,933	2,318	2,702	3,087	3,472	3,856	4,241	4,626
190	0,763	1,139	1,515	1,891	2,268	2,644	3,020	3,397	3,773	4,149	4,526
200	0,746	1,115	1,483	1,852	2,220	2,588	2,957	3,325	3,693	4,062	4,430
220	0,716	1,070	1,423	1,776	2,130	2,483	2,837	3,190	3,543	3,897	4,250
240	0,688	1,028	1,368	1,707	2,047	2,386	2,726	3,066	3,405	3,745	4,085
260	0,662	0,989	1,316	1,643	1,970	2,297	2,624	2,951	3,278	3,605	3,931
280	0,639	0,954	1,269	1,584	1,899	2,214	2,529	2,844	3,159	3,474	3,789
300	0,616	0,920	1,224	1,528	1,833	2,137	2,441	2,745	3,049	3,353	3,657

t [°C]	GAUGE PRESSURE [bar]										
	6	7	8	9	10	12	14	16	18	20	25
0	8,950	10,226	11,502	12,778	14,054	16,606	19,159	21,711	24,263	26,815	33,196
10	8,634	9,865	11,096	12,327	13,558	16,020	18,482	20,944	23,406	25,868	32,024
20	8,339	9,528	10,717	11,906	13,095	15,473	17,852	20,230	22,608	24,986	30,931
30	8,064	9,214	10,364	11,514	12,663	14,963	17,263	19,562	21,862	24,162	29,911
40	7,807	8,920	10,033	11,146	12,259	14,485	16,711	18,938	21,164	23,390	28,956
50	7,565	8,644	9,722	10,801	11,880	14,037	16,194	18,352	20,509	22,666	28,060
60	7,338	8,384	9,430	10,470	11,523	13,616	15,708	17,800	19,893	21,986	27,217
70	7,124	8,140	9,156	10,171	11,187	13,219	15,250	17,280	19,314	21,345	26,424
80	6,922	7,909	8,896	9,883	10,870	12,845	14,819	16,793	18,767	20,741	25,676
90	6,732	7,692	8,651	9,611	10,571	12,491	14,411	16,330	18,250	20,170	24,969
100	6,551	7,485	8,420	9,354	10,288	12,156	14,024	15,893	17,761	19,629	24,300
110	6,380	7,290	8,200	9,110	10,019	11,839	13,658	15,478	17,297	19,117	23,666
120	6,218	7,105	7,991	8,878	9,764	11,538	13,311	15,084	16,857	18,631	23,064
130	6,064	6,928	7,793	8,658	9,522	11,252	12,981	14,710	16,439	18,168	22,492
140	5,917	6,761	7,604	8,448	9,292	10,979	12,667	14,354	16,041	17,729	21,947
150	5,777	6,601	7,425	8,248	9,072	10,720	12,367	14,015	15,662	17,310	21,429
160	5,644	6,449	7,253	8,058	8,863	10,472	12,082	13,691	15,301	16,910	20,934
170	5,516	6,303	7,090	7,876	8,663	10,236	11,809	13,382	14,955	16,529	20,461
180	5,395	6,164	6,933	7,702	8,472	10,010	11,548	13,087	14,625	16,164	20,010
190	5,278	6,031	6,783	7,536	8,289	9,794	11,299	12,804	14,310	15,815	19,578
200	5,167	5,903	6,640	7,377	8,114	9,587	11,060	12,534	14,007	15,481	19,164
220	4,957	5,664	6,371	7,078	7,784	9,198	10,612	12,025	13,439	14,853	18,387
240	4,764	5,443	6,123	6,802	7,481	8,840	10,198	11,557	12,915	14,274	17,670
260	4,585	5,243	5,893	6,547	7,200	8,508	9,816	11,123	12,431	13,738	17,007
280	4,419	5,050	5,680	6,310	6,940	8,200	9,461	10,721	11,981	13,242	16,392
300	4,265	4,873	5,482	6,090	6,698	7,914	9,131	10,347	11,563	12,780	15,820

t – temperature.

PROPERTIES OF LIQUIDS

Liquid	t _{ref} [°C]	ρ [kg/m³]	Ca [kcal/kg °C]	λ [kcal/m h °C]	Liquid	t _{ref} [°C]	ρ [kg/m³]	Ca [kcal/kg °C]	λ [kcal/m h °C]
Acetic acid	25	1049	0,51	0,166	Methane	-90	162	–	–
Acetone	20	790	0,515	0,139	Methanol	20	791	0,33	–
Ammonia solution (25%)	20	771	–	0,425	Methyl alcohol (95% vol.)	20	792	0,596	0,174
Apple juice	20	1356	0,446	–	Milk, cow, heavy cream	20	994	0,94	0,434
Argon	-186	1430	–	–	Naphta	15	665	0,92	–
Automobile oils	15	880 - 940	–	0,125	Nitric acid	20	1520	0,411	0,456
Beer	10	1010	–	–	Nitrogen	-201	808	–	–
Benzene	20	870	0,43	0,138	Oil, coconut	20	924	–	–
Benzole	20	879	0,43	0,132	Oil, corn	20	922	–	–
	80	–	0,44	0,13	Oil, castor	25	956,1	0,43	0,155
Butane	25	599	0,55	–	Oil, cotton seed	15	926	–	–
Butter	20	911	0,56 - 0,69	–	Oil, olive	10	918	0,47	0,146
Carbon tetrachloride	25	1584	0,207	0,089	Oil, palm	20	915	–	–
Carbon disulphide	20	1266	0,241	0,138	Oil, soya	20	927	0,47	–
Chloride	25	1560	–	–	Oil, sunflower	20	920	–	–
Chloroform	20	1489	0,251	0,11	Oil, peanut	20	914	–	–
Citric acid	25	1660	–	–	Oil, whale	15	925	–	–
Crude oil	20	900	–	0,113	Oxygen (liquid)	-186	1155	–	–
Diesel	20	800	–	–	Petrol	30	680 - 710	0,45	0,112
Ethane (liquid)	-89	570	–	–	Phenol	25	1072	0,34	0,163
Ethyl acetate	20	901	–	–	Propanol	25	804	–	–
Ethyl alcohol (95% vol.)	0	789	0,547	0,166	Propyl alcohol	25	800	0,57	0,138
	40	–	0,648	0,144	Sea water	25	1025	0,94	–
Fuel oil	20	840 - 920	0,471	0,103	Sodium carbonate	20	2530	0,86	0,516
Gasoline	20	803	0,53	0,129	Sodium Hydroxide (caustic soda)	15	1250	0,77	0,37
Glycerine	10	1260	0,576	0,25	Sulphuric acid	12	1853	0,33	0,28
Glycerol	25	1126	–	–	Sulphurous acid (96%)	20	1840	0,351	0,43
Helium	-271	147	–	–	Water	8	999,88	1	0,485
Honey	20	1420	0,54 - 0,6	0,00648		41	991,66	1	0,538
Hydrazine	25	795	–	–		72	976,36	1	0,58
Hydrochloric acid (25%)	20	1150	0,75	0,404		100	958,38	1,006	0,586
Kerosene	16	820,1	0,48	0,125		200	0 - 200	1,037	0,572

t_{ref} – reference temperature. ρ – density at 20 °C. v – specific volume. Ca – actual specific heat capacity at t_{ref}. λ – thermal conductivity at t_{ref}.

PROPERTIES OF THE ELEMENTS

Element	Symbol	Atomic number	Mass number *	t _f [°C]	t _b [°C]	Element	Symbol	Atomic number	Mass number *	t _f [°C]	t _b [°C]
Actinium	Ac	89	(227)	1600	–	Mendelevium	Mv	101	(256)	–	–
Aluminum	Al	13	27	659.7	2057	Mercury	hg	80	202	-38.87	356.58
Americum	Am	95	(243)	–	–	Molybdenum	Mo	42	98	2620±10	4800
Antimony	Sb	51	121	630.5	1380	Neodymium	Nd	60	142	840	–
Argon	Ar	18	40	-189.2	-185.7	Neon	Ne	10	20	-248.67	-245.9
Arsenic	As	33	75	–	–	Neptunium	Np	93	(237)	–	–
Astatine	At	85	(210)	–	–	Nickel	Ni	28	58	1455	2900
Barium	Ba	56	138	850	1140	Niobium	Nb	41	93	2500±50	3700
Berkelium	Bk	97	(247)	–	–	Nitrogen	N	7	14	-209.86	-195.8
Beryllium	Be	4	9	1278±5	2970	Nobelium	No	102	(253)	–	–
Bismuth	Bi	83	209	271.3	1560±5	Osmium	Os	76	192	2700	>5300
Boron	B	5	11	2300	2550	Oxygen	O	8	16	-218.4	-182.86
Bromine	Br	35	79	-7.2	58.78	Palladium	Pd	46	106	1549.4	2000
Cadmium	Cd	48	114	320.9	767±2	Phosphorus	P	15	31	–	–
Calcium	Ca	20	40	842±8	1240	Platinum	Pt	78	195	1773.5	4300
Californium	Cf	98	(249)	–	–	Plutonium	Pu	94	(242)	–	–
Carbon	C	6	12	>3550	4200	Polonium	Po	84	(209)	–	–
Cerium	Ce	58	140	804	1400	Potassium	K	19	39	53.3	760
Cesium	Cs	55	133	-103±5	670	Praseodymium	Pr	59	141	940	–
Chlorine	Cl	17	35	28.5	-34.6	Promethium	Pm	61	(145)	–	–
Chromium	Cr	24	52	1890	2480	Protactinium	Pa	91	(231)	–	–
Cobalt	Co	27	59	1495	2900	Radium	Ra	88	(226)	700	–
Copper	Cu	29	63	1083	2336	Radon	Rn	86	(222)	-71	1140
Curium	Cm	96	(248)	–	–	Rhenium	Re	75	187	3167±60	-61.8
Dysprosium	Dy	66	164	–	–	Rhodium	Rh	45	103	1966±3	>2500
Einsteinium	Es	99	(254)	–	–	Rubidium	Rb	37	85	38.5	700
Erbium	Er	68	166	–	–	Ruthenium	Ru	44	102	2450	2700
Europium	Eu	63	153	1150±50	–	Samarium	Sm	62	152	>1300	–
Fermium	Fm	100	(252)	–	–	Scandium	Sc	21	45	1200	2400
Fluourine	F	9	19	-223	-188	Selenium	Se	34	80	217	688
Francium	Fr	87	(223)	–	–	Silicon	Si	14	28	1420	2355
Gadolinium	Gd	64	158	–	–	Silver	Ag	47	107	960.8	1950
Gallium	Ga	31	69	29.78	1983	Sodium	Na	11	23	97.5	880
Germanium	Ge	32	74	958.5	2700	Strontium	Sr	38	88	800	1150
Gold	Au	79	197	1063	2600	Sulfur	S	16	32	–	–
Hafnium	hf	72	180	–	–	Tantalum	Ta	73	180	2996±50	–
Helium	he	2	4	-272	-268.9	Technetium	Tc	43	(99)	–	–
Holmium	ho	67	165	–	–	Tellurium	Te	52	130	452	1390
Hydrogen	h	1	1	-259.14	-252.8	Terbium	Tb	65	159	327±5	–
Indium	In	49	115	156.4	2000±10	Thallium	Tl	81	205	302	1457±10
Iodine	I	53	127	113.7	184.35	Thorium	Th	90	232	1845	4500
Iridium	Ir	77	193	2454	>4800	Thulium	Tm	69	169	–	–
Iron	Fe	26	56	1535	3000	Tin	Sn	50	120	231.89	2270
Krypton	Kr	36	84	-156.6	-152.9	Titanium	Ti	22	48	1800	>3000
Lanthanum	La	57	139	826	–	Tungsten	W	74	184	3370	5900
Lawrencium	Lw	103	(257)	–	–	Uranium	U	92	238	1133	–
Lead	Pb	82	208	327.43	1620	Vanadium	V	23	51	1710	3000
Lithium	Li	3	7	186	1336±5	Xenon	Xe	54	132	-112	-107.1
Lutetium	Lu	71	175	–	–	Ytterbium	Yb	70	174	1800	–
Magnesium	Mg	12	24	651	1107	Yttrium	Y	39	89	1490	2500
Manganese	Mn	25	55	1260	1900	Zinc	Zn	30	64	419.47	907
–	–	–	–	–	–	Zirconium	Zr	40	90	1857	>2900

t_f – melting temperature. t_b – boiling temperature.

* From the most common and stable isotop. Values in parentheses refer to the isotope with the longest half-life for those elements having an unstable isotope.

PROPERTIES AND COMPATIBILITY OF ELASTOMERS

Elastomer	NITRILE (NBR)	ETHYLENE-PROPYLENE (EPDM)	NEOPRENE (CR)	SILICONE (VMQ)	POLY-URETHANE (EU)	FLUORO-ELASTOMER (FPM)	PETROFLUORO ELASTOMER (FFKM)
Maximum temperature *	110 °C	130 °C	120 °C	230 °C	80 °C	210 °C	326 °C
Minimum temperature *	-35 °C	-55 °C	-45 °C	-55 °C	-30 °C	-15 °C	-58 °C
Compression set	B	C	C	A	E	C	B
Wear resistance	C	C	C	E	A	C	C
Gas permeability	C	C	C	E	B	C	C
Weather resistance	E	A	C	A	A	A	A
Ozone resistance	E	A	A	A	A	A	A
Air, Ambient	A	A	A	A	A	A	A
Air, Hot (90 °C)	U	A	C	A	U	A	A
Alcohol	B	A	B	B	U	E	A
Aldehydes	U	B	U	C	U	U	B
Aliphatic Hydrocarbons	C	U	E	E	C	A	A
Alkalis	B	A	C	B	B	C	A
Amines	B	B	B	E	U	U	B
Animal Fats	B	U	C	C	C	B	A
Aromatic Hydrocarbons	D	U	D	U	D	A	A
Esters, Alkyl Phosphate	U	B	U	C	U	U	A
Esters, Aryl Phosphate	U	A	U	C	U	A	A
Esters, Silicate	C	U	E	U	U	A	A
Ethers	U	E	U	U	E	U	A
Halogenated hydrocarbons	U	U	U	U	E	A	A
Inorganic Acids	E	C	B	B	U	A	A
Ketones	U	A	A	C	U	U	B
Lacquer, Solvents	B	E	E	E	E	E	A
L.P. Gases & Fuel oils	A	E	A	C	B	A	A
Mineral Oil, high aniline fats	B	U	C	C	A	A	A
Mineral Oil, low aniline fats	B	U	U	E	B	A	A
Organic Acids	C	C	C	B	U	C	A
Petroleum	A	E	A	E	E	A	A
Silicone Oils	A	A1	A	E	A	A	A
Vegetable Oils	A	U	C	B	E	A	A
Water / Steam	C	A	E	E	U	B2	C2

* Reference values. Actual values are strongly dependent on the specific compound and operating medium.

A – good. **B** – satisfactory. **C** – fair. **D** – Doubtful. **E** – Poor. **U** – Unsatisfactory. **1** – EPDM may shrink. **2** – Depending on compound.

Remarks: This information is intended only as a guideline. Detailed chemical compatibility lists should be consulted.

Whenever possible the fluid compatibility of the O-ring compound should be rated "A". For a static seal application a rating "B" is usually acceptable, but it should be tested.

Where a "B" rated compound must be used, do not expect to re-use it after disassembly. It may have swollen enough that it cannot be reassembled.

When a compound rated "C" is to be tried, be sure it is first tested under the full range of operating conditions.

Common trade names: NBR - Perbunan N®, Buna N®. FPM - Viton®, Fluorel®. FFKM - Kalrez®, Chemraz®, Parafluor®.

CONVERSION FACTORS

MASS					
UNIT	kg	lb	oz	ton (US)	ton (UK)
kg	1	2,2046	35,274	1,1x10 ⁻³	9,8x10 ⁻⁴
lb	0,4536	1	16	5x10 ⁻⁴	4,5x10 ⁻⁴
oz	0,0283	0,0625	1	3,125x10 ⁻⁵	2,79x10 ⁻⁵
ton (US)	907,19	2 000	32 000	1	0,8929
ton (UK)	1 016,05	2 240	35 840	1,12	1

LENGTH					
UNIT	m	in	ft	yd	mi
m	1	39,37	3,2808	1,0936	0,00062
in	0,0254	1	0,0833	0,0278	1,578x10 ⁻⁵
ft	0,3048	12	1	0,3333	0,00019
yd	0,914	36	3	1	0,00057
mi	1 609	63 360	5 280	1 760	1

AREA					
UNIT	m ²	in ²	ft ²	yd ²	ac
m ²	1	1 550	10,764	10,764	2,47x10 ⁻⁴
in ²	6,452x10 ⁻⁴	1	6,944x10 ⁻³	7,7x10 ⁻⁴	1,594
ft ²	9,29x10 ⁻²	144	1	0,111	2,296x10 ⁻⁵
yd ²	0,836	1 296	9	1	2x10 ⁻⁴
ac	4 046,86	6 272 640	43 560	4 840	1

VOLUME					
UNIT	dm ³	in ³	ft ³	gal (US)	gal (UK)
dm ³	1	61,024	0,353	0,264	0,22
in ³	0,016	1	5,787x10 ⁻⁴	0,0043	3,605x10 ⁻³
ft ³	28,317	1728	1	7,48	6,229
gal (US)	3,785	231	0,13	1	0,83
gal (UK)	4,546	277,419	0,161	1,2	1

VOLUMETRIC FLOW RATE					
UNIT	m ³ /h	l/h	cfm	gpm (US)	gpm (UK)
m ³ /h	1	1000	0,589	4,403	3,67
l/h	1x10 ⁻³	1	5,886x10 ⁻⁴	4,4x10 ⁻³	3,7x10 ⁻³
cfm	1,699	1 699	1	7,481	6,229
gpm (US)	0,227	227,125	0,161	1	0,833
gpm (UK)	0,272	270,27	0,161	1,2	1

ENERGY					
UNIT	J	kcal	Wh	Btu	kgf m
J	1	0,239x10 ⁻³	0,278x10 ⁻³	0,948x10 ⁻³	0,102
kcal	4 186,8	1	1,162	3,966	426,92
Wh	3600	0,861	1	3,413	367,08
Btu	1055,06	0,252	0,293	1	107,58
kgf m	9,807	2,342x10 ⁻³	2,724x10 ⁻³	9,295x10 ⁻³	1

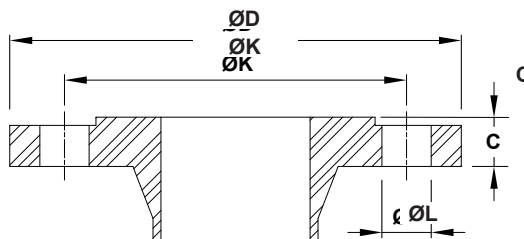
POWER					
UNIT	W	kcal/h	Btu/h	hp	ft lb/s
W	1	0,8598	3,412	1,34x10 ⁻³	0,7376
kcal/h	1,163	1	3,968	1,6x10 ⁻³	0,858
Btu/h	0,293	0,252	1	3,93x10 ⁻⁴	0,216
hp	745,7	641,19	2 545	1	550
ft lb/s	1,356	1,166	4,63	1,818x10 ⁻³	1

PRESSURE					
UNIT	Pa	bar	atm	psi	mm Hg
Pa	1	1x10 ⁻⁵	9,869x10 ⁻⁶	1,45x10 ⁻⁴	7,5x10 ⁻³
bar	1x10 ⁵	1	0,987	14,504	750,06
atm	101 325	1,01325	1	14,696	760
psi	6 894,76	0,06894	0,068	1	51,715
mm Hg	133,32	1,333x10 ⁻³	1,316x10 ⁻³	0,0193	1

VELOCITY				
UNIT	m/s	ft/s	km/h	mph
m/s	1	3,281	3,6	2,237
ft/s	0,305	1	1,097	0,682
km/h	0,278	0,911	1	0,621
mph	0,447	1,467	1,609	1

WATER HARDNESS					
UNIT	mg/L	ppm	gpg	°fH	°dH
mg/L	1	1	0,058	0,1	0,056
ppm	1	1	0,058	0,1	0,056
gpg	17,1	17,1	1	1,71	0,958
°fH	10	10	0,583	1	0,56
°dH	17,8	17,8	1,04	1,79	1

EN 1092-1 STEEL FLANGE DIMENSIONS



PN 16						
DN	ØD	ØK	C	ØL	BOLTING	
					Nº	SIZE
10	90	60	16	14	4	M12
15	95	65	16	14	4	M12
20	105	75	18	14	4	M12
25	115	85	18	14	4	M12
32	140	100	18	18	4	M16
40	150	110	18	18	4	M16
50	165	125	18	18	4	M16
65	185	145	18	18	8	M16
80	200	160	20	18	8	M16
100	220	180	20	18	8	M16
125	250	210	22	18	8	M16
150	285	240	22	22	8	M20
200	340	295	24	22	12	M20
250	405	355	26	26	12	M24
300	460	410	28	26	12	M24
350	520	470	30	26	16	M24
400	580	525	32	30	16	M27

PN 25						
DN	ØD	ØK	C	ØL	BOLTING	
					Nº	SIZE
10	90	60	16	14	4	M12
15	95	65	16	14	4	M12
20	105	75	18	14	4	M12
25	115	85	18	14	4	M12
32	140	100	18	18	4	M16
40	150	110	18	18	4	M16
50	165	125	20	18	4	M16
65	185	145	22	18	8	M16
80	200	160	24	18	8	M16
100	235	190	24	22	8	M20
125	270	220	26	26	8	M24
150	300	250	28	26	8	M24
200	360	310	30	26	12	M24
250	425	370	32	30	12	M27
300	485	430	34	30	16	M27
350	555	490	38	33	16	M30
400	620	550	40	36	16	M33

PN 40						
DN	ØD	ØK	C	ØL	BOLTING	
					Nº	SIZE
10	90	60	16	14	4	M12
15	95	65	16	14	4	M12
20	105	75	18	14	4	M12
25	115	85	18	14	4	M12
32	140	100	18	18	4	M16
40	150	110	18	18	4	M16
50	165	125	20	18	4	M16
65	185	145	22	18	8	M16
80	200	160	24	18	8	M16
100	235	190	24	22	8	M20
125	270	220	26	26	8	M24
150	300	250	28	26	8	M24
200	375	320	34	30	12	M27
250	450	385	38	33	12	M30
300	515	450	42	33	16	M30
350	580	510	46	36	16	M33
400	660	585	50	39	16	M36

PN 63						
DN	ØD	ØK	C	ØL	BOLTING	
					Nº	SIZE
10	100	70	20	14	4	M12
15	105	75	20	14	4	M12
20	130	90	22	18	4	M16
25	140	100	24	18	4	M16
32	155	110	24	22	4	M20
40	170	125	26	22	4	M20
50	180	135	26	22	4	M20
65	205	160	26	22	8	M20
80	215	170	28	22	8	M20
100	250	200	30	26	8	M24
125	295	240	34	30	8	M27
150	345	280	36	33	8	M30
200	415	345	42	36	12	M33
250	470	400	46	36	12	M33
300	530	460	52	36	16	M33
350	600	525	56	39	16	M36
400	670	585	60	42	16	M39

PN 100						
DN	ØD	ØK	C	ØL	BOLTING	
					N°	SIZE
10	100	70	20	14	4	M12
15	105	75	20	14	4	M12
20	130	90	22	18	4	M16
25	140	100	24	18	4	M16
32	155	110	24	22	4	M20
40	170	125	26	22	4	M20
50	195	145	28	26	4	M24
65	220	170	30	26	8	M24
80	230	180	32	26	8	M24
100	265	210	36	30	8	M27
125	315	250	40	33	8	M30
150	355	290	44	33	12	M30
200	430	360	52	36	12	M33
250	505	430	60	39	12	M36
300	585	500	68	42	16	M39
350	655	560	74	48	16	M45

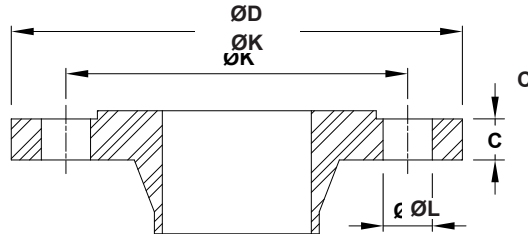
PN 160						
DN	ØD	ØK	C	ØL	BOLTING	
					N°	SIZE
10	100	70	20	14	4	M12
15	105	75	20	14	4	M12
25	140	100	24	18	4	M16
40	170	125	28	22	4	M20
50	195	145	30	26	4	M24
65	220	170	34	26	8	M24
80	230	180	36	26	8	M24
100	265	210	40	30	8	M27
125	315	250	44	33	8	M30
150	355	290	50	33	12	M30
200	430	360	60	36	12	M33
250	515	430	68	42	12	M39
300	585	500	78	42	16	M39

PN 250						
DN	ØD	ØK	C	ØL	BOLTING	
					N°	SIZE
10	125	85	24	18	4	M16
15	130	90	26	18	4	M16
25	150	105	28	22	4	M20
40	185	135	34	26	4	M24
50	200	150	38	26	8	M24
65	230	180	42	26	8	M24
80	255	200	46	30	8	M27
100	300	235	54	33	8	M30
125	340	275	60	33	12	M30
150	390	320	68	36	12	M33
200	485	400	82	42	12	M39
250	585	490	100	48	16	M45

PN 320						
DN	ØD	ØK	C	ØL	BOLTING	
					N°	SIZE
10	125	85	24	18	4	M16
15	130	90	26	18	4	M16
25	160	115	34	22	4	M20
40	195	145	38	26	4	M24
50	210	160	42	26	8	M24
65	255	200	51	30	8	M27
80	275	220	55	30	8	M27
100	335	265	65	36	8	M33
125	380	310	75	36	12	M33
150	425	350	84	39	12	M36
200	525	440	103	42	16	M39
250	640	540	125	52	16	M48

PN 400						
DN	ØD	ØK	C	ØL	BOLTING	
					N°	SIZE
10	125	85	28	18	4	M16
15	145	100	30	22	4	M20
25	180	130	38	26	4	M24
40	220	165	48	30	4	M27
50	235	180	52	30	8	M27
65	290	225	64	33	8	M30
80	305	240	68	33	8	M30
100	370	295	80	39	8	M36
125	415	340	92	39	12	M36
150	475	390	105	42	12	M39
200	585	490	130	48	16	M45

ASME B16.5 STEEL FLANGE DIMENSIONS



CLASS 150						
NPS	ØD	ØK	C	ØL	BOLTING	
					Nº	SIZE
1/2"	90	60,3	9,6	15,88	4	1/2"
3/4"	100	69,9	11,2	15,88	4	1/2"
1"	110	79,4	12,7	15,88	4	1/2"
1 1/4"	115	88,9	14,3	15,88	4	1/2"
1 1/2"	125	98,4	15,9	15,88	4	1/2"
2"	150	120,7	17,5	19,05	4	5/8"
2 1/2"	180	139,7	20,7	19,05	4	5/8"
3"	190	152,4	22,3	19,05	4	5/8"
3 1/2"	215	177,8	22,3	19,05	8	5/8"
4"	230	190,5	22,3	19,05	8	5/8"
5"	255	215,9	22,3	22,23	8	3/4"
6"	280	241,3	23,9	22,23	8	3/4"
8"	345	298,5	27	22,23	8	3/4"
10"	405	362	28,6	25,40	12	7/8"
12"	485	431,8	30,2	25,40	12	7/8"
14"	535	476,3	33,4	28,58	12	1"
16"	595	539,8	35	28,58	16	1"

CLASS 300						
NPS	ØD	ØK	C	ØL	BOLTING	
					Nº	SIZE
1/2"	95	66,7	12,7	15,88	4	1/2"
3/4"	115	82,6	14,3	19,05	4	5/8"
1"	125	88,9	15,9	19,05	4	5/8"
1 1/4"	135	98,4	17,5	19,05	4	5/8"
1 1/2"	155	114,3	19,1	22,23	4	3/4"
2"	165	127	20,7	19,05	8	5/8"
2 1/2"	190	149,2	23,9	22,23	8	3/4"
3"	210	168,3	27	22,23	8	3/4"
3 1/2"	230	184,2	28,6	22,23	8	3/4"
4"	255	200	30,2	22,23	8	3/4"
5"	280	235	33,4	22,23	8	3/4"
6"	320	269,9	35	22,23	12	3/4"
8"	380	330,2	39,7	25,4	12	7/8"
10"	445	387,4	46,1	28,58	16	1"
12"	520	450,8	49,3	31,75	16	1 1/8"
14"	585	514,4	52,4	31,75	20	1 1/8"
16"	650	571,5	55,6	34,93	20	1 1/4"

CLASS 600						
NPS	ØD	ØK	C	ØL	BOLTING	
					Nº	SIZE
1/2"	95	66,7	14,3	15,88	4	1/2"
3/4"	115	82,6	15,9	19,05	4	5/8"
1"	125	88,9	17,5	19,05	4	5/8"
1 1/4"	135	98,4	20,7	19,05	4	5/8"
1 1/2"	155	114,3	22,3	22,23	4	3/4"
2"	165	127	25,4	19,05	8	5/8"
2 1/2"	190	149,2	28,6	22,23	8	3/4"
3"	210	168,3	31,8	22,23	8	3/4"
3 1/2"	230	184,2	35	25,4	8	7/8"
4"	275	215,9	38,1	25,4	8	7/8"
5"	330	266,7	44,5	28,58	8	1"
6"	355	292,1	47,7	28,58	12	1"
8"	420	349,2	55,6	31,75	12	1 1/8"
10"	510	431,8	63,5	34,93	16	1 1/4"
12"	560	489	66,7	34,93	20	1 1/4"
14"	605	527	69,9	38,1	20	1 3/8"
16"	685	603,2	76,2	41,28	20	1 1/2"

CLASS 900						
NPS	ØD	ØK	C	ØL	BOLTING	
					Nº	SIZE
1/2"	120	82,6	22,3	22,23	4	3/4"
3/4"	130	88,9	25,4	22,23	4	3/4"
1"	150	101,6	28,6	25,4	4	7/8"
1 1/4"	160	111,1	28,6	25,4	4	7/8"
1 1/2"	180	123,8	31,8	28,58	4	1"
2"	215	165,1	38,1	25,4	8	7/8"
2 1/2"	245	190,5	41,3	28,58	8	1"
3"	240	190,5	38,1	25,4	8	7/8"
4"	290	235	44,5	31,75	8	1 1/8"
5"	350	279,4	50,8	34,93	8	1 1/4"
6"	380	317,5	55,6	31,75	12	1 1/8"
8"	470	393,7	63,5	38,1	12	1 3/8"
10"	545	469,9	69,9	38,1	16	1 3/8"
12"	610	533,4	79,4	38,1	20	1 3/8"
14"	640	558,8	85,8	41,28	20	1 1/2"
16"	705	616	88,9	44,45	20	1 5/8"
18"	785	685,8	101,6	50,8	20	1 7/8"