



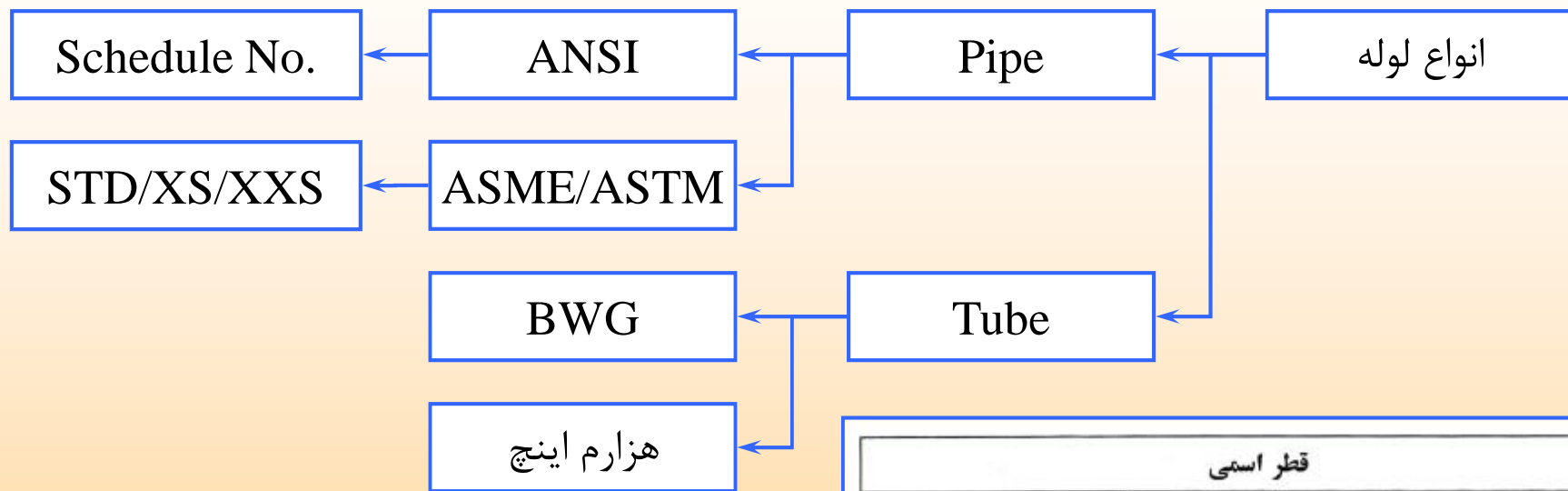
دانشگاه صنعتی شریف

طرح سیستم های تهویه مطبوع

دکتر محمد حسن سعیدی

نیمسال دوم 92-93

لوله‌ها



قطر اسمی		
شماره رایج در بازار ایران	سیستم اینچی	سیستم متریک
۲	$\frac{1}{2}$	۱۵
۲/۵	$\frac{3}{4}$	۲۰
۳	۱	۲۵
۴	$1\frac{1}{4}$	۳۲
۵	$1\frac{1}{2}$	۴۰
۶	۲	۵۰
۷	$2\frac{1}{2}$	۶۵
۸	۳	۸۰
۱۰	۴	۱۰۰

STEEL PIPES

NOM. PIPE SIZE (in.)	SCHEDULE NO.†	OUTSIDE DIAM (in.)	INSIDE DIAM (in.)	WALL THICK-NESS (in.)	WEIGHT OF PIPE (lb/ft)	WT OF WATER IN PIPE* (lb/ft)	OUTSIDE SURFACE (sq ft/ft)	INSIDE SURFACE (sq ft/ft)	TRANS-VERSE AREA (sq in.)
¼	40(S)	.405	.269	.068	.244	.0246	.106	.0705	.0568
	80(X)	.405	.215	.095	.314	.0157	.106	.0563	.0364
¼	40(S)	.540	.364	.088	.424	.0451	.141	.0935	.1041
	80(X)	.540	.302	.119	.535	.0310	.141	.0794	.0716
¾	40(S)	.675	.493	.091	.567	.0827	.177	.1295	.1910
	80(X)	.675	.423	.126	.738	.0609	.177	.1106	.1405
½	40(S)	.840	.622	.109	.850	.1316	.220	.1637	.3040
	80(X)	.840	.546	.147	1.087	.1013	.220	.1433	.2340
¾	40(S)	1.050	.824	.113	1.130	.2301	.275	.2168	.5330
	80(X)	1.050	.742	.154	1.473	.1875	.275	.1948	.4350
1	40(S)	1.315	1.049	.133	1.678	.3740	.344	.2740	.8640
	80(X)	1.315	.957	.179	2.171	.3112	.344	.2520	.7190
1¼	40(S)	1.660	1.380	.140	2.272	.4471	.434	.3620	1.495
	80(X)	1.660	1.278	.191	2.996	.5553	.434	.3356	1.283
1½	40(S)	1.900	1.610	.145	2.717	.8820	.497	.4213	2.036
	80(X)	1.900	1.500	.200	3.631	.7648	.497	.3927	1.767
2	40(S)	2.375	2.067	.154	3.652	1.452	.622	.5401	3.355
	80(X)	2.375	1.939	.218	5.022	1.279	.622	.5074	2.953
2½	40(S)	2.875	2.469	.203	5.79	2.072	.753	.6462	4.788
	80(X)	2.875	2.323	.276	7.66	1.834	.753	.6095	4.238
3	40(S)	3.500	3.068	.216	7.57	3.20	.916	.802	7.393
	80(X)	3.500	2.900	.300	10.25	2.86	.916	.761	6.605
3½	40(S)	4.000	3.548	.226	9.11	4.28	1.047	.929	9.89
	80(X)	4.000	3.364	.318	12.51	3.85	1.047	.880	8.89
4	40(S)	4.500	4.026	.237	10.79	5.51	1.178	1.055	12.73
	80(X)	4.500	3.826	.337	14.98	4.98	1.178	1.002	11.50
5	40(S)	5.563	5.047	.258	14.62	8.66	1.456	1.321	20.01
	80(X)	5.563	4.813	.375	20.78	7.87	1.456	1.260	18.19
6	40(S)	6.625	6.065	.280	18.97	12.51	1.735	1.587	28.99
	80(X)	6.625	5.761	.432	28.57	11.29	1.735	1.510	26.07
8	40(S)	8.625	7.981	.322	28.55	21.6	2.26	2.090	50.0
	80(X)	8.625	7.625	.500	43.39	19.8	2.26	2.006	45.6
10	40(S)	10.750	10.020	.365	40.48	34.1	2.81	2.62	78.9
	60(X)	10.750	9.750	.500	54.70	32.4	2.81	2.55	74.7
	80	10.750	9.564	.593	64.33	31.1	2.81	2.50	71.8
12	30(S)	12.750	12.090	.330	43.80	49.6	3.34	3.17	115.0
	40	12.750	11.938	.406	53.53	48.5	3.34	3.13	111.9
	(X)	12.750	11.750	.500	65.40	46.9	3.34	3.08	108.0
	80	12.750	11.576	.687	88.51	44.0	3.34	2.98	101.6
14	30(S)	14.000	13.250	.375	54.60	59.8	3.67	3.46	138.0
	40	14.000	13.125	.438	63.37	58.5	3.67	3.44	135.3
	(X)	14.000	13.000	.500	72.10	55.8	3.67	3.40	133.0
	80	14.000	12.500	.750	106.31	51.2	3.67	3.27	122.7
16	30(S)	16.000	15.250	.375	62.40	79.1	4.18	3.99	183.0
	40(X)	16.000	15.000	.500	82.77	76.5	4.18	3.93	176.7
	80	16.000	14.314	.843	136.46	69.7	4.18	3.75	160.9
18	(S)	18.000	17.250	.375	70.60	100.8	4.71	4.52	234.0
	(X)	18.000	17.000	.500	93.50	98.3	4.71	4.45	227.0
	40	18.000	16.874	.562	104.75	97.2	4.71	4.42	224.0
	80	18.000	16.126	.937	170.75	88.5	4.71	4.22	204.2
20	20(S)	20.000	19.250	.375	78.60	126.7	5.24	5.04	291.0
	30(X)	20.000	19.000	.500	104.20	122.5	5.24	4.97	284.0
	40	20.000	18.814	.593	122.91	120.4	5.24	4.93	278.0
	80	20.000	17.938	1.031	208.87	109.4	5.24	4.70	252.7
24	20(S)	24.000	23.250	.375	94.60	184.6	6.28	6.08	426.0
	(X)	24.000	23.000	.500	125.50	179.0	6.28	6.03	415.0
	40	24.000	22.626	.687	171.17	174.2	6.28	5.92	402.1
	80	24.000	21.564	1.218	296.36	158.2	6.28	5.65	365.2

*To change "Wt of Water in Pipe (lb/ft)" to "Gallons of Water in Pipe (gal/ft)," divide values in table by 8.34.

†S is designation of standard wall pipe.

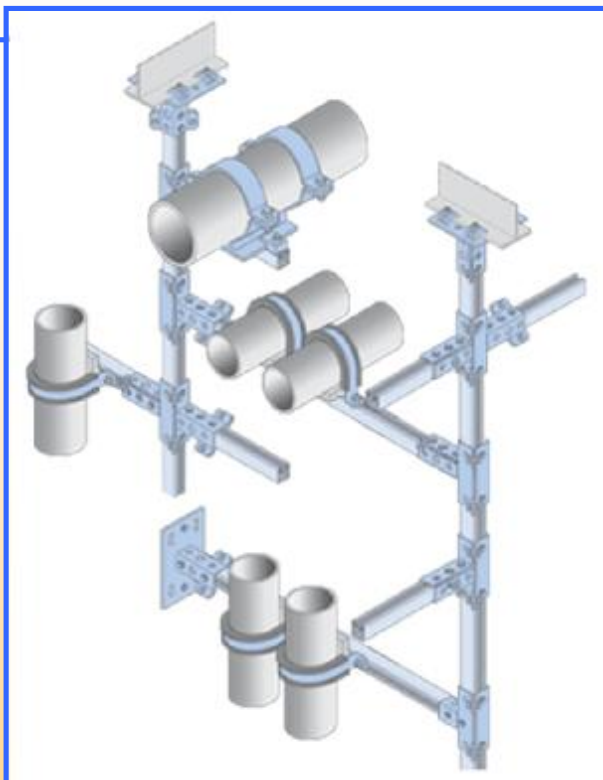
X is designation of extra strong wall pipe.

COPPER TUBES

CLASSIFICATION	NOM. TUBE SIZE (in.)	OUTSIDE DIA M (in.)	STUBBS GAGE	WALL THICK-NESS (in.)	INSIDE DIA M (in.)	TRANS-VERSE AREA (sq in.)	MINIMUM TEST PRESSURE (psi)	WEIGHT OF TUBE (lb/ft)	WT OF WATER IN TUBE* (lb/ft)	OUTSIDE SURFACE (sq ft/ft)	
HARD	¼	¾	23	.025	.325	.083	1000	.106	.036	.098	
	¾	1½	23	.025	.450	.159	1000	.144	.069	.131	
	½	¾	22	.028	.569	.254	890	.203	.110	.164	
Govt. Type "M" 250 Lb Working Pressure	¾	¾	21	.032	.811	.516	710	.328	.224	.229	
	1	1¼	20	.035	1.055	.874	600	.464	.379	.295	
	1¼	1¾	19	.042	1.291	1.309	590	.681	.566	.360	
	1½	1¾	18	.049	1.527	1.831	580	.94	.793	.425	
	2	2¼	17	.058	2.009	3.17	520	1.46	1.372	.556	
	2½	2¾	16	.065	2.495	4.89	470	2.03	2.120	.687	
	3	3¼	15	.072	2.981	6.98	440	2.66	3.020	.818	
	3½	3¾	14	.083	3.459	9.40	430	3.58	4.060	.949	
	4	4¼	13	.095	3.935	12.16	430	4.66	5.262	1.08	
	5	5¼	12	.109	4.907	18.91	400	6.66	8.180	1.34	
	6	6¼		.122	5.881	27.16	375	8.91	11.750	1.60	
	8	8¼		.170	7.785	47.6	375	16.46	20.60	2.13	
HARD	¾	1½	19	.035	.430	.146	1000	.198	.063	.131	
	½	¾		.040	.545	.233	1000	.284	.101	.164	
	¾	¾		.045	.785	.484	1000	.454	.209	.229	
Govt. Type "L" 250 Lb Working Pressure	1	1¼		.050	1.025	.825	880	.653	.358	.295	
	1¼	1¾		.055	1.265	1.256	780	.882	.554	.360	
	1½	1¾		.060	1.505	1.78	720	1.14	.770	.425	
	2	2¼		.070	1.985	3.094	640	1.75	1.338	.556	
	2½	2¾		.080	2.465	4.77	580	2.46	2.070	.687	
	3	3¼		.090	2.945	6.812	550	3.33	2.975	.818	
	3½	3¾		.100	3.425	9.213	530	4.29	4.000	.949	
	4	4¼		.110	3.905	11.97	510	5.38	5.180	1.08	
	5	5¼		.125	4.875	18.67	460	7.61	8.090	1.34	
	6	6¼		.140	5.845	26.83	430	10.20	11.610	1.60	
	HARD	¾	¾	21	.032	.311	.076	1000	.133	.033	.098
		¾	1½	18	.049	.402	.127	1000	.269	.055	.131
½		¾	18	.049	.527	.218	1000	.344	.094	.164	
¾		¾	16	.065	.745	.436	1000	.641	.189	.229	
1		1¼	16	.065	.995	.778	780	.839	.336	.295	
1¼		1¾	16	.065	1.245	1.217	630	1.04	.526	.360	
1½		1¾	15	.072	1.481	1.722	580	1.36	.745	.425	
2		2¼	14	.083	1.959	3.014	510	2.06	1.300	.556	
2½		2¾	13	.095	2.435	4.656	470	2.92	2.015	.687	
3		3¼	12	.109	2.907	6.637	450	4.00	2.870	.818	
3½		3¾	11	.120	3.385	8.999	430	5.12	3.890	.949	
4		4¼	10	.134	3.857	11.68	420	6.51	5.05	1.08	
5	5¼		.160	4.805	18.13	400	9.67	7.80	1.34		
6	6¼		.192	5.741	25.88	400	13.87	11.20	1.60		
SOFT	¾	¾	21	.032	.311	.076	1000	.133	.033	.098	
	¾	1½	18	.049	.402	.127	1000	.269	.055	.131	
	½	¾	18	.049	.527	.218	1000	.344	.094	.164	
Govt. Type "K" 250 Lb Working Pressure	¾	¾	16	.065	.745	.436	1000	.641	.189	.229	
	1	1¼	16	.065	.995	.778	780	.839	.336	.295	
	1¼	1¾	16	.065	1.245	1.217	630	1.04	.526	.360	
	1½	1¾	15	.072	1.481	1.722	580	1.36	.745	.425	
	2	2¼	14	.083	1.959	3.014	510	2.06	1.300	.556	
	2½	2¾	13	.095	2.435	4.656	470	2.92	2.015	.687	
	3	3¼	12	.109	2.907	6.637	450	4.00	2.870	.818	
	3½	3¾	11	.120	3.385	8.999	430	5.12	3.89	.949	
	4	4¼	10	.134	3.857	11.68	420	6.51	5.05	1.08	
	5	5¼		.160	4.805	18.13	400	9.67	7.80	1.34	
	6	6¼		.192	5.741	25.88	400	13.87	11.2	1.60	

*To change "Wt of Water in Tube (lb/ft)" to "Gallons of Water in Tube (gal/ft)," divide values in table by 8.34.

تکیه گاه‌ها



STEEL

NOMINAL PIPE SIZE (in.)	DISTANCE BETWEEN SUPPORTS (ft)
¾ - 1¼	8
1½ - 2½	10
3 - 3½	12
4 - 6	14
8 - 12	16
14 - 24	20

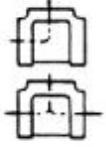









COPPER

TUBE OD (in.)	DISTANCE BETWEEN SUPPORTS (ft)
¾	6
7/8 - 1¼	8
1¾ - 2¼	10
2¾ - 5¼	12
6¼ - 8¼	14

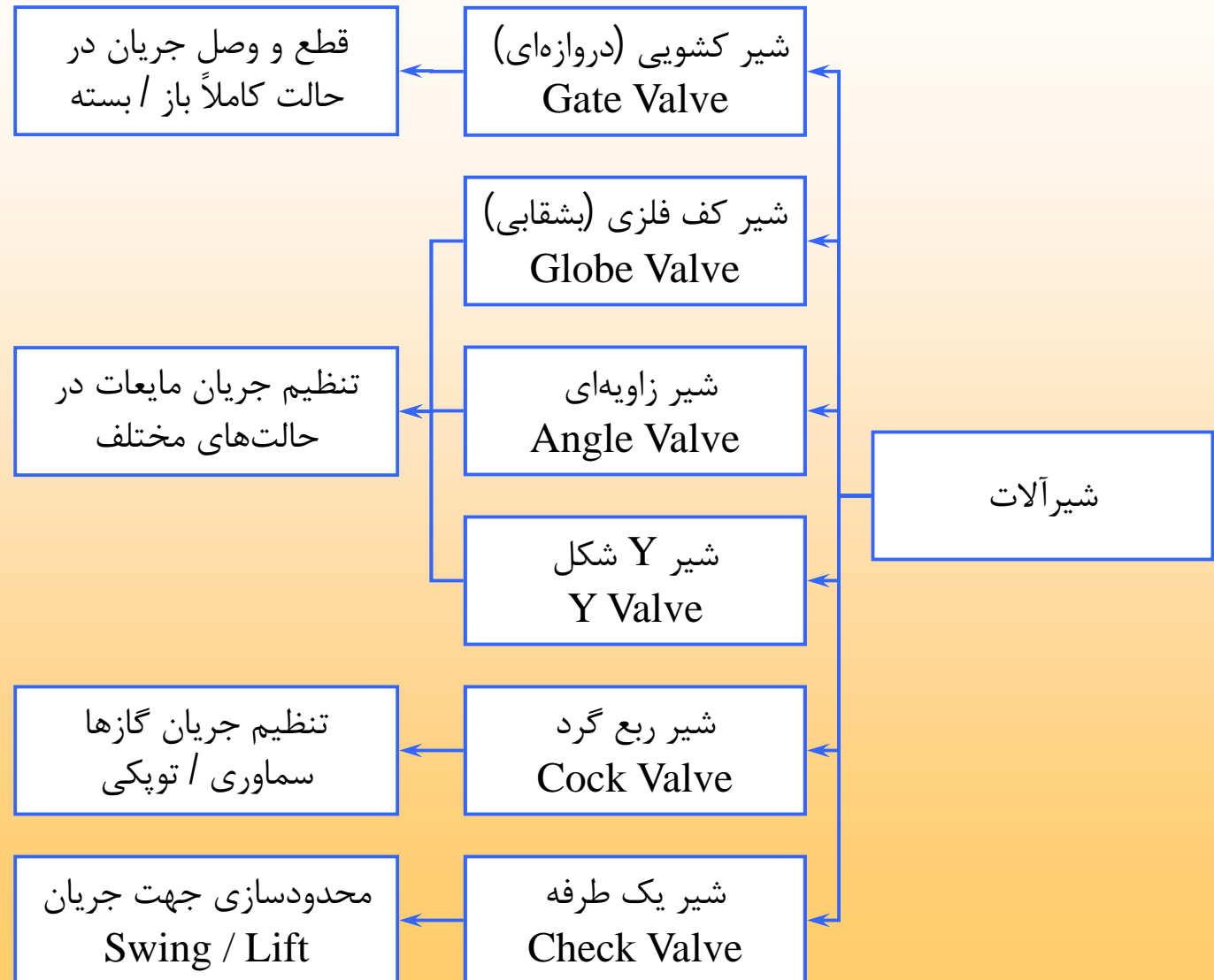
§ برای تحمل وزن لوله‌ها و سیال داخل آن، وصاله‌ها و شیرآلات، تمامی خطوط لوله‌کشی باید با استفاده از تکیه‌گاه‌های مطمئن محکم شود.

§ عامل اصلی در تعیین فاصله تکیه‌گاه‌ها برای لوله‌های افقی، تغییر شکل ناشی از وزن خطوط است. جداول فوق فواصل توصیه شده برای لوله‌های فولادی با ضخامت استاندارد و مسی در شرایط پر از آب را نشان می‌دهد.

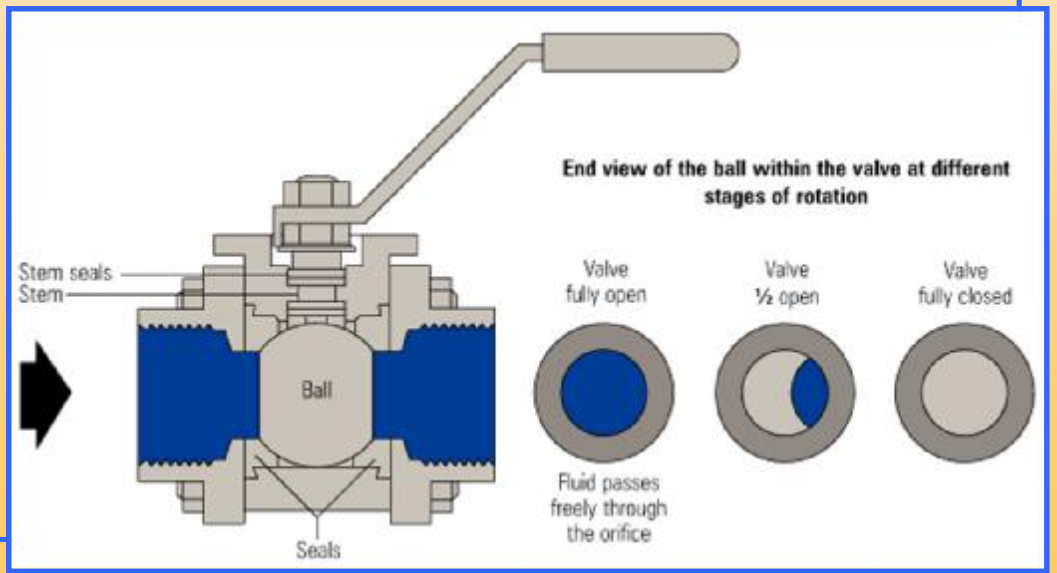
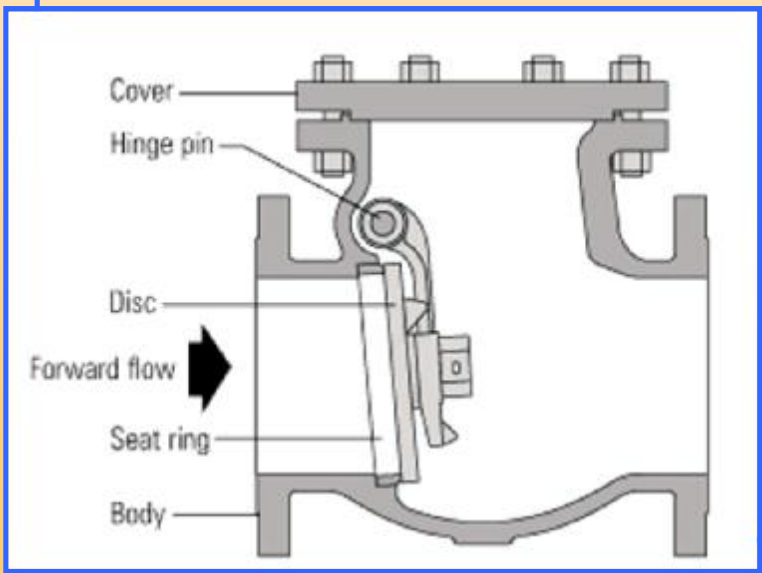
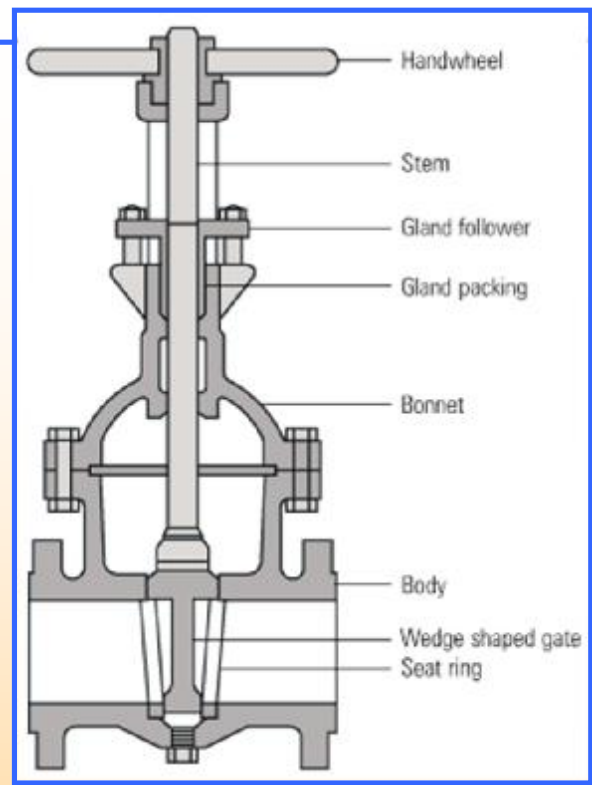
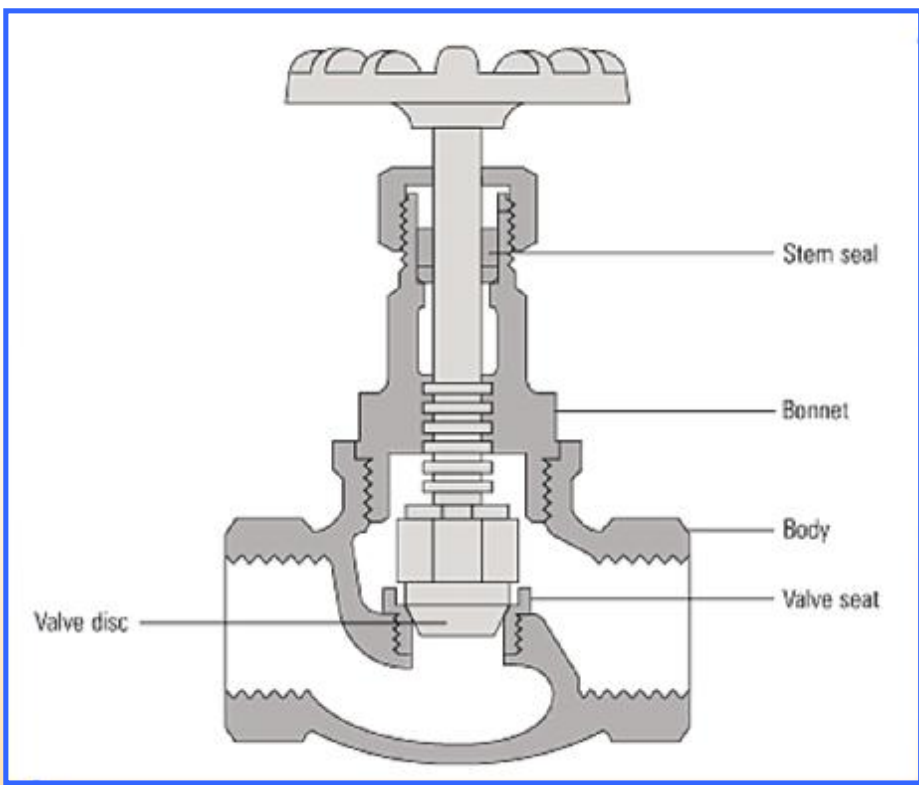
وصالها

NOMINAL PIPE OR TUBE SIZE (in.)	SMOOTH BEND ELBOWS						SMOOTH BEND TEES			
	90° Std*	90° Long Red.†	90° Street*	45° Std*	45° Street*	180° Std*	Flow-Thru Branch 	Straight-Thru Flow		
								No Reduction 	Reduced ¼ 	Reduced ½ 
¾	1.4	0.9	2.3	0.7	1.1	2.3	2.7	0.9	1.2	1.4
½	1.6	1.0	2.5	0.8	1.3	2.5	3.0	1.0	1.4	1.6
¾	2.0	1.4	3.2	0.9	1.6	3.2	4.0	1.4	1.9	2.0
1	2.6	1.7	4.1	1.3	2.1	4.1	5.0	1.7	2.3	2.6
1¼	3.3	2.3	5.6	1.7	3.0	5.6	7.0	2.3	3.1	3.3
1½	4.0	2.6	6.3	2.1	3.4	6.3	8.0	2.6	3.7	4.0
2	5.0	3.3	8.2	2.6	4.5	8.2	10	3.3	4.7	5.0
2½	6.0	4.1	10	3.2	5.2	10	12	4.1	5.6	6.0
3	7.5	5.0	12	4.0	6.4	12	15	5.0	7.0	7.5
3½	9.0	5.9	15	4.7	7.3	15	18	5.9	8.0	9.0
4	10	6.7	17	5.2	8.5	17	21	6.7	9.0	10
5	13	8.2	21	6.5	11	21	25	8.2	12	13
6	16	10	25	7.9	13	25	30	10	14	16
8	20	13	—	10	—	33	40	13	18	20
10	25	16	—	13	—	42	50	16	23	25
12	30	19	—	16	—	50	60	19	26	30
14	34	23	—	18	—	55	68	23	30	34
16	38	26	—	20	—	62	78	26	35	38
18	42	29	—	23	—	70	85	29	40	42
20	50	33	—	26	—	81	100	33	44	50
24	60	40	—	30	—	94	115	40	50	60


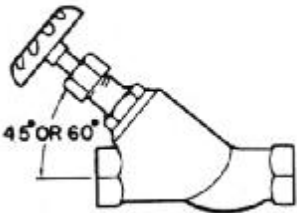
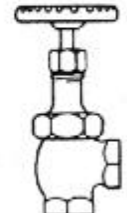
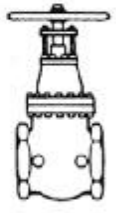

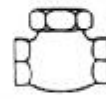
شیرآلات



VALVES



شیرآلات

NOMINAL PIPE OR TUBE SIZE (in.)	GLOBE†	60° - Y	45° - Y	ANGLE†	GATE††	SWING CHECK‡	LIFT CHECK
							
3/8	17	8	6	6	0.6	5	Globe & Vertical Lift Same as Globe Valve**
1/2	18	9	7	7	0.7	6	
3/4	22	11	9	9	0.9	8	
1	29	15	12	12	1.0	10	
1 1/4	38	20	15	15	1.5	14	
1 1/2	43	24	18	18	1.8	16	
2	55	30	24	24	2.3	20	
2 1/2	69	35	29	29	2.8	25	
3	84	43	35	35	3.2	30	
3 1/2	100	50	41	41	4.0	35	
4	120	58	47	47	4.5	40	Angle Lift Same as Angle Valve
5	140	71	58	58	6	50	
6	170	88	70	70	7	60	
8	220	115	85	85	9	80	
10	280	145	105	105	12	100	
12	320	165	130	130	13	120	
14	360	185	155	155	15	135	
16	410	210	180	180	17	150	
18	460	240	200	200	19	165	
20	520	275	235	235	22	200	
24	610	320	265	265	25	240	

*Losses are for all valves in fully open position.

†These losses do not apply to valves with needle point type seats.

‡Losses also apply to the in-line, ball type check valve.

**For "Y" pattern globe lift check valve with seat approximately equal to the nominal pipe diameter, use values of 60° "Y" valve for loss.

††Regular and short pattern plug cock valves, when fully open, have same loss as gate valve. For valve losses of short pattern plug cocks above 6 ins. check manufacturer.