DESIGN AND TEST REQUIREMENTS FOR GAS PIPING SYSTEMS

PURPOSE:

1. To establish a uniform company policy for designing and testing gas piping systems that will conform to the requirements of G.O. 112A of the CPUC.

RESCISSIONS:

2. Supersedes earlier letter and instructions including:

   a. Letter, April 2, 1962, [redacted] to Division Gas Superintendents, "Marking Estimates for Work on Piping Systems Designed to Operate at Stress Levels over 20% of the Specified Minimum Yield Strength".

   b. Letter, May 4, 1962, [redacted] to Division Gas Superintendents, "Replacement of Pipe in Mains Operating at Stress Levels over 20% of the Specified Minimum Yield Strength".

POLICY AND APPLICATION:

3. Scope - Gas piping systems both new construction and reconstruction, except for the station piping at compressor, holder, meter, and regulator stations.

4. All facilities within the scope of this standard procedure must be designed and tested in accordance with the requirements of the appropriate design category.

5. Six design categories are established for the operating pressures and pipe sizes normally encountered.

6. Pipe to meet the design pressure is to be selected from standards established in this standard procedure. The design pressure shall be selected within the operating range of the category in Appendix "A".

7. All fittings, valves, and other components must satisfy the design requirements established for the category in Appendix "C".

8. Strength test and leak test requirements are established.

9. Design and test requirements appear in the following pages of this standard procedure.

RESPONSIBILITIES:

10. The Engineer - When the facility falls in Categories 2 to 6 inclusive, responsibility lies with the engineer in the office that originates the estimate to:

a. Mark the need for strength testing on the estimate.
b. Show the design criteria on drawings accompanying the estimate.
c. Prepare and forward a "Strength Test Report" to the job foreman.
d. Correct pipe specification and stress level notations on all copies of the estimate and strength test report when pipe of equivalent or greater wall strength is substituted.

11. The Job Foreman - Responsibility lies with the job foreman to:

a. Observe the specified testing requirements.
b. Complete the "Strength Test Report" and return it to the appropriate District Gas Superintendent or other personnel as directed.

DEFINITIONS:

12. Stress Level - Stress induced in piping system by the design pressure expressed as a percent of the Specified Minimum Yield Strength. (SMYS).

13. Design Pressure - The pressure selected in the engineering of a facility. It may be:

a. The manufacturer's rating of a component.
b. The maximum permitted by the pipeline design procedures of G.O. 112A, or
c. A lower pressure established by the Company.

14. Test Pressure - The internal fluid pressure required under provisions of General Order 112A to test the tightness and/or strength of a system.

15. Strength Test - A pressure test to prove the mechanical strength of the system.

16. Leak Test - A pressure test to determine the tightness of the system.

DESIGN:

17. Operating pressures for design purposes should be determined in the light of probable future developments, including:

a. Growth patterns
b. Available gas supply pressures
c. Increases in supply pressures

18. Initial Construction - Design of all gas facilities within the scope of this standard procedure must be in accordance with the requirements of the appropriate design category.

19. Reconstruction of Existing Facilities - Subsequent additions or alterations must be designed in accordance with, or better than, the requirements of the category of the initial construction.

20. Six categories, based on operating pressure and pipe size, are established for the purpose of design. (See Appendix A)

21. Specifications of steel pipe that will satisfy the design pressure requirements are shown in Appendix B for pipe sizes normally used.

22. Fittings, valves, and other piping components must be carefully selected to satisfy the design pressure requirements established for the piping system. A reference table for standard gas line material of this kind appears as Appendix C.

23. Requests shall be directed to the Manager, Gas System Design Department, 245 Market Street - Room 645, San Francisco for:

    a. Guidance in design situations not covered by the six categories, or

    b. Deviations from the design requirements.

TESTING:

24. All facilities must be strength and/or leak tested as specified for the category in Appendix A. When the test medium is air or gas, all mains and services must be leak tested at 100 psig before going on to higher pressures for strength testing.

25. The test medium must be one permitted for the category. (See Appendix A). Factors to be considered in the choice of test medium will include economy, availability, and safety.

26. Short Replacements of 40' or Less:

    a. In categories 1 and 2 need not be strength tested provided pipe equal to that shown in Appendix B is used.

    b. In categories 3 to 6 inclusive need not be strength tested provided double-submerged arc welded or seamless pipe is used and the pipe is selected for Type D construction.

    c. All electric-resistance or butt welded pipe must be tested to the test pressure specified for the category.

27. Proprietary items such as valves, forged fittings, and fittings designed by Department of Gas System Design, selected for Type C construction or better need not be strength tested.

RECORDS:

28. Estimate Sketches and Design Drawings:

a. The essential design considerations listed below shall be noted on the estimate sketch for facilities in categories 2 through 6:

1. Category _____
2. Design Pressure _____
3. Stress Level _____
4. Strength TP Max._____Min._____
5. Test Fluid _____
6. Fittings _____
7. Pipe Specs._____

_____

_____

b. For valves and fittings shown on estimate sketches or design drawings (for facilities in categories 2 through 6), specify the required pressure rating and refer to the appropriate Gas Standards and Specification sheets to assure correct material selection and construction practices. (See Appendix C)

29. Reports

a. Strength test pressure reports shall be made whenever a strength test is required. File one copy with the completed foreman's copy of the estimate. Distribute other copies as indicated on the form.

b. Weld inspection reports in accordance with SP 1605 shall be made for all piping systems designed to operate over 20% of SMYS. Distribute reports as indicated in SP 1605.

RECORD RETENTION:

30. The copy of the Strength Test Pressure Report filed with the completed foreman's copy of the estimate shall be retained for the life of the facility.

$P = \frac{2St}{d}$ $S = \frac{Pd}{2t}$ where P = Design Pressure lb/in²
d = Outside ~~Nominal~~ diameter in
t = Wall Thickness in.

Example $S = \frac{960 \times 6.625}{2 \times .280}$

$S = \frac{430 \times 6.625}{.280}$ S = 10,200 psi

Y.S. = yield Strength.

$S.L. = \frac{S}{Y.S.} \times 100$

Stress Level = $\frac{10,200}{35,000} \times 100$

Stress Level = 29%

DATE [redacted]

APPROVE [redacted]

E. H. FISHER

CATEGORY SELECTION CHART

Strength Test Requirements for Mains in Each Category

Category	Design Pressure Range (Psig)	Test Pressure Psig	Permissible Test Medium for Sizes through *Air	*Gas	Water
1	0 - 100	100	Max All	All	All
2	101 - 175	265 (Min) 350 (Max)	All	All	All
3	176 - 400	600 (Min) 800 (Max)	16"	4"	All
4	401 - 720	1080 (Min) 1200 (Max)	4"	3"	All
5	721 - 960	1435 (Min) 1600 (Max)			All
6	961 - 1040	1560 (Min) 1600 (Max)			All

only

1. Design pressures shall be:
   1.1 Maximum for Category 1, 2, or 3.
   1.2 As required within limits of Category 4, 5, or 6.

2. Pipe selected from Appendix B:
   2.1 Shall not be designed for less than Type C construction.
   2.2 In Category 4 to 6:
      2.2.1 The minimum test pressure shall be 1-1/2 times the design working pressure.
      2.2.2 The maximum test pressure shall not exceed either theoretical yield stress or that shown in Appendix A.

3. For service piping that operates:
   3.1 Upstream of primary regulation, test to requirements of main including all 3/4" pipe. Exception: any 3/4" pipe in Category 4, 5, and 6 must be hydrostatically tested.
   3.2 Downstream of primary regulation, test to 100 psig.

4. For services operating at more than 20% Specified Minimum Yield Strength, test to requirements for mains.

5. All other requirements of General Order 112A Section 849, Gas Services, must also be observed.

*Maximum test using air shall not exceed 50% of SMYS. Maximum test using gas shall not exceed 30% of SMYS.

STEEL PIPE SPECIFICATIONS

NOMINAL PIPE SIZE (INCHES)	OUTSIDE DIAMETER (INCHES)	WALL THICKNESS (INCHES)	API 5L BUTT-WELDED CLASS II PHYSICALS 28,000 PSI SMYS		API 5L GR. B SEAMLESS OR ELECTRIC WELDED 3/4" - 26" OR DSA 20" & LARGER 35,000 PSI SMYS				
			MILL TEST PRESSURE (PSIG)	MAX. DESIGN PRESSURE (PSIG)	MILL TEST PRESSURE (PSIG)	MAXIMUM DESIGN PRESSURE PSIG C 50%	D 40%	— 30%	— 20%
3/4	1.05	.113	700	(COMPANY LIMIT	700	3767	3013	2260	1507
1-1/4	1.66	.140	1000	IS 400 PSIG)	1300	2952	2361	1772	1181
2	2.375	.154	1000	↓	1300	2269	1815	1362	908
3	3.5	.156	1000		—	—	—	—	—
3	3.5	.188			2200	1880	1504	1128	752
4	4.5	.148			1200	1150	921	691	460
	4.5	.156			1500	1213	971	728	485
	4.5	.188			1800	1462	1169	878	585
6	6.625	.188			1200	993	794	596	397
		.280			1800	1479	1183	888	592
8	8.625	.188			900	763	610	458	305
		.250			1200	1015	812	609	406
		.322			1600	1307	1045	785	523
10	10.750	.188			750	612	490	368	245
		.219			850	713	570	428	285
		.365			1400	1189	915	714	476
12	12.750	.219			700	601	481	360	240
		.250			800	687	549	413	275
		.312			1000	857	685	515	343
		.375			1200	1030	824	618	412
		.500			1650	1373	1098	824	549
16	16	.281			750	615	492	369	246
		.312			800	682	546	410	273
		.375			1000	820	656	492	328
		.500			1300	1094	875	657	438
18	18	.250			600	486	389	293	195
20	20	.281			600	492	394	296	197
		.312			650	546	437	329	219
		.375			800	656	525	395	263
		.500			1000	875	700	525	350
24	24	.250			450	364	291	219	146
		.281			500	410	328	246	164
		.312			550	455	364	273	182
		.375			650	546	437	329	219
		.500			850	729	583	438	292
30	30	.312			435	364	291	219	146
		.375			525	437	350	263	175
		.500			700	583	467	351	234

THE ABBREVIATIONS AND SYMBOLS USED ABOVE HAVE THESE MEANINGS:

SMYS – SPECIFIED MINIMUM YIELD STRENGTH.
C – TYPE "C" CONSTRUCTION.
D – TYPE "D" CONSTRUCTION.
40% – 40% OF SPECIFIED MINIMUM YIELD STRENGTH.
DSA – DOUBLE SUBMERGED ARC.

FOR EXAMPLE, 6" PIPE .188" WALL (API 5L GR. B) HAS A SPECIFIED MINIMUM YIELD STRENGTH OF 35,000 P.S.I. FOR TYPE "C" CONSTRUCTION (WHICH IS 50% OF SMYS), MAXIMUM DESIGN PRESSURE WOULD BE 993 P.S.I.G.

APPROVED	CHG.	DATE	DESCRIPTION	BY	CH.	APPRD.

SUPERV. BY
DSGN.
DR. [redacted]
CH.
O.K.
DATE 10-13-64
SCALE

GAS STANDARD

STEEL PIPE DATA

PACIFIC GAS AND ELECTRIC COMPANY
SAN FRANCISCO, CALIFORNIA

SUPERSEDES
SUPERSEDED BY
SHEET NO. 1 of 2 SHEETS
DRAWING NUMBER 283253
CHANGE

STEEL PIPE SPECIFICATIONS

NOMINAL PIPE SIZE (INCHES)	OUTSIDE DIAMETER (INCHES)	WALL THICKNESS (INCHES)	API 5LX GR. X42 42,000 PSI SMYS					API 5LX GR. X52 52,000 PSI SMYS				
			MILL TEST PRESSURE (PSIG)	MAXIMUM DESIGN PRESSURE PSIG C 50%	D 40%	– 30%	– 20%	MILL TEST PRESSURE (PSIG)	MAXIMUM DESIGN PRESSURE PSIG C 50%	D 40%	– 30%	– 20%
6	6.625	.188	1790	1192	954	716	477	2220	1472	1177	884	589
		.280	2670	1775	1420	1065	710	3000	2197	1758	1319	879
8	8.625	.188	1380	915	732	549	366	1710	1128	903	678	452
		.250	1830	1218	974	731	487	2270	1503	1202	902	601
		.322	2360	1568	1254	941	627	2920	1941	1553	1166	777
10	10.750	.188	1250	735	588	441	294	1550	905	724	543	362
		.219	1460	856	684	513	342	1810	1056	844	636	424
		.365	2430	1426	1141	857	571	3000	1766	1412	1059	706
12	12.750	.219	1230	721	577	434	289	1520	889	711	534	356
		.250	1410	824	659	495	330	1740	1020	818	612	408
		.312	1750	1028	822	617	411	2170	1269	1015	762	508
		.375	2100	1236	988	741	494	2600	1529	1223	918	612
		.500	2810	1647	1318	989	659	3000	2039	1631	1223	816
16	16	.250	1120	657	525	395	262	1390	813	650	488	325
		.281	1260	735	590	443	295	1560	913	731	549	366
		.312	1400	819	655	492	328	1730	1014	811	609	406
		.375	1680	984	787	591	394	2080	1219	975	732	488
		.500	2240	1313	1050	788	525	2770	1625	1300	1125	750
18	18	.250	1000	584	467	351	234	1230	722	578	434	289
20	20	.281	1070	590	472	354	236	1320	732	584	438	292
		.312	1180	655	524	393	262	1420	811	649	488	325
		.375	1420	788	630	473	315	1760	975	780	585	390
		.500	1890	1050	840	630	420	2340	1300	1040	780	520
24	24	.250	790	437	350	262	175	980	541	433	325	216
		.281	890	492	393	296	197	1100	609	487	366	244
		.312	990	546	437	324	219	1220	676	541	407	271
		.375	1190	656	525	395	263	1470	813	650	488	325
		.500	1580	875	700	525	350	1950	1083	867	651	434
26	26	.312	910	504	403	253	201	1130	624	499	374	250
		.500	1460	808	646	585	323	1800	1000	800	600	400
30	30	.312	790	437	349	263	175	980	541	433	324	216
		.375	950	525	420	315	210	1170	650	520	390	260
		.500	1270	700	560	420	280	1570	876	693	521	347
34	34	.312	700	385	308	231	154	860	477	381	294	191
		.375	840	463	371	279	186	1040	574	459	345	230
		.500	1120	618	494	371	247	1380	765	612	459	306
36	36	.312	660	364	291	219	146	820	450	360	270	180
		.438	930	511	409	308	205	1140	633	506	380	253
		.500	1060	583	467	351	234	1310	722	578	434	289
		.625	1320	727	581	436	291	1630	903	722	542	361
		.687	1440	801	641	482	321	1780	992	793	596	397
		.750	1570	875	700	525	350	1950	1083	867	650	433

NOTES:- 1. THE ABBREVIATIONS AND SYMBOLS USED ABOVE HAVE THESE MEANINGS:

SMYS – SPECIFIED MINIMUM YIELD STRENGTH.
C – TYPE "C" CONSTRUCTION.
D – TYPE "D" CONSTRUCTION.
40% – 40% OF SPECIFIED MINIMUM YIELD STRENGTH.

2. PIPE TYPE - SIZES 6" - 18" - ELECTRIC RESISTANCE WELD OR SEAMLESS.
SIZES 20" & LARGER - EITHER SEAMLESS OR DOUBLE SUBMERGED ARC.

FOR EXAMPLE, 6" PIPE .188" WALL (API 5LX GR. X42) HAS A SPECIFIED MINIMUM YIELD STRENGTH OF 42,000 PSI. FOR TYPE "C" CONSTRUCTION (WHICH IS 50% OF SMYS), MAXIMUM DESIGN PRESSURE WOULD BE 1,192 PSIG.

APPROVED	CHG.	DATE	DESCRIPTION	BY.	CH.	APPRD.

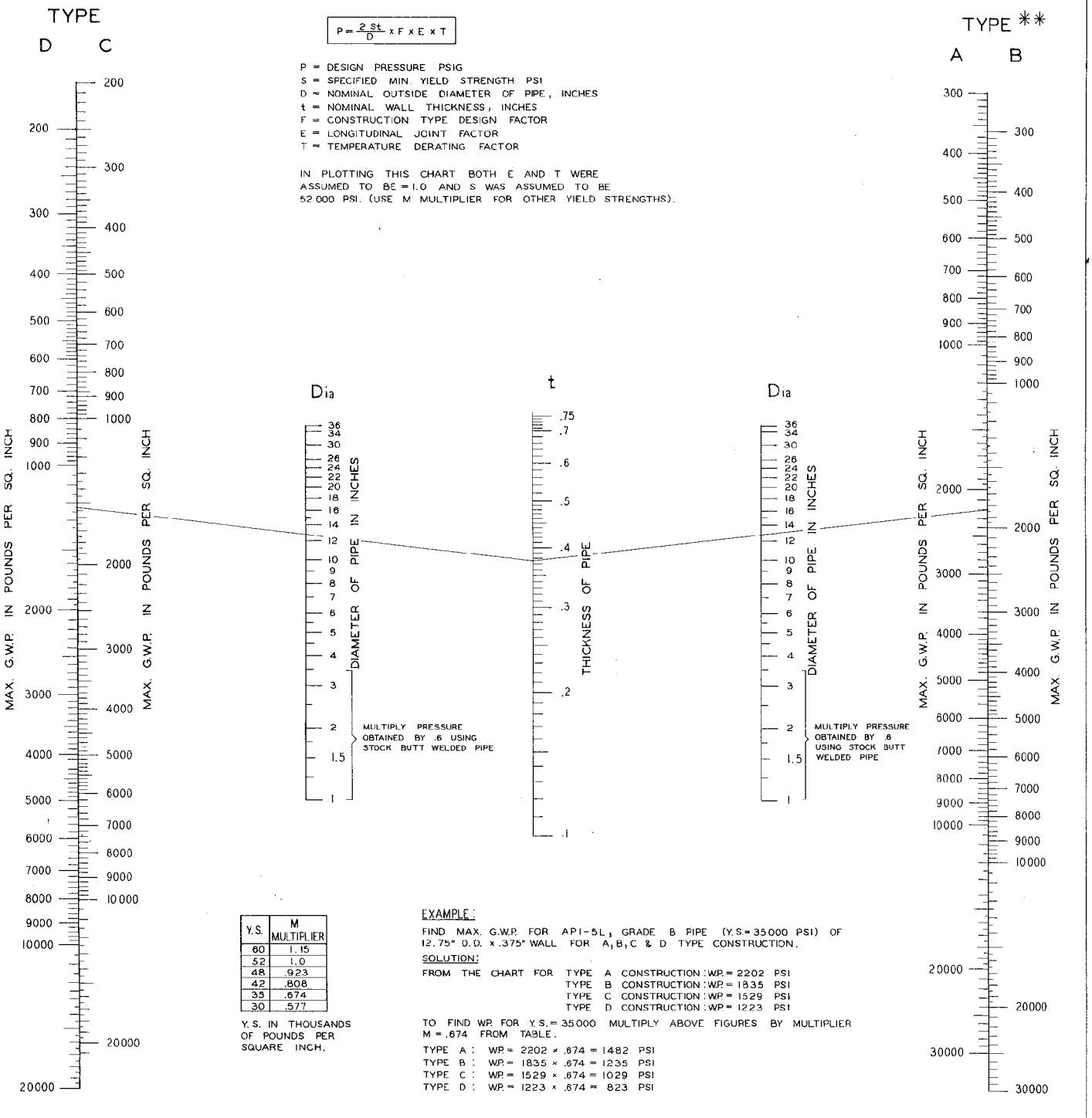
SUPERV. BY
DSGN.
DR.
CH.
O.K.
DATE 10-14-64
SCALE

GAS STANDARD

STEEL PIPE DATA

PACIFIC GAS AND ELECTRIC COMPANY
SAN FRANCISCO, CALIFORNIA

SUPERSEDES
SUPERSEDED BY
SHEET NO. 2 of 2 SHEETS
DRAWING NUMBER 283253
CHANGE



Y.S.	M MULTIPLIER
60	1.15
52	1.0
48	.923
42	.808
35	.674
30	.577

Y. S. IN THOUSANDS OF POUNDS PER SQUARE INCH.

EXAMPLE:

FIND MAX. G.W.P. FOR API-5L, GRADE B PIPE (Y.S.= 35000 PSI) OF 12.75" O.D. x .375" WALL FOR A, B, C & D TYPE CONSTRUCTION.

SOLUTION:

FROM THE CHART FOR TYPE A CONSTRUCTION: W.P. = 2202 PSI
TYPE B CONSTRUCTION: W.P. = 1835 PSI
TYPE C CONSTRUCTION: W.P. = 1529 PSI
TYPE D CONSTRUCTION: W.P. = 1223 PSI

TO FIND W.P. FOR Y.S. = 35000 MULTIPLY ABOVE FIGURES BY MULTIPLIER M = .674 FROM TABLE.

TYPE A: W.P. = 2202 x .674 = 1482 PSI
TYPE B: W.P. = 1835 x .674 = 1235 PSI
TYPE C: W.P. = 1529 x .674 = 1029 PSI
TYPE D: W.P. = 1223 x .674 = 823 PSI

** TYPE A & B NOT FOR USE WITHOUT APPROVAL OF G.S.D.D.
* CONSTRUCTION TYPE AS DEFINED IN G.O. 112 A PAR. 841.02

TABLE OF CHANGES

NO. | DATE | DESCRIPTION | APPRD

APPROVED BY
GM
DWG. LIST
BY
DWN.
DR.
CH.
C.K.
DATE 3-5-65
SCALES

GAS STANDARD
MAX G.W.P. FOR PIPE
BASED UPON CONSTRUCTION TYPE *

PACIFIC GAS AND ELECTRIC COMPANY
SAN FRANCISCO, CALIFORNIA

BILL OF MATERIAL
ELECT. EQUIP. LIST
SUPERSEDES
SUPERSEDED BY
SHEET NO. | SHEETS
DRAWING NUMBER 385210
CHANGE

REFERENCE TABLE FOR STANDARD GAS LINE FITTINGS AND APPURTENANCES

Description	CATEGORIES 1	2	3	4	5	6
Service Tees	MS1012	MS1012	MS1013	MS1013	MS1013	MS1013
Pressure Control Fittings 3/4" and 1-1/4"	MS1020A	MS1020A	H17056	H17056	H17056	H17056
1-1/2" and 2"	MS1020B	MS1020B	H17156	H17156	H17156	H17156
3" to 8"	MS1021	MS1021	MS1021A	MS1021A	H17257	H17258
Valves - As listed in MS14053	175# CI	175# CI	400# CI	ASA 300# Steel	ASA 400# Steel	ASA 600# Steel
Service Cocks	MS14001	--	--	--	--	--
Primary Service Regulation	None CS5	CS5	CS3,4,8 9,10	CS3,4,8 9,10	CS3,4,8 9,10	
Lateral Reinforcement	None	CS101	CS101	CS101	CS101	CS101
Flanges	MS1056 MS1056C	MS1056	MS1056	MS1056	MS1056A	MS1056A
	MS1057 MS1056E MS1056F	MS1057 MS1056E MS1056F	MS1057A	MS1057A	MS1057B	MS1057C
Forged Tees and Elbows	MS1063	MS1063	MS1063	MS1063	MS1063	MS1063
	MS1064	MS1064	MS1064	MS1064	MS1064	MS1064
	MS1051	MS1051	MS1051	MS1051	MS1051	MS1051
	MS1052	MS1052	MS1052	MS1052	MS1052	MS1052
	MS1050	MS1050	MS1050	MS1050	MS1050	MS1050

NOTE: MS and CS numbers refer to "Gas Standards and Specifications".

H numbers refer to Mueller Catalog numbers.

ASA refers to American Standards Association.