



MANUAL OF RECOMMENDED PRACTICE FOR

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# Hydrogen Fuel Gas Piping



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## FORWARD AND PURPOSE

The world-wide energy industry seeks to address the impact of global climate change through a reduction in the use of fossil fuels. One of the many proposed approaches includes the use of alternative clean fuels, renewable fuels, and fuel blends. These approaches include gaseous hydrogen, hydrogen blended with natural gas, and renewable natural gas. These alternative fuels are not new, but the mainstream introduction of these fuels into the flow of commerce dictates that the model fuel gas codes be amended to accommodate their anticipated impact on general safety, reliability, and efficiency.

This Manual of Recommended Practices for Hydrogen Fuel Gas Piping contains many new and/or amended industry practices for designing, sizing, installing, and inspecting new fuel gas piping systems containing either hydrogen admixtures or pure gaseous hydrogen. As a fuel, hydrogen has the smallest molecule, and thus presents a challenge to piping system designers and operators regarding containment of the fuel within the piping system. Furthermore, hydrogen has three times less energy content than natural gas making it more challenging to deliver sufficient fuel to maintain proper operation and efficiency within traditional gas appliances.

This manual provides the user with guidance on how the use of hydrogen fuel and admixtures (annex) will impact the customary industry practices associated with the distribution of fuel gas within buildings. The user is advised to ensure that only appliances and piping system components that have been tested and listed to a nationally recognized consensus standard for hydrogen service be specified for use within hydrogen piping systems. Furthermore, the user of this document must be aware that the practices recommended within are subject to frequent updating and revision as newer data and research become known regarding the impact of hydrogen gas for this type of service.

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# MANUAL OF RECCOMENDED PRACTICE FOR HYDROGEN FUEL GAS PIPING

## 101.0 General.

**101.1 Applicability.** The regulations of this Manual shall govern the installation of new hydrogen fuel gas piping in or in connection with a building, structure or within the property lines of premises, and as supplied by an authorized hydrogen generator or supplier. In accordance with the Uniform Plumbing Code and National Fuel Gas Code, fuel gas includes natural gas (up to 5% hydrogen by volume), manufactured liquefied petroleum or a mixture of these.”

## 102.0 Hydrogen Gas Piping System Requirements.

**102.1 General.** The purpose of the Manual is specific to gas piping systems utilizing 95% to 100% gaseous hydrogen, unless otherwise noted.

**102.2 Applications.** This Manual shall not apply to fuel gas types described in the Uniform Plumbing Code, the Uniform Mechanical Code, and the National Fuel Gas Code.

### 102.3 Definitions.

**102.3.1 Hydrogen Gas.** For purposes of this Manual, “Gas” is described as 95% or more gaseous hydrogen, unless otherwise specified as a hydrogen admixture.

**102.3.2 Hydrogen Admixtures.** Fuel gas to which hydrogen is blended and/or mixed over 5% but not exceeding 20% by volume from the generator or supplier at the point of delivery.

**102.3.3 Fuel Gas.** Natural, manufactured liquefied petroleum or a mixture of these.

## 103.0 Inspection.

**103.1 Inspection Notification.** Upon completion of the installation, alteration, or repair of hydrogen gas piping, and prior to the use thereof, the Authority Having Jurisdiction shall be notified that such hydrogen gas piping is ready for inspection.

**103.2 Excavation.** Excavations required for the installation of underground piping shall be kept open until the piping has been inspected and approved. Where such piping is covered or concealed before such approval, it shall be exposed upon the direction of the Authority Having Jurisdiction.

**103.3 Type of Inspections.** The Authority Having Jurisdiction shall make the following inspections and either shall approve that portion of the work as completed or shall notify the permit holder wherein the same fails to be in accordance with this manual.

**103.3.1 Rough Piping Inspection.** This inspection shall be made after hydrogen gas piping authorized by the permit has been installed and before such piping has been covered or concealed or fixture or appliance has been attached thereto. This inspection shall include a visual inspection to determine that the hydrogen gas piping size, material, and installation meet the requirements of this code, and a pressure test in accordance with the Authority Having Jurisdiction.

**103.3.2 Final Piping Inspection.** This inspection shall be made after hydrogen gas piping authorized by the permit has been installed, and after portions, thereof that are to be covered or concealed are so concealed, and before fixtures, appliances, or shutoff valves has been attached thereto. This inspection shall comply with Section 103.0. Test gauges used in conducting tests shall be in accordance with The Authority Having Jurisdiction.

## 104.0 Certificate of Inspection.

**104.1 Issuance.** Whereupon final piping inspection, the installation is found to be in accordance with the provisions of this manual, evidence of inspection shall be provided by the Authority Having Jurisdiction.

**104.2 Hydrogen Gas Generator or Supplier.** When requested by the hydrogen gas supplier, a copy of the certificate of such final piping inspection shall be issued by the Authority Having Jurisdiction to the serving hydrogen gas supplier supplying gas to the premises.

**104.4 Unlawful.** When piping has been installed or replaced, it shall be unlawful for a serving hydrogen gas supplier to turn on or cause to be turned on, a hydrogen gas or a hydrogen gas meter or meters, without approval from the Authority Having Jurisdiction. All piping, appliances and appurtenances shall be listed and approved.

## **105.0 Authority to Render Hydrogen Gas Service.**

**105.1 Authorized Personnel.** It shall be unlawful for a person, firm, or corporation, except the Authority Having Jurisdiction to turn on or reconnect hydrogen gas service in or on a premises where and when hydrogen gas service is, at the time, not being rendered.

**105.2 Outlets.** It shall be unlawful to turn on or connect gas in or on the premises unless outlets are securely connected to gas appliances or capped or plugged with screw joint fittings.

**105.3 Notification.** The utility provider shall supply the Authority Having Jurisdiction a notification letter of any changes to hydrogen gas supplies that include admixtures of gaseous hydrogen above 5% by volume.

## **106.0 Authority to Disconnect Service.**

**106.1 Disconnection.** The Authority Having Jurisdiction or the serving hydrogen gas supplier is hereby authorized to disconnect hydrogen gas piping or appliance or both that shall be found not to be in accordance with the requirements of this Manual or that are found defective and, in such condition, as to endanger life or property.

**106.2 Notice.** Where such disconnection has been made, a notice shall be attached to such hydrogen gas piping or appliance or both that shall state the same has been disconnected, together with the reasons thereof.

**106.3 Capped Outlets.** It shall be unlawful to remove or disconnect hydrogen gas piping or appliance without capping or plugging with a screw joint fitting, the outlet from which said pipe or appliance was removed. Outlets to which appliances are not connected shall be left capped and gastight on a piping system that has been installed, altered, or repaired.

## **107.0 Temporary Use of Hydrogen Gas.**

**107.1 General.** Where temporary use of hydrogen gas is desired, and the Authority Having Jurisdiction deems the use necessary, a permit shall be permitted to be issued for such use for a period not to exceed that designated by the Authority Having Jurisdiction, provided that such hydrogen gas piping system otherwise is in accordance with the requirements of this Manual regarding material, sizing, and safety.

## **108.0 Hydrogen Gas Piping System Design, Materials, and Components.**

**108.1 Design of Hydrogen Piping System.** Where required by the Authority Having Jurisdiction, a piping sketch or plan shall be prepared prior to commencing with the installation. This plan must display the intended material to be used, the piping's location, the dimensions and lengths of different branches, the assorted load demands, and the point of delivery's position.

### **108.2 Maximum Hydrogen Gas Demand.**

**108.2.1 Sizing of Hydrogen Gas Piping Systems.** Hydrogen gas piping systems shall be sized and installed to provide the maximum demand, and supply hydrogen gas to each appliance inlet at no less than the minimum supply pressure in accordance with the requirements of the appliance manufacturer.

**108.2.2 Sizing Methods.** Hydrogen gas piping shall be sized in accordance with one of the following:

- (1) Pipe sizing tables or sizing equations in this manual.
- (2) In accordance with the piping manufacturer's instructions.
- (3) Approved engineering methods.

**108.3 Maximum Operating Pressure in Buildings.** The maximum operating pressure for any piping systems located inside buildings shall not exceed 5 psi (34 kPa) unless one or more of the following conditions are met:

- (1) The piping joints are welded or brazed.
- (2) The piping joints are flanged, and all pipe-to-flange connections are made by welding or brazing
- (3) The piping is located in a ventilated chase or otherwise enclosed for protection against accidental gas accumulation.
- (4) The piping is located inside buildings or separate areas of buildings used exclusively for one of the following:
  - (a) Industrial processing or heating
  - (b) Research
  - (c) Warehousing
  - (d) Boiler or mechanical rooms
- (5) Piping is a temporary installation for buildings under construction.

- (6) The piping serves appliances or equipment used for agricultural purposes.
- (7) Manufacturer products shall be specifically listed and approved for pressures exceeding 5 psi (34 kPa) distributing gaseous hydrogen.

**108.4 Acceptable Piping Materials and Joining Methods.** The materials used in the piping system shall comply with the listed and approved standards outlined in this Manual or as approved by the Authority Having Jurisdiction.

**108.4.1 Used Materials.** Pipe, fittings, valves, or any other materials cannot be reused unless they are entirely devoid of foreign substances and deemed suitable for the use of hydrogen gas.

**108.4.2 Other Materials.** Material not covered by specifications listed herein shall meet the following criteria:

- (1) Be investigated and tested to determine that it is safe and suitable for the proposed service.
- (2) Be recommended for that service by the manufacturer.
- (3) Be acceptable to the Authority Having Jurisdiction.

**108.5 Metallic Pipe.** Wrought and Cast-iron pipe shall not be used.

**108.5.1 Steel, Stainless Steel, and-Copper Pipe.** Steel, stainless steel, copper and copper alloy tubing pipe and tubing shall be listed for the use with hydrogen gas.

**108.6 Metallic Tubing.**

**108.6.1 Steel and Stainless Steel Tubing.** Steel and stainless-steel tubing shall be listed for the use with hydrogen gas.

**108.6.2 Copper and Copper Alloy Tubing.** Copper and copper alloy tubing shall be of Type K or L and shall be listed for the use with hydrogen gas.

**108.6.3 Corrugated Stainless Steel Tubing.** Corrugated stainless steel tubing systems shall be listed for the use with hydrogen gas.

**108.7 Metallic Piping Joints and Fittings.** The piping joint used shall be suitable for the pressure and temperature conditions while taking into consideration joint tightness and mechanical strength under the service conditions. The joint shall have the capacity to withstand the maximum end force resulting from internal pressure, temperature-induced expansion or contraction, vibration, fatigue, or the weight of the pipe and its contents.

**108.7.1 Pipe Joints.** Schedule 40 and heavier pipe joints shall be threaded, flanged, brazed, welded, or assembled with press-connect fittings listed for the use with hydrogen gas.

**108.7.2 Metallic Pipe Threads.** Metallic pipe and fitting threads shall be taper pipe threads and shall be listed for the use with hydrogen gas. Thread sealant shall also be listed for use with hydrogen gas.

**108.7.3 Copper Tubing Joints.** Copper tubing joints shall be brazed using a material that melts at over 1000°F (538°C) or assembled with press-connect fittings listed for use with hydrogen gas. Brazing alloys should not contain more than 0.05 percent phosphorus.

**108.7.4 Stainless Steel Tubing Joints.** Stainless steel joints shall be welded, assembled with listed tubing fittings, brazed using materials that melt at over 1000°F (538°C), or assembled with press-connect fittings listed for use with hydrogen gas. Only manufacturer-recommended brazing alloys and fluxes shall be used when working with stainless steel alloys.

**108.7.5 Metallic Pipe Fittings.** Metallic fittings shall comply with the following:

- (1) Threaded fittings in sizes larger than 4 inches (100 mm) shall not be used.
- (2) Fittings used with steel, stainless steel-pipe shall be steel, stainless steel, or copper alloy.
- (3) Fittings used with copper or copper alloy pipe shall be copper or copper alloy.
- (4) Special fittings such as couplings, proprietary-type joints, saddle tees, gland-type compression fittings, and flared, flareless, or compression-type tubing fittings shall be as follows:
  - (a) Used within the fitting manufacturer's pressure-temperature recommendations.
  - (b) Used within the service conditions anticipated with respect to vibration, fatigue, thermal expansion, or contraction.
  - (c) Acceptable to the Authority Having Jurisdiction.
  - (d) Listed for use with hydrogen gas.

**108.8 Plastic Piping, Joints, and Fittings.** Plastic pipes, tubing, and fittings shall only be installed outdoors and underground in accordance with the instructions provided by the manufacturer and this code. All plastic piping and fittings shall be listed for use with hydrogen gas.

**108.8.1 Joint Design.** The joint shall be created and installed in a way that the longitudinal pullout resistance of the joint is equivalent to, or greater than, the tensile strength of the plastic piping material. The joints shall be listed for use with for Hydrogen gas.

**108.8.2 Heat-Fusion Joint.** Heat-fusion joints shall be performed based on qualified and approved procedures. Heat fusions fittings shall be approved and tested for hydrogen gas applications.

**108.9 Flange Specification.** Flanges shall be approved and listed by the manufacturer in accordance with sections 108.9.1 through 108.9.2.

**108.9.1 Flange Gaskets.** Gasket material shall be able to endure the design temperature and pressure of the piping system, along with the chemical elements of hydrogen gas being transmitted without any alteration to its chemical or physical characteristics. When selecting the gasket material, the potential impact of fire exposure on the joint shall be considered.

**108.9.2 Flange Gasket Materials.** Acceptable materials shall be approved and listed by the manufacturer for the use of hydrogen gas.

**109.0 Hydrogen Gas Meters.** Meters shall be listed for hydrogen use and in accordance with the testing procedures in accordance with Chapter 12 of the Uniform Plumbing Code, manufacturer approved installation instructions and the Authority Having Jurisdiction.

**110.0 Hydrogen Gas Pressure Regulators.** Regulators shall be listed for hydrogen use and in accordance with the testing procedures in accordance with Chapter 12 of the Uniform Plumbing Code, manufacturer approved installation instructions and the Authority Having Jurisdiction.

**110.1 Identification.** A metal tag or another form of permanent identification shall be used to label all line pressure regulators in multi-regulator installations, indicating the building or specific area being serviced.

**110.2 Discharge of Vents.** The discharge stacks, vents, or outlet parts of all pressure relieving and pressure limiting devices shall be located so that gas is safely discharged outdoors. Discharge stacks or vents shall be designed to prevent the entry of water, insects, or other foreign material that could cause blockage.

**111.0 Gas Piping Installation.** Piping systems shall be installed in accordance with the testing procedures in accordance with Chapter 12 of the Uniform Plumbing Code Fuel Gas Chapter, manufacturer approved installation instructions and the Authority Having Jurisdiction.

**111.1 Hydrogen Gas Shutoff Valves.** Shutoff valves shall be listed for hydrogen use and in accordance with the testing procedures in accordance with Chapter 12 of the Uniform Plumbing Code, manufacturer approved installation instructions and the Authority Having Jurisdiction.

**112.0 Appliance and Equipment Connections to Building Piping.**

**112.1 Connecting Appliances and Equipment.** Appliances and equipment shall be connected to the building piping in compliance with the following:

- (1) Rigid metallic pipe and fittings.
- (2) Semirigid metallic tubing and metallic fittings.
- (3) A listed connector shall be used in accordance with the manufacturer's installation instructions and shall be in the same room as the appliance. Only one connector shall be used per appliance.
- (4) Only one connector shall be used per appliance.
- (5) CSST where installed in accordance with the manufacturer's installation instructions. CSST shall connect only to appliances that are fixed in place.

**113.0 Pressure Testing, Inspection, and Purging.**

**113.1 Test Preparation.** Test preparation shall be in accordance with the testing procedures in accordance with Chapter 12 of the Uniform Plumbing Code, manufacturer approved installation instructions and the Authority Having Jurisdiction.

**113.2 Test Pressure.** The pressure test shall be performed using air, CO<sub>2</sub>, or nitrogen at a test pressure, not less than 10 psi (69 kPa) gauge pressure. Test pressures shall be held for a length of time satisfactory to the Authority Having Jurisdiction

but in no case less than 15 minutes with no perceptible drop in pressure. These tests shall be made in the presence of the Authority Having Jurisdiction. Necessary apparatus for conducting tests shall be furnished by the permit holder. Test gauges used in conducting tests shall be in accordance with the Uniform Plumbing Code.

**113.3 Purging and Initial Filling Requirements.** Purging of pressure test gas shall be performed in accordance with the purging requirements of the Authority Having Jurisdiction. Initial filling of the piping system with hydrogen gas shall be monitored at each outlet to ensure that all the pressure test gas has been removed. Once hydrogen gas is detected at each outlet, the purging process shall be stopped, and the piping system capped leak-tight at each outlet.

#### 114.0 Required Gas Supply.

**114.1 General.** The installation of hydrogen gas piping shall comply with this section, Sections 114.2 through 114.4 and Section 115.0. The hydrogen gas piping regulations and tables are based on the use of a gas having a specific gravity of 0.07. Where blended gas of a different specific gravity is to be delivered, the specific gravity conversion factors provided by the serving gas supplier shall be used in sizing piping systems in lieu of the hydrogen gas demand sizing table in this manual.

**114.2 Volume.** The hourly volume of gas required at each piping outlet shall be taken at not less than the maximum hourly rating as specified by the manufacturer of the appliance or appliances to be connected to each such outlet.

**114.3 Gas Appliances.** Where the gas appliances to be installed have not been specified, the piping system designer shall be permitted to estimate the hourly volume requirements of the expected hydrogen appliances.

To obtain the cubic feet per hour (m<sup>3</sup>/h) of gas required, divide the input of the appliances by the average Btu (kW•h) heating value per cubic foot (m<sup>3</sup>) of the hydrogen gas. The average Btu (kW•h) per cubic foot (m<sup>3</sup>) of the hydrogen gas in the area of the installation shall be permitted to be obtained from the serving gas supplier.

**114.4 Size of Piping Outlets.** The size of the supply piping outlet for a gas appliance shall be not less than 1/2 of an inch in diameter (15 mm). The size of a piping outlet for a mobile home shall be not less than 3/4 of an inch in diameter (20 mm).

#### 115.0 Required Gas Piping Size.

**115.1 Pipe Sizing Methods.** When determining the pipe size using methods in Section 115.2.1. The diameter of each pipe segment should be obtained from the pipe sizing tables in Section 115.2, or the sizing tables supplied by the manufacturer of a listed hydrogen gas piping system.

**115.2 Sizing of Hydrogen Gas Piping Systems.** The sizing of the hydrogen gas piping shall be in accordance with Table 115.2 (A) or Table 115.2(B).

**115.2.1 Sizing Equations.** The internal diameter of smooth wall pipe or tubing can be determined in accordance with Table 115.2(A) and 115.2(B) based on the capacity or calculated with the following equation.

$$Q = 187.3 \sqrt{\frac{D^5 \cdot \Delta H}{C_r \cdot fba \cdot L}}$$
$$= 2313 D^{2.623} \left( \frac{\Delta H}{C_r \cdot L} \right)^{0.541}$$

**115.2.2 Sizing of Piping Sections.** To determine the size of each section of pipe in a system within the range of Table 115.2 proceed as follows:

- (1) Measure the length of the pipe from the gas meter location to the most remote outlet on the system.
- (2) Select the length in feet column and row showing the distance, or the next longer distance where the table does not give the exact length.
- (3) Starting at the most remote outlet, find in the row just selected the gas demand for that outlet. Where the exact figure of demand is not shown, choose the next larger figure in the row.
- (4) At the top of this column will be found the correct size of pipe.
- (5) Using this same row, proceed in a similar manner to each section of pipe serving this outlet. For each section of pipe, determine the total gas demand supplied by that section. Where gas piping sections serve both heating and cooling appliances and the installation prevents both units from operating simultaneously, the larger of the two demand loads shall be used in sizing these sections.

- (6) Size each section of branch piping not previously sized by measuring the distance from the gas meter location to the most remote outlet in that branch and follow the procedures of steps 2, 3, 4, and 5 above. Size branch piping in the order of their distance from the meter location, beginning with the most distant outlet not previously sized.

**TABLE 115.2(A)**  
**100% HYDROGEN GAS (SG=0.07, HV=325 BTU/cu.ft.)**  
**Capacities in MBTU / hr (Thousands of BTU per Hour)**

**Schedule 40 Steel Pipe**  
**Less than 2-PSI and 0.5-inch WC Drop**

Length (ft)	Pipe Size (Nominal Inch)											
	1/2"	3/4"	1"	1-1/4"	1-1/2"	2"	2-1/2"	3"	4"	5"	6"	8"
<b>10</b>	165	344	649	1,333	1,998	3,849	6,137	10,853	22,147	40,083	64,923	133,454
<b>20</b>	113	237	446	916	1,373	2,646	4,219	7,461	15,225	27,555	44,631	91,742
<b>30</b>	91	190	358	736	1,103	2,125	3,388	5,992	12,228	22,130	35,845	73,682
<b>40</b>	78	163	307	630	944	1,819	2,900	5,129	10,466	18,942	30,682	63,068
<b>50</b>	69	144	272	558	837	1,612	2,571	4,546	9,277	16,790	27,194	55,900
<b>60</b>	62	131	246	506	758	1,461	2,329	4,119	8,406	15,213	24,642	50,652
<b>70</b>	57	120	227	466	698	1,344	2,143	3,790	7,734	13,997	22,671	46,602
<b>80</b>	53	112	211	433	649	1,251	1,994	3,526	7,195	13,022	21,092	43,356
<b>90</b>	50	105	198	406	609	1,173	1,871	3,308	6,751	12,218	19,791	40,681
<b>100</b>	47	99	187	384	575	1,108	1,767	3,125	6,377	11,542	18,695	38,428
<b>125</b>	42	88	166	340	510	982	1,566	2,770	5,653	10,230	16,570	34,061
<b>150</b>	38	80	150	308	462	890	1,419	2,510	5,122	9,270	15,014	30,863
<b>175</b>	35	73	138	284	425	819	1,306	2,309	4,712	8,528	13,814	28,395
<b>200</b>	33	68	128	264	395	762	1,215	2,148	4,384	7,934	12,852	26,417
<b>250</b>	29	60	114	234	351	675	1,077	1,904	3,886	7,033	11,391	23,415
<b>300</b>	26	55	103	212	318	612	976	1,725	3,521	6,372	10,322	21,217
<b>350</b>	24	50	95	195	292	563	898	1,587	3,239	5,863	9,496	19,520
<b>400</b>	22	47	88	181	272	524	835	1,477	3,014	5,454	8,835	18,160
<b>450</b>	21	44	83	170	255	492	784	1,386	2,828	5,118	8,290	17,040
<b>500</b>	20	42	78	161	241	464	740	1,309	2,671	4,835	7,831	16,096

**TABLE 115.2(B)**  
**100% HYDROGEN GAS (SG=0.07, HV=325 BTU/cu.ft.)**  
**Capacities in CFH (Cubic Feet per Hour)**

**Schedule 40 Steel Pipe**  
**Less than 2-PSI and 0.5-inch WC Drop**

Length (ft)	Pipe Size (Nominal Inch)											
	1/2"	3/4"	1"	1-1/4"	1-1/2"	2"	2-1/2"	3"	4"	5"	6"	8"
<b>10</b>	507	1,060	1,997	4,102	6,147	11,844	18,884	33,395	68,146	123,332	199,764	410,628
<b>20</b>	348	728	1,373	2,820	4,226	8,142	12,981	22,957	46,847	84,784	137,327	282,285
<b>30</b>	280	585	1,103	2,265	3,394	6,539	10,426	18,438	37,624	68,093	110,293	226,714
<b>40</b>	239	501	944	1,938	2,905	5,597	8,924	15,782	32,204	58,284	94,405	194,055
<b>50</b>	212	444	836	1,718	2,575	4,961	7,910	13,988	28,544	51,660	83,675	172,000
<b>60</b>	192	402	758	1,557	2,333	4,495	7,167	12,675	25,865	46,811	75,820	155,853
<b>70</b>	177	370	697	1,432	2,147	4,136	6,594	11,661	23,796	43,067	69,757	143,390
<b>80</b>	165	344	649	1,333	1,997	3,848	6,135	10,849	22,139	40,067	64,898	133,402
<b>90</b>	154	323	609	1,250	1,874	3,611	5,756	10,180	20,773	37,595	60,894	125,172
<b>100</b>	146	305	575	1,181	1,770	3,411	5,438	9,616	19,623	35,514	57,522	118,241
<b>125</b>	129	270	510	1,047	1,569	3,023	4,820	8,523	17,392	31,477	50,985	104,802
<b>150</b>	117	245	462	949	1,422	2,739	4,367	7,723	15,760	28,522	46,198	94,964
<b>175</b>	108	225	425	873	1,308	2,520	4,018	7,105	14,499	26,241	42,504	87,370
<b>200</b>	100	210	395	812	1,217	2,345	3,738	6,611	13,489	24,414	39,543	81,284
<b>250</b>	89	186	350	720	1,079	2,078	3,313	5,859	11,956	21,639	35,049	72,046
<b>300</b>	81	168	317	652	977	1,883	3,002	5,309	10,834	19,608	31,759	65,282
<b>350</b>	74	155	292	600	899	1,732	2,762	4,885	9,968	18,040	29,219	60,062
<b>400</b>	69	144	272	558	837	1,612	2,570	4,544	9,273	16,783	27,184	55,878
<b>450</b>	65	135	255	524	785	1,512	2,411	4,264	8,701	15,748	25,507	52,431
<b>500</b>	61	128	241	495	741	1,429	2,278	4,028	8,219	14,876	24,094	49,527

**116.0 Variable Gas Pressure.** Where the supply hydrogen gas pressure exceeds 5 psi (34.6 kPa) or is less than 6 inches of water column (1.5 kPa), or where diversity demand factors are used, the design, pipe sizing, materials, location, and use of such systems first shall be approved by the Authority Having Jurisdiction. Piping systems designed for pressures exceeding the serving gas supplier's standard delivery pressure shall have prior verification from the gas supplier of the availability of the design pressure.

**117.0 Engineering Methods.** For conditions other than those covered by Section 115.0, such as longer runs or greater hydrogen gas demands, the size of each hydrogen gas piping system shall be determined by standard engineering methods acceptable to the Authority Having Jurisdiction, and each such system shall be so designed that the total pressure drop between the meter or another point of supply and an outlet where full demand is being supplied to all outlets, shall be in accordance with the requirements of Section 108.

Public Comment  
Draft

**ANNEX I  
HYDROGEN ADMIXTURES**

**102.0 Applicability.**

**102.1 Systems Supplied by Hydrogen Admixtures.** Fuel gas systems, where hydrogen admixtures are delivered, shall meet the piping requirements in accordance with Chapter 12 of the Uniform Plumbing Code for the supplier-defined hydrogen admixture limitations, defined by volume concentration of gaseous hydrogen, and approved by the manufacturer, installer, or Authority Having Jurisdiction.

**102.2 Fuel Gas Specifications.** The Authority Having Jurisdiction shall be provided with specific compositional descriptions for the fuel gas supplied by a utility, including hydrogen admixtures.

**102.3 Appliances and Equipment Listings.** Appliances operating on hydrogen admixtures shall be tested and listed for the specified operation of hydrogen admixtures. All piping systems and fuel gas system components shall be tested and listed for approval for hydrogen admixture limits or as required by the Authority Having Jurisdiction.

**103.0 Materials.** The applicability of piping and fittings materials for systems with hydrogen admixtures shall be in accordance with Table 103.0.

**TABLE 103.0  
MATERIAL APPLICABILITY TABLE  
FOR HYDROGEN ADMIXTURES**

PIPE AND TUBBING	UP TO 20% Hydrogen	100% Hydrogen
Steel	Y	Y
Copper	Y	Y
CSST tubing	Y	Y
Plastic (Aboveground)	N	N
Plastic (Underground)	Y	Y
JOINTS AND FITTINGS	UP TO 20% Hydrogen	100% Hydrogen
Steel	Y	Y
Copper	Y	Y
Stainless	Y	Y
Plastic (Underground)	Y	Y

Note:

1. All materials listed shall be individually tested, listed and approved for hydrogen gas and appliances served.



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