

PSC 135,192 Filed March 2, 1972  
4:15 P.M.

BEFORE THE  
PUBLIC SERVICE COMMISSION

STATE OF WISCONSIN            )  
  ) SS  
PUBLIC SERVICE COMMISSION)

I, John F. Goetz, Secretary of the Public Service Commission and legal custodian of the official records of said Commission, do hereby certify under my signature and official seal of the Commission that the attached recreated rules, Wis. Adm. Code Chapter PSC 135 relating to Gas Safety were duly approved and adopted by order of December 21, 1971.

I further certify that the copy of the recreated rules attached hereto has been compared by me with the original on file in this Commission and that the same is a true copy thereof.

Dated at Madison, Wisconsin

February 29, 1972

John F. Goetz  
John F. Goetz  
Secretary

ORDER OF THE  
PUBLIC SERVICE COMMISSION  
ADOPTING RECREATED RULES

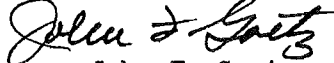
Pursuant to authority vested in the Public Service Commission by section 196.745, Wis. Stats., the Public Service Commission hereby repeals and recreates rules as follows:

Chapter PSC 135 of the WISCONSIN ADMINISTRATIVE CODE is repealed and recreated to read as shown (attached).

The recreated rules contained herein shall take effect on June 1, 1972 as provided in section 227.026 (1) (Intro. par.), Wis. Stats.

Dated:

PUBLIC SERVICE COMMISSION

  
John F. Goetz  
Secretary

CHAPTER PSC 135

GAS SAFETY

PSC 135.01 CHARACTER OF CONSTRUCTION, MAINTENANCE, AND OPERATION. All gas transmission, distribution, and utilization equipment and facilities shall be constructed, installed, operated, and maintained in a reasonably adequate and safe manner and as a minimum more specifically provided for herein.

PSC 135.02 FACILITIES, INSPECTION AND REPAIRS. All facilities shall be cleaned when necessary and inspected at such intervals as experience has shown to be necessary. Any facilities known to be defective so as to endanger life or property shall be promptly repaired, permanently disconnected, or isolated until repairs can be made. Construction, repairs, additions, and changes to gas transmission and distribution facilities shall be made by qualified persons only.

PSC 135.03 APPLICATION OF RULES. Every gas utility that operates gas transmission or distribution facilities in the state shall comply with the rules in this chapter.

(1) WAIVING RULES. The rules may be modified or waived by the public service commission. They may be so modified or waived in particular cases wherever shown to be impracticable for special reasons or where the advantage of uniformity with existing construction is greater than the advantage of construction in compliance with the rules providing the existing construction is reasonably safe or if equivalent or safer construction is secured in other ways.

(2) TEMPORARY INSTALLATIONS. It will sometimes be necessary to modify or waive certain of the rules in case of temporary installations or installations which are shortly to be dismantled or reconstructed. Such temporary

PSC 135.04 INTERFERENCE WITH PUBLIC SERVICE FACILITIES.

(1) No utility or operating company having any work upon, over, along, or under any public street or highway or upon, over, along, or under any private property shall interfere with, destroy, or disturb the facilities of any other public service corporation or railroad encountered in the performance of such work so as to interrupt, impair, or affect the public service for which such facilities may be used, without first reaching an agreement concerning the location and the nature of the proposed work.

(2) A utility or operating company shall exercise care when working in close proximity of existing facilities. When the facilities are underground and are to be exposed or possibly may be exposed, hand-digging shall be employed. In these cases, such support as may be reasonably necessary for protection of the facilities shall be provided in and near the construction area. When backfilling an excavation, such procedures and materials shall be employed to provide reliable support for existing underground facilities in and near the construction area.

(3) A utility or operating company shall, in the absence of working arrangements, give at least 3 days' written notice (not counting Saturdays, Sundays, and legal holidays) to all utilities, operating companies, or railroads and to those who may have facilities in and near the construction area which may be affected by the proposed work. The utility or operating company proposing to work shall obtain from the affected party the location of the existing facilities determined to be affected or to be in and near the construction area.

(4) A utility or operating company upon receiving a notice of proposed construction shall furnish in 3 days detailed information relative to location and type of facilities that are present in the proposed construction area. In those cases where the facilities are underground, they shall be marked physically in the field relative to location.

(5) Nothing in the above shall prevent a utility or operating company from proceeding as quickly as possible

(1) Shall investigate and decide what action, if any, must reasonably be taken to protect or alter facilities, in order to protect service to the public and to avoid unnecessary damage, such as identifying in a suitable manner the location of any underground facilities which may be affected by the work.

(2) The utility or operating company shall take such action as is reasonably and legally necessary to protect, remove, alter, or reconstruct its facilities, and shall perform such work with reasonable dispatch taking into account the conditions to be met, provided that nothing in this rule shall be deemed to affect any right which the utility or operating company may have to require advance payment or adequate assurance of payment of the reasonable cost thereof to the utility or operating company by the property owner or contractor.

(3) The utility or operating company may, in order to protect its interests, require that the owner or contractor perform certain work upon that part of the service piping or wiring on or being removed from the property upon which the excavating, building, or wrecking operations are being performed.

(4) This rule is not intended to affect the responsibility of the contractor or owner, or the liability or legal rights of any party.

PSC 135.06 LEAK SURVEY REPORTS. On or before April 15 of each year all gas utilities shall report to the commission a summary of the results of the leak surveys made during the previous calendar years. The report shall contain at least the following information:

(1) The number and type of leak surveys which were made by the utility during the previous calendar year.

(2) The number of leaks, both inside and outside, which were found, by either a survey or complaint, in the utility's service area during the previous calendar year.

(3) The number of leaks found during the previous calendar year which were repaired the same year.

PSC 135.08 REPORT OF PROPOSED CONSTRUCTION. Prior to construction or reconstruction of any gas transmission line exceeding one mile in length or any gas main exceeding 1,000 feet in length intended to be subjected to pressures in excess of 100 p.s.i.g., a report shall be filed with the commission setting forth the specifications for such pipeline or main. This report shall contain at least the following information:

(1) The necessary data to calculate the design pressure as set forth in 192.105.

(2) The design pressure as determined by the utility or operating company.

(3) The expected pressure at which the pipeline or main will be operated.

(4) The pressure to which the pipeline or main will be tested.

PSC 135.09 ADOPTION OF FEDERAL MINIMUM SAFETY STANDARDS.

(1) The federal Department of Transportation, Office of Pipeline Safety, pursuant to the Natural Gas Pipeline Safety Act of 1968 (49 U.S.C. 1675, -et seq.) has established Minimum Safety Standards for pipeline facilities and the transportation of gas, as set forth in Part 192 in Title 49, Code of Federal Regulations. In accordance with the Natural Gas Pipeline Safety Act of 1968 and requirements of the federal Department of Transportation, such Minimum Safety Standards are hereby adopted as state Safety Standards. (The numbering system and sequence used in said Minimum Safety Standards are herein used for convenience and clarity.) Additions have been made to the Minimum Safety Standards of the federal Department of Transportation as adopted herein and follow the section of the adopted federal standards to which the additions directly relate or if the additions do not directly relate to any particular adopted federal standard the additions are inserted in the numbering sequence within the appropriate subpart. In all cases the additions appear in italics preceded by PSC 192 plus the appropriate section number.

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WISCONSIN CODE ADOPTION

OF

PART 192 IN TITLE 49

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SUBPART A--GENERAL

192.1 SCOPE OF PART.

(a) This part prescribes minimum safety requirements for pipeline facilities and the transportation of gas, including pipeline facilities and the transportation of gas within the limits of the outer continental shelf as that term is defined in the Outer Continental Shelf Lands Act (43 U.S.C. 1331).

(b) This part does not apply to the gathering of gas outside of the following areas:

(1) An area within the limits of any incorporated or unincorporated city, town or village.

(2) Any designated residential or commercial area such as a subdivision, business or shopping center, or community development.

192.3 DEFINITIONS.

As used in this part--

"Distribution Line" means a pipeline other than a gathering or transmission line.

"Gas" means natural gas, flammable gas, or gas which is toxic or corrosive.

"Gathering Line" means a pipeline that transports gas from a current production facility to a transmission line or main.

"High pressure distribution system" means a distribution system in which the gas pressure in the main is higher than the pressure provided to the customer.

"Listed specification" means a specification listed in section I of Appendix B of this part.

"Municipality" means a city, county, or any other political subdivision of a State.

"Operator" means a person who engages in the transportation of gas.

"Person" means any individual, firm, joint venture, partnership, corporation, association, State, municipality, cooperative association, or joint stock association, and includes any trustee, receiver, assignee, or personal representative thereof.

"Pipe" means any pipe or tubing used in the transportation of gas, including pipe-type holders.

"Pipeline" means all parts of those physical facilities through which gas moves in transportation, including pipe, valves, and other appurtenance attached to pipe, compressor units, metering stations, regulator stations, delivery stations, holders, and fabricated assemblies.

"Pipeline facility" means new and existing pipelines, rights-of-way, and any equipment, facility, or building used in the transportation of gas or in the treatment of gas during the course of transportation.

"Secretary" means the Secretary of Transportation or any person to whom he has delegated authority in the matter concerned.

"Service Line" means a distribution line that transports gas to a customer meter set assembly from a common source of supply.

"SMYS" means specified minimum yield strength is--

(1) For steel pipe manufactured in accordance with a listed specification, the yield strength specified as a minimum in that specification; or

(2) For steel pipe manufactured in accordance with an unknown or unlisted specification, the yield strength determined in accordance with 192.107(b).

"Transportation of gas" means the gathering, transmission, or distribution of gas by pipeline or the storage of gas, in or affecting interstate or foreign commerce.

192.5 CLASS LOCATIONS.

(a) Class location is determined by applying the criteria set forth in this section. The class location unit is an area that extends 220 yards on either side of the centerline of any continuous 1-mile length of pipeline. Except as provided in paragraph (d) (2) and (f), of this section, the class location is determined by the buildings in the class location unit. For the purposes of this section, each separate dwelling unit in a multiple dwelling unit building is counted as a separate building intended for human occupancy.

(b) A Class 1 location is any class location unit that has 10 or less buildings intended for human occupancy.

(c) A Class 2 location is any class location unit that has more than 10 but less than 46 buildings intended for human occupancy.

(d) A Class 3 location is--

(1) Any class location unit that has 46 or more buildings intended for human occupancy; or

(2) An area where the pipeline lies within 100 yards of any of the following:

(i) A building that is occupied by 20 or more persons during normal use.

(ii) A small, well-defined outside area that is occupied by 20 or more persons during normal use, such as a playground, recreation area, outdoor theater, or other place of public assembly.

(e) A Class 4 location is any class location unit where buildings with four or more stories above ground are prevalent.

192.7 INCORPORATION BY REFERENCE.

(a) Any documents or parts thereof incorporated by reference in this part are a part of this regulation as though set out in full.

(b) All incorporated documents are available for inspection in the Office of Pipeline Safety, Room 107, 400 Sixth Street SW., Washington, D. C. In addition, the documents are available at the addresses provided in Appendix A to this part.

(c) The full titles for the publications incorporated by reference in this part are provided in Appendix A to this part.

192.9 GATHERING LINES.

Each gathering line must comply with the requirements of this part applicable to transmission lines.

192.11 PETROLEUM GAS SYSTEMS.

(a) No operator may transport petroleum gas in a system that serves 10 or more customers, or in a system, any portion of which is located in a public place (such as a highway), unless that system meets the requirements of this part and of NFPA Standards No. 58 and No. 59. In the event of a conflict, the requirements of this part prevail.

(b) Each petroleum gas system covered by paragraph (a) of this section must comply with the following:

(1) Aboveground structures must have open vents near the floor level.

(2) Belowground structures must have forced ventilation that will prevent any accumulation of gas.

(3) Relief valve discharge vents must be located so as to prevent any accumulation of gas at or below ground level.

(b) No person may operate a segment of a pipeline that is replaced, relocated, or otherwise changed after November 12, 1970, unless that replacement, relocation, or change has been made in accordance with this part.

(c) Each operator shall maintain, modify as appropriate, and follow the plans, procedures, and programs that it is required to establish under this part.

192.15 RULES OF REGULATORY CONSTRUCTION.

(a) As used in this part--

"Includes" means including but not limited to.

"May" means "is permitted to" or "is authorized to".

"May not" means "is not permitted to" or "is not authorized to".

"Shall" is used in the mandatory and imperative sense.

(b) In this part--

(1) Words importing the singular include the plural;

(2) Words importing the plural include the singular; and

(3) Words importing the masculine gender include the feminine.

192.17 FILING OF INSPECTION AND MAINTENANCE PLANS.

(a) Except as provided in paragraph (b) of this section, each operator shall file with the secretary not later than February 1, 1971 a plan for inspection and maintenance of each pipeline facility which he owns or operates. In addition, each change to an inspection and maintenance plan must be filed with the secretary within 20 days after the change is made.

(b) The provisions of paragraph (a) of this section

SUBPART B--MATERIALS

192.51 SCOPE.

This subpart prescribes minimum requirements for the selection and qualification of pipe and components for use in pipelines.

192.53 GENERAL.

Materials for pipe and components must be--

(a) Able to maintain the structural integrity of the pipeline under temperature and other environmental conditions that may be anticipated.

*PSC 192.53(a) Some of the materials conforming to specifications approved for use under this code may not have properties suitable for the lower portion of the temperature band covered by this code. Engineers are cautioned to give attention to the low-temperature properties of the materials used for facilities to be exposed to unusually low ground temperatures or low atmospheric temperatures. Twenty (20) inch steel pipe and larger, with a specified minimum yield strength of 52,000 p.s.i. or higher, shall be tested for fracture toughness in accordance with the applicable section of respective API standard under which it was produced, except for small lot purchases of pipe where testing for fracture toughness is impractical.*

(b) Chemically compatible with any gas that they transport and with any other material in the pipeline with which they are in contact; and

(c) Qualified in accordance with the applicable requirements of this subpart.

*PSC 192.53(d) When substantial quantities of pipe are acquired certified reports of chemical composition*



(1) It was manufactured in accordance with a listed specification and it meets the requirements of paragraph II-C of Appendix B to this part;

(2) It meets the requirements of paragraph II-A through II-D of Appendix B to this part.

(3) It has been used in an existing line of the same or higher pressure and meets the requirements of paragraph II-C of Appendix B to this part; or

(4) It is used in accordance with paragraph (c) of this section.

(c) New or used steel pipe may be used at a pressure resulting in a hoop stress of less than 6,000 p.s.i. where no close coiling or close bending is to be done, if visual examination indicates that the pipe is in good condition and that it is free of split seams and other defects that would cause leakage. If it is to be welded, steel pipe that has not been manufactured to a listed specification must also pass the weldability tests prescribed in paragraph II-B of Appendix B to this part.

(d) Steel pipe that has not been previously used may be used as replacement pipe in a segment of pipeline if it has been manufactured prior to November 12, 1970, in accordance with the same specification as the pipe used in constructing that segment of pipeline.

(e) New steel pipe that has been cold expanded must comply with the mandatory provisions of API Standard 5LX.

*PSC 192.55(f) Pipe manufactured from steel made by the Bessmer process shall not be used.*

192.57 CAST IRON OR DUCTILE IRON PIPE.

(a) New cast iron or new ductile iron pipe is qualified for use under this part if it has been manufactured in accordance with a listed specification.

(b) Used cast iron or used ductile iron pipe is quali-

*PSC 192.57(c) Cast iron pipe shall not be used as a permanent part of any piping system constructed under this code except where it is used as a temporary installation or replacement of short sections of existing cast iron pipe because of maintenance or relocation. In those cases where cast iron pipe is used it shall be designed, installed, and operated in accordance with the applicable sections of this code.*

192.59 PLASTIC PIPE.

(a) New plastic pipe is qualified for use under this part if--

(1) It is manufactured in accordance with a listed specification; and

(2) It is resistant to chemicals with which contact may be anticipated.

(b) Used plastic pipe is qualified for use under this part if--

(1) It meets the requirements of a listed specification;

(2) It is resistant to chemicals with which contact may be anticipated;

(3) It has been used only in natural gas service;

(4) Its dimensions are still within the tolerances of the specification to which it was manufactured; and

(5) It is free of visible defects.

*PSC 192.59(c) Plastic pipe and tubing shall be adequately supported during storage. Thermoplastic pipe, tubing and fittings shall be protected from long term exposure to direct sunlight.*

192.61 COPPER PIPE.

Copper pipe is qualified for use under this part if

(b) Surfaces of pipe and components that are subject to stress from internal pressure may not be field die stamped.

(c) If any item is marked by die stamping, the die must have blunt or rounded edges that will minimize stress concentrations.

(d) Paragraph (a) of this section does not apply to items manufactured before November 12, 1970, that meet all of the following:

(1) The item is identifiable as to type, manufacturer, and model.

(2) Specifications or standards giving pressure, temperature, and other appropriate criteria for the use of items are readily available.

#### 192.65 TRANSPORTATION OF PIPE.

In a pipeline to be operated at a hoop stress of 20 percent or more of SMYS, no operator may use pipe having an outer diameter to wall thickness ratio of 70 to one, or more, that is transported by railroad unless that transportation was performed in accordance with API RP5L1.

### SUBPART C--PIPE DESIGN

#### 192.101 SCOPE.

This subpart prescribes the minimum requirements for the design of pipe.

#### 192.103 GENERAL.

Pipe must be designed with sufficient wall thickness, or must be installed with adequate protection, to withstand anticipated external pressures and loads that will be imposed on the pipe after installation.

D = Nominal outside diameter of the pipe in inches.

t = Nominal wall thickness of the pipe in inches. If this is unknown, it is determined in accordance with 192.109. Additional wall thickness required for concurrent external loads in accordance with 192.103 may not be included in computing design pressure.

F = Design factor determined in accordance with 192.111.

E = Longitudinal joint factor determined in accordance with 192.113.

T = Temperature derating factor determined in accordance with 192.115.

(b) If steel pipe that has been cold worked to meet the SMYS is heated, other than by welding, to 600° F. or more, the design pressure is limited to 75 percent of the pressure determined under paragraph (a) of this section.

#### 192.107 YIELD STRENGTH (S) FOR STEEL PIPE.

(a) For pipe that is manufactured in accordance with a specification listed in section I of Appendix B of this part, the yield strength to be used in the design formula in 192.105 is the SMYS stated in the listed specification, if that value is known.

(b) For pipe that is manufactured in accordance with a specification not listed in section I of Appendix B to this part or whose specification or tensile properties are unknown, the yield strength to be used in the design formula in 192.105 is one of the following:

(1) If the pipe is tensile tested in accordance with section 11-D of Appendix B to this part, the lower of the following:

(i) 80 percent of the average yield strength determined by the tensile tests.

(b) However, if the pipe is of uniform grade, size, and thickness and there are more than 10 lengths, only 10 percent of the individual lengths, but not less than 10 lengths, need be measured. The thickness of the lengths that are not measured must be verified by applying a gage set to the minimum thickness found by the measurement. The nominal wall thickness to be used in the design formula in 192.105 is the next wall thickness found in commercial specifications that is below the average of all the measurements taken. However, the nominal wall thickness used may not be more than 1.14 times the smallest measurement taken on pipe less than 20 inches in outside diameter, nor more than 1.11 times the smallest measurement taken on pipe 20 inches or more in outside diameter.

192.111 DESIGN FACTOR (F) FOR STEEL PIPE.

(a) Except as otherwise provided in paragraphs (b), (c), and (d) of this section, the design factor to be used in the design formula in 192.105 is determined in accordance with the following table:

<u>Class location</u>	<u>Design factor (F)</u>
1 -----	0.72
2 -----	0.60
3 -----	0.50
4 -----	0.40

(b) A design factor of 0.60 or less must be used in the design formula in 192.105 for steel pipe in Class 1 locations that:

(1) Crosses the right-of-way of an unimproved public road, without a casing;

(2) Crosses without a casing, or makes a parallel encroachment on, the right-of-way of either a hard surfaced road, a highway, a public street, or a railroad:

(c) For Class 2 locations, a design factor of 0.50 or less, must be used in the design formula in 192.105 for uncased steel pipe that crosses the right-of-way of a hard surfaced road, a highway, a public street, or a railroad.

(d) For Class 1 or Class 2 locations, a design factor of 0.50, or less, must be used in the design formula in 192.105 for each compressor station, regulator station, and measuring station.

192.113 LONGITUDINAL JOINT FACTOR (E) FOR STEEL PIPE.

The longitudinal joint factor to be used in the design formula in 192.105 is determined in accordance with the following table:

Specification	Pipe class	Longitudinal joint factor (E)
ASTM A 53 ---	Seamless -----	1.00
	Electric resistance welded -----	1.00
	Furnace butt welded -----	.60
ASTM A 106---	Seamless -----	1.00
ASTM A 134---	Electric fusion arc welded -----	.80
ASTM A 135---	Electric resistance welded -----	1.00
ASTM A 139---	Electric fusion welded -----	.80
ASTM A 155---	Electric fusion arc welded -----	1.00
ASTM A 211---	Spiral welded steel pipe -----	.80
ASTM A 333---	Seamless -----	1.00
	Electric resistance welded -----	1.00
ASTM A 381---	Double submerged arc welded -----	1.00
API 5 L -----	Seamless -----	1.00
	Electric resistance welded -----	1.00
	Electric flash welded -----	1.00
	Submerged arc welded -----	1.00
	Furnace butt welded -----	.60

192.115 TEMPERATURE DERATING FACTOR (T) FOR STEEL PIPE.

The temperature derating factor to be used in the design formula in 192.105 is determined as follows:

<u>Gas temperature</u> <u>in degrees</u> <u>Fahrenheits</u>	<u>Temperature</u> <u>derating</u> <u>factor (T)</u>
250 or less -----	1.000
300 -----	0.967
350 -----	0.933
400 -----	0.900
450 -----	0.867

For intermediate gas temperatures, the derating factor is determined by interpolation.

192.117 DESIGN OF CAST IRON PIPE.

Cast iron pipe must be designed in accordance with ANSI A 21.1 using the following values for S (bursting tensile strength) and R (modulus of rupture) in the design equations:

<u>Specification</u>	<u>Type of pipe</u>	<u>S</u>	<u>R</u>
		<u>psi</u>	<u>psi</u>
ANSI A 21.3	Pit cast	11,000	31,000
ANSI A 21.7	Centrifugal (metal mold)	18,000	40,000
ANSI A 21.9	Centrifugal (sand-lined mold)	18,000	40,000

192.119 DESIGN OF DUCTILE IRON PIPE.

(a) Ductile iron pipe must be designed in accordance with ANSI A21.50 using the following values in the design equations:

$$P = 2S \frac{t}{(D - t)} \times F$$

P = Design pressure in pounds per square inch gage.

S = For thermoplastic pipe, the long-term hydrostatic strength in pounds per square inch as stated in the listed specification; for thermosetting plastic pipe, 11,000 p.s.i.

t = Specified wall thickness in inches.

D = Specified outside diameter in inches.

F = Design factor for plastic pipe.

(b) The design factor for plastic pipe is determined as follows:

<u>Class</u> <u>location</u>	<u>Design</u> <u>factor</u>
1 -----	0.32
2 -----	0.25
3 -----	0.25
4 -----	0.20

192.123 DESIGN LIMITATION FOR PLASTIC PIPE.

(a) The design pressure may not exceed 100 p.s.i.g. for plastic pipe used in--

- (1) Distribution systems; or
- (2) Classes 3 and 4 locations.

(b) Plastic pipe may not be used where operating temperatures of the pipe will be--

- (1) Below minus 20° F.; or
- (2) Above 100° F. for thermoplastic pipe or above



<u>Nominal size in inches</u>	<u>Minimum wall thickness in inches</u>
2 -----	0.060
3 -----	0.060
4 -----	0.070
6 -----	0.100

192.125 DESIGN OF COPPER PIPE.

(a) Copper pipe used in mains must have a minimum wall thickness of 0.065 inches and must be hard drawn.

(b) Copper pipe used in service lines must have a minimum wall thickness as specified for type "L" pipe in ASTM B 88.

(c) Copper pipe used in mains and service lines may not be used at pressures in excess of 100 p.s.i.g.

(d) Copper pipe that does not have an internal corrosion resistant lining may not be used to carry gas that has an average hydrogen sulfide content of more than 0.3 grains per 100 standard cubic feet of gas.

*PSC 192.125(e) Fittings in copper piping. It is recommended that fittings in copper piping and exposed to the soil, such as service tees, pressure control fittings, etc., be made of bronze, copper or brass.*

SUBPART D--DESIGN OF PIPELINE COMPONENTS

192.141 SCOPE.

This subpart prescribes minimum requirements for the design and installation of pipeline components and facilities. In addition, it prescribes requirements relating to protection against accidental overpressuring.

(b) Each valve must be able to meet the anticipated operating conditions.

(c) No valve having shell components made of ductile iron may be used at pressures exceeding 80 percent of the pressure ratings for comparable steel valves at their listed temperature. However, a valve having shell components made of ductile iron may be used at pressures up to 80 percent of the pressure ratings for comparable steel valves at their listed temperature, if--

(1) The temperature-adjusted service pressure does not exceed 1,000 p.s.i.g.; and

(2) Welding is not used on any ductile iron component in the fabrication of the valve shells or their assembly.

(d) No valve having pressure containing parts made of ductile iron may be used in the gas pipe components of compressor stations.

#### 192.147 FLANGES AND FLANGE ACCESSORIES.

(a) General requirements. Each flange or flange accessory must meet the minimum requirements of ANSI B16.5, MSS SP-44, or ANSI B16.24, or the equivalent.

(b) Each flange assembly must be able to withstand the maximum pressure at which the pipeline is to be operated and to maintain its physical and chemical properties at any temperature to which it is anticipated that it might be subjected in service.

#### 192.149 STANDARD FITTINGS.

(a) The minimum metal thickness of threaded fittings may not be less than specified for the pressures and temperatures in the applicable standards referenced in this part, or their equivalent.

(b) Each steel butt-welding fitting must have pressure and temperature ratings based on stresses for pipe of

(b) Where a ductile iron pipe is tapped, the extent of full-thread engagement and the need for the use of outside-sealing service connections, tapping saddles, or other fixtures must be determined by service conditions.

(c) Where a threaded tap is made in cast iron or ductile iron pipe, the diameter of the tapped hole may not be more than 25 percent of the nominal diameter of the pipe unless the pipe is reinforced, except that

(1) Existing taps may be used for replacement service, if they are free of cracks and have good threads; and

(2) A 1¼-inch tap may be made in a 4-inch cast iron or ductile iron pipe, without reinforcement.

However, in areas where climate, soil, and service conditions may create unusual external stresses on cast iron pipe, unreinforced taps may be used only on 6-inch or larger pipe.

#### 192.153 COMPONENTS FABRICATED BY WELDING.

(a) Except for branch connections and assemblies of standard pipe and fittings joined by circumferential welds, the design pressure of each component fabricated by welding, whose strength cannot be determined, must be established in accordance with paragraph UG-101 of section VIII of the ASME Boiler and Pressure Vessel Code.

(b) Each prefabricated unit that uses plate and longitudinal seams must be designated, constructed, and tested in accordance with the ASME Boiler and Pressure Vessel Code, except for the following:

(1) Regularly manufactured butt-welding fittings.

(2) Pipe that has been produced and tested under a specification listed in Appendix B to this part.

(3) Partial assemblies such as split rings or collars.

#### 192.155 WELDED BRANCH CONNECTIONS.

Each welded branch connection made to pipe in the form of a single connection, or in a header or manifold as a series of connections, must be designed to ensure that the strength of the pipeline system is not reduced, taking into account the stresses in the remaining pipe wall due to the opening in the pipe or header, the shear stresses produced by the pressure acting on the area of the branch opening, and any external loadings due to thermal movement, weight, and vibration.

#### 192.157 EXTRUDED OUTLETS.

Each extruded outlet must be suitable for anticipated service conditions and must be at least equal to the design strength of the pipe and other fittings in the pipeline to which it is attached.

#### 192.159 FLEXIBILITY.

Each pipeline must be designed with enough flexibility to prevent thermal expansion or contraction from causing excessive stresses in the pipe or components, excessive bending or unusual loads at joints, or undesirable forces or moments at points of connection to equipment, or at anchorage or guide points.

#### 192.161 SUPPORTS AND ANCHORS.

(a) Each pipeline and its associated equipment must have enough anchors or supports to--

- (1) Prevent undue strain on connected equipment;
- (2) Resist longitudinal forces caused by a bend or offset in the pipe; and
- (3) Prevent or damp out excessive vibration.

(b) Each exposed pipeline must have enough supports

(3) Movement of the pipeline may not cause disengagement of the support equipment.

(d) Each support on an exposed pipeline operated at a stress level of 50 percent or more of SMYS must comply with the following:

(1) A structural support may not be welded directly to the pipe.

(2) The support must be provided by a member that completely encircles the pipe.

(3) If an encircling member is welded to a pipe, the weld must be continuous and cover the entire circumference.

(e) Each underground pipeline that is connected to a relatively unyielding line or other fixed object must have enough flexibility to provide for possible movement, or it must have an anchor that will limit the movement of the pipeline.

(f) Each underground pipeline that is being connected to new branches must have a firm foundation for both the header and the branch to prevent lateral and vertical movement.

#### 192.163 COMPRESSOR STATIONS: DESIGN AND CONSTRUCTION.

(a) Location of compressor building. Each main compressor building of a compressor station must be located on property under the control of the operator. It must be far enough away from adjacent property, not under control of the operator, to minimize the possibility of fire being communicated to the compressor building from structures on adjacent property. There must be enough open space around the main compressor building to allow the free movement of fire-fighting equipment.

(b) Building construction. Each building on a compressor station site must be made of noncombustible materials if it contains either--

*PSC 192.163(c) Exits shall be provided in compliance with the requirements of the Wisconsin state building code administered by the department of industry, labor and human relations. Ladders shall not be used for exits.*

(d) Fenced areas. Each fence around a compressor station must have at least two gates located so as to provide a convenient opportunity for escape to a place of safety, or have other facilities affording a similarly convenient exit from the area. Each gate located within 200 feet of any compressor plant building must open outward and, when occupied, must be openable from the inside without a key.

(e) Electrical facilities. Electrical equipment and wiring installed in compressor stations must conform to the National Electrical Code, ANSI Standard C1, so far as that code is applicable.

*PSC 192.163(e) All electrical equipment and wiring installed in gas transmission and distribution compressor stations shall conform to the requirements of the Wisconsin state electrical code.*

192.165 COMPRESSOR STATIONS: LIQUID REMOVAL.

(a) Where entrained vapors in gas may liquefy under the anticipated pressure and temperature conditions, the compressor must be protected against the introduction of those liquids in quantities that could cause damage.

(b) Each liquid separator used to remove entrained liquids at a compressor station must--

(1) Have a manually operable means of removing these liquids.

(2) Where slugs of liquid could be carried into the compressors, have either automatic liquid removal facilities, an automatic compressor shutdown device, or

192.167 COMPRESSOR STATIONS: EMERGENCY SHUTDOWN.

(a) Except for unattended field compressor stations of 1,000 horsepower or less, each compressor station must have an emergency shutdown system that meets the following:

(1) It must be able to block gas out of the station and blow down the station piping.

(2) It must discharge gas from the blowdown piping at a location where the gas will not create a hazard.

(3) It must provide means for the shutdown of gas compressing equipment, gas fires, and electrical facilities in the vicinity of gas headers and in the compressor building, except, that--

(i) Electrical circuits that supply emergency lighting required to assist station personnel in evacuating the compressor building and the area in the vicinity of the gas headers must remain energized; and

(ii) Electrical circuits needed to protect equipment from damage may remain energized.

(4) It must be operable from at least two locations, each of which is--

(i) Outside the gas area of the station;

(ii) Near the exit gates in the station fence; and

(iii) Not more than 500 feet from the limits of the station.

(b) If a compressor station supplies gas directly to a distribution system with no other adequate source of gas available, the emergency shutdown system must be designed so that it will not function at the wrong time and cause an unintended outage on the distribution system.

192.169 COMPRESSOR STATIONS: PRESSURE LIMITING DEVICES.

(a) Each compressor station must have pressure relief

*PSC 192.171(a) Fire Protection. Fire-protection facilities shall be provided as specifically directed by the department of industry, labor and human relations and the local fire department. The operation of fire-protection facilities, such as pumps, shall not be affected by an emergency shutdown.*

(b) Each compressor station prime mover, other than an electrical induction or synchronous motor, must have an automatic device to shut down the unit before the speed of either the prime mover or the driven unit exceeds a maximum safe speed.

(c) Each compressor unit in a compressor station must have a shutdown or alarm device that operates in the event of inadequate cooling or lubrication of the unit.

(d) Each compressor station gas engine that operates with pressure gas injection must be equipped so that stoppage of the engine automatically shuts off the fuel and vents the engine distribution manifold.

(e) Each muffler for a gas engine in a compressor station must have vent slots or holes in the baffles of each compartment to prevent gas from being trapped in the muffler.

192.173 COMPRESSOR STATIONS: VENTILATION.

Each compressor station building must be ventilated to ensure that employees are not endangered by the accumulation of gas in rooms, sumps, attics, pits, or other enclosed places.

*PSC 192.173 There shall be compliance with the department of industry, labor and human relations' heating, ventilation, and air conditioning code.*

192.175 PIPE-TYPE AND BOTTLE-TYPE HOLDERS.

(a) Each pipe type and bottle type holder must be



$C$  = Minimum clearance between pipe containers or bottles in inches.  
 $D$  = Outside diameter of pipe containers or bottles in inches.  
 $P$  = Maximum allowable operating pressure, p.s.i.g.  
 $F$  = Design factor as set forth in 192.111 of this part.

192.177 ADDITIONAL PROVISIONS FOR BOTTLE-TYPE HOLDERS.

(a) Each bottle-type holder must be--

(1) Located on a storage site entirely surrounded by fencing that prevents access by unauthorized persons and with minimum clearance from the fence as follows:

<u>Maximum allowable operating pressure</u>	<u>Minimum Clearance (feet)</u>
Less than 1,000 p.s.i.g. -----	25
1,000 p.s.i.g. or more -----	100

(2) Designed using the design factors set forth in 192.111; and

(3) Buried with a minimum cover in accordance with 192.327.

(b) Each bottle-type holder manufactured from steel that is not weldable under field conditions must comply with the following:

(1) A bottle-type holder made from alloy steel must meet the chemical and tensile requirements for the various grades of steel in either API Standard 5A or ASTM A 372.

(2) The actual yield-tensile ratio of the steel may not exceed 0.85.

(3) Welding may not be performed on the holder after it has been heat treated or stress relieved, except that copper wires may be attached to the small diameter portion of the bottle end closure for cathodic protection if a localized thermit welding process is used.

(1) Each point on the pipeline in a Class 4 location must be within  $2\frac{1}{2}$  miles of a valve.

(2) Each point on the pipeline in a Class 3 location must be within 4 miles of a valve.

(3) Each point on the pipeline in a Class 2 location must be within  $7\frac{1}{2}$  miles of a valve.

(4) Each point on the pipeline in a Class 1 location must be within 10 miles of a valve.

(b) Each sectionalizing block valve on a transmission line, other than offshore segments, must comply with the following:

(1) The valve and the operating device to open or close the valve must be readily accessible and protected from tampering and damage.

(2) The valve must be supported to prevent settling of the valve or movement of the pipe to which it is attached.

(c) Each section of a transmission line, other than offshore segments, between main line valves must have a blowdown valve with enough capacity to allow the transmission line to be blown down as rapidly as practicable. Each blowdown discharge must be located so the gas can be blown to the atmosphere without hazard and, if the transmission line is adjacent to an overhead electric line, so that the gas is directed away from the electrical conductors.

#### 192.181 DISTRIBUTION LINE VALVES.

(a) Each high-pressure distribution system must have valves spaced so as to reduce the time to shut down a section of main in an emergency. The valve spacing is determined by the operating pressure, the size of the mains, and the local physical conditions.

(c) Each valve on a main installed for operating or emergency purposes must comply with the following:

(1) The valve must be placed in a readily accessible location so as to facilitate its operation in an emergency,

(2) The operating stem or mechanism must be readily accessible.

(3) If the valve is installed in a buried box or enclosure, the box or enclosure must be installed so as to avoid transmitting external loads to the mains.

#### 192.183 VAULTS: STRUCTURAL DESIGN REQUIREMENTS.

(a) Each underground vault or pit for valves, pressure relieving, pressure limiting, or pressure regulating stations, must be able to meet the loads which may be imposed upon it, and to protect installed equipment.

(b) There must be enough working space so that all of the equipment required in the vault or pit can be properly installed, operated, and maintained.

(c) Each pipe entering, or within, a regulator vault or pit must be steel for sizes 10 inches, and less, except that control and gage piping may be copper. Where pipe extends through the vault or pit structure, provision must be made to prevent the passage of gases or liquids through the opening and to avert strains in the pipe.

*PSC 192.183(d) In the design of vaults and pits for pressure limiting, pressure relieving and pressure regulating equipment, consideration shall be given to the protection of the installed equipment from damage, such as that resulting from an explosion within the vault or pit, which may cause portions of the roof or cover to fall into the vault.*

192.185 VAULTS: ACCESSIBILITY.

Each vault must be located in an accessible location and, so far as practical, away from--

(a) Street intersections or points where traffic is heavy or dense;

(b) Points of minimum elevation, catch basins, or places where the access cover will be in the course of surface waters; and

(c) Water, electric, steam, or other facilities.

192.187 VAULTS: SEALING, VENTING, AND VENTILATION.

Each underground vault or closed top pit containing either a pressure regulating or reducing station, or a pressure limiting or relieving station, must be sealed, vented or ventilated, as follows:

(a) When the internal volume exceeds 200 cubic feet--

(1) The vault or pit must be ventilated with two ducts, each having at least the ventilating effect of a pipe 4 inches in diameter;

(2) The ventilation must be enough to minimize the formation of combustible atmosphere in the vault or pit; and

(3) The ducts must be high enough above grade to disperse any gas-air mixtures that might be discharged.

*PSC 192.187(a)(3) The outside end of the ducts shall be equipped with a suitable weatherproof fitting or vent-head designed to prevent foreign matter from entering or obstructing the duct. The effective area of the openings in such fittings or vent-heads shall be at least equal to the cross-sectional area of a 4-inch duct. The horizontal section of the ducts shall be as*

(2) If the vault or pit is vented, there must be a means of preventing external sources of ignition from reaching the vault atmosphere; or

(3) If the vault or pit is ventilated, paragraph (a) or (c) of this section applies.

(c) If a vault or pit covered by paragraph (b) of this section is ventilated by openings in the covers or gratings and the ratio of the internal volume, in cubic feet, to the effective ventilating area of the cover or grating, in square feet, is less than 20 to 1, no additional ventilation is required.

#### 192.189 VAULTS: DRAINAGE AND WATERPROOFING.

(a) Each vault must be designed so as to minimize the entrance of water.

*PSC 192.189(a) Nevertheless, vault equipment shall always be designed to operate safely, if submerged.*

(b) A vault containing gas piping may not be connected by means of a drain connection to any other underground structure.

(c) All electrical equipment in vaults must conform to the applicable requirements of Class 1, Group D, of the National Electrical Code, ANSI Standard C1.

*PSC 192.189(c) Electrical equipment in vaults shall conform to the applicable requirements of the Wisconsin state electrical code.*

#### 192.191 DESIGN PRESSURE OF PLASTIC FITTINGS.

(a) Thermosetting fittings for plastic pipe must conform to ASTM D 2517.

(b) The design pressure of Acrylonitrile-butadiene-styrene (ABS) and polyvinyl chloride (PVC) Schedule 40 and

DESIGN PRESSURE OF THERMOPLASTIC FITTINGS. P.S.I.G. OF  
VARIOUS STRENGTHS, MATERIALS AND CLASS LOCATIONS

Size Inches	Schedule	ABS Type I and PVC Type II class location			PVC Type 1 class location		
		1	2 and 3	4	1	2 and 3	4
½	40	100	100	100	100	100	100
	80	100	100	100	100	100	100
¾	40	100	100	96	100	100	100
	80	100	100	100	100	100	100
1	40	100	100	90	100	100	100
	80	100	100	100	100	100	100
1¼	40	100	92	74	100	100	100
	80	100	100	100	100	100	100
1½	40	100	83	66	100	100	100
	80	100	100	94	100	100	100
2	40	89	69	55	100	100	100
	80	100	100	81	100	100	100
2½	40	99	76	61	100	100	100
	80	100	100	85	100	100	100
3	40	84	66	53	100	100	100
	80	100	94	75	100	100	100
3½	40	77	60	48	100	100	96
	80	100	86	69	100	100	100
4	40	71	56	44	100	100	89
	80	100	81	65	100	100	100
5	40	62	49	39	100	97	78
	80	93	72	58	100	100	100
6	40	56	44	35	100	88	71
	80	89	70	56	100	100	100

NOTE: These pressure ratings are the same value as the design pressure of the corresponding pipe size and schedule in the same class location, as determined by the formula given in 192.121 and the limitations in 192.123 of this part.

192.193 VALVE INSTALLATION IN PLASTIC PIPE.

Each valve installed in plastic pipe must be approved

(b) Additional requirements for distribution systems.  
Each distribution system that is supplied from a source of gas that is at a higher pressure than the maximum allowable operating pressure for the system must--

(1) Have pressure regulation devices capable of meeting the pressure, load, and other service conditions that will be experienced in normal operation of the system, and that could be activated in the event of failure of some portion of the system; and

(2) Be designed so as to prevent accidental overpressuring.

*PSC 192.195(3) Suitable types of protective devices to prevent overpressuring of high-pressure distribution systems include:*

*(i) Spring-loaded relief valves of types meeting the provisions of the ASME Unfired Pressure Vessel Code.*

*(ii) Pilot-loaded back-pressure regulators used as relief valves, so designed that failure of the pilot system or control lines will cause the regulator to open.*

*(iii) Weight-loaded relief valves.*

*(iv) A monitoring regulator installed in series with the primary pressure regulator.*

*(v) A series regulator installed upstream from the primary regulator, and set to continuously limit the pressure on the inlet of the primary regulator to the maximum allowable operating pressure of the distribution system or less.*

*(vi) An automatic shut-off device installed in series with the primary pressure regulator, and set to shut off when the pressure on the distribution system reaches the maximum allowable operating pressure, or less. This device must remain closed until manually reset. It should not be used where it might cause an interruption in*

(iv) A pilot loaded back-pressure regulator as described in PSC 192.195(3)(ii).

(v) A monitoring regulator as described in PSC 192.195(3)(iv).

(vi) A series regulator as described in PSC 192.195(3)(v).

PSC 192.195(c) Suitable types of protective devices to prevent overpressuring of gas pressure holders, pipelines and other facilities that might at times be bottle tight include:

(1) Spring-loaded relief valves of types meeting the provisions of the ASME Unfired Pressure Vessel Code.

(2) Pilot-loaded back-pressure regulators used as relief valves, so designed that failure of the pilot system or control lines will cause the regulator to open.

192.197 CONTROL OF THE PRESSURE OF GAS DELIVERED FROM HIGH-PRESSURE DISTRIBUTION SYSTEMS.

(a) If the maximum actual operating pressure of the distribution system is under 60 p.s.i.g. and a service regulator having the following characteristics is used, no other pressure limiting device is required:

(1) A regulator capable of reducing distribution line pressure to pressures recommended for household appliances.

(2) A single port valve with proper orifice for the maximum gas pressure at the regulator inlet.

(3) A valve seat made of resilient material designed to withstand abrasion of the gas, impurities in gas, cutting by the valve, and to resist permanent deformation when it is pressed against the valve port.

(4) Pipe connections to the regulator not exceeding



(b) If the maximum actual operating pressure of the distribution system is 60 p.s.i.g., or less, and a service regulator that does not have all of the characteristics listed in paragraph (a) of this section is used, or if the gas contains materials that seriously interfere with the operation of service regulators, there must be suitable protective devices to prevent unsafe overpressuring of the customer's appliances if the service regulator fails.

(c) If the maximum actual operating pressure of the distribution systems exceeds 60 p.s.i.g. one of the following methods must be used to regulate and limit, to the maximum safe value, the pressure of gas delivered to the customer:

(1) A service regulator having the characteristics listed in paragraph (a) of this section, and another regulator located upstream from the service regulator. The upstream regulator may not be set to maintain a pressure higher than 60 p.s.i.g. A device must be installed between the upstream regulator and the service regulator to limit the pressure on the inlet of the service regulator to 60 p.s.i.g. or less in case the upstream regulator fails to function properly. This device may be either a relief valve or an automatic shutoff that shuts, if the pressure on the inlet of the service regulator exceeds the set pressure (60 p.s.i.g. or less), and remains closed until manually reset.

(2) A service regulator and a monitoring regulator set to limit, to a maximum safe value, the pressure of the gas delivered to the customer.

(3) A service regulator with a relief valve vented to the outside atmosphere, with the relief valve set to open so that the pressure of gas going to the customer does not exceed a maximum safe value. The relief valve may either be built into the service regulator or it may be a separate unit installed downstream from the service regulator. This combination may be used alone only in those cases where the inlet pressure on the service regulator does not exceed the manufacturer's safe working

PSC 192.197(d) The service regulator must be of a type that is capable under normal operating conditions of regulating the downstream pressure within the limits of section PSC 134.23 and of limiting the build-up of pressure under no-flow conditions to 50% or less of the discharge pressure maintained under flow conditions.

PSC 192.197(e) In addition to the provisions of 192.197(a) and (b) if the maximum actual operating pressure of the distribution system is greater than low pressure, is equal to or less than 60 p.s.i.g. a suitable protective device shall be installed to prevent unsafe overpressuring of the customers' appliances should the service regulator fail. Some of the suitable types of protective devices to prevent overpressuring of customers' appliances are:

- (a) A monitoring regulator
- (b) A relief valve
- (c) An automatic shut-off device

These devices may be installed as an integral part of the service regulator or as a separate unit.

PSC 192.197(f) Breather vents shall be provided on all service regulators.

#### 192.199 REQUIREMENTS FOR DESIGN OF PRESSURE RELIEF AND LIMITING DEVICES.

Except for rupture discs each pressure relief or pressure limiting device must--

(a) Be constructed of materials such that the operation of the device will not be impaired by corrosion;

(b) Have valves and valve seats that are designed not to stick in a position that will make the device inoperative;

(c) Be designed and installed so that it can be readily operated to determine if the valve is free, can be tested to determine the pressure at which it will oper-

(f) Be designed and installed so that the size of the openings, pipes, and fittings located between the system to be protected and the pressure relieving device, and the size of the vent line, are adequate to prevent hammering of the valve and to prevent impairment of relief capacity;

(g) Where installed at a district regulator station to protect a pipeline system from overpressuring, be designed and installed to prevent any single incident such as an explosion in a vault or damage by a vehicle from affecting the operation of both the overpressure protective device and the district regulator; and

(h) Except for a valve that will isolate the system under protection from its source of pressure, be designed to prevent unauthorized operation of any stop valve that will make the pressure relief valve or pressure limiting device inoperative.

*PSC 192.199(h) Acceptable methods for complying with 192.199(h) are:*

*(i) Lock the stop valve in the open position. Instruct authorized personnel of the importance of not inadvertently leaving the stop valve closed and of being present during the entire period that the stop valve is closed so that they can lock it in the open position before they leave the location.*

*(ii) Install duplicate relief valves, each having adequate capacity by itself to protect the system and arrange the isolating valves or 3-way valve so that mechanically it is possible to render only one safety device inoperative at a time.*

*PSC 192.199(i) Precautions shall be taken to prevent unauthorized operation of any valve which will make pressure limiting devices inoperative. This provision applies to isolating valves, by-pass valves, and valves on control or float lines which are located between the*

(1) The pressure from exceeding the maximum allowable operating pressure plus 10 percent or the pressure that produces a hoop stress of 75 percent of SMYS, whichever is lower; or

(2) In a low-pressure distribution system, a pressure that would cause the unsafe operation of any connected and properly adjusted gas utilization equipment.

(b) When more than one pressure regulating or compressor station feeds into a pipeline, relief valves or other protective devices must be installed at each station to ensure that the complete failure of the largest capacity regulator or compressor, or any single run of lesser capacity regulators or compressors in that station, will not impose pressures on any part of the pipeline or distribution system in excess of those for which it was designed, or against which it was protected, whichever is lower.

(c) Relief valves or other pressure limiting devices must be installed at or near each regulator station in a low-pressure distribution system, with a capacity to limit the maximum pressure in the main to a pressure that will not exceed the safe operating pressure for any connected and properly adjusted gas utilization equipment.

#### 192.203 INSTRUMENT, CONTROL, AND SAMPLING PIPE AND COMPONENTS.

(a) Applicability. This section applies to the design of instrument, control, and sampling pipe and components. It does not apply to permanently closed systems, such as fluid-filled temperature-responsive devices.

(b) Materials and design. All materials employed for pipe and components must be designed to meet the particular conditions of service and the following:

(1) Each takeoff connection and attaching boss, fitting, or adapter must be made of suitable material, be able to withstand the maximum service pressure and tem-

(5) Pipe or components in which liquids may accumulate must have drains or drips.

(6) Pipe or components subject to clogging from solids or deposits must have suitable connections for cleaning.

(7) The arrangement of pipe, components, and supports must provide safety under anticipated operating stresses.

(8) Each joint between sections of pipe, and between pipe and valves or fittings, must be made in a manner suitable for the anticipated pressure and temperature condition. Slip type expansion joints may not be used. Expansion must be allowed for by providing flexibility within the system itself.

(9) Each control line must be protected from anticipated causes of damage and must be designed and installed to prevent damage to any one control line from making both the regulator and the overpressure protective device inoperative.

PSC 192.204 PIPELINES ON PRIVATE RIGHT-OF-WAY OF ELECTRIC TRANSMISSION LINES.

*Where gas pipelines parallel overhead electric transmission lines on the same right-of-way, the company operating the pipelines shall take the following precautions:*

*(a) Employ blow-down connections that will direct the gas away from the electric conductors.*

*(b) Install a bonding conductor across points where the main is to be separated and maintain this connection while the pipeline is separated. The current carrying capacity of the bonding conductor should be at least one-half of the capacity of the overhead line conductors.*

*(c) Make a study in collaboration with the electric*

(4) Bonding connections between the pipeline and either the steel tower footings or the buried ground facilities or the ground-wire of the overhead electric system.

(d) Investigate the necessity of protecting insulating joints in the pipeline against induced voltages or currents resulting from lightning strokes. Such protection can be obtained by connecting buried sacrificial anodes to the pipe near the insulating joints or by bridging the pipeline insulator with a spark-gap or by other effective means.

#### SUBPART E--WELDING OF STEEL IN PIPELINES

##### 192.221 SCOPE.

(a) This subpart prescribes minimum requirements for welding steel materials in pipelines.

(b) This subpart does not apply to welding that occurs during the manufacture of steel pipe or steel pipeline components.

##### 192.223 GENERAL.

(a) Welding must be performed in accordance with established written welding procedures that have been qualified under 192.225 to produce sound, ductile welds.

(b) Welding must be performed by welders who are qualified under 192.227 and 192.229 for the welding procedures to be used.

*PSC 192.223(c) Prior to welding in or around a structure or area containing gas facilities, a thorough check shall be made to determine the possible presence of a combustible gas mixture. Welding shall begin only when safe conditions are indicated.*

##### 192.225 QUALIFICATIONS OF WELDING PROCEDURES.

(1) Carbon steels that have a carbon content of 0.32 (ladle analysis) or less.

(2) Carbon steels that have a carbon equivalent ( $C + \frac{1}{4} Mn$ ) of 0.65 percent (ladle analysis) or less.

(3) Alloy steels with weldability characteristics that have been shown to be similar to the carbon steels listed in subparagraphs (1) and (2) of this paragraph.

Alloy steels and carbon steels that are not covered by subparagraph (1), (2), or (3) of this paragraph require separate qualification of procedures for each individual pipe specification in accordance with sections VIII and IX of the ASME Boiler and Pressure Vessel Code.

(c) Each welding procedure must be recorded in detail during the qualifying tests. This record must be retained and followed whenever the procedure is used.

#### 192.227 QUALIFICATION OF WELDERS.

(a) Except as provided in paragraph (c) of this section, each welder must be qualified in accordance with one of the following:

(1) Section IX of the ASME Boiler and Pressure Vessel Code.

(2) Section 3 of API Standard 1104.

(b) When a welder is being qualified under section IX of the ASME Boiler and Pressure Vessel Code, the following steels are considered to fall within the P-Number 1 grouping for the purpose of the essential variables and do not require separate qualification:

(1) Carbon steels that have a carbon content of 0.32 percent (ladle analysis) or less.

(2) Carbon steels that have a carbon equivalent

stress of less than 20 percent of SMYS by performing an acceptable test weld, for the process to be used, under the test set forth in section I of Appendix C to this part. A welder who makes welded service line connections to mains must also perform an acceptable test weld under section II of Appendix C to this part as a part of his qualifying test. After initial qualification, a welder may not perform welding unless--

(1) Within the preceding 12 calendar months, he has requalified; or

(2) Within the preceding 6 calendar months he has had--

(i) A production weld cut out, tested and found acceptable in accordance with the qualifying test; or

(ii) For welders who work only on service lines 2 inches or smaller in diameter, two sample welds tested and found acceptable in accordance with the test in section III of Appendix C to this part.

#### 192.229 LIMITATIONS ON WELDERS.

(a) No welder whose qualification is based on non-destructive testing may weld compressor station pipe and components.

(b) No welder may weld with a particular welding process unless, within the preceding 6 calendar months, he has engaged in welding with that process.

(c) No welder who is qualified under 192.227(a) may weld unless, within the preceding 6 calendar months, he has had at least one weld tested and found acceptable under either section 3 or 6 of API Standards 1104.

#### 192.231 PROTECTION FROM WEATHER.



(c) A miter joint on steel pipe to be operated at a pressure that produces a hoop stress of 10 percent or less of SMYS may not deflect the pipe more than 90°.

#### 192.235 PREPARATION FOR WELDING.

Before beginning any welding, the welding surfaces must be clean and free of any material that may be detrimental to the weld, and the pipe or component must be aligned to provide the most favorable condition for depositing the root bead. This alignment must be preserved while the root bead is being deposited.

#### 192.237 PREHEATING.

(a) Carbon steel that has a carbon content in excess of 0.32 percent (ladle analysis) or a carbon equivalent ( $C + \frac{1}{4} Mn$ ) in excess of 0.65 percent (ladle analysis) must be preheated for welding.

(b) Carbon steel that has a lower carbon content or carbon equivalent than the steels covered by paragraph (a) of this section must be preheated for welding when reheating will alleviate existing conditions that would limit the welding technique or tend to adversely affect the quality of the weld.

(c) When steel materials with different preheat temperatures are being preheated for welding, the higher temperature must be used.

(d) Preheat temperature must be monitored to ensure that the required preheat temperature is reached before, and maintained during, the welding operation.

#### 192.239 STRESS RELIEVING.

(a) Except as provided in paragraph (f) of this section, each weld on carbon steel that has a carbon content in excess of 0.32 percent (ladle analysis) or a

(d) When a weld connects pipe or components that are of different thickness, the wall thickness to be used in determining whether stress relieving is required under this section is--

(1) In the case of pipe connections, the thicker of the two pipes joined; or

(2) In the case of branch connections, slip-on flanges, or socket weld fittings, the thickness of the pipe run or header.

(e) Each weld of different materials must be stress relieved, if either material requires stress relieving under this section.

(f) Notwithstanding paragraphs (a), (b), and (c) of this section, stress relieving is not required for the following:

(1) A fillet or groove weld one-half inch, or less, in size (leg) that attaches a connection 2 inches, or less in diameter; or

(2) A fillet or groove weld three-eighths inch, or less, in groove size that attaches a supporting member or other nonpressure attachment.

(g) Stress relieving required by this section must be performed at a temperature of at least 1,100° F. for carbon steels and at least 1,200° F. for ferritic alloy steels. When stress relieving a weld between steel materials with the different stress relieving temperatures, the higher temperature must be used.

(h) When stress relieving, the temperature must be monitored to ensure that a uniform temperature is maintained and that the proper stress relieving cycle is accomplished.

(1) The pipe has a nominal diameter of less than 6 inches; or

(2) The pipeline is to be operated at a pressure that produces a hoop stress of less than 40 percent of SMYS and the welds are so limited in number that non-destructive testing is impractical.

*PSC 192.241(b) The provisions of 192.241(b) will also be applicable to inspection and tests of weld on piping systems intended to operate at either 100 p.s.i.g. or more or 20 percent or more of the specified minimum yield strength whichever is the lesser operating pressure.*

(c) The acceptability of a weld that is nondestructively tested or visually inspected is determined according to the standards in section 6 of API Standard 1104.

#### 192.243 NONDESTRUCTIVE TESTING.

(a) Nondestructive testing of welds must be performed by any process, other than trepanning, that will clearly indicate defects that may affect the integrity of the weld.

(b) Nondestructive testing of welds must be performed--

(1) In accordance with written procedures; and

(2) By persons who have been trained and qualified in the established procedures and with the equipment employed in testing.

(c) Procedures must be established for the proper interpretation of each nondestructive test of a weld to ensure the acceptability of the weld under 192.241(c).

(d) When nondestructive testing is required under 192.241(b), the following percentages of each day's field

*PSC 192.243(d)(5) In addition, all welds within 500 feet of buildings intended for human occupancy shall be tested.*

*PSC 192.243(d)(6) If one weld in any random sample is found to be unacceptable then the minimum percentage of welds selected for examination will be that of the next higher class location. If a second weld is found to be unacceptable or if 2 or more welds are found to be unacceptable in the original random sample, then 100 percent of the welds shall be inspected if practicable, but in no case less than 90 percent of the welds in that day's construction.*

(e) Except for a welder whose work is isolated from the principal welding activity, a sample of each welder's work for each day must be nondestructively tested, when nondestructive testing is required under 192.241(b).

(f) When nondestructive testing is required under 192.241(b), each operator must retain, for the life of the pipeline, a record showing by milepost, engineering station, or by geographic feature, the number of girth welds made, the number of nondestructively tested, the number of rejected, and the disposition of the rejects.

#### 192.245 REPAIR OR REMOVAL OF DEFECTS.

(a) Each weld that is unacceptable under 192.241(c) must be removed or repaired. A weld must be removed if it has a crack that is more than 2 inches long or that penetrates either the root or second bead.

(b) Each weld that is repaired must have the defect removed down to clean metal and the segment to be repaired must be preheated. After repair, the segment of the weld that was repaired must be inspected to insure its acceptability. If the repair is not acceptable, the weld must be removed.

#### PSC 192.246 PRECAUTIONS TO AVOID EXPLOSIONS OF GAS-AIR

(2) The gas pressure at the site of the work shall be controlled by suitable means.

(3) Close all slots or open ends immediately after they are cut with tape, and/or tightly fitting canvas or other suitable material.

(4) Do not permit two openings to remain uncovered at the same time. This is doubly important if the two openings are at different elevations.

(b) No welding or acetyline cutting shall be done on a pipeline, main, or auxiliary apparatus that contains air if it is connected to a source of gas, unless a suitable means has been provided to prevent the leakage of gas into the pipeline or mains.

(c) In situations where welding or cutting must be done on facilities which are filled with air and connected to a source of gas and the precautions recommended above cannot be taken, one or more of the precautions, depending upon the circumstances at the job are required.

(1) Purging of the pipe or equipment upon which welding or cutting is to be done, with combustible gas or inert gas.

(2) Testing of the atmosphere in the vicinity of the zone to be heated before the work is started and at intervals as the work progresses, with a combustible gas indicator or by other suitable means.

(3) Careful verification before the work starts that the valves that isolate the work from a source of gas do not leak.

SUBPART F--JOINING OF MATERIALS OTHER THAN BY WELDING

192.271 SCOPE.

(a) This subpart prescribes minimum requirements for joining materials in pipelines, other than by welding.

(c) Each joint must be inspected to insure compliance with this subpart.

192.275 CAST IRON PIPE.

(a) Each caulked bell and spigot joint in cast iron pipe must be sealed with mechanical leak clamps.

(b) Each mechanical joint in cast iron pipe must have a gasket made of a resilient material as the sealing medium. Each gasket must be suitably confined and retained under compression by a separate gland or follower ring.

(c) Cast iron pipe may not be joined by threaded joints.

(d) Cast iron pipe may not be joined by brazing.

(e) Each flange on a flanged joint in cast iron pipe must conform in dimensions and drilling to ANSI Standard B16.1 and be cast integrally with the pipe, valve, or fitting.

192.277 DUCTILE IRON PIPE.

(a) Each mechanical joint in ductile iron pipe must conform to ANSI Standard A21.52 and ANSI Standard A21.11.

(b) Ductile iron pipe may not be joined by threaded joints.

(c) Ductile iron pipe may not be joined by brazing.

192.279 COPPER PIPE.

Copper pipe may not be threaded, except that copper pipe used for joining screw fittings or valves may be threaded if the wall thickness is equivalent to the comparable size of standard wall pipe, as defined in

(b) Solvent cement joints. Each solvent cement joint on plastic pipe must comply with the following:

(1) The mating surfaces of the joint must be clean, dry, and free of material which might be detrimental to the joint.

(2) The solvent cement must conform to ASTM Specification D 2513.

(3) The safety requirements of Appendix A of ASTM Specification D 2513 must be met.

(4) The joint may not be heated to accelerate the setting of the cement.

*PSC 192.281(b)(5) Proper fit between the pipe or tubing and mating socket or sleeve is essential to a good joint. Sound joints cannot normally be made between loose fitting parts.*

*PSC 192.281(b)(6) A uniform coating of the solvent cement is required on both mating surfaces. After the joint is made, excess cement shall be removed from the outside of the joint. The joint shall not be disturbed until it has properly set.*

*PSC 192.281(b)(7) This type joint shall not be made between different kinds of plastics.*

(c) Heat-fusion joints. Each heat-fusion joint on plastic pipe must comply with the following:

(1) A butt heat-fusion joint must be joined by a device that holds the heater element square to the ends of the piping, compresses the heated ends together, and holds the pipe in proper alignment while the plastic hardens.

(2) A socket heat-fusion joint must be joined by a device that heats the mating surfaces of the joint uniformly and simultaneously to essentially the same temperature.

(3) Heat may not be applied with a torch or other open flame.

*PSC 192.281(d)(3) An adhesive bonded joint may be heated in accordance with the pipe manufacturer's recommendation in order to accelerate cure.*

*PSC 192.281(d)(4) Provision shall be made to clamp or otherwise prevent the joined materials from moving until the adhesive is properly set.*

(e) Mechanical joints. Each compression type mechanical joint on plastic pipe must comply with the following:

(1) The gasket material in the coupling must be compatible with the plastic.

(2) A rigid internal tubular stiffener, other than a split tubular stiffener, must be used in conjunction with the coupling.

*PSC 192.281(e)(2) The tubular stiffener should be flush with end of pipe or tubing and project at least 1/2 in. beyond the outside end of the compression fitting when installed. The stiffener shall be free of rough or sharp edges and shall not be a force fit in the plastic.*

SUBPART G--GENERAL CONSTRUCTION REQUIREMENTS FOR TRANSMISSION LINES AND MAINS

191.301 SCOPE.

This subpart prescribes minimum requirements for constructing transmission lines and mains.

192.303 COMPLIANCE WITH SPECIFICATIONS OR STANDARDS.

Each transmission line or main must be constructed in accordance with comprehensive written specifications or standards that are consistent with this part.

192.305 INSPECTION: GENERAL.

Each transmission line or main must be inspected to ensure that it is constructed in accordance with this part.

192.307 INSPECTION OF MATERIALS.



192.309 REPAIR OF STEEL PIPE.

(a) Each imperfection or damage that impairs the serviceability of a length of steel pipe must be repaired or removed. If a repair is made by grinding, the remaining wall thickness must at least be equal to either:

(1) The minimum thickness required by the tolerances in the specification to which the pipe was manufactured; or

(2) The nominal wall thickness required for the design pressures of the pipeline.

(b) Each of the following dents must be removed from steel pipe to be operated at a pressure that produces a hoop stress of 20 percent, or more, of SMYS:

(1) A dent that contains a stress concentrator such as a scratch, gouge, groove, or arc burn.

(2) A dent that affects the longitudinal weld or a circumferential weld.

(3) In pipe to be operated at a pressure that produces a hoop stress of 40 percent or more of SMYS, a dent that has a depth of--

(i) More than one-quarter inch in pipe 12-3/4 inches or less in outer diameter; or

(ii) More than 2 percent of the nominal pipe diameter in pipe over 12-3/4 inches in outer diameter.

For the purpose of this section a "dent" is a depression that produces a gross disturbance in the curvature of the pipe wall without reducing the pipe-wall thickness. The depth of a dent is measured as the gap between the lowest point of the dent and a prolongation of the original contour of the pipe.

(c) Each arc burn on steel pipe to be operated at a pressure that produces a hoop stress of 40 percent, or more, of SMYS must be repaired or removed. If a repair is made by grinding, the arc burn must be completely removed and the remaining wall thickness must be at least equal

*PSC 192.309 (f) Due primarily to climate conditions, gouges, grooves, notches, and dents have been found to be an important cause of steel pipe failures and an attempt shall be made to prevent or eliminate harmful defects of this nature. Subsection 192.309(b) pertains to transmission lines and mains intended to operate at hoop stresses of 20 percent or 40 percent or more of the specified minimum yield strength. However, applicable portions of these paragraphs should also be applied to facilities intended to operate below this hoop stress level.*

192.311 REPAIR OF PLASTIC PIPE.

Each imperfection or damage that would impair the serviceability of plastic pipe must be repaired by a patching saddle or removed.

192.313 BENDS AND ELBOWS.

(a) Each field bend in steel pipe, other than a wrinkle bend made in accordance with 192.315, must comply with the following:

(1) A bend may not impair the serviceability of the pipe.

(2) On pipe containing a longitudinal weld, the longitudinal seam must be as near as practicable to the neutral axis of the bend.

(3) A bend on pipe that is 12 inches, or more, in nominal diameter must not deflect the pipe more than 1-1/2° in any length of pipe equal to the diameter.

(4) For pipe more than 4 inches in nominal diameter, the difference between the maximum and minimum diameter at a bend may not be more than 2-1/2 percent of the nominal diameter.

*PSC 192.313 (a)(5) Smooth bends on pipe 4 inches in size and smaller shall have a difference between the maximum and minimum diameter of not more than 12.5 percent of the nominal diameter.*

192.315 WRINKLE BENDS IN STEEL PIPE.

(a) A wrinkle bend may not be made on steel pipe to be operated at a pressure that produces a hoop stress of 30 percent, or more, of SMYS.

(b) Each wrinkle bend on steel pipe must comply with the following:

(1) The bend must not have any sharp kinks.

(2) When measured along the crotch of the bend, the wrinkles must be a distance of at least one pipe diameter.

(3) On pipe 16 inches or larger in diameter, the bend may not have a deflection of more than  $1-1/2^{\circ}$  for each wrinkle.

(4) On pipe containing a longitudinal weld the longitudinal seam must be as near as practicable to the neutral axis of the bend.

192.317 PROTECTION FROM HAZARDS.

(a) Each transmission line or main must be protected from washouts, floods, unstable soil, landslides, or other hazards that may cause the pipe to move or to sustain abnormal loads.

(b) Each transmission line or main that is constructed above ground must be protected from accidental damage by vehicular traffic or other similar causes, either by being placed at a safe distance from the traffic or by installing barricades.

192.319 INSTALLATION OF PIPE IN A DITCH.

(a) When installed in a ditch, each transmission line that is to be operated at a pressure producing a hoop stress of 20 percent or more of SMYS must be installed so that the pipe fits the ditch so as to minimize stresses and protect the pipe coating from damage.

*PSC 192.319 (a) This includes grading the ditch so that*

PSC 192.319(b)(3) *If there are large rocks in the material to be used for backfill, care should be used to prevent damage to the coating or pipe by such means as the use of rock shield material, or by making the initial fill with rock free material to a sufficient depth over the pipe to prevent rock damage.*

PSC 192.319(b)(4) *Where flooding of the trench is done to consolidate the backfill, care shall be exercised to see that the pipe is not floated from its firm bearing on the trench bottom.*

PSC 192.319(c) *The provisions of 192.319(a) shall also apply to mains operating at less than 20% of the SMYS.*

#### 192.321 INSTALLATION OF PLASTIC PIPE.

- (a) Plastic pipe must be installed below ground level.
- (b) Plastic pipe that is installed in a vault or any other below grade enclosure must be completely encased in gas-tight metal pipe and fittings that are adequately protected from corrosion.
- (c) Plastic pipe must be installed so as to minimize shear or tensile stresses.
- (d) Thermoplastic pipe that is not encased must have a minimum wall thickness of 0.090 inches, except that pipe with an outside diameter of 0.875 inches or less may have a minimum wall thickness of 0.062 inches.
- (e) Plastic pipe that is not encased must have an electrically conductive wire or other means of locating the pipe while it is underground.
- (f) Plastic pipe that is being encased must be inserted into the casing pipe in a manner that will protect the plastic. The leading end of the plastic must be closed before insertion.

PSC 192.321(f) *The casing pipe shall be reamed and cleaned to the extent necessary to remove any sharp edges, projections, or abrasive material which could*

PSC 192.321(h) Changes in direction of plastic piping may be made with bends, tees or elbows under the following limitations:

(1) Plastic pipe and tubing may be deflected to a radius not less than the minimum recommended by the manufacturer for the kind, type, grade, wall thickness and diameter of the particular plastic used.

(2) The bends shall be free of buckles, cracks, or other evidence of damage.

(3) Changes in direction that cannot be made in accordance with PSC 192.321(h)(1) above shall be made with elbow-type fittings.

(4) Miter bends are not permitted.

(5) Branch connections shall be made only with socket-type tees or other suitable fittings specifically designed for the purpose.

PSC 192.321(i) Plastic piping shall be laid on undisturbed or well compacted soil. If plastic piping is to be laid in soils which may damage it, the piping shall be protected by suitable rock free materials before back-filling is completed. Plastic piping shall not be supported by blocking. Well tamped earth or other continuous support shall be used.

#### 192.323 CASING.

Each casing used on a transmission line or main under a railroad or highway must comply with the following:

(a) The casing must be designed to withstand the superimposed loads.

(b) If there is a possibility of water entering the casing, the ends must be sealed.

(c) If the ends of an unvented casing are sealed and the sealing is strong enough to retain the maximum

(b) Each main must be installed with enough clearance from any other underground structure to allow proper maintenance and to protect against damage that might result from proximity to other structures.

*PSC 192.325(b) If the structure is a public building where people assemble or in areas such as playground, assembly ground, or park, wherever possible the clearance shall be at least 100 feet if the main is operated at more than 100 p.s.i. but less than 500 p.s.i. and shall be at least 150 feet if operated at 500 p.s.i. or more. If these clearances cannot be maintained, then the next higher type of construction shall be used except such construction may be pressure-tested the same as the remainder of the line. No distribution main or transmission line shall be installed under buildings.*

(c) In addition to meeting the requirements of paragraph (a) or (b) of this section, each plastic transmission line or main must be installed with sufficient clearance, or must be insulated, from any source of heat so as to prevent the heat from impairing the serviceability of the pipe.

(d) Each pipe-type or bottle-type holder must be installed with a minimum clearance from any holder as prescribed in 192.175(b).

192.327 COVER.

(a) Except as provided in paragraph (c) of this section, each buried transmission line must be installed with a minimum cover as follows:

Location	Normal Soil Inches	Consolidated Rock Inches
Class 1 locations . . . . .	30	18
Class 2, 3, and 4 locations . . . . .	36	24
Drainage ditches of public roads and railroad crossings . . . . .	36	24

(1) Establishes a minimum cover of less than 24 inches;

(2) Requires that mains be installed in a common trench with other utility lines; and

(3) Provides adequately for prevention of damage to the pipe by external forces.

SUBPART H---CUSTOMER METERS, SERVICE REGULATORS, AND SERVICE LINES

192.351 SCOPE.

This subpart prescribes minimum requirements for installing customer meters, service regulators, service lines, service line valves, and service line connections to mains.

192.353 CUSTOMER METERS AND REGULATORS: LOCATION.

(a) Each meter and service regulator, whether inside or outside of a building, must be installed in a readily accessible location and be protected from corrosion and other damage. However, the upstream regulator in a series may be buried.

(b) Each service regulator installed within a building must be located as near as practical to the point of service line entrance.

*PSC 192.353(b) Whenever practical, the meters shall be installed at the same location.*

(c) Each meter installed within a building must be located in a ventilated place and not less than 3 feet from any source of ignition or any source of heat which might damage the meter.

*PSC 192.353(c) Meters shall not be installed in bedrooms, closets, bathrooms, under combustible stairways or in unventilated or inaccessible places, nor closer than three feet to sources of ignition, including furnaces and water heaters.*

(d) Where feasible, the upstream regulator in a series must be located outside the building, unless it is located

(ii) The gas utilization equipment is connected to a source of oxygen or compressed air.

(iii) Liquefied petroleum gas or other supplementary gas is used as standby and might flow back into the meter. A three-way valve installed to admit the standby supply and at the same time shut off the regular supply, can be substituted for a check valve if desired.

(b) Service regulator vents and relief vents. The outside terminal of each service regulator vent and relief vent must--

(1) Be rain and insect resistant;

(2) Be located at a place where gas from the vent can escape freely into the atmosphere and away from any opening into the building; and

(3) Be protected from damage caused by submergence in areas where flooding may occur.

*PSC 192.355(b)(3) At locations where service regulators might be submerged during floods, either a special anti-flood type breather vent fitting shall be installed, or the vent line shall be extended above the height of the expected flood waters.*

(c) Pits and vaults. Each pit or vault that houses a customer meter or regulator at a place where vehicular traffic is anticipated, must be able to support that traffic.

#### 192.357 CUSTOMER METERS AND REGULATORS: INSTALLATION.

(a) Each meter and each regulator must be installed so as to minimize anticipated stresses upon the connecting piping and the meter.

(b) When close all-thread nipples are used, the wall thickness remaining after the threads are cut must meet the minimum wall thickness requirements of this part.

(c) Connections made of lead or other easily damaged material may not be used in the installation of meters



(c) A rebuilt or repaired tinned steel case meter may not be used at a pressure that is more than 50 percent of the pressure used to test the meter after rebuilding or repairing.

192.361 SERVICE LINES: INSTALLATION.

(a) Depth. Each buried service line must be installed with at least 12 inches of cover in private property and at least 18 inches of cover in streets and roads. However, where an underground structure prevents installation at those depths, the service line must be able to withstand any anticipated external load.

(b) Support and backfill. Each service line must be properly supported on undisturbed or well-compacted soil, and material used for backfill must be free of materials that could damage the pipe or its coating.

(c) Grading for drainage. Where condensate in the gas might cause interruption in the gas supply to the customer, the service line must be graded so as to drain into the main or into drips at the low points in the service line.

(d) Protection against piping strain and external loading. Each service line must be installed so as to minimize anticipated piping strain and external loading.

(e) Installation of service lines into buildings. Each underground service line installed below grade through the outer foundation wall of a building must--

(1) In the case of a metal service line, be protected against corrosion;

(2) In the case of a plastic service line, be protected from shearing action and backfill settlement; and

(3) Be sealed at the foundation wall to prevent leakage into the building.

(f) Installation of service lines under buildings. Where an underground service line is installed under a

*PSC 192.361(g) It is recommended that service to one customer and/or one building be supplied through one service and one shut-off valve.*

192.363 SERVICE LINES: VALVE REQUIREMENTS.

(a) Each service line must have a service-line valve that meets the applicable requirements of subparts B and D of this part. A valve incorporated in a meter bar, that allows the meter to be bypassed, may not be used as a service-line valve.

(b) A soft seat service line valve may not be used if its ability to control the flow of gas could be adversely affected by exposure to anticipated heat.

(c) Each service-line valve on a high-pressure service line, installed above ground or in an area where the blowing of gas would be hazardous, must be designed and constructed to minimize the possibility of the removal of the core of the valve with other than specialized tools.

192.365 SERVICE LINES: LOCATION OF VALVES.

(a) Relation to regulator or meter. Each service-line valve must be installed upstream of the regulator or, if there is no regulator, upstream of the meter.

(b) Outside valves. Each service line must have a shut-off valve in a readily accessible location that, if feasible, is outside of the building.

*PSC 192.365(b) Whenever gas is supplied to a theatre, church, school, factory or other building where large numbers of persons assemble, an outside valve in such case will be required.*

(c) Underground valves. Each underground service-line valve must be located in a covered durable curb box or standpipe that allows ready operation of the valve and is supported independently of the service lines.

192.367 SERVICE LINES: GENERAL REQUIREMENTS FOR CONNECTIONS TO MAIN PIPING.

(2) If gaskets are used in connecting the service line to the main connection fitting, have gaskets that are compatible with the kind of gas in the system.

192.369 SERVICE LINES: CONNECTIONS TO CAST IRON OR DUCTILE IRON MAINS.

(a) Each service line connected to a cast iron or ductile iron main must be connected by a mechanical clamp, by drilling and tapping the main, or by another method meeting the requirements of 192.273.

(b) If a threaded tap is being inserted, the requirements of 192.151 (b) and (c) must also be met.

192.371 SERVICE LINES: STEEL.

Each steel service line to be operated at less than 100 p.s.i.g. must be constructed of pipe designed for a minimum of 100 p.s.i.g.

PSC 192.371

*(a) When coated steel pipe is to be installed as a service line in a bore, care should be exercised to prevent damage to the coating during installation. For all installations to be made by boring, driving or similar methods or in a rocky type soil, the following practices or their equivalents are recommended:*

*(b) When a service line is to be installed by boring or driving and a coated steel pipe is to be used for the service line, the coated pipe should not be used as the bore pipe or drive pipe and left in the ground as part of the service line. It is preferable to make such installations by first making an oversize bore, removing the pipe used for boring and then inserting the coated pipe.*

*(c) Coated steel pipe preferably should not be inserted through a bore in exceptionally rocky soil where there is a likelihood of damage to the coating resulting from the insertion.*

192.373 SERVICE LINES: CAST IRON AND DUCTILE IRON.

192.375 SERVICE LINES: PLASTIC.

(a) Each plastic service line outside a building must be installed below ground level, except that it may terminate above ground and outside the building, if--

(1) The above ground part of the plastic service line is protected against deterioration and external damage; and

(2) The plastic service line is not used to support external loads.

*PSC 192.375(3) The above ground portion of the plastic service line is completely enclosed in a rigid metal tube or metal pipe. The metal tube or pipe shall have a minimum wall thickness of 0.035 in., adequate protection against corrosion, and shall extend a minimum of six inches below grade.*

(b) Each plastic service line inside a building must be protected against external damage.

*PSC 192.375(c) Plastic service lines shall be designed in accordance with the applicable requirements of 192.121 and 192.123 and be considered as a class 4 location.*

192.377 SERVICE LINES: COPPER.

Each copper service line installed within a building must be protected against external damage.

PSC 192.377

*Copper service lines installed within a building may not be concealed.*

*PSC 192.377(a) Ferrous valves and fittings installed on underground copper service lines shall be protected from contact with the soil or insulated from the copper pipe.*

SUBPART I--REQUIREMENTS FOR CORROSION CONTROL

192.455 EXTERNAL CORROSION CONTROL: BURIED OR SUBMERGED  
PIPELINES INSTALLED AFTER JULY 31, 1971.

(a) Except as provided in paragraphs (b) and (c) of this section, each buried or submerged pipeline installed after July 31, 1971 must be protected against external corrosion, including the following:

(1) It must have an external protective coating meeting the requirements of 192.46.

(2) It must have a cathodic protection system designed to protect the pipeline in its entirety in accordance with this subpart, installed and placed in operation within one year after completion of construction.

(b) An operator need not comply with paragraph (a) of this section, if the operator can demonstrate by tests, investigation, or experience in the area of application, including, as a minimum, soil resistivity measurements and tests for corrosion accelerating bacteria, that a corrosive environment does not exist. However, within 6 months after an installation made pursuant to the preceding sentence, the operator shall conduct tests, including pipe-to-soil potential measurements with respect to either a continuous reference electrode, or an electrode using close spacing, not to exceed 20 feet, and soil resistivity measurements at potential profile peak locations, to adequately evaluate the potential profile along the entire pipeline. If the tests made indicate that a corrosive condition exists, the pipeline must be cathodically protected in accordance with paragraph (a)(2) of this section.

(c) An operator need not comply with paragraph (a) of this section, if the operator can demonstrate by tests, investigation, or experience that--

(1) For a copper pipeline, a corrosive environment does not exist; or

(2) For a temporary pipeline with an operating period of service not to exceed 5 years beyond installation, corrosion during the 5-year period of service of the pipe-

192.457 EXTERNAL CORROSION CONTROL: BURIED OR SUBMERGED  
PIPELINES INSTALLED BEFORE AUGUST 1, 1971.

(a) Except for buried piping at compressor, regulator, and measuring stations, each buried or submerged transmission line installed before August 1, 1971, that has an effective external coating must, not later than August 1, 1974, be cathodically protected along the entire area that is effectively coated, in accordance with this subpart. For the purposes of this subpart, a pipeline does not have an effective external coating if its cathodic protection current requirements are substantially the same as if it were bare. The operator shall make tests to determine the cathodic protection current requirements.

(b) Except for cast iron or ductile iron, each of the following buried or submerged pipelines installed before August 1, 1971, must, not later than August 1, 1976, be cathodically protected in accordance with this subpart in areas in which active corrosion is found:

(1) Bare or ineffectively coated transmission lines.

(2) Bare or coated pipes at compressor, regulator, and measuring stations.

(3) Bare or coated distribution lines. The operator shall determine the areas of active corrosion by electrical survey, or where electrical survey is impractical, by the study of corrosion and leak history records, by leak detection survey, or by other means.

(c) For the purpose of this subpart, active corrosion means continuing corrosion which, unless controlled, could result in a condition that is detrimental to public safety.

*PSC 192.457(d) Notwithstanding the provisions of 192.457(b) (regarding active corrosion), effectively coated steel distribution pipelines must, not later than August 1, 1975, be cathodically protected along the entire area that is effectively coated in accordance with this subpart.*

192.459 EXTERNAL CORROSION CONTROL: EXAMINATION OF BURIED

- (1) Be applied on a properly prepared surface;
- (2) Have sufficient adhesion to the metal surface to effectively resist underfilm migration of moisture;
- (3) Be sufficiently ductile to resist cracking;
- (4) Have sufficient strength to resist damage due to handling and soil stress; and
- (5) Have properties compatible with any supplemental cathodic protection.

(b) Each external protective coating which is an electrically insulating type must also have low moisture absorption and high electrical resistance.

(c) Each external protective coating must be inspected just prior to lowering the pipe into the ditch and back-filling, and any damage detrimental to effective corrosion control must be repaired.

(d) Each external protective coating must be protected from damage resulting from adverse ditch conditions or damage from supporting blocks.

(e) If coated pipe is installed by boring, driving, or other similar method, precautions must be taken to minimize damage to the coating during installation.

#### 192.463 EXTERNAL CORROSION CONTROL: CATHODIC PROTECTION.

(a) Each cathodic protection system required by this subpart must provide a level of cathodic protection that complies with one or more of the applicable criteria contained in Appendix D of this subpart. If none of these criteria is applicable, the cathodic protection system must provide a level of cathodic protection at least equal to that provided by compliance with one or more of these criteria.

(b) If amphoteric metals are included in a buried or submerged pipeline containing a metal of different anodic potential--

192.465 EXTERNAL CORROSION CONTROL: MONITORING.

(a) Except where impractical on offshore pipelines, each pipeline that is under cathodic protection must be tested at least once each calendar year, but with intervals not exceeding 15 months, to determine whether the cathodic protection meets the requirements of 192.463. However, if tests at those intervals are impractical for separately protected service lines or short sections of protected mains, not in excess of 100 feet, these service lines and mains may be surveyed on a sampling basis. At least 10 percent of these protected structures, distributed over the entire system, must be surveyed each calendar year, with a different 10 percent checked each subsequent year, so that the entire system is tested in each 10-year period.

(b) At intervals not exceeding 2 months, each cathodic protection rectifier or other impressed current power source must be inspected to ensure that it is operating.

(c) At intervals not exceeding 2 months, each reverse current switch, each diode, and each interference bond whose failure would jeopardize structure protection, must be electrically checked for proper performance. Each other interference bond must be checked at least once each calendar year, but with intervals not exceeding 15 months.

(d) Each operator shall take prompt remedial action to correct any deficiencies indicated by the monitoring.

(e) After the initial evaluation required by paragraphs (b) and (c) of 192.455 and paragraph (b) of 192.457, each operator shall, at intervals not exceeding 3 years, reevaluate its unprotected pipelines and cathodically protect them in accordance with this subpart in areas in which active corrosion is found. The operator shall determine the areas of active corrosion by electrical survey, or where electrical survey is impractical, by the study of corrosion and leak history records, by leak detection survey, or by other means.

192.467 EXTERNAL CORROSION CONTROL: ELECTRICAL ISOLATION.



(d) Inspection and electrical tests must be made to assure that electrical isolation is adequate.

(e) An insulating device may not be installed in an area where a combustible atmosphere is anticipated unless precautions are taken to prevent arcing.

(f) Where a pipeline is located in close proximity to electrical transmission tower footings, ground cables or counterpoise, or in other areas where fault currents or unusual risk of lightning may be anticipated, it must be provided with protection against damage due to fault currents or lightning, and protective measures must also be taken at insulating devices.

192.469 EXTERNAL CORROSION CONTROL: TEST STATIONS.

Except where impractical on offshore and wet marsh area pipelines, each pipeline under cathodic protection required by this subpart must have sufficient test stations or other contact points for electrical measurements to determine the adequacy of cathodic protection.

192.471 EXTERNAL CORROSION CONTROL: TEST LEADS.

(a) Each test lead wire must be connected to the pipeline so as to remain mechanically secure and electrically conductive.

(b) Each test lead wire must be attached to the pipeline so as to minimize stress concentration on the pipe.

(c) Each bared test lead wire and bared metallic area at point of connection to the pipeline must be coated with an electrical insulating material compatible with the pipe coating and the insulation on the wire.

192.473 EXTERNAL CORROSION CONTROL: INTERFERENCE CURRENTS.

(a) After July 31, 1973, each operator whose pipeline system is subjected to stray currents shall have in effect a continuing program to minimize the detrimental effects of such currents.

(b) Whenever any pipe is removed from a pipeline for any reason, the internal surface must be inspected for evidence of corrosion. If internal corrosion is found--

(1) The adjacent pipe must be investigated to determine the extent of internal corrosion;

(2) Replacement must be made to the extent required by the applicable paragraphs of 192.485, 192.487 or 192.489; and

(3) Steps must be taken to minimize the internal corrosion.

(c) Gas containing more than 0.1 grain of hydrogen sulfide per 100 standard cubic feet may not be stored in pipe-type or bottle-type holders.

192.477 INTERNAL CORROSION CONTROL: MONITORING.

If corrosive gas is being transported, coupons or other suitable means must be used to determine the effectiveness of the steps taken to minimize internal corrosion. After July 31, 1972, each coupon or other means of monitoring internal corrosion must be checked at internals not exceeding 6 months.

192.479 ATMOSPHERIC CORROSION CONTROL: GENERAL.

(a) Pipelines installed after July 31, 1971. Each aboveground pipeline or portion of a pipeline installed after July 31, 1971 that is exposed to the atmosphere must be cleaned and either coated or jacketed with a material suitable for the prevention of atmospheric corrosion. An operator need not comply with this paragraph, if the operator can demonstrate by test, investigation, or experience in the area of application, that a corrosive atmosphere does not exist.

(b) Pipelines installed before August 1, 1971. Not later than August 1, 1974, each operator having an aboveground pipeline or portion of a pipeline installed before August 1, 1971 that is exposed to the atmosphere,

192.481 ATMOSPHERIC CORROSION CONTROL: MONITORING.

After meeting the requirements of paragraphs (a) and (b) of 192.479, each operator shall, at intervals not exceeding 3 years, reevaluate its aboveground pipelines or portions of pipelines that are exposed to the atmosphere and take remedial action wherever necessary to maintain protection against atmospheric corrosion.

192.483 REMEDIAL MEASURES: GENERAL.

(a) Each segment of metallic pipe that replaces pipe removed from a buried or submerged pipeline because of external corrosion must have a properly prepared surface and must be provided with an external protective coating that meets the requirements of 192.461.

(b) Each segment of metallic pipe that replaces pipe removed from a buried or submerged pipeline because of external corrosion must be cathodically protected in accordance with this subpart.

(c) Except for cast iron or ductile iron pipe, each segment of buried or submerged pipe that is required to be repaired because of external corrosion must be cathodically protected in accordance with this subpart.

192.485 REMEDIAL MEASURES: TRANSMISSION LINES.

(a) General corrosion. Each segment of transmission line pipe with general corrosion and with a remaining wall thickness less than that required for the maximum allowable operating pressure of the pipeline, must be replaced or the operating pressure reduced commensurate with the actual remaining wall thickness. However, if the area of general corrosion is small, the corroded pipe may be repaired. Corrosion pitting so closely grouped as to affect the overall strength of the pipe is considered general corrosion for the purpose of this paragraph.

(b) Localized corrosion pitting. Each segment of transmission line pipe with localized corrosion pitting to a degree where leakage might result must be replaced or repaired, or the operating pressure must be reduced

(b) Localized corrosion pitting. Except for cast iron or ductile iron pipe, each segment of distribution line pipe with localized corrosion pitting to a degree where leakage might result must be replaced or repaired.

192.489 REMEDIAL MEASURES: CAST IRON AND DUCTILE IRON PIPELINES.

(a) General graphitization. Each segment of cast iron or ductile iron pipe on which general graphitization is found to a degree where a fracture or any leakage might result, must be replaced.

(b) Localized graphitization. Each segment of cast iron or ductile iron pipe on which localized graphitization is found to a degree where any leakage might result, must be replaced or repaired, or sealed by internal sealing methods adequate to prevent or arrest any leakage.

192.491 CORROSION CONTROL RECORDS.

(a) After July 31, 1972, each operator shall maintain records or maps to show the location of cathodically protected piping, cathodic protection facilities, other than unrecorded galvanic anodes installed before August 1, 1971, and neighboring structures bonded to the cathodic protection system.

(b) Each of the following records must be retained for as long as the pipeline remains in service:

(1) Each record or map required by paragraph (a) of this section.

(2) Records of each test, survey, or inspection required by this subpart, in sufficient detail to demonstrate the adequacy of corrosion control measures or that a corrosive condition does not exist.

SUBPART J--TEST REQUIREMENTS

192.501 SCOPE.

(2) Each potentially hazardous leak has been located and eliminated.

(b) The test medium must be liquid, air, natural gas, or inert gas that is--

(1) Compatible with the material of which the pipeline is constructed;

(2) Relatively free of sedimentary materials; and

(3) Except for natural gas, nonflammable.

(c) Except as provided in 192.505 (a), if air, natural gas, or inert gas is used as the test medium, the following maximum hoop stress limitations apply:

Class location	Maximum hoop stress allowed as percentage of SMYS	
	Natural gas	Air or inert gas
1. . . . .	80	80
2. . . . .	30	75
3. . . . .	30	50
4. . . . .	30	40

(d) Each weld used to tie-in a test segment of pipeline is excepted from the test requirements of this subpart.

192.505 STRENGTH TEST REQUIREMENTS FOR STEEL PIPELINE TO OPERATE AT A HOOP STRESS OF 30 PERCENT OR MORE OF SMYS.

(a) Except for service lines, each segment of a steel pipeline that is to operate at a hoop stress of 30 percent or more of SMYS must be strength tested in accordance with this section to substantiate the proposed maximum allowable operating pressure. In addition, in a Class 1 or Class 2 location, if there is a building intended for human occupancy with 300 feet of a pipeline, a hydrostatic test must be conducted to a test pressure of at least 125 percent of maximum operating pressure on that segment of the pipeline within 300 feet of such a building, but in no event may the test section be less than 600 feet unless the length of the newly installed or relocated pipe is less than 600 feet. However, if the buildings are evacuated while the hoop stress exceeds 50 percent of SMYS, air or inert gas may be used as the test medium.

(b) In a Class 1 or Class 2 location, each compressor station, regulator station, and measuring station, must be tested to at least Class 3 location test requirements.

(c) Except as provided in paragraph (e) of this section, the strength test must be conducted by maintaining the pressure at or above the test pressure for at least 8 hours.

(d) If a component other than pipe is the only item being replaced or added to a pipeline, a strength test after installation is not required, if the manufacturer of the component certifies that--

(1) The component was tested to at least the pressure required for the pipeline to which it is being added; or

(2) The component was manufactured under a quality control system that ensures that each item manufactured is at least equal in strength to a prototype and that the prototype was tested to at least the pressure required for the pipeline to which it is being added.

(e) For fabricated units and short sections of pipe, for which a post installation test is impractical, a preinstallation strength test must be conducted by maintaining the pressure at or above the test pressure for at least 4 hours.

*PSC 192.505(f) Except in freezing weather or when water is not available, pipelines or mains larger than 6 inches in diameter, installed in class locations 1, 2, or 3, shall be hydrostatically tested in place to at least 90% of the specified minimum yield strength.*

192.507 TEST REQUIREMENTS FOR PIPELINES TO OPERATE AT A HOOP STRESS LESS THAN 30 PERCENT OF SMYS AND ABOVE 100 P.S.I.G.

Except for service lines and plastic pipelines, each segment of a pipeline that is to be operated at a hoop stress less than 30 percent of SMYS and above 100 p.s.i.g. must be tested in accordance with the following:

(a) The pipeline operator must use a test procedure that will ensure discovery of all potentially hazardous leaks in the segments being tested.

(b) If, during the test, the segment is to be stressed to 20 percent or more of SMYS and natural gas, inert gas, or air is the test medium--

(1) A leak test must be made at a pressure between 100 p.s.i.g. and the pressure required to produce a hoop stress of 20 percent of SMYS; or

(2) The line must be walked to check for leaks while the hoop stress is held at approximately 20 percent of SMYS.

(c) The pressure must be maintained at or above the test pressure for at least 1 hour.

192.509 TEST REQUIREMENTS FOR PIPELINES TO OPERATE AT OR BELOW 100 P.S.I.G.

Except for service lines and plastic pipelines, each segment of a pipeline that is to be operated at or below 100 p.s.i.g. must be leak tested in accordance with the following:

(a) The test procedure used must ensure discovery of all potentially hazardous leaks in the segment being tested.

(b) Each main that is to be operated at less than 1 p.s.i.g. must be tested to at least 10 p.s.i.g. and each main to be operated at or above 1 p.s.i.g. must be tested to at least 90 p.s.i.g.

*PSC 192.509(c) If substantial protective coatings are used that would seal a split seam, the leak test pressure shall be 100 p.s.i.g.*

192.511 TEST REQUIREMENTS FOR SERVICE LINES.

(a) Each segment of a service line (other than plastic) must be leak tested in accordance with this section before being placed in service. If feasible, the service-line connection to the main must be included in the test; if not feasible, it must be given a leakage test at the operating pressure when placed in service.

(b) Each segment of a service line (other than plastic) intended to be operated at a pressure of at least 1 p.s.i.g. but not more than 40 p.s.i.g. must be given a leak test at a pressure of not less than 50 p.s.i.g.

(c) Each segment of a service line (other than plastic) intended to be operated at pressures of more than 40 p.s.i.g. must be tested to at least 90 p.s.i.g., except that each segment of a steel service line stressed to 20 percent or more of SMYS must be tested in accordance with 192.507 of this subpart.

*PSC 192.511(d) Each segment of a service line (other than plastic) intended to be operated at a pressure between 0 and 1 p.s.i.g. must be given a leak test at a pressure of not less than 50 p.s.i.g.*

192.513 TEST REQUIREMENTS FOR PLASTIC PIPELINES.

(a) Each segment of a plastic pipeline must be tested in accordance with this section.

(b) The test procedure must insure discovery of all potentially hazardous leaks in the segment being tested.

(c) The test pressure must be at least 150 percent of the maximum operating pressure or 50 p.s.i.g., whichever is greater. However, the maximum test pressure may not be more than three times the design pressure of the pipe.

(d) The temperature of thermoplastic material must not be more than 100°F. during the test.

#### 192.515 ENVIRONMENTAL PROTECTION AND SAFETY REQUIREMENTS.

(a) In conducting tests under this subpart, each operator shall insure that every reasonable precaution is taken to protect its employees and the general public during the testing. Whenever the hoop stress of the segment of the pipeline being tested will exceed 50 percent of SMYS, the operator shall take all practicable steps to keep persons not working on the testing operation outside of the testing area until the pressure is reduced to or below the proposed maximum allowable operating pressure.

(b) The operator shall insure that the test medium is disposed of in a manner that will minimize damage to the environment.

#### 192.517 RECORDS.

Each operator shall make, and retain for the useful life of the pipeline, a record of each test performed under 192.505 and 192.507. The record must contain at least the following information:

(a) The operator's name, the name of the operator's employee responsible for making the test, and the name of any test company used.

(b) Test medium used.

(c) Test pressure.

(d) Test duration.

(e) Pressure recording charts, or other record of pressure readings.

(f) Elevation variations, whenever significant for the particular test.

(g) Leaks and failures noted and their disposition.

#### SUBPART K--UPRATING

#### 192.551 SCOPE.

This subpart prescribes minimum requirements for increasing maximum allowable operating pressures (uprating) for pipelines.

#### 192.553 GENERAL REQUIREMENTS.

(a) Pressure increases. Whenever the requirements of this subpart require that an increase in operating pressure be made in increments, the pressure must be increased gradually, at a rate that can be controlled, and in accordance with the following:



(1) At the end of each incremental increase, the pressure must be held constant while the entire segment of pipeline that is affected is checked for leaks.

(2) Each leak detected must be repaired before a further pressure increase is made, except that a leak determined not to be potentially hazardous need not be repaired, if it is monitored during the pressure increase and it does not become potentially hazardous.

(b) Records. Each operator who uprates a segment of pipeline shall retain for the life of the segment a record of each investigation required by this subpart, of all work performed, and of each pressure test conducted, in connection with the uprating.

(c) Written plan. Each operator who uprates a segment of pipeline shall establish a written procedure that will ensure that each applicable requirement of this subpart is complied with.

(d) Limitation on increase in maximum allowable operating pressure. Except as provided in 192.555(c), a new maximum allowable operating pressure established under this subpart may not exceed the maximum that would be allowed under this part for a new segment of pipeline constructed of the same materials in the same location.

192.555 UPGRADING TO A PRESSURE THAT WILL PRODUCE A HOOP STRESS OF 30 PERCENT OR MORE OF SMYS IN STEEL PIPELINES.

(a) Unless the requirements of this section have been met, no person may subject any segment of a steel pipeline to an operating pressure that will produce a hoop stress of 30 percent or more of SMYS and that is above the established maximum allowable operating pressure.

(b) Before increasing operating pressure above the previously established maximum allowable operating pressure the operator shall--

(1) Review the design, operating, and maintenance history and previous testing of the segment of pipeline and determine whether the proposed increase is safe and consistent with the requirements of this part; and

(2) Make any repairs, replacements, or alterations in the segment of pipeline that are necessary for safe operation at the increased pressure.

(c) After complying with paragraph (b) of this section, an operator may increase the maximum allowable operating pressure of a segment of pipeline constructed before September 12, 1970, to the highest pressure that is permitted under 192.619, using as test pressure the highest pressure to which the segment of pipeline was previously subjected (either in a strength test or in actual operation).

(d) After complying with paragraph (b) of this section, an operator that does not qualify under paragraph (c) of this section may increase the previously established maximum allowable operating pressure if at least one of the following requirements is met:

(1) The segment of pipeline is successfully tested in accordance with the requirements of this part for a new line of the same material in the same location.

(2) An increased maximum allowable operating pressure may be established for a segment of pipeline in a Class 1 location if the line has not previously been tested, and if--

(i) It is impractical to test it in accordance with the requirements of this part;

(ii) The new maximum operating pressure does not exceed 80 percent of that allowed for a new line of the same design in the same location; and

(iii) The operator determines that the new maximum allowable operating pressure is consistent with the condition of the segment of pipeline and the design requirements of this part.

(e) Where a segment of pipeline is uprated in accordance with paragraph (c) or (d) (2) of this section, the increase in pressure must be made in increments that are equal to--

(1) 10 percent of the pressure before the uprating; or

(2) 25 percent of the total pressure increase, whichever produces the fewer number of increments.

192.557 UPRATING: STEEL PIPELINES TO A PRESSURE THAT WILL PRODUCE A HOOP STRESS LESS THAN 30 PERCENT OF SMYS; PLASTIC, CAST IRON, AND DUCTILE IRON PIPELINES.

(a) Unless the requirements of this section have been met, no person may subject--

(1) A segment of steel pipeline to an operating pressure that will produce a hoop stress less than 30 percent of SMYS and that is above the previously established maximum allowable operating pressure; or

(2) A plastic, cast iron, or ductile iron pipeline segment to an operating pressure that is above the previously established maximum allowable operating pressure.

(b) Before increasing operating pressure above the previously established maximum allowable operating pressure, the operator shall--

(1) Review the design, operating, and maintenance history of the segment of pipeline;

(2) Make a leakage survey (if it has been more than 1 year since the last survey) and repair any leaks that are found, except that a leak determined not to be potentially hazardous need not be repaired, if it is monitored during the pressure increase and it does not become potentially hazardous;

(3) Make any repairs, replacements, or alterations in the segment of pipeline that are necessary for safe operation at the increased pressure;

(4) Reinforce or anchor offsets, bends and dead ends in pipe joined by compression couplings or bell and spigot joints to prevent failure of the pipe joint, if the offset, bend, or dead end is exposed in an excavation;

(5) Isolate the segment of pipeline in which the pressure is to be increased from any adjacent segment that will continue to be operated at a lower pressure; and

(6) If the pressure in mains or service lines, or both, is to be higher than the pressure delivered to the customer, install a service regulator on each service line and test each regulator to determine that it is functioning. Pressure may be increased as necessary to test each regulator, after a regulator has been installed on each pipeline subject to the increased pressure.

(c) After complying with paragraph (b) of this section, the increase in maximum allowable operating pressure must be made in increments that are equal to 10 p.s.i.g. or 25 percent of the total pressure increase, whichever produces the fewer number of increments. Whenever the requirements of paragraph (b) (6) of this section apply, there must be at least two approximately equal incremental increases.

(d) If records for cast iron or ductile iron pipeline facilities are not complete enough to ascertain compliance with 192.117 or 192.119, as applicable, the following procedures must be followed:

(1) If the original laying conditions cannot be ascertained, the operator shall assume, when applying the design formulas of ANSI A21.1, that cast iron pipe was supported on blocks with tamped backfill and, when applying the design formulas of ANSI A21.50, that ductile iron pipe was laid without blocks with tamped backfill.

(2) Unless the actual maximum cover depth is known, the operator shall measure the actual cover in at least three places where the cover is most likely to be greatest and shall use the greatest cover measured.

(3) Unless the actual nominal wall thickness is known, the operator shall determine the wall thickness by cutting and measuring coupons from at least three separate pipe lengths. The coupons must be cut from pipe lengths in areas where the cover depth is most likely to be the greatest. The average of all measurements taken must be increased by the allowance indicated in the following table:

Pipe Size (inches)	Allowance (inches)		
	Cast iron pipe		
	Pit cast pipe	Centrifugally cast pipe	Ductile iron pipe
3-8. . . . .	0.075	0.065	0.065
10-12. . . . .	0.08	0.07	0.07
14-24. . . . .	0.08	0.08	0.075
30-42. . . . .	0.09	0.09	0.075
48 . . . . .	0.09	0.09	0.08
54-60. . . . .	0.09	----	----

Note--The nominal wall thickness of the cast iron is the standard thickness listed in table 10 or table 11, as applicable, of ANSI A21.1 nearest the value obtained under this subparagraph. The nominal wall thickness of ductile iron pipe is the standard thickness listed in table 6 of ANSI A21.50 nearest the value obtained under this subparagraph.

(4) For cast iron pipe, unless the pipe manufacturing process is known, the operator shall assume that the pipe is pit case pipe with a bursting tensile strength of 11,000 p.s.i. and a modulus of rupture of 31,000 p.s.i.

SUBPART L--OPERATIONS

192.601 SCOPE.

This subpart prescribes minimum requirements for the operation of pipeline facilities.

192.603 GENERAL PROVISIONS.

(a) No person may operate a segment of pipeline unless it is operated in accordance with this subpart.

(b) Each operator shall establish a written operating and maintenance plan meeting the requirements of this part and keep records necessary to administer the plan.

192.605 ESSENTIALS OF OPERATING AND MAINTENANCE PLAN.

Each operator shall include the following in its operating and maintenance plan:

(a) Instructions for employees covering operating and maintenance procedures during normal operations and repairs.

(b) Items required to be included by the provisions of Subpart M of this part.

(c) Specific programs relating to facilities presenting the greatest hazard to public safety either in an emergency or because of extraordinary construction or maintenance requirements.

(d) A program for conversion procedures, if conversion of a lowpressure distribution system to a higher pressure is contemplated.

(e) Provision for periodic inspections to ensure that operating pressures are appropriate for the class location.

192.607 INITIAL DETERMINATION OF CLASS LOCATION AND CONFIRMATION OR ESTABLISHMENT OF MAXIMUM ALLOWABLE OPERATING PRESSURE.

(a) Before April 15, 1971, each operator shall complete a study to determine for each segment of pipeline with a maximum allowable operating pressure that will produce a hoop stress that is more than 40 percent of SMYS--

(1) The present class location of all such pipeline in its system; and

(2) Whether the hoop stress corresponding to the maximum allowable operating pressure for each segment of pipeline is commensurate with the present class location.

(b) Each segment of pipeline that has been determined under paragraph (a) of this section to have an established maximum allowable operating pressure producing a hoop stress that is not commensurate with the class location of the segment of pipeline and that is found to be in satisfactory condition, must have the maximum allowable operating pressure confirmed or revised in accordance with 192.611. The confirmation or revision must be completed not later than December 31, 1974.

(c) Each operator required to confirm or revise an established maximum allowable operating pressure under paragraph (b) of this section shall, not later than December 31, 1971, prepare a comprehensive plan, including a schedule, for carrying out the confirmations or revisions. The comprehensive plan must also provide for confirmations or revisions determined to be necessary under 192.609 to the extent that they are caused by changes in class locations taking place before July 1, 1973.

192.609 CHANGE IN CLASS LOCATION: REQUIRED STUDY.

Whenever an increase in population density indicates a change in class location for a segment of an existing steel pipeline operating at hoop stress that is more than 40 percent of SMYS, or indicates that the hoop stress corresponding to the established maximum allowable operating pressure for a segment of existing pipeline is not commensurate with the present class location, the operator shall immediately make a study to determine--

(a) The present class location for the segment involved.

(b) The design, construction, and testing procedures followed in the original construction, and a comparison of these procedures with those required for the present class location by the applicable provisions of this part.

(c) The physical condition of the segment to the extent it can be ascertained from available records;

(d) The operating and maintenance history of the segment;

(e) The maximum actual operating pressure and the corresponding operating hoop stress, taking pressure gradient into account, for the segment of pipeline involved; and

(f) The actual area affected by the population density increase, and physical barriers or other factors which may limit further expansion of the more densely populated area.

192.611 CHANGE IN CLASS LOCATION: CONFIRMATION OR REVISION OF MAXIMUM ALLOWABLE OPERATING PRESSURE.

If the hoop stress corresponding to the established maximum allowable operating pressure of a segment of pipeline is not commensurate with the present class location, and the segment is in satisfactory physical condition, the maximum allowable operating pressure of that segment of pipeline must be confirmed or revised as follows:

(a) If the segment involved has been previously tested in place to at least 90 percent of its SMYS for a period of not less than 8 hours, the maximum allowable operating pressure must be confirmed or reduced so that the corresponding hoop stress will not exceed 72 percent of SMYS of the pipe in Class 2 locations, 60 percent of SMYS in Class 3 locations, or 50 percent of SMYS in Class 4 locations.

(b) If the segment involved has not been previously tested in place as described in paragraph (a) of this section, the maximum allowable operating pressure must be reduced so that the corresponding hoop stress is not more than that allowed by this part for new segments of pipelines

(c) If the segment of pipeline involved has not been qualified for operation under paragraph (a) or (b) of this section, it must be tested in accordance with the applicable requirements of Subpart J of this part, and its maximum allowable operating pressure must then be established so as to be equal to or less than the following:

(1) The maximum allowable operating pressure after the requalification test is 0.8 times the test pressure for Class 2 locations, 0.667 times the test pressure for Class 3 locations, and 0.555 times the test pressure for Class 4 locations.

(2) The maximum allowable operating pressure confirmed or revised in accordance with this section, may not exceed the maximum allowable operating pressure established before the confirmation or revision.

(3) The corresponding hoop stress may not exceed 72 percent of the SMYS of the pipe in Class 2 locations, 60 percent of SMYS in Class 3 locations, or 50 percent of the SMYS in Class 4 locations.

(d) Confirmation or revision of the maximum allowable operating pressure of a segment of pipeline in accordance with this section does not preclude the application of 192.553 and 192.555.

(e) Confirmation or revision of the maximum allowable operating pressure that is required as a result of a study under 192.609 must be completed as follows:

(1) Confirmation or revision due to changes in class location that occur before July 1, 1973, must be completed not later than December 31, 1974.

(2) Confirmation or revision due to changes in class location that occur on or after July 1, 1973, must be completed within 18 months of the change in class location.

#### 192.613 CONTINUING SURVEILLANCE.

(a) Each operator shall have a procedure for continuing surveillance of its facilities to determine and take appropriate action concerning changes in class location, failures, leakage history, corrosion, substantial changes in cathodic protection requirements, and other unusual operating and maintenance conditions.

(b) If a segment of pipeline is determined to be in unsatisfactory condition but no immediate hazard exists, the operator shall initiate a program to recondition or phase out the segment involved, or, if the segment cannot be reconditioned or phased out, reduce the maximum allowable operating pressure in accordance with 192.619(a) and (b).

PSC 192.613(c) When street is paved or repaved.  
Whenever a road or street is paved or repaved with permanent pavement, the operator shall:

(1) check for leaks along all mains and services in the streets and abutting property. This check shall be conducted by testing with a combustible gas indicator air samples taken from holes placed near the pipes.

(2) Determine condition of pipe and joints by sample visual examination.

(3) Place clamps on, reconstruct, or repair joints if they are likely to dry out or are leaking.

(4) Replace pipe if existing pipe is corroded to such an extent that it is likely to require replacement before the street is again resurfaced.

PSC 192.613(d) Underground pipes. Whenever underground pipes are exposed in order to repair leaks, the utility shall record on the repair order the nature of the leak and possible cause from observation.

#### 192.615 EMERGENCY PLANS.

Each operator shall--

(a) Have written emergency procedures;

(b) Acquaint appropriate operating and maintenance employees with the procedures;

(c) Establish liaison with appropriate public officials, including fire and police officials, with respect to the procedures; and

(d) Establish an educational program to enable customers and the general public to recognize and report a gas emergency to the appropriate officials.

#### 192.617 INVESTIGATION OF FAILURES.

Each operator shall establish procedures for analyzing accidents and failures, including the selection of samples of the failed facility or equipment for laboratory examination, where appropriate, for the purpose of determining the causes of the failure and minimizing the possibility of a recurrence.

#### 192.619 MAXIMUM ALLOWABLE OPERATING PRESSURE: STEEL OR PLASTIC PIPELINES.

(a) Except as provided in paragraph (c) of this section, no person may operate a segment of steel or plastic



(1) The design pressure of the weakest element in the segment, determined in accordance with Subparts C and D of this part.

(2) The pressure obtained by dividing the pressure to which the segment was tested after construction as follows:

(i) For plastic pipe in all locations, the test pressure is divided by a factor of 1.5.

(ii) For steel pipe operated at 100 p.s.i.g. or more, the test pressure is divided by a factor determined in accordance with the following table:

Class location	Factor	
	Segment installed before (Nov. 12, 1970)	Segment installed after (Nov. 11, 1970)
1 -----	1.1	1.1
2 -----	1.25	1.25
3 -----	1.4	1.5
4 -----	1.4	1.5

(3) The highest actual operating pressure to which the segment was subjected during the 5 years preceding July 1, 1970, unless the segment was tested in accordance with paragraph (a)(2) of this section after July 1, 1965, or the segment was updated in accordance with Subpart K of this part.

(4) For furnace butt welded steel pipe, a pressure equal to 60 percent of the mill test pressure to which the pipe was subjected.

(5) For steel pipe other than furnace butt welded pipe, a pressure equal to 85 percent of the highest test pressure to which the pipe has been subjected, whether by mill test or by the post installation test.

(6) The pressure determined by the operator to be the maximum safe pressure after considering the history of the segment, particularly known corrosion and the actual operating pressure.

(b) No person may operate a segment to which paragraph (a)(6) of this section is applicable, unless over-pressure protective devices are installed on the segment in a manner that will prevent the maximum allowable operating pressure from being exceeded, in accordance with 192.195.

(c) Notwithstanding the other requirements of this section, an operator may operate a segment of pipeline found to be in satisfactory condition, considering its operating and maintenance history, at the highest actual operating pressure to which the segment was subjected during the 5 years preceding July 1, 1970, subject to the requirements of 192.611.

192.621 MAXIMUM ALLOWABLE OPERATING PRESSURE: HIGH-PRESSURE DISTRIBUTION SYSTEMS.

(a) No person may operate a segment of a high pressure distribution system at a pressure that exceeds the lowest of the following pressures, as applicable:

(1) The design pressure of the weakest element in the segment, determined in accordance with Subparts C and D of this part.

(2) 60 p.s.i.g., for a segment of a distribution system otherwise designed to operate at over 60 p.s.i.g., unless the service lines in the segment are equipped with service regulators or other pressure limiting devices in series that meet the requirements of 192.197(c).

(3) 25 p.s.i.g. in segments of cast iron pipe in which there are unreinforced bell and spigot joints.

*PSC 192.621(a)(3) No person may operate a segment of a cast iron pipe in which there are unreinforced bell and spigot joints at a pressure higher than low pressure unless it can be proven to the commission that they can be operated at a higher pressure. However, the maximum allowable operating pressure under any circumstances shall not exceed 15 p.s.i.g.*

(4) The pressure limits to which a joint could be subjected without the possibility of its parting.

(5) The pressure determined by the operator to be the maximum safe pressure after considering the history of the segment, particularly known corrosion and the actual operating pressures.

(b) No person may operate a segment of pipeline to which paragraph (a)(5) of this section applies, unless overpressure protective devices are installed on the segment in a manner that will prevent the maximum allowable operating pressure from being exceeded, in accordance with 192.195.

*PSC 192.621(c) Sixty p.s.i.g. in individual distribution systems or portions thereof. The intercity or supply mains for these distribution systems may be operated at higher pressures provided by this code if the number of services supplied from these mains are limited and these*

mains are not in integral part of the distribution system. The pressure and the services supplied from these higher pressure intercity and supply mains shall be limited to 60 p.s.i.g. unless the service lines are equipped with series regulators or other pressure limiting devices as prescribed in 192.197(c).

192.623 MAXIMUM AND MINIMUM ALLOWABLE OPERATING PRESSURE:  
LOW-PRESSURE DISTRIBUTION SYSTEMS.

(a) No person may operate a low-pressure distribution system at a pressure high enough to make unsafe the operation of any connected and properly adjusted low-pressure gas burning equipment.

(b) No person may operate a low pressure distribution system at a pressure lower than the minimum pressure at which the safe and continuing operation of any connected and properly adjusted low-pressure gas burning equipment can be assured.

*PSC 192.623(c) A pressure in excess of that provided by section PSC 134.23(1).*

192.625 ODORIZATION OF GAS.

(a) Combustible gases in mains and service lines must be odorized as provided in paragraphs (b) through (f) of this section.

(b) The intensity of the odor of combustible gases must be such as to be readily detectable at concentrations of one fifth of the lower explosive limit.

(c) In the concentrations in which it is used, the odorant in combustible gases must comply with the following:

(1) The odorant may not be deleterious to persons, materials, or pipe.

(2) The products of combustion from the odorant may not be toxic when breathed nor may they be corrosive or harmful to those materials to which the products of combustion will be exposed.

(d) The odorant may not be soluble in water to an extent greater than 2.5 parts to 100 parts by weight.

(e) Equipment for odorization must introduce the odorant without wide variations in the level of odorant.

(f) Each operator shall conduct periodic sampling of combustible gases to assure the proper concentration of odorant in accordance with this section.

(g) The odorization requirements of Part 190 of this chapter, as in effect on August 12, 1970, must be complied with, in each State in which odorization of gas in transmission lines is required by that part, until the earlier of the following dates:

(1) January 1, 1972; or

(2) The date upon which the distribution companies in that State are odorizing gas in accordance with paragraphs (a) through (f) of this section.

192.627 TAPPING PIPELINES UNDER PRESSURE.

Each tap made on a pipeline under pressure must be performed by a crew qualified to make hot taps.

192.629 PURGING OF PIPELINES.

(a) When a pipeline is being purged of air by use of gas, the gas must be released into one end of the line in a moderately rapid and continuous flow. If gas cannot be supplied in sufficient quantity to prevent the formation of a hazardous mixture of gas and air, a slug of inert gas must be released into the line before the gas.

(b) When a pipeline is being purged of gas by use of air, the air must be released into one end of the line in a moderately rapid and continuous flow. If air cannot be supplied in sufficient quantity to prevent the formation of a hazardous mixture of gas and air, a slug of inert gas must be released into the line before the air.

*PSC 192.629(c) No pipeline, main, or service shall be purged into any building or confined space.*

SUBPART M--MAINTENANCE

192.701 SCOPE.

This subpart prescribes minimum requirements for maintenance of pipeline facilities.

192.703 GENERAL.

(a) No person may operate a segment of pipeline, unless it is maintained in accordance with this subpart.

(b) Each segment of pipeline that becomes unsafe must be replaced, repaired, or removed from service.

(c) Hazardous leaks must be repaired promptly.

192.705 TRANSMISSION LINES: PATROLLING.

(a) Each operator shall have a patrol program to observe, at intervals not exceeding 1 year, surface conditions on and adjacent to the transmission line right-of-way for indications of leaks, construction activity, and other factors affecting safety and operation.

(b) The frequency of the patrol must be determined by the size of the line, the operating pressures, the class location, terrain, weather, and other relevant factors.

(c) Highway and railroad crossings must be patrolled more often and in greater detail than transmission lines in open country.

192.707 TRANSMISSION LINES: MARKERS.

Each operator shall install signs or markers wherever necessary to identify the location of a transmission line in order to reduce the possibility of damage or interference.

PSC 192.707

*When transmission lines are located outside urban areas, their location shall be marked (recognizable to the public) at each fence line, road crossing, railroad crossing, river, lake stream, or drainage ditch crossing and wherever it is considered necessary to identify the location of a pipeline to reduce the possibility of damage or interference.*

192.709 TRANSMISSION LINES: RECORD-KEEPING.

Each operator shall keep records covering each leak discovered, repair made, transmission line break, leakage survey, line patrol, and inspection, for as long as the segment of transmission line involved remains in service.

192.711 TRANSMISSION LINES: GENERAL REQUIREMENTS FOR REPAIR PROCEDURES.

(a) Each operator shall take immediate temporary measures to protect the public whenever--

(1) A leak, imperfection, or damage that impairs its serviceability is found in a segment of steel transmission line operating at or above 40 percent of the SMYS; and

(2) It is not feasible to make a permanent repair at the time of discovery.

As soon as feasible, the operator shall make permanent repairs.

(b) Except as provided in 192.717(c), no operator may use a welded patch as a means of repair.

192.713 TRANSMISSION LINES: PERMANENT FIELD REPAIR OF IMPERFECTIONS AND DAMAGE.

Each imperfection or damage that impairs the serviceability of a segment of steel transmission line operating at or above 40 percent of SMYS must be repaired as follows:

(a) If it is feasible to take the segment out of service, the imperfection or damage must be removed by cutting out a cylindrical piece of pipe and replacing it with pipe of similar or greater design strength.

(b) If it is not feasible to take the segment out of service, a full encirclement welded split sleeve of appropriate design must be applied over the imperfection or damage.

(c) If the segment is not taken out of service, the operating pressure must be reduced to a safe level during the repair operations.

*PSC 192.713 (d) Gouges and grooves of lesser depth than 10% of the nominal wall thickness of the pipe may be removed by grinding out to a smooth contour provided the grinding does not reduce the remaining wall thickness to less than the minimum prescribed by this code for the conditions of use.*

192.715 TRANSMISSION LINES: PERMANENT FIELD REPAIR OF WELDS.

Each weld that is unacceptable under 192.241(c) must be repaired as follows:

(a) If it is feasible to take the segment of transmission line out of service, the weld must be repaired in accordance with the applicable requirements of 192.245.

(b) A weld may be repaired in accordance with 192.245 while the segment of transmission line is in service if--

(1) The weld is not leaking;

(2) The pressure in the segment is reduced so that it does not produce a stress that is more than 20 percent of the SMYS of the pipe; and

(3) Grinding of the defective area can be limited so that at least 1/8-inch thickness in the pipe weld remains.

(c) A defective weld which cannot be repaired in accordance with paragraph (a) or (b) of this section must be repaired by installing a full encirclement welded split sleeve of appropriate design.

192.717 TRANSMISSION LINES: PERMANENT FIELD REPAIR OF LEAKS.

Each permanent field repair of a leak must be made as follows:

(a) If feasible, the segment of transmission line must be taken out of service and repaired by cutting out a cylindrical piece of pipe and replacing it with pipe of similar or greater design strength.

(b) If it is not feasible to take the segment of transmission line out of service, it must be repaired by installing a full encirclement welded split sleeve of appropriate design.

(c) If the leak is due to a corrosion pit, the repair may be made by installing a properly designed bolt-on leak clamp; or, if the leak is due to a corrosion pit and on pipe of not more than 40,000 p.s.i. SMYS, the repair may be made by fillet welding over the pitted area a steel plate patch with rounded corners, of the same or greater thickness than the pipe, and not more than one-half the diameter of the pipe in size.

192.719 TRANSMISSION LINES: TESTING OF REPAIRS.

(a) Testing of replacement pipe. (1) If a segment of transmission line is repaired by cutting out the damaged portion of the pipe as a cylinder, the replacement pipe must be tested to the pressure required for a new line installed in the same location.

(2) The test required by subparagraph (1) of this paragraph may be made on the pipe before it is installed, but all field girth butt welds that are not strength tested must be tested after installation by nondestructive tests meeting the requirements of 192.243.

(b) Testing of repairs made by welding. Each repair made by welding in accordance with 192.713, 192.715, and 192.717 must be examined in accordance with 192.241.

PSC 192.720 REPAIR OF STEEL PIPE OPERATING BELOW 40% OF THE SPECIFIED MINIMUM YIELD STRENGTH.

*If inspections at any time reveal an injurious defect, gouge, groove, dent, or leak, immediate temporary measures shall be employed to protect the property and public if it is not feasible to make permanent repair at time of discovery. As soon as feasible, permanent repairs shall be made using recognized methods of repair.*

192.721 DISTRIBUTION SYSTEMS: PATROLLING.

(a) The frequency of patrolling mains must be determined by the severity of the conditions which could cause failure or leakage, and the consequent hazards to public safety.

(b) Mains in places or on structures where anticipated physical movement or external loading could cause failure or leakage must be patrolled at intervals not exceeding 3 months.

PSC 192.722 Distribution Mains: Markers.

*Each operator shall install signs or markers wherever necessary to identify the location of a distribution main in order to reduce the possibility of damage or interference. When distribution mains are located outside urban areas, their location shall be marked (recognizable to the public) at each fence line, road crossing, railroad crossing, river, lake, stream, or drainage ditch crossing and wherever it is considered necessary to identify the location of a pipeline to reduce the possibility of damage or interference.*

192.723 DISTRIBUTION SYSTEMS: LEAKAGE SURVEYS AND PROCEDURES.

(a) Each operator of a distribution system shall provide for periodic leakage surveys in its operating and maintenance plan.

(b) The type and scope of the leakage control program must be determined by the nature of the operations and the local conditions, but it must meet the following minimum requirements:

(1) A gas detector survey must be conducted in business districts, including tests of the atmosphere in gas, electric, telephone, sewer and water system manholes, at cracks in pavement and sidewalks, and at other locations providing an opportunity for finding gas leaks, at intervals not exceeding 1 year.

(2) Leakage surveys of the distribution system outside of the principal business areas must be made as frequently as necessary, but at intervals not exceeding 5 years.

PSC 192.723

*Every operator shall maintain a gas leak-detection program and shall maintain records of operation under the program. The program shall consist of not less than the following:*

(a) *In principal business districts (as shown by maps filed with the public service commission by each utility) a reasonable street-opening survey shall be conducted twice annually by making tests with combustible gas indicators in street openings such as telephone and electric vaults and manholes, catch basins and sewer system manholes, and gas system openings.*



(b) In each principal business district a building survey shall be conducted once a year. The piping from the entrance to the meter outlet and metering and regulating equipment shall be tested for gas leakage in those buildings that have gas service.

(c) A survey of all buildings used for public gatherings such as schools, churches, hospitals, and theaters shall be conducted once each year. The piping from the service entrance to the meter outlet and metering and regulating equipment shall be tested for gas leakage.

(d) In residential areas, in addition to a survey of public buildings the vegetation shall be checked. At least 3 barhole tests shall be made in each block; at least one street opening shall be checked if one exists in each block or at each intersection; and on streets where system is operating at a pressure of more than 10 p.s.i.g., all street openings shall be checked. (See 192.723(b)(1) above for types of street openings.) The utility may substitute for the barhole tests a ground surface survey with a hand-operated, continuous-sampling instrument capable of detecting combustible gas in air concentrations of 100 parts per million. The utility may substitute for all the tests required by this section above a survey by mobile flame ionization or infrared gas detection units, provided that a method be included to check individual services. The tests required by this section shall be made once each year.

(e) Along lines in rural areas, the vegetation shall be checked annually.

(f) When a leak complaint is received and the odor of gas indicates that there is a leak in or near the premises, a search shall be carried to conclusion until such leak is found.

#### PSC 192.724

When a leak is found and repaired, a further check shall be made in the vicinity of the repaired leak to determine if there is any other source of migrant gas in the neighborhood.

#### 192.725 TEST REQUIREMENTS FOR REINSTATING SERVICE LINES.

(a) Except as provided in paragraph (b) of this section, each disconnected service line must be tested in the same manner as a new service line, before being reinstated.

(b) Each service line temporarily disconnected from the main must be tested from the point of disconnection to the service line valve in the same manner as a new service line, before reconnecting. However, if provisions are made to maintain continuous service, such as by installation of a bypass, any part of the original service line used to maintain continuous service need not be tested.

192.727 ABANDONMENT OR INACTIVATION OF FACILITIES.

Each operator shall provide for abandonment or inactivation of facilities in its operating and maintenance plan, including the following provisions:

(a) Each facility abandoned in place, or, except when undergoing maintenance, each line not subject to gas pressure, must be disconnected from all sources and supplies of gas, purged of gas, and the ends sealed; however, the line need not be purged when the volume of gas is so small that there is no potential hazard.

(b) If air is used for purging, the operator shall ensure that a combustible mixture is not present after purging.

(c) Each abandoned vault must be filled with a suitable compacted material.

*PSC 192.727(d) Special efforts shall be made to include services which have not been used for two years in a way that will remove gas from the customers' premises. The plan shall include the following provisions:*

*(1) If the facilities are abandoned in place, they shall be physically disconnected from the piping system. The open ends of all abandoned facilities shall be capped, plugged, or otherwise effectively sealed.*

*(2) In cases where a main is abandoned, together with the service lines connected to it, insofar as service lines are concerned, only the customers' end of such service lines need be sealed as stipulated above.*

192.729 COMPRESSOR STATIONS: PROCEDURES FOR GAS COMPRESSOR UNITS.

Each operator shall establish starting, operating, and shutdown procedures for gas compressor units.

192.731 COMPRESSOR STATIONS: INSPECTION AND TESTING OF RELIEF DEVICES.

(a) Except for rupture discs, each pressure relieving device in a compressor station must be inspected and tested in accordance with 192.739 and 192.743, and must be operated periodically to determine that it opens at the correct set pressure.

(b) Any defective or inadequate equipment found must be promptly repaired or replaced.

(c) Each remote control shutdown device must be inspected and tested, at intervals not to exceed 1 year, to determine that it functions properly.

192.733 COMPRESSOR STATIONS: ISOLATION OF EQUIPMENT FOR MAINTENANCE OR ALTERATIONS.

Each operator shall establish procedures for maintaining compressor stations, including provisions for isolating units or sections of pipe for purging before returning to service.

192.735 COMPRESSOR STATIONS: STORAGE OF COMBUSTIBLE MATERIALS.

(a) Flammable or combustible materials in quantities beyond those required for everyday use, or other than those normally used in compressor buildings, must be stored a safe distance from the compressor building.

(b) Aboveground oil or gasoline storage tanks must be protected in accordance with National Fire Protection Association Standard No. 30.

*PSC 192.735(c) All aboveground oil or gasoline storage tanks shall be constructed and protected in accordance with the applicable codes of the department of industry, labor and human relations.*

192.737 PIPE-TYPE AND BOTTLE-TYPE HOLDERS: PLAN FOR INSPECTION AND TESTING.

Each operator having a pipe-type or bottle-type holder shall establish a plan for the systematic, routine inspection and testing of these facilities, including the following:

(a) Provision must be made for detecting external corrosion before the strength of the container has been impaired.

(b) Periodic sampling and testing of gas in storage must be made to determine the dew point of vapors contained in the stored gas, that if condensed, might cause internal corrosion or interfere with the safe operation of the storage plant.

(c) The pressure control and pressure limiting equipment must be inspected and tested periodically to determine that it is in a safe operating condition and has adequate capacity.

192.739 PRESSURE LIMITING AND REGULATING STATIONS: INSPECTION AND TESTING.

Each pressure limiting station, relief device (except rupture discs), and pressure regulating station and its equipment must be subjected, at intervals not exceeding 1 year, to inspections and tests to determine that it is--

(a) To read more . . . . .

(c) Set to function at the correct pressure; and

(d) Properly installed and protected from dirt, liquids, or other conditions that might prevent proper operation.

192.741 PRESSURE LIMITING AND REGULATING STATIONS: TELE-METERING OR RECORDING GAGES.

(a) Each distribution system supplied by more than one district pressure regulating station must be equipped with telemetering or recording pressure gages to indicate the gas pressure in the district.

(b) On distribution systems supplied by a single district pressure regulating station, the operator shall determine the necessity of installing telemetering or recording gages in the district, taking into consideration the number of customers supplied, the operating pressures, the capacity of the installation, and other operating conditions.

(c) If there are indications of abnormally high- or low-pressure, the regulator and the auxiliary equipment must be inspected and the necessary measures employed to correct any unsatisfactory operating conditions.

*PSC 192.741(d) Each low pressure distribution system must be equipped with telemetering or recording pressure gages to indicate the gas pressure in the system at all times. At least once each year the pressure variation shall be determined throughout each system.*

192.743 PRESSURE LIMITING AND REGULATING STATIONS: TESTING OF RELIEF DEVICES.

(a) If feasible, pressure relief devices (except rupture discs) must be tested in place, at intervals not exceeding 1 year, to determine that they have enough capacity to limit the pressure on the facilities to which they are connected to the desired maximum pressure.

(b) If a test is not feasible, review and calculation of the required capacity of the relieving device at each station must be made, at intervals not exceeding one year, and these required capacities compared with the rated or experimentally determined relieving capacity of the device for the operating conditions under which it works.

(c) If the relieving device is of insufficient capacity, a new or additional device must be installed to provide the additional capacity required.

PSC 192.744 SERVICE REGULATORS AND ASSOCIATED SAFETY DEVICES:  
INSPECTION AND TESTING.

*Company service regulators and associated safety devices on customers' premises shall be inspected and tested periodically to determine whether they are in proper operating condition. The above shall include testing of the set pressure of the regulator at a specific flow rate, determination of the lock-up pressure, and determine as to whether there are any leaks, internal or external, associated with the regulator. The test interval shall be the same as the interval between meter changes in the meter rotation program. (See section PSC 134.30.)*

192.745 VALVE MAINTENANCE: TRANSMISSION LINES.

Each transmission line valve that might be required during any emergency must be inspected and partially operated, at intervals not exceeding 1 year.

192.747 VALVE MAINTENANCE: DISTRIBUTION SYSTEMS.

Each valve, the use of which may be necessary for the safe operation of a distribution system, must be checked and serviced, at intervals not exceeding 1 year.

PSC 192.747

*(a) Inspection shall include checking of alignment to permit use of a key or wrench and clearing from the valve box or vault any debris which would interfere or delay the operation of the valve. Records shall be maintained to show specific valve location and such records shall be made continuously accessible for use under emergency conditions.*

*(b) Existing connections in the form of inline valves between low pressure gas distribution systems and high pressure gas distribution systems shall be physically severed January 1, 1974.*

*(c) The by-pass valves in district regulator stations supplying gas to a low pressure distribution system shall be sealed, locked or otherwise be rendered incapable of operation, except by authorized personnel by January 1, 1974.*

192.749 VAULT MAINTENANCE.

(a) Each vault housing pressure regulating and pressure limiting equipment, and having a volumetric internal content of 200 cubic feet or more, must be inspected, at intervals not exceeding 1 year, to determine that it is in good physical condition and adequately ventilated.

(b) If gas is found in the vault, the equipment in the vault must be inspected for leaks, and any leaks found must be repaired.

(c) The ventilating equipment must also be inspected to determine that it is functioning properly.

(d) Each vault cover must be inspected to assure that it does not present a hazard to public safety.

#### 192.751 PREVENTION OF ACCIDENTAL IGNITION.

Each operator shall take steps to minimize the danger of accidental ignition of gas in any structure or area where the presence of gas constitutes a hazard of fire or explosion, including the following:

(a) When a hazardous amount of gas is being vented into open air, each potential source of ignition must be removed from the area and a fire extinguisher must be provided.

(b) Gas or electric welding or cutting may not be performed on pipe or on pipe components that contain a combustible mixture of gas and air in the area of work.

(c) Post warning signs, where appropriate.

*PSC 192.751(d) Whenever the accidental ignition in the open air of gas-air mixture might be likely to cause personal injury or property damage, precautions shall be taken as, for example:*

*(1) Prohibit smoking and open flames in the area,*  
*and*

*(2) Install a metallic bond around the location of cuts in gas pipes to be made by other means than cutting torches, and*

*(3) Take precautions to prevent static electricity sparks, and*

*(4) Provide fire extinguishers of appropriate size and type in accordance with the department of industry, labor and human relations' requirements.*

#### 192.753 CAULKED BELL AND SPIGOT JOINTS.

(a) Each cast iron caulked bell and spigot joint that is subject to pressures of 25 p.s.i.g. or more must be sealed with mechanical leak clamps.

(b) Each cast iron caulked bell and spigot joint that is subject to pressures of less than 25 p.s.i.g. and is exposed for any reason, must be sealed by a means other than caulking.

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*Existing unreinforced bell and spigot jointed cast iron pipe shall be operated at low pressure unless it can be proved to the commission that they can be satisfactorily operated at a higher pressure. However, the operating pressure under any circumstances shall not exceed 15 p.s.i.g.*

APPENDIX A--INCORPORATED BY REFERENCE

I. List of organizations and addresses.

A. American National Standards Institute (ANSI), 1430 Broadway, New York, N. Y. 10018 (formerly the United States of American Standards Institute (USASI)). All current standards issued by USASI and ASA have been re-designed as American National Standards and continued in effect.

B. American Petroleum Institute (API), 1271 Avenue of the Americas, New York, N. Y. 10020 or 300 Corrigan Tower Building, Dallas, Tex. 75201.

C. The American Society of Mechanical Engineers (ASME) United Engineering Center, 345 East 47th Street, New York, N. Y. 10017.

D. American Society for Testing and Materials (ASTM), 1916 Race Street, Philadelphia, Pa. 19103.

E. Manufacturers Standardization Society of the Valve and Fittings Industry (MSS), 1815 North Fort Myer Drive, Room 913, Arlington, Va. 22209.

F. National Fire Protection Association (NFPA), 60 Batterymarch Street, Boston, Mass. 02110.

II. Documents incorporated by reference.

A. American Petroleum Institute:

1. API Standard 5L "API Specification for Line Pipe" (1967, 1970 editions).

2. API Standard 5LS "API Specification for Spiral-Weld Line Pipe" (1967, 1970 editions).

3. API Standard 5LX "API Specification for High-Test Line Pipe" (1967, 1970 editions).

4. API Recommended Practice 5LI entitled "API Recommended Practice for Railroad Transportation of Line Pipe" (1967 edition).

5. API Standard 5A "API Specification for Casing, Tubing, and Drill Pipe" (1968 edition).

6. API Standard 6A "Specification for Wellhead Equipment" (1968 edition).

7. API Standard 6D "Specification for Pipeline Valves" (1968 edition).

8. API Standard 1104 "Standard for Welding Pipe Line and Related Facilities" (1968 edition).

B. The American Society for Testing and Materials:

1. ASTM Specification A53 "Standard Specification for Welded and Seamless Steel Pipe" (A53-65, A53-68).

2. ASTM Specification A72 "Standard Specification for Welded Wrought-Iron Pipe" (A72-64T, A72-68).

3. ASTM Specification A106 "Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service" (A106-66, A106-68).

4. ASTM Specification A134 "Standard Specification for Electric-Fusion (ARC)-Welded Steel Plate Pipe, Sizes 16 in. and over" (A134-64, A134-68).

5. ASTM Specification A135 "Standard Specification for Electric-Resistance-Welded Steel Pipe" (A135-63T, A135-68).

6. ASTM Specification A139 "Standard Specification for Electric-Fusion (ARC)-Welded Steel Pipe (Sizes 4 in. and over)" (A139-64, A139-68).

7. ASTM Specification A155 "Standard Specification for Electric-Fusion-Welded Steel Pipe for High-Pressure Service" (A155-65, A155-68).

8. ASTM Specification 211 "Standard Specification for Spiral Welded Steel or Iron Pipe" (A211-63, A211-68).

9. ASTM Specification A333 "Standard Specification for Seamless and Welded Steel Pipe for Low-Temperature Service" (A333-64, A333-67).

10. ASTM Specification A377 "Standard Specification for Cast Iron and Ductile Iron Pressure Pipe" (A377-66).

11. ASTM Specification A381 "Standard Specification for Metal-Arc-Welded Steel Pipe for High-Pressure Transmission Service" (A381-66, A381-68).

12. ASTM Specification A539 "Standard Specification for Electric-Resistance Welded Coiled Steel Tubing for Gas and Fuel Oil Lines" (A539-65).



13. ASTM Specification B42 "Standard Specification for Seamless Copper Pipe, Standard Sizes" (B42-62, B42-66).

14. ASTM Specification B68 "Standard Specification for Seamless Copper Tube Bright Annealed" (B68-65, B68-68).

15. ASTM Specification B75 "Standard Specification for Seamless Copper Tube" (B75-65, B75-68).

16. ASTM Specification B88 "Standard Specification for Seamless Copper Water Tube" (B88-66).

17. ASTM Specification B251 "Standard Specification for General Requirements for Wrought Seamless Copper and Copper-Alloy Tube" (B251-66, B251-68).

18. ASTM Specification D2513 "Standard Specification for Thermoplastic Gas Pressure Pipe, Tubing and Fittings" (D2513-66T, D2513-68).

19. ASTM Specification D2517 "Standard Specification for Reinforced Thermosetting Plastic Gas Pressure Piping and Fittings" (D2517-66T, D2517-67).

20. ASTM Specification A372 "Standard Specification for Carbon and Alloy Steel Forgings for Pressure Vessel Shells" (A372-67).

C. The American National Standards Institute, Inc.:

1. ANSI A21.1 "Thickness Design of Cast-Iron Pipe" (A21.1-1967).

2. ANSI A21.3 "Specifications for Cast Iron Pit Cast Pipe for Gas" (A21.3-1953).

3. ANSI A21.7 "Cast-Iron Pipe Centrifugally Cast in Metal Molds for Gas" (A21.7-1962).

4. ANSI A21.9 is titled "Cast-Iron Pipe Centrifugally Cast in Sand-Lined Molds for Gas" (A21.9-1962).

5. ANSI A21.11 "Rubber Gasket Joints for Cast-Iron Pressure Pipe and Fittings" (A21.11-1964).

6. ANSI 21.50 "Thickness Design of Ductile-Iron Pipe" (A21.50-1965).

6a. ANSI A21.52 "Ductile-Iron Pipe, Centrifugally Cast, in Metal Molds or Sand-Lined Molds for Gas" (A21.52-1965).

7. ANSI B16.1 "Cast Iron Pipe Flanges and Flanged Fittings" (B16.1-1967).

8. ANSI B16.5 "Steel Pipe Flanges and Flanged Fittings" (B16.5-1968).

9. ANSI B16.24 "Bronze Flanges and Flanged Fittings" (B16.24-1962).

10. ANSI B36.10 "Wrought-Steel and Wrought-Iron Pipe" (B36.10-1959).

11. ANSI C1 "National Electrical Code, 1968" (C1-1968).

D. The American Society of Mechanical Engineers:

1. ASME Boiler and Pressure Vessel Code, section VIII is titled "Pressure Vessels, Division 1" (1968 edition).

2. ASME Boiler and Pressure Vessel Code, section IX is titled "Welding Qualifications" (1968 edition).

E. Manufacturer's Standardization Society of the Valve and Fittings Industry:

1. MSS SP-25 "Standard Marking System for Valves, Fittings, Flanges and Union" (1964 edition).

2. MSS SP-44 "Steel Pipe Line Flanges" (1955 edition).

3. MSS SP-52 "Cast Iron Pipe Line Valves" (1957 edition).

F. National Fire Protection Association:

1. NFPA Standard 30 "Flammable and Combustible Liquids Code" (1969 edition).

2. NFPA Standard 58 "Storage and Handling, Liquefied Petroleum Gases" (1969 edition).

3. NFPA Standard 59 "LP Gases at Utility Gas Plants" (1968 edition).

#### APPENDIX B--QUALIFICATION OF PIPE

I. Listed Pipe Specifications. Numbers in parentheses indicate applicable editions.

API 5L--Steel and iron pipe (1967, 1970).

API 5LS--Steel pipe (1967, 1970).

API 5LX--Steel pipe (1967, 1970).

ASTM A53--Steel pipe (1965, 1968).

ASTM A106--Steel pipe (1966, 1968).

ASTM A134--Steel pipe (1964, 1968).

ASTM A135--Steel pipe (1963T, 1968).

ASTM A139--Steel pipe (1964, 1968).

ASTM A155--Steel pipe (1965, 1968).  
ASTM A211--Steel and iron pipe (1963, 1968).  
ASTM A333--Steel pipe (1964, 1967).  
ASTM A377--Cast iron pipe (1966).  
ASTM A381--Steel pipe (1966, 1968).  
ASTM A539--Steel tubing (1965).  
ANSI A21.3--Cast iron pipe (1953).  
ANSI A21.7--Cast iron pipe (1962).  
ANSI A21.9--Cast iron pipe (1962).  
ANSI A21.52--Ductile iron pipe (1965).  
ASTM A72--Wrought iron pipe (1964T, 1968).  
ASTM B42--Copper pipe (1962, 1966).  
ASTM B68--Copper tubing (1965, 1968).  
ASTM B75--Copper tubing (1965, 1968).  
ASTM B88--Copper tubing (1966).  
ASTM B251--Copper pipe and tubing (1966, 1968).  
ASTM D2513--Thermoplastic pipe and tubing (1966T, 1968).  
ASTM D2517--Thermosetting plastic pipe and tubing (1966T, 1967).

## II. Steel pipe of unknown or unlisted specification.

A. Bending Properties. For pipe 2 inches or less in diameter, a length of pipe must be cold bent through at least 90 degrees around a cylindrical mandrel that has a diameter 12 times the diameter of the pipe, without developing cracks at any portion and without opening the longitudinal weld.

For pipe more than 2 inches in diameter, the pipe must meet the requirements of the flattening test set forth in ASTM A53, except that the number of tests must be at least equal to the minimum required in paragraph II-D of this appendix to determine yield strength.

B. Weldability. A girth weld must be made in the pipe by a welder who is qualified under Subpart E of this part. The weld must be made under the most severe conditions under which welding will be allowed in the field and by means of the same procedure that will be used in the field. On pipe more than 4 inches in diameter, at least one test weld must be made for each 100 lengths of pipe. On pipe 4 inches or less in diameter, at least one test weld must be made for each 400 lengths of pipe. The weld must be tested in accordance with API Standard 1104. If the requirements of API Standard 1104 cannot be met, weldability may be established by making chemical tests for carbon and manganese, and proceeding in accordance with section IX of the ASME Boiler and Pressure Vessel Code. The same number of chemical tests must be made as are required for testing a girth weld.

C. Inspection. The pipe must be clean enough to permit adequate inspection. It must be visually inspected to ensure that it is reasonably round and straight and there are no defects which might impair the strength or tightness of the pipe.

D. Tensile Properties. If the tensile properties of the pipe are not known, the minimum yield strength may be taken as 24,000 p.s.i.g. or less, or the tensile properties may be established by performing tensile tests as set forth in API Standard 5LX. All test specimens shall be selected at random and the following number of tests must be performed:

NUMBER OF TENSILE TESTS--ALL SIZES

10 lengths or less---	1 set of tests for each length.
11 to 100 lengths----	1 set of tests for each 5 lengths, but not less than 10 tests.
Over 100 lengths-----	1 set of tests for each 10 lengths, but not less than 20 tests.

If the yield-tensile ratio, based on the properties determined by those tests, exceeds 0.85, the pipe may be used only as provided in 192.55(c).

APPENDIX C--QUALIFICATION FOR WELDERS OF LOW STRESS LEVEL PIPE

I. Basic test. The test is made on pipe 12 inches or less in diameter. The test weld must be made with the pipe in a horizontal fixed position so that the test weld includes at least one section of overhead position welding. The beveling, root opening, and other details must conform to the specifications of the procedure under which the welder is being qualified. Upon completion, the test weld is cut into four coupons and subjected to a root bend test. If, as a result of this test, two or more of the four coupons develop a crack in the weld material, or between the weld material and base metal, that is more than 1/8-inch long in any direction, the weld is unacceptable. Cracks that occur on the corner of the specimen during testing are not considered.

II. Additional tests for welders of service line connections to mains. A service line connection fitting is welded to a pipe section with the same diameter as a typical main. The weld is made in the same position as it is made in the field. The weld is unacceptable if it shows a serious undercutting or if it has rolled edges. The weld is tested by attempting to break the fitting off the run pipe. The weld is unacceptable if it breaks and shows incomplete fusion, overlap, or poor penetration at the junction of the fittings and run pipe.

III. Periodic tests for welders of small service lines. Two samples of the welder's work each about 8 inches long with the weld located approximately in the center, are cut from steel service line and tested as follows:

(1) One sample is centered in a guided bend testing machine and bent to the contour of the die for a distance of 2 inches on each side of the weld. If the sample shows any breaks or cracks after removal from the bending machine, it is unacceptable.

(2) The ends of the second sample are flattened and the entire joint subjected to a tensile strength test. If failure occurs adjacent to or in the weld metal, the weld is unacceptable. If a tensile strength testing machine is not available, this sample must also pass the bending test prescribed in subparagraph (1) of this paragraph.

APPENDIX D--CRITERIA FOR CATHODIC PROTECTION AND DETERMINATION OF MEASUREMENTS

I. Criteria for cathodic protection--A. Steel, cast iron, and ductile iron structures.

(1) A negative (cathodic) voltage of at least 0.85 volt, with reference to a saturated copper-copper sulfate half cell. Determination of this voltage must be made with the protective current applied, and in accordance with sections II and IV of this appendix.

(2) A negative (cathodic) voltage shift of at least 300 millivolts. Determination of this voltage shift must be made with the protective current applied, and in accordance with sections II and IV of this appendix. This criterion of voltage shift applies to structures not in contact with metals of different anodic potentials.

(3) A minimum negative (cathodic) polarization voltage shift of 100 millivolts. This polarization voltage shift must be determined in accordance with sections III and IV of this appendix.

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(4) A voltage at least as negative (cathodic) as that originally established at the beginning of the Tafel segment of the E-log-I curve. This voltage must be measured in accordance with section IV of this appendix.

(5) A net protective current from the electrolyte into the structure surface as measured by an earth current technique applied at predetermined current discharge (anodic) points of the structure.

B. Aluminum structures. (1) Except as provided in subparagraph (3) and (4) of this paragraph, a minimum negative (cathodic) voltage shift of 150 millivolts, produced by the application of protective current. The voltage shift must be determined in accordance with sections II and IV of this appendix.

(2) Except as provided in subparagraphs (3) and (4) of this paragraph, a minimum negative (cathodic) polarization voltage shift of 100 millivolts. This polarization voltage shift must be determined in accordance with sections III and IV of this appendix.

(3) Notwithstanding the alternative minimum criteria in subparagraphs (1) and (2) of this paragraph, aluminum, if cathodically protected at voltages in excess of 1.20 volts as measured with reference to a copper-copper sulfate half cell, in accordance with section IV of this appendix, and compensated for the voltage (IR) drops other than those across the structure-electrolyte boundary, may suffer corrosion resulting from the buildup of alkali on the metal surface. A voltage in excess of 1.20 volts may not be used unless previous test results indicate no appreciable corrosion will occur in the particular environment.

(4) Since aluminum may suffer from corrosion under high pH conditions, and since application of cathodic protection tends to increase the pH at the metal surface, careful investigation or testing must be made before applying cathodic protection to stop pitting attack on aluminum structures in environments with a natural pH in excess of 8.

C. Copper structures. A minimum negative (cathodic) polarization voltage shift of 100 millivolts. This polarization voltage shift must be determined in accordance with sections III and IV of this appendix.

D. Metals of different anodic potentials. A negative (cathodic) voltage, measured in accordance with section IV of this appendix, equal to that required for the most anodic metal in the system must be maintained. If amphoteric structures are involved that could be damaged by high alkalinity covered by subparagraphs (3) and (4) of paragraph B of this section, they must be electrically isolated with insulating flanges, or the equivalent.

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II. Interpretation of voltage measurement. Voltage (IR) drops other than those across the structure-electrolyte boundary must be considered for valid interpretation of the voltage measurement in paragraph A(1) and (2) and paragraph B(1) of section I of this appendix.

III. Determination of polarization voltage shift. The polarization voltage shift must be determined by interrupting the protective current and measuring the polarization decay. When the current is initially interrupted, an immediate voltage shift occurs. The voltage reading after the immediate shift must be used as the base reading from which to measure polarization decay in paragraphs A(3), B(2), and C of section I of this appendix.

IV. Reference half cells. A. Except as provided in paragraphs B and C of this section, negative (cathodic) voltage must be measured between the structure surface and a saturated copper-copper sulfate half cell contacting the electrolyte.

B. Other standard reference half cells may be substituted for the saturated copper-copper sulfate half cell. Two commonly used reference half cells are listed below along with their voltage equivalent to -0.85 volt as referred to a saturated copper-copper sulfate half cell:

(1) Saturated KCl calomel half cell: -0.78 volt.

(2) Silver-silver chloride half cell used in sea water: -0.80 volt.

C. In addition to the standard reference half cells, an alternate metallic material or structure may be used in place of the saturated copper-copper sulfate half cell if its potential stability is assured and if its voltage equivalent referred to a saturated copper-copper sulfate half cell is established.