Design & Construction Requirements

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3. Design

A. External Loading (Ref. G.O. 112–D, Par. 192.161)

1. All lines must have sufficient wall thickness or adequate protection to withstand anticipated external pressures and loads after installation. Provide enough flexibility to prevent excessive stress from thermal expansion or contraction. Consider bending, and unusual or excessive loads at joints, equipment connections, anchor or guide points, stations or locations where pipe passes through pit walls, etc. Provide sufficient anchors or supports to prevent undue strain, resist longitudinal forces, and prevent or damp out excessive vibration. Use only steel pipe above ground, in pits, or where pipe passes through a wall. Plastic service risers must be encased by steel pipe.

2. Exposed pipe joints must be protected from any end forces caused by internal pressure and additional forces such as thermal expansion or contraction, or weight of pipe, where such end forces exceed the design strength of the weakest component of pipe exposed to those forces. Supports or anchors for exposed lines must be durable and noncombustible. These anchors shall not restrict expansion and contraction between supports, and shall remain fully engaged when pipe moves.

3. All lines must be protected from washouts, floods, unstable soil, landslides or other hazards. If above ground, protect from vehicles or other hazards by placing at a safe distance or by installing barricades.

4. Where supports are provided for above ground spans of piping, the supporting equipment shall include a steel member fully encircling the pipe, and be designed and installed so that the support will not be disengaged from the pipe by movement of the piping.

5. Supports on all above ground spans of piping must also comply with the following:

(a) Where it is necessary to attach support system members to the pipe, as at an anchor, the pipe may be welded to the encircling member only; the support may be welded only to the encircling member, and not to the pipe.

(b) If an encircling member is welded to the pipe, the longitudinal and circumferential welds must be continuous, rather than intermittent, welds.

6. Each underground pipeline that is connected to a relatively unyielding line or other fixed object must have enough flexibility to provide for possible movement,

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or it must have an anchor that will limit the movement of the pipeline.

7. 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.

B. Pits and Vaults

1. Vaults must be adequate for external loading which may occur, and to protect enclosed equipment. Adequate space must be provided for installation, operation and maintenance.

2. Each pipe entering or within a regulator vault or pit must be steel except that stainless steel may be used for control and gauge lines. 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 strain in the pipe.

3. Locate each vault where it is accessible. If practical, avoid street intersections, heavy traffic areas, catch basins or other areas subject to flooding, and other utilities or facilities.

4. Underground vaults or closed-top pits containing either a pressure regulating or reducing station, or pressure limiting or relieving station, must be sealed, vented or ventilated, as shown on Gas Std. H–14, Schematic Vault Ventilating Requirements, and shall comply with the following (Ref. G.O. 112–D, Par. 192.187):

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

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

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

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

   (b) When the internal volume is more than 75 cubic feet, but less than 200 cubic feet,

      (i) If the vault or pit is sealed, each opening must have a tight–fitting cover without open holes through which an explosive mixture might be ignited, and there must be a means for testing the internal atmosphere before removing the cover;

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

      (iii) If the vault or pit is ventilated, paragraph 3.B.4.a or 3.B.4.c of this section applies.

   (c) If a vault or pit covered by paragraph 3.B.4.b of this section is ventilated by openings in the covers or grating 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 one, no additional ventilation is required.

5. Vaults should be designed and installed to minimize entrance of water. In areas with high water table, the outside of vaults shall be sealed with a suitable water sealant. Vaults containing gas facilities shall not be connected by a drain connection to any other underground structure.

6. All electrical equipment in vaults must be explosion proof (conform to Class I, Group D, of the National Electrical Code, ANSI Standard C1 latest edition).

C. Sectionalizing and Emergency Valves

1. Transmission line valves (Ref. G.O. 112–D, Par. 192.179)

   (a) Each transmission line, other than offshore segments, must have sectionalizing block valves spaced as follows:

      (i) Each point on the pipeline in a Class 4 location must be within two and one–half miles of a block valve.

      (ii) Each point on the pipeline in a Class 3 location must be within four miles of a block valve.

      (iii) Each point on the pipeline in a Class 2 location must be within

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seven and one–half miles of a block valve.

(iv) Each point on the pipeline in a Class 1 location must be within ten miles of a block valve.

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

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

(ii) 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 sectionalizing block 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. If the transmission line is adjacent to an overhead electric line, the gas must be directed away from the electrical conductors. Consider direction of prevailing winds.

2. Distribution line valves (Ref. G.O. 112–D, Par. 192.181)

(a) Each high pressure distribution system must have valves spaced so as to minimize the time to shutdown a section of the main in an emergency. The valve spacing is determined by the operating pressure, the size of the mains and the local physical conditions. The basic responsibility for determining the need for valves shall rest with the Division Gas and Electric Operations Manager or his delegated subordinate.

(b) Each regulator station controlling the flow or pressure of gas in a distribution system must have a valve (fire valve) installed on the inlet piping at a distance from the regulator station sufficient to permit the operation of the valve during an emergency that might preclude access to the station. Requirements for a downstream fire valve must be determined in accordance with Gas Standard H–14.

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

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

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

(iii) 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 main.

3. Identification of Valves

(a) An operating diagram is to be prepared for all major pressure and flow control facilities on gas transmission and distribution lines. This shall include, but shall not be limited to the following facilities:

(i) System control points such as Terminal Stations and Region Gas Load Centers.

(ii) Major gas field regulating stations such as volume ratio control and mixing stations, which deliver into PG&E pipeline systems.

(iii) Transmission pipeline valve installations. (May be shown only on an operating map).

(iv) Pipeline pressure limiting stations

(v) Line rupture control facilities.

(vi) Gas facilities serving major customer and steam electric generating plants.

(vii) Underground storage system facilities.

(viii) All delivery points off of transmission lines, except for "farm tap" sets serving a limited number of customers (20 or less) in an isolated system.

(ix) All distribution system regulator sets.

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(b) All valves on the operating diagrams required by Paragraph 3.C.3.(a) and all emergency distribution valves, shall be numbered; and each valve at the facilities is to be marked with the number corresponding to that shown on the operating diagram. The number on each valve should be of a size, and in a location, so that the valve can be readily identified. The markers shown on Gas Standards L–41, L–42 and L–42.1 should be used. On larger valves the number may be stenciled on the valve.

(c) Shut–off valves located at the mainline tap or outside a building for all tap connections for fuel gas, power gas, instrumentation and control gas, and other similar lines, shall be numbered to correspond to numbers shown on piping and instrumentation diagrams and piping schematics.

(d) All valves in the distribution system designated as emergency valves shall be clearly numbered and tagged so that they can be readily identified, and the valve number shall be shown on the appropriate operating diagram. When appropriate, supplementary location drawings shall be provided for emergency distribution valves. The requirements of this paragraph 3.C.3.(d) are applicable to both new and existing facilities.

(e) The markings on the valves identified in Paragraph 3.C.3 must be maintained so that the valves may be readily identified at all times.

D. Other

1. In locations where liquids may be a problem, service lines must be graded to drain back into the main, or into a drip at the low point in the service line.

2. Seal around underground services entering the outer foundation wall of a building to prevent leakage into the building. Tac Tape, Code 50–7036, or other suitable sealant may be used.

3. Seal ends of all casing pipes (see Standards A–73 and A–74)

4. Installation and Handling of Steel Pipe
(For Plastic Pipe, See Standard A–93.1)

A. Installation in Trench

1. Trench must be wide enough for installing pipe without damaging coating or inducing unnecessary stresses. At horizontal angles, the trench must have sufficient width to accommodate the welding elbow or bend and provide clearance between the side of the trench and the pipe (at least 6" on each side for pipe sizes 6" and larger). The bottom of the trench shall be smooth and provide a firm base for the pipe.

2. The bottom of the trench shall be cleared of rocks, skid blocks or other hard substances so as to provide a continuous smooth base for the pipe to rest on without damage to the coating. Where these conditions cannot be obtained due to rock, etc., a minimum padding of 4" of fine earth or sand (not ocean sand) shall be provided to cushion the pipe. A backfill of 8" of fine materials should be placed over the top of the pipe to prevent damage from rocks while backfilling. If exceptionally large rocks are in the native backfill material, an initial backfill of 12" of fine material should be placed over the pipe. (For backfill sand specification, refer to Engineering Standard Specification No. 90).

3. All offshore pipe in water from 12 feet to 200 feet deep, as measured from mean low tide, must be installed so that the top of the pipe is below the natural bottom. This requirement does not apply if the pipe is supported by stanchions, held in place by anchors, heavy concrete coating, or protected by an equivalent means.

B. Handling of Pipe

1. Pipe must be handled carefully so that it is not bent, dented, buckled, scratched, gouged or otherwise damaged.

2. If coated pipe is to be handled with lifting equipment, use belts, slings and padded skids to minimize the damage to the coating. Metallic equipment shall not be allowed to come in contact with the coating.

3. In hauling coated pipe 20" diameter or larger, the coated pipe shall be supported on suitable padded cradles to fit the radius of the pipe. Pipe joints must be separated so as not to bear against each other. Pipe under 20" diameter may be hauled on flat wooden dunnage, such as 2 x 6, suitably padded to avoid damage to the coating.

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4. The entire load must be adequately secured to prevent movement in transit. All metallic tie–down equipment and/or lines shall be carefully padded.

C. Stringing of Coated Pipe

1. Pipe should be supported on skids placed to prevent contact between the coating and the ground. Pads shall be used between coating and skids. Bare skids may be used only at uncoated ends of the pipe.

2. Pipe shall not be strung on the right–of–way in rocky areas where blasting is probable, until after the trench is completely shot.

D. Miter Joints, Bends and Elbows (Ref. G.O. 112–D, Par. 192.233)

1. A change in direction should normally be made with an elbow or a pipe bend. A miter joint may be used only where elbows or bending equipment are not readily available; or where a very small change in direction makes the use of an elbow impractical. Miter joints shall only be made by cutting equal amounts from both pipe ends which are to be joined. Care must be taken to insure a proper fit up for welding. Miter joints may be used only under the following conditions:

(a) For lines designed to operate at 20% of SMYS or more, a miter joint may not deflect the pipe more 3 degrees. Multiple miter joints are not allowed.

(b) For lines designed to operate under 20%, but over 10% of SMYS, a miter joint shall not deflect the pipe more than 12–1/2 degrees. More than two miter joints are not allowed, and the joints shall not be closer than one pipe diameter, measured between the crotches of the joints.

(c) For lines designed to operate at 10% or less of SMYS, a miter joint may not deflect the pipe more than 45 degrees. Total deflection shall not exceed 90 degrees. Miter joints shall not be closer than one pipe diameter across the crotch of the joints.

2. Wrinkle bends are not allowed.

3. Bends shall not buckle or damage pipe and shall have a smooth contour. Pipe out–of–roundness in the bend shall not exceed the values given below (ref. G.O. 112–D Par. 192.313).

Pipe Diameter	Out–of–roundness
1/2" nominal and smaller	The difference between minimum and maximum O.D. shall not exceed 25% of the nominal diameter.
3/4" nominal thru 6" nominal	The difference between minimum and maximum O.D. shall not exceed 5/32".
8" nominal and larger	The difference between minimum and maximum O.D. shall not exceed 2–1/2% of the nominal diameter.

(a) Any bend in pipe of 8" through 12" nominal diameter may not deflect the pipe more than 1–1/2 degrees in any length of pipe equal to one foot.

(b) Any bend in pipe of 12" or larger nominal diameter may not deflect the pipe more than 1–1/2 degrees in any length of pipe equal to one diameter.

(c) Internal bending mandrel requirements:

If the nominal pipe diameter is greater than or equal to 8" and less than 16", and either the wall thickness is less than 0.250" or the specified minimum yield strength is greater than 42,000 PSI, then an internal bending mandrel is required.

If the nominal pipe diameter is greater than or equal to 16" and less than or equal to 24", and either the wall thickness is less than 0.375" or the specified minimum yield strength is greater than 52,000 PSI, then an internal bending mandrel is required.

Internal bending mandrels are required for all pipe with a nominal diameter greater than 24", for compound bends that do not occur in the same plane, and whenever the out-of-roundness tolerances given in paragraph 4.D.3 can not be met.

(d) When bending pipe with a longitudinal weld, the weld shall be within plus or minus 15 degrees of the neutral axis (i.e., on vertical bends at either side and

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on horizontal bends at the top or bottom).

(e) In no event shall the end of a bend be closer than 6 feet or two pipe diameters, whichever is greater, from the end of a pipe section or a girth weld.

4. Welding elbows may be cut into segments to provide proper angle. Refer to Gas Standard B–25. Segments of elbows 2" or more in diameter must be at least 1" across the crotch (throat).

E. Inspection

1. Coating must be inspected just prior to lowering the pipe into the ditch and backfilling, and damage must be repaired. See Gas Standard E–25 for coating repair requirements.

2. All transmission lines, distribution mains, services, trenches and related facilities must be inspected to insure that construction is in compliance with General Order 112–D, this Standard, other standards and standard practices, and any other applicable instructions.

3. Welds must be inspected as required by Gas Standard D–40.

4. All valves, regulators, filters and other appurtenances to a pipeline shall be tested to verify proper installation and operation prior to being placed in service.

F. Tie–ins on Pressurized Mains

1. When making a hot tie–in between two pressurized lines, adequate precautions shall be taken to verify that the systems involved have the same MAOP. Special care must be taken when both low–pressure and high–pressure lines exist in an area, to make certain that they are not inadvertently interconnected. Pressure gauges shall be used on the tapping equipment and/or main where there is any potential for an improper tie–in.

2. When making a hot tie–in or service connection on older mains, check for the possibility that the main may have been replaced by insertion of plastic.

3. The use of tapping equipment when making hot taps shall be limited to qualified personnel experienced and familiar with its operation and shall be done in accordance with manufacturers instruction manuals. Documentation is required to be kept on file showing that personnel are qualified to use tapping equipment. Documentation shall include name, date, location, and type of tapping equipment tested on.

G. Safety Precautions for Cutting or Welding on Purged Lines

1. Before performing any welding or cutting operation on an existing pipeline which has been taken out of service and purged, a combustible gas indicator shall be used to verify that a combustible mixture has not developed in the line due to leakage from a section of pipeline remaining in service or from any other source.

2. Special precautions, such as continuous venting, must be considered to prevent the possibility of a combustible mixture developing during the course of work on the pipeline. In addition, after pauses in the work, the line shall be retested before resuming welding or cutting operations.

3. Check for liquids by cutting a small inspection hole in the top of the pipe or by installing drains per Gas Standards A–32 or A–32.1.

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