A-38-1h

Purging Gas Facilities

Pacific Gas and Electric Company

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Purpose and Scope

This gas design standard (GDS) contains procedures for purging natural gas into or from transmission and distribution facilities for Pacific Gas and Electric Company (PG&E or Company). This document describes how to purge the facilities, how to determine when the purge is complete, and what to consider before and during purging.

General Information

1. Purging is the process of displacing gaseous substances within a natural gas facility for instances such as the following:

   A. Natural gas replaces air as new or existing facilities are brought into service.

   B. Air displaces the natural gas as existing facilities are temporarily or permanently taken out of service and the removal of natural gas is necessary. When facilities are abandoned, Company policy requires that all sections of the abandoned main be purged of natural gas. For abandonment procedures, refer to Utility Procedure TD-9500P-16, "Abandonment of Underground Gas Facilities."

2. Purging is ordinarily done while the system is depressurized in conjunction with a facility clearance, either immediately before pressurizing (packing) when facilities are brought into service or immediately following depressurizing (blowdown) when facilities are taken out of service. Attach the purge plan to the clearance and ensure any valves or other control points used for purging during the clearance are appropriately tagged. For clearance procedures, refer to Utility Standard TD-4441S, "Gas Clearances."

3. This standard is for purging pipelines, mains, and service pipes without excess flow valves (EFVs). This GDS is not for purging customer appliances or house lines.

   A. For purging service pipes with EFVs, refer to GDS A-93.3, "Excess Flow Valves."

   B. For purging risers at residential or small commercial meter sets, refer to Step 3.7, "Purge gas service," in Utility Procedure TD-6100P-07, "Meter Set Installation for New Business."

   C. For guidance on purging gauge and control lines, station and compression equipment, or storage wells and processing facilities, consult with facilities integrity management program (FIMP), station, or storage engineering personnel.

   D. For additional instructions for purging low pressure (LP) mains and services, refer to GDS C-37, "Tapping, Bagging, Tieing-in and Cutting-off LP or SHP Gas Lines."

General Information (continued)

4. Purging substances must be limited to air (driven by air compressors or drawn in with air movers), natural gas (available from PG&E's gas system or driven by portable natural gas [PNG] equipment), and nitrogen (available compressed in bottles or bulk supply). Carbon dioxide or helium may be used only after personnel consult with the responsible engineer, because requirements for flow rates and monitoring differ from the tables and figures in this GDS. Other inert substances, such as, diesel exhaust or steam, must not be used.

5. Purging Operational Qualification requirements:

07-01 "Air Purging"	07-03 "Inert Purging"
07-02 "Gas Purging"	07-04 "Air Mover Operations"

6. Based on research by the Gas Research Institute (GRI) that developed a method of calculating the minimum purge velocity needed to minimize mixing, a 440 feet per minute (ft/min) (7.3 feet per second [ft/sec] or 5 miles per hour [mph]) velocity is recommended for large-bore pipe and a 1000 ft/min (16.7 ft/sec or 11.4 mph) velocity for small-bore pipe. Figure 1 illustrates how the recommended purge velocities compare and exceed the minimum GRI-calculated velocities.

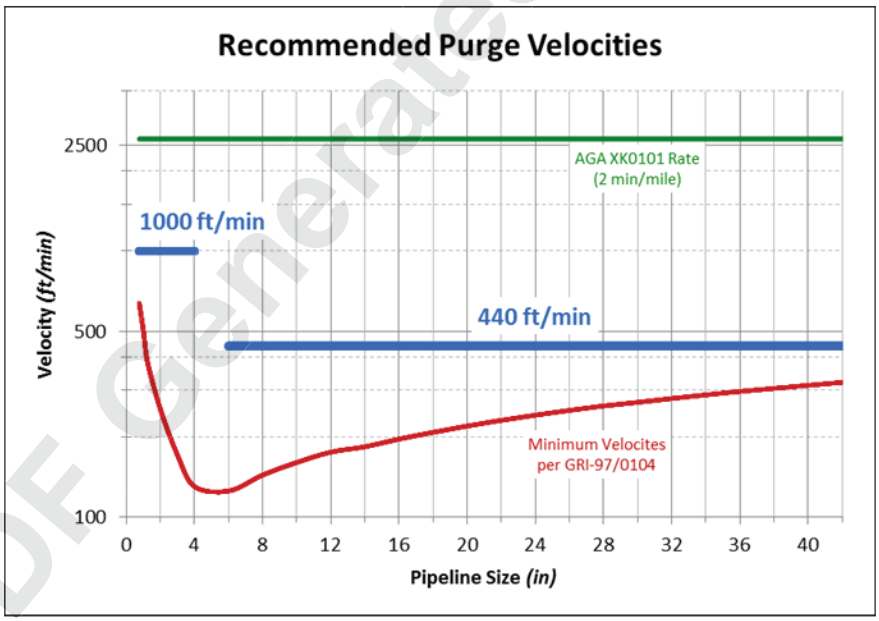


Figure 1. Recommended Purge Velocities

7. To avoid erratic pressure fluctuations as well as potential material thermal damage, the temperature of all entering substances during purging should be kept as near as practical to the same temperature of the facility and always within 40°F–120°F (Fahrenheit).

8. When gas facilities are to be left out of service for extended periods, they can be purged and then successively filled with moisture-free nitrogen to minimize internal corrosion.

Safety

1. Vented natural gas and air/gas mixtures must be diffused into the air without hazard to Company personnel, the public, or property. For venting requirements and safety guidelines, refer to the *Code of Safe Practices* (CSP) Section 1304, "Vent Stacks," and Section 1305, "Sources of Ignition or Fire Near Escaping Gas."

   A. Mixing of natural gas and air may result in a flammable blend. Ensure all sources of ignition are prevented or eliminated from venting locations. Any equipment used in the flow at the venting locations, such as air movers, must be explosion-proof.

   B. Monitor oxygen (O_2) levels at vent locations throughout purging. Venting nitrogen or natural gas can displace the available air at the venting locations.

   C. Consider buildings, equipment, overhead electric lines, wind direction, aircraft landing patterns, and other obstructions or sources of ignition when determining the locations for venting the gas.

   D. When a vent is located in a vault, in an excavation, near a structure, or near a source of ignition, temporarily extend the vent to safely dissipate the purged gasses into the atmosphere.

   E. Fire extinguishers must be present and easily and immediately available at all gas release areas during purging activities.

      (1) Fire extinguishers must be at least 20 pounds, type ABC.

   F. Signs must be posted in all gas release areas in advance of any gas release, with the following text: "DANGER, FLAMMABLE GAS. Keep Fire or Flame Away. NO SMOKING."

      (2) Signs are available via the ARIBA S&S online catalog, under part #2821672.

   G. When purging plastic facilities, refer to Utility Procedure TD-4170P-01, "Static Electricity Control for Polyethylene PE) Pipe."

   H. For ordering information and guidance for use of the CrazeWeld purge stand to purge plastic facilities, refer to Job Aid A-38-JA02, "Purging Plastic Pipe With CrazeWeld Purge Stand."

2. If nitrogen or helium is being used, ensure there is adequate ventilation and O_2 monitoring available at all venting and sampling points.

3. Secure temporary vent piping from thrust forces and turbulent flow movement in accordance with GDS A-38.3, "Temporary Vent Stacks."

4. Purging can create a significant amount of noise, dust, and odor. Use of noise suppressors, hearing protection, filtration, dust masks, and eye protection may be needed. In addition to notifying applicable state and local noise and air pollution agencies, consideration should be made to notify residents near the venting operations.

   A. Equipment used to mitigate noise, dust, and odor must not have any large chambers where a hazardous mixture could accumulate.

Safety (continued)

B. Purging could, but does not necessarily, expel liquids or hazardous solids from a pipeline. If cleaning is required, a specialized process would need to be performed for that purpose. Consult the responsible engineer and safety and environmental specialist.

Purge Planning

1. Before beginning work, prepare a plan for purging and review the plan with the personnel involved. Each purge (except individual service lines), whether putting a facility into service or taking it out of service, requires a unique plan (see Attachment 1, "Purge Plan Checklist and Examples," for creating and reviewing a purge plan). Address the following items based on the processes outlined later in this GDS, and if applicable, include or note such items in the purge plan:

   A. A drawing, map, or sketch of the facility to be purged that shows the routes of the purge flow, all points of isolation, points of segmentation, location of the drivers, location of the source inlets, locations of vents, and monitoring points. Use clearance drawing if applicable (see examples in Attachment 1).

   B. The required purge drive pressure. If the purge will be done in multiple segments, include the purge drive pressure for each segment.

   C. The sequence of purge operations, including all changes in purge-driving pressures, isolation points, venting locations, and monitoring points.

   D. For complex gas distribution purge plans, include Attachment 2, "Distribution Gas Clearance Purge Plan," to identify purge control points (PCP) and establish a sequential order of steps to complete the purge plan.

   E. The required capacities of the equipment to be used to drive the purge (e.g., the connected gas system, air compressors, air movers, and CNG equipment).

   F. The volume of the nitrogen slug, if needed.

   G. The expected duration of each segment of the purge, as well as the overall purging operation.

   H. The estimated amount of natural gas that will be vented into the atmosphere.

   I. A listing of hazards, risks, and mitigations for venting natural gas, debris, liquids, black powder, sulfur, potential ignition sources, and any asphyxiation hazards.

2. Form A-38-F01, "Purge Calculation Worksheet," uses the equations and tables in this GDS to provide a quick approach to determining information for common purge applications. Refer to Job Aid A-38-JA01, "Purge Calculation Worksheet Instructions," for step-by-step instructions on using the worksheet.

Purge Planning (continued)

3. If purging in conjunction with a system new clearance for transmission facilities or complex distribution systems, enter the purge plan information into the clearance. For gas clearance procedures, refer to the following:

   Utility Procedure TD-4441P-01, “System New Clearances for Gas Distribution Facilities”

   Utility Procedure TD-4441P-04, “Emergency Clearances for Gas Distribution Facilities”

   Utility Procedure TD-4441P-10, “System New Clearances for Gas Transmission Facilities”

4. If conditions vary from the purge plan and could create a potentially hazardous situation, the purge must be stopped in a controlled manner.

   A. All equipment driving the purge flow must be shut down.

   B. The facility being purged must be depressurized and sealed.

   C. All inlet, vent, and checkpoint locations must be ventilated.

   D. Gas readings will need to continue to be monitored because the substances left within the facility will continue to mix through stratification and diffusion.

   E. A new purge plan will need to be developed before resuming purging operations.

Purge Routing and Segmentation

1. Identify the extent of the facility to be purged. Highlight an operating map or plat sheet or sketch the facility (see Figure 2). Show the points of isolation, location of the source inlet, route of the purge flow, and locations of vents.

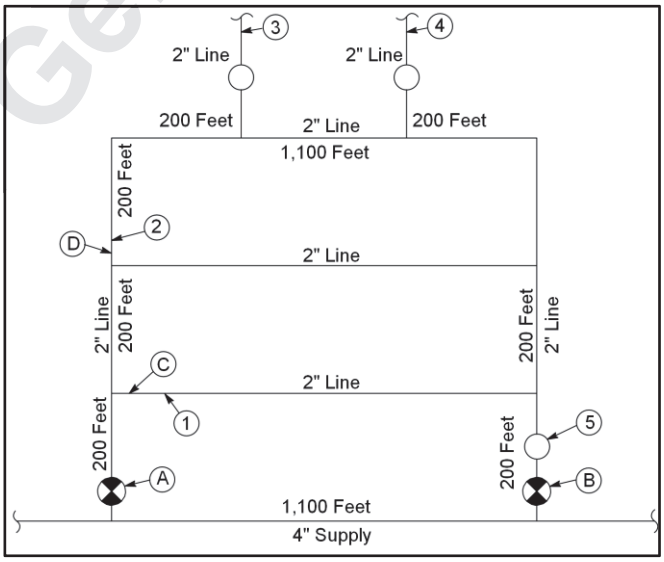


Figure 2. Example Sketch of Facility to Be Purged

Purge Routing and Segmentation (continued)

A. Looped networked grids must be separated into phased segments showing the points of segment separation. If such systems cannot be separated, additional analysis must be conducted, such as flow modeling, to determine the feasibility of the purge plan.

B. Configurations such as multi-legged assemblies, or long laterals should be separated into phased segments showing the points of segment separation.

C. Inlet and venting locations must be at extreme ends of each segment to be purged. Use existing blowdown piping where available.

D. Isolate and purge all ties, laterals, and taps individually where possible.

   (1) Side-tapped stubs or branching laterals of less than 30 pipe diameters in length will clear during the purging of the mainline in a moderate amount of time and will generally not have to be purged individually.

   (2) Top-tapped services and bottom-tapped branches do not have to be isolated but need to be purged individually, promptly after the mainline purge.

   (3) Stubbed services 1 inch or less in size and 100 feet or less in length on new sections of distribution systems do not have to be isolated during purging of the main. They need to be purged after completing the service to the riser.

   (4) During a major regasification of high pressure distribution systems, dead-end, side-tapped branching laterals measuring no more than 100 total feet for every 1000 feet or more of mainline being purged do not have to be individually purged as long as they are not larger in diameter than the mainline. This is only allowable for purging high pressure systems into service.

E. Note the length of each segment to be purged, including any temporary piping used for inlet and venting.

F. Note the pipe size for each segment to be purged. Consider separating sections of piping that differ in diameter by over 50% to avoid the potential to choke flow.

G. Note pressure-restricting features such as plug valves, orifice meters, or check valves.

CAUTION

Check valves may need to be locked-open during purging, depending on purge flow direction.

H. Check elevation profiles along the route of the purge by using the geographic information system (GIS). Consider separating sections with elevation changes greater than 500 feet on low-pressure (LP) systems or when pulling purges with air movers.

I. Note the maximum allowable operating pressure (MAOP) of the facility to be purged.

Purge Routing and Segmentation (continued)

2. Separation points for looped networked grids must be temporarily closed and sequentially opened during the purging process. Separation points for multi-legged assemblies or long laterals should be temporarily closed and sequentially opened during the purging process. If valves are not available, separation points should be controlled by installing pressure control fittings (PCFs), squeezing for plastic mains, or bagging for low-pressure mains. Pipelines segmented with a “hot cut” window are regarded as two separate segments. Purge those two segments simultaneously.

3. To purge natural gas out of a segment or lateral where the far end is not accessible, insert an appropriately sized hose into the accessible end and then inject compressed air or nitrogen through the hose to push out the natural gas.

Purge Driving

1. Purges are driven by either pushing with compressed air or gas or pulling with air movers.

   A. Control devices for push purges must be at the inlet location, and controls for pull purges must be at the vent location.

2. Table 1 shows the recommended driving pressures to purge at the flow rates shown in Figure 1. The driving pressure is the overall differential pressure between the inlet and the vent. When driving a purge with pressurized natural gas or compressed air (or CNG), the driving pressure must be maintained at the inlet location (measured in pounds per square inch gauge [psig]). When pulling a purge with air movers, the driving pressure is the negative suction pressure at the throat of the air mover.

Purge Driving (continued)

Table 1. Minimum Purge Driving Pressures (psig)

<table>
<tr><th rowspan="3">Pipeline Size (Inches)</th><th rowspan="3">Blowoff Size (Inches)</th><th colspan="14">Length of Pipeline</th><th rowspan="3">Purge Velocity</th></tr>
<tr><th colspan="4">(Feet)</th><th colspan="10">(Miles)</th></tr>
<tr><th>500</th><th>1000</th><th>2000</th><th>4000</th><th>1</th><th>2</th><th>4</th><th>6</th><th>8</th><th>10</th><th>12</th><th>15</th><th>20</th><th>40</th></tr>
<tr><td>2</td><td>¾</td><td>10</td><td>10</td><td>10</td><td>11</td><td>12</td><td>14</td><td colspan="8" rowspan="3">Consult with Engineering or segment as needed.</td><td rowspan="3">1000 (ft/min)</td></tr>
<tr><td>3</td><td>1¼</td><td>3</td><td>3</td><td>4</td><td>4</td><td>4</td><td>6</td></tr>
<tr><td>4</td><td>2</td><td colspan="5">2</td><td>3</td></tr>
<tr><td rowspan="2">6</td><td>2</td><td colspan="6">2</td><td colspan="4">2</td><td>3</td><td>3</td><td>3</td><td>4</td><td>6</td><td rowspan="15">440 (ft/min)</td></tr>
<tr><td>4</td><td colspan="6">1</td><td colspan="4">1</td><td>2</td><td>2</td><td>2</td><td>3</td><td>5</td></tr>
<tr><td>8</td><td>4</td><td colspan="6" rowspan="15">1</td><td colspan="4" rowspan="15">1</td><td colspan="4">2</td><td>3</td></tr>
<tr><td>10</td><td>4</td><td colspan="4">2</td><td>3</td></tr>
<tr><td rowspan="2">12</td><td>4</td><td colspan="4">2</td><td>3</td></tr>
<tr><td>6</td><td colspan="4">1</td><td>2</td></tr>
<tr><td>16</td><td>6</td><td colspan="4">1</td><td>2</td></tr>
<tr><td rowspan="2">20</td><td>6</td><td colspan="3" rowspan="2">1</td><td rowspan="2">2</td></tr>
<tr><td>8</td></tr>
<tr><td rowspan="3">24</td><td>6</td><td>1</td><td colspan="3">2</td></tr>
<tr><td>8</td><td colspan="4">1</td></tr>
<tr><td>10</td><td colspan="4">1</td></tr>
<tr><td>30</td><td>10</td><td colspan="4" rowspan="5">1</td></tr>
<tr><td>34</td><td>12</td></tr>
<tr><td rowspan="2">36</td><td>12</td></tr>
<tr><td>16</td></tr>
<tr><td rowspan="2">42</td><td>12</td></tr>
<tr><td>16</td></tr>
</table>

A. The purge pressure must never exceed the minimum MAOP of the system being purged.

   (1) The purge pressure must never exceed the rating of any temporary equipment being used.

   (2) Valves used for inlet control must be capable of fine throttling, especially if the purge source has a higher pressure than the minimum MAOP of the system being purged.

B. For piping sections less than 500 feet in length, use the pressures listed for 500 feet.

C. For multi-diameter segments, use the smallest mainline pipe diameter, not including blowoff or venting piping, as the pipeline size to determine the purge-driving pressure from Table 1. Calculate the total equivalent length of the pipeline by using Equation 1 with diameters and friction factors from Table 2.

Purge Driving (continued)

$$L_{eq} = L_1 + L_2 \frac{(f_2/f_1)}{(d_2/d_1)^5}$$

Equation 1. Equivalent Length of Pipeline for Multi-Diameter Pipelines

Where: L_{eq} = equivalent length of the pipeline
L_1 = actual length of smaller pipe
L_2 = actual length of larger pipe
f_2 = friction factor of larger pipe (fully turbulent)
f_1 = friction factor of smaller pipe (fully turbulent)
d_2 = inside diameter (ID) of larger pipe (inches)
d_1 = ID of smaller pipe (inches)

Table 2. Typical Inside Diameters and Friction Factors

Steel Pipe			Plastic Pipe		
Pipe Size	**ID (Inches)**	**Friction Factor**	**Pipe Size**	**ID (Inches)**	**Friction Factor**
¾	0.742	0.0224	½	0.439	0.0121
1¼	1.380	0.0207	1	0.919	0.0108
2	2.067	0.0192	2	1.917	0.0093
3	3.068	0.0174	4	3.830	0.0085
4	4.026	0.0162	6	5.404	0.0083
6	6.065	0.0150			
8	7.981	0.0142			
10	10.250	0.0132			
12	12.188	0.0130			
16	15.376	0.0122			
24	23.250	0.0115			
30	29.250	0.0111			
34	33.250	0.0108			
36	35.000	0.0107			
42	41.000	0.0104			

D. For purging and subsequently filling the pipeline with nitrogen, use Table 1 to determine the minimum inlet pressures needed to drive the purge with compressed nitrogen.

3. Table 1 is based on inlet and outlet piping being ⅓–½ the size of the mainline pipe (e.g., 4-inch inlet and outlet piping for a 12-inch mainline pipe), being less than 100 feet in length, and having minimal restrictive fittings (e.g., plug valves, numerous elbows).

Note: Smaller inlet or outlet piping may require higher purge-driving pressures to maintain the recommended purge velocity and minimize mixing. Larger outlet piping may also require higher purge-driving pressures to ensure the velocity of the venting gasses are greater than the rate of flame travel, should the emerging gas mixture be ignited.

Purge Driving (continued)

A. If the only available vents are smaller than ⅓ the size of the mainline pipe, are over 100 feet long, or contain restrictive fittings, consult with engineering to determine if higher purge-driving pressures will be required to maintain the recommended purge velocity.

(1) If purging through Save-a-Valve fittings without extended inlet or outlet stack piping, refer to Table 3 below.

Table 3. Recommended Purge Driving Pressures and Flow Rates through a Save-a-Valve

Pipeline Size (inches)	Inlet/Outlet Size (inches)	Upstream Control Pressure (psig)	Flow Rate (standard cubic feet per minute, scfm)	Estimated Purge Duration (feet/minute)
4	1	2	90	800
6	1		175	700
8	1		205	500
10	1		215	300
	2		780	1100
12	1		220	200
	2		915	900
16	2		1025	650
20	2		1060	400
24	2		1070	300

(2) For purging plastic pipelines through a 10’ long pigtail, refer to Table 4 below.

Table 4. Recommended Purge Driving Pressures and Flow Rates through a Pigtail

Pipeline Size (inches)	Inlet/Outlet Size (inches)	Upstream Control Pressure (psig)	Flow Rate (scfm)	Estimated Purge Duration (feet/minute)
2	1/2	5	27	1000
4	1		175	1500
6	1		183	800
8	1		184	400

Purge Driving (continued)

(3) For purging low pressure pipelines through pigtail or Save-a-Valve, refer to Table 5 below.

Table 5. Recommended Purge Driving Pressures and Flow Rates for Low Pressure Pipelines through a Pigtail or Save-a-Valve

Pipeline Size (inches)	Inlet/Outlet Size	Upstream Control Pressure (inches water column, WC)	Flow Rate (scfm)	Estimated Purge Duration (feet/minute)
2	1" Pigtail	7	20	800
4	1" Pigtail		35	400
	1" SAV		55	550
6	1" Pigtail		40	250
	1" SAV		65	300
8	1" SAV		65	200
	2" SAV		290	800
10	2" SAV		310	500
12	2" SAV		320	350
16	2" SAV		320	235

B. If atmospheric air is to be drafted into the inlet, ensure that the nominal size of the inlet is at least ⅓ the size of the mainline pipe and a maximum of 100 feet long. If a stack or fitting of sufficient size is not available, consider compressed air as the source.

C. For segments that include pressure-restrictive features (e.g., plug valve, check valve, orifice meter, stuck pig), for segments that undergo elevation changes greater than 500 feet, or for blowoff or venting piping that exceeds 100 feet in length, consult with engineering to determine if the purge-driving pressure needs to be adjusted.

4. Table 6 shows the induced flow rates required to drive the purge at the recommended flow rates shown in Figure 1. When purging into service, ensure the gas system feeding the purge is capable of meeting or exceeding the required induced flow rate without impacting service upstream. When purging out of service, ensure the air compressor, air mover, or other driving equipment to be used for purging is capable of meeting or exceeding the required induced flow rate.

Purge Driving (continued)

Table 6. Purge Flow Rates

Required Flow Rate		Q_h (MSCFH)			q_m (SCFM)		
Pipeline Size (Inches)	Purge Velocity	Length of Pipeline			Length of Pipeline		
		<1 Mile	≥1 Mile, <10 Miles	≥10 Miles, ≤40 Miles	<1 Mile	≥1 Mile, <10 Miles	≥10 Miles, ≤40 Miles
2	1000 (ft/min)	2	3		35	45	
3		4	5		70	80	
4		7	8		125	150	
6	440 (ft/min)	6	7	9	100	125	175
8		11	12	15	200	225	250
10		16	19	23	275	325	400
12		23	26	31	375	450	525
16		40	45	50	600	700	800
20		55	60	70	1000	1100	1200
24		80	90	100	1400	1500	1700
30		130	140	160	2200	2400	2700
34		165	185	205	2800	3100	3500
36		180	200	225	3100	3400	3800
42		250	280	310	4200	4700	5200

A. Convert the flow rate from thousand standard cubic feet per hour (MSCFH) to standard cubic feet per minute (SCFM), using Equation 2.

$$q_m = 16.67 \times Q_h$$

Equation 2. Flow Rate Conversion

Where: q_m = flow rate (SCFM)
Q_h = flow rate (MSCFH)

B. For multi-diameter segments, use the largest mainline pipe diameter, not including blowoff or venting piping, as the pipeline size to determine the induced flow required. The total length of the pipeline is the sum of the various-sized segment lengths.

5. Ensure the equipment available (e.g., the connected gas system, air compressors, air blowers, air movers, CNG equipment) has the capacity to achieve the necessary flow rate to drive the purge at the minimum inlet pressure. See GDS A-38.1 for information on the use of air movers.

Purge Driving (continued)

A. The capabilities of the available equipment may allow for purging at a significantly higher rate than the minimum needed. Increasing the purge flow rate shortens the overall purge duration. Other considerations to note when increasing purge flow rates:

(1) Overly high purge flow rates may produce excessive noise and projectile problems at the vents.

(2) The range of flammability of gas/air mixes increases as the pressure of the mixture increases.

(3) Solid particles travelling at high speeds within the facility could possibly ignite combustible mixtures or pyrophoric materials.

(4) Increasing purge flow rates will only minimally increase the mixing of the gases.

6. For low-pressure systems, the available injection pressure and the physical characteristics of the facility to be purged must be examined to determine if the required purge rates can be achieved.

Nitrogen Slug

1. A nitrogen slug is not needed for purging facilities 4 inches in diameter or less OR during hot-cut operations when air movers are the sole drivers for the purging.

2. A nitrogen slug is required when:

A. The purge drivers are not sufficient to meet the recommended purge rates.

B. Purging gas gathering pipelines.

C. Pyrophoric materials are suspected to exist in the pipeline. Consult with gas quality personnel to determine the potential of pyrophoric materials.

3. A nitrogen slug is recommended for purging pipelines out of service by using an air compressor or air blower when:

A. The elevation profile of the pipeline being purged includes elevation differences of over 500 feet.

B. The volume of the pipeline to be purged is greater than 9300 standard cubic feet (scf).

4. If a nitrogen slug is needed, determine the volume and injection rate of the nitrogen slug per Table 7.

Nitrogen Slug (continued)

Table 7. Nitrogen Required for Inert Slug (scf)[1,2]

Pipe Size (inches)	Pipe Length (feet)							Injection Rate (cfm)
	500	1,000	2,000	5,000	10,000	20,000	50,000	
4	19	23	29	40	53	71	107	11
6	46	56	70	98	129	173	261	29
8	77	94	117	164	217	291	439	56
10	121	147	184	257	340	457	688	96
12	173	211	263	368	486	653	985	149
16	280	342	430	605	802	1,080	1,632	273
18	360	440	553	777	1,030	1,387	2,097	367
20	448	548	689	968	1,283	1,728	2,611	489
22	541	661	831	1,168	1,548	2,085	3,151	615
24[3]	646	789	991	1,394	1,847	2,488	3,760	765
26	757	925	1,162	1,633	2,165	2,916	4,406	930
30	1,007	1,230	1,546	2,173	2,880	3,880	5,863	1331
34	1,400	1,733	2,204	3,137	4,138	5,677	8,630	1821
36	1,576	1,951	2,480	3,531	4,716	6,391	9,714	2117
42[4]	2,170	2,703	3,453	4,945	6,627	9,003	13,718	2946

1. Based on America Gas Associated (AGA) XK0101, Table 5–4
2. 100 feet of additional pipelines is included
3. Interpolated
4. Extrapolated

A. Determine inlet supply pressure per section “Injecting Compressed Natural Gas, Air, or Nitrogen.”

B. The nitrogen slug must be injected between the gas and air at the beginning of the purge.

C. Changes in horizontal or vertical direction due to elbows or return bends will not destroy the nitrogen slug.

D. Typically, one cylinder of nitrogen at 2200 pounds per square inch (psi) contains 220 scf (at atmospheric pressure).

E. If the facility is to be purged and successively filled with nitrogen, the minimum volume of nitrogen needed will equal the volume of the facility plus the volume of the slug. The slug will mix during purging and will be vented.

Injecting Compressed Natural Gas, Air, or Nitrogen

1. When injecting compressed natural gas, air, or nitrogen, assemble the equipment as shown in Figure 3.

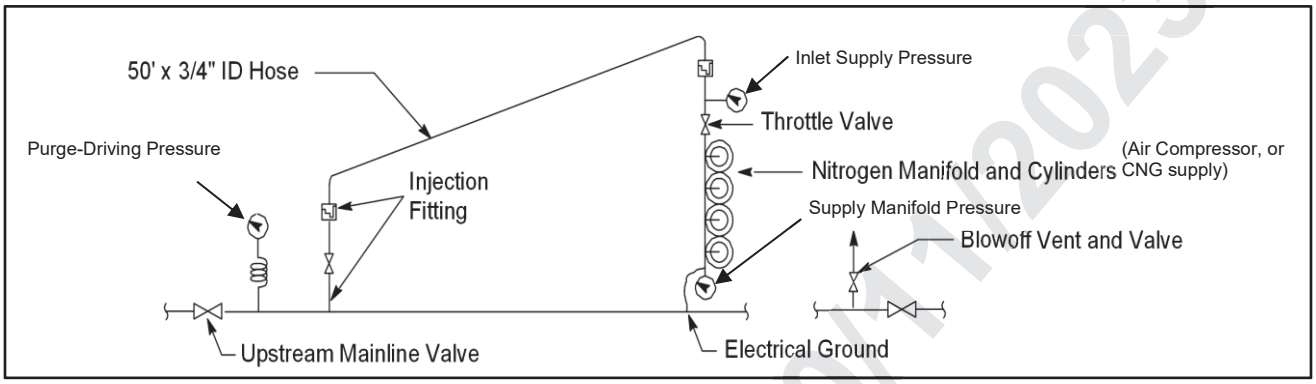


Figure 3. Injecting Compressed Natural Gas, Air, or Nitrogen to Purge Gas System

   A. Inject within 10 pipe diameters of the upstream isolation valve.

   B. Assemble an air compressor, bottled gas manifold, or other bulk supply to a valve for throttle control and a gauge accurate and readable to within 1 psi. (The small tube connecting the bottles of nitrogen “six-pack” assemblies may not meet the injection rate needed for pipelines larger than 12 inches.)

   C. Electrically ground all equipment and bond to the mainline pipe with 14 American wire gauge (AWG) minimum wire. Make sure the ground is metal on metal contact.

   D. Measure the length of hose needed to connect the injection supply to the injection fitting on the pipeline.

2. Determine the applicable hose size and inlet supply control pressure by using Table 8.

   A. For example, if the desired injection rate is 200 cfm, 150 feet of hose is needed, and an air compressor rated for 100 psig is to be used; then three, 50-foot lengths of 1¼-inch hose would be needed and the minimum required pressure upstream of the hose would be 17 × 3 = 51 psig.

   B. To increase the volume of injection, use multiple parallel hoses or multiple full sets of injection equipment.

   C. If driving a purge with injected air, add the minimum inlet pressure from Table 1 to the inlet supply control pressure from Table 8.

Injecting Compressed Natural Gas, Air, or Nitrogen (continued)

Table 8. Minimum Inlet Supply Pressure[1]

Desired Inject Rate (cfm)	Minimum Required Pressure Upstream of Hose (psig)					
	Each 50′ Length of ¾" ID Hose		Each 50′ Length of 1¼" ID Hose		Each 50′ Length of 2" ID Hose	
	Gas	Air/N_2	Gas	Air/N_2	Gas	Air/N_2
10	3	3				
20	4	5				
40	9	11				
60	15	18				
80	21	26				
100	28	35	4	6		
120	35	44	5	8		
130	39	49	6	9		
140	43	54	7	10		
160	51	64	8	12		
200	68	87	11	17		
230	82	103	14	21		
270	100		19	26	3	4
320			23	33	4	5
370			28	40	5	7
420			34	46	6	8
430	**Note:** Multiple parallel hoses may be used to increase the volume.		35	47	7	9
530			44	60	8	12
620			55	75	11	16
700			62	87	13	17
720			65	89	14	20
830			78	105	17	26
900			85		18	30
950			90		20	31
1,000			95		21	32
1,050					23	33
1,070					24	34
1,170					27	38
1,200					28	39
1,350					33	45
1,520					38	52

1. Based on AGA XK0101, Table 5-3

3. When injecting a nitrogen slug, subsequent purging operations must commence immediately after injecting the nitrogen slug. Any delay will shorten the slug, and a delay beyond 3 minutes will require reinjecting a new slug.

Estimated Duration of the Purge

1. Estimate the total duration of the purge by dividing the overall length by the purge flow rate as shown in Equation 3.

$$T = \frac{L}{R}$$

Equation 3. Estimated Duration of the Purge

Where: T = purge duration (minutes)
L = overall length (feet)
R = purge flow rate (ft/min)

A. Do not include the length of stubs in the total overall length of the purge. Expect the duration of the purge to extend up to 10 minutes for clearing all the stubs.

B. For multi-diameter segments, calculate the estimated duration to purge by using Equation 4.

$$T = \frac{L_1}{R}\left(\frac{d_1}{d_2}\right)^2 + \frac{L_2}{R}$$

Equation 4. Estimated Duration of Purge Through Multi-Diameter Pipelines

Where: T = purge duration (minutes)
L_1 = length of smaller pipe (ft)
L_2 = length of larger pipe (ft)
R = purge flow rate (ft/min)
d_1 = ID of smaller pipe (inches)
d_1 = ID of larger pipe (inches)

C. If purging a pipeline at a pressure higher than the recommended driving pressure, adjust the estimated duration to purge by using Equation 5.

$$T_B = T_A\sqrt{\frac{P_A(P_B + 14.7)}{P_B(P_A + 14.7)}}$$

Equation 5. Estimated Duration of Purge if Using Higher-Driving Pressure

Where: T_B = new purge duration (minutes)
T_A = original purge duration (minutes)
P_A = original purge-driving pressure (psig)
P_B = new purge-driving pressure (psig)

2. Add time if injecting a nitrogen slug.

3. Add time for the operation of any isolating valves for cross-ties and branches.

4. Add a 3 to 5 minute safety margin depending on the complexity of the system.

Estimated Amount of Gas Released Into Atmosphere

1. When purging a facility out of service, the estimated amount of natural gas released into the atmosphere is equal to the total internal volume of the facility.

   Note: This amount of natural gas does not include the amount released during blowdown or depressurization. Ensure this amount is included in accordance with Form TD-4441P-01-F02, “Natural Gas Release Notification.”

2. When purging a facility into service, the estimated amount of natural gas released into the atmosphere is the expected mixed volume plus the natural gas released during the safety margin.

   A. The amount of the gases expected to mix during purging is equal to 2% of the total volume of the section being purged. Estimate the volume of mixed gases by summing the volumes of each purge section calculated, using Equation 6.

$$V_m = \frac{d^2 L}{9167}$$

Equation 6. Estimated Volume of Gases Expected to Mix

Where: V_m = volume of mixed gases (scf)
d = predominant pipe size (inches)
L = length of segment (feet)

3. If driving air movers with natural gas, add the volume of natural gas used to drive the air movers.

Purge Monitoring

CAUTION

The presence of gas must be readily detectable by smell at the completion of a purge. Low odor gas is a hazard as customers will be unaware of potential gas leaks. Utility Procedure TD-4570P-03, “Odorizing Natural Gas,” describes the steps for responding to the abnormal operating condition of low odor gas.

1. Monitor gasses being released into the atmosphere at all venting locations, including every branching lateral and service, throughout the purging operation.

Purge Monitoring (continued)

2. Monitor the state of the venting gas by using a combustible gas indicator (CGI) (see GDS M-58, “Leak Survey and Leak Investigation Tools and Equipment”).

Note: Do not rely on odors and sounds to monitor purging.

A. When purging a facility into service:

(1) Measure the upstream gas composition using a CGI device set to the percent gas scale and determine the source gas percent reading.

(2) Use CGI device to validate the source gas percent reading at the purge point at the downstream purge location.

- Whenever feasible, use the same CGI device to avoid variations in calibrations that can range +/- 2% of the gas reading between properly calibrated devices.

(3) Monitor the composition of the gasses being released into the atmosphere at the venting location.

(4) Purging is complete when the CGI continuously indicates a reading that matches or exceeds the upstream source gas minus the allowable gas concentration from Table 9 or when the reading is at least 95% gas or more.

- Table 9 indicates allowable gas differential readings between the upstream gas source and the downstream venting location as determined by the operating pressure of the upstream source. As the gas system pressure increases, O2 is diluted to allowable levels. For example: a 200 psig system reading 94.5% gas at the source allows a minimum reading of 94.5% - 3% = 91.5% at the purge point to end a clearance.

- For transmission work, large diameter pipelines, and complex distribution system purges, the purge is typically complete when the CGI reading continuously indicates 95% gas reading for 3–4 minutes.

Table 9. Allowable Gas Concentration

System Operating Pressure (psig)	Allowable Gas Concentration Difference
0–49	0.5%
50–109	1.0%
110–169	2.0%
170+	3.0%

B. For source gas with low odorant or percent gas readings below 91.5%, contact Gas Quality on Call by visiting the Directory Access at www.pge.com or request Gas Quality On Call contact information from Gas Control.

Purge Monitoring (continued)

C. When purging a facility out of service, start monitor with the CGI set on the percent gas scale. When the CGI reads below 5% gas, switch to the more sensitive percent lower explosive limit (LEL) scale. Purging is complete when the reading indicates 20% or less LEL continuously for 15 minutes.

   (1) If a nitrogen slug is used while purging a facility out of service, subsequently verify the complete purge of the nitrogen slug by using a CGI set on the percent O_2 scale. Purging of the nitrogen slug is essentially complete when the reading indicates 15% O_2 or higher continuously for 15 minutes.

   (2) If purging with air movers during a hot-cut operation, ensure the sampling point is before the air mover as shown in GDS A-38.1, especially if natural gas is being used to operate the air movers.

3. If purging with nitrogen, monitor all venting locations for O_2 throughout the purge duration.

4. If the purging end conditions are met significantly sooner than the expected purge duration, check isolation points and consult with engineering.

5. Intermediate monitoring points may be added along the route for tracking the purge progress on long pipelines. Ensure intermediate monitoring points do not allow air to enter the facility.

6. Visually monitor for dust, debris, or projectiles.

Purging Sequence and Guidelines

Note: Always assume the pipeline is pressurized until verified with pressure gauges.

1. Ensure that the facilities to be purged are depressurized.

2. Ensure wind conditions at vent locations are within expected ranges for plume sizes.

3. Ensure contingencies are in place for leaky valves or equipment failure.

Purging Sequence and Guidelines (continued)

4. If purging the facility out of service, test all isolation and segmentation points for leaks. If test fails, consult engineering before continuing with purging.

5. Verify valves and isolation points are closed or open in accordance with purge route and phasing plan. All open valves must be fully open except isolation valves and the throttled driver valve, if used.

6. Verify all vents are open and safety precautions are in place.

7. On the section to be purged and near the upstream mainline valve, install a pressure gauge that is accurate and readable within 1 psi so that the inlet pressure can be observed. (The gauge should be connected through several feet of flexible tubing to minimize vibration.)

8. Open throttle control valve steadily while monitoring the inlet pressure gauge. Continually monitor the pressure and gradually adjust the throttle control valve throughout the purge.

9. Once purging has started, it must be continued until the purge is complete. If purging is stopped, the two gases can begin mixing by stratification and diffusion. A long delay in purging (more than 3 minutes), can result in substantial mixing throughout the entire main. Long-delay mixing of a nitrogen slug destroys the slug, necessitating reinjection.

10. Isolated segments must be purged sequentially without delay.

11. Ensure all associated valve body bleeds, pressure taps, and control lines are purged.

Working on Facilities That Have Been Purged Out of Service

1. When it is necessary to perform work on a facility that has been purged out of service, verify that a combustible mixture has not developed inside the facility due to leakage from an isolation point, gas released from residual liquids within the facility, or pyrophoric solids.

2. Special care must be taken when performing cutting or welding on such a line.

3. Recheck each segment of purged or cut-off line by using an appropriate CGI, and clear of any combustible gas by repeating the purge.

4. Refer to GDS A-36, “Design and Construction Requirements for Gas Pipelines.”

Target Audience

Personnel involved in the planning and execution of purging gas facilities.

Definitions

Blowdown	Depressurizing a pipeline by opening a blowoff vent and releasing pressurized gas into the atmosphere.
Hot-cut	Torch-cutting a pipeline while maintaining 100% natural gas in the pipeline and controlling natural gas present by ignition and venting.
Purge	Displacing one gas in a facility with another; such as replacing air in a pipeline with natural gas when placing the pipeline into service or replacing natural gas in a pipeline with air when taking the pipeline out of service.

Acronyms and Abbreviations

AGA:	American Gas Association
cfm:	cubic feet per minute
CGI:	combustible gas indicator
CNG	compressed natural gas
EFVs:	excess flow valves
FIMP:	facilities integrity management program
GIS:	geographic information system
GRI:	Gas Research Institute
ID:	inside diameter
LEL:	lower explosive limit
LP:	low pressure
MAOP:	maximum allowable operating pressure
MSCFH:	thousand standard cubic feet per hour
N_2:	nitrogen
O_2:	oxygen
PCFs:	pressure control fittings
psi:	pounds per square inch
psig:	pounds per square inch gauge
scf:	standard cubic feet
SCFM:	standard cubic feet per minute

Compliance Requirement / Regulatory Commitment

Code of Federal Regulations (CFR) Title 49, Transportation of Natural and Other Gas by Pipeline: Minimum Federal Safety Standards, Section 192.727, “Abandonment or deactivation of facilities”

Code of Federal Regulations (CFR) Title 49, Transportation of Natural and Other Gas by Pipeline: Minimum Federal Safety Standards, Section 192.629, “Purging of pipelines”

Compliance Requirement / Regulatory Commitment (continued)

Records and Information Management:

Information or records generated by this procedure must be managed in accordance with the Enterprise Records and Information (ERIM) Policy, Standards and Enterprise Records Retention Schedule (ERRS). Refer to GOV-7101S, "Enterprise Records and Information Management Standard," and related standards. Management of records includes, but is not limited to:

- Integrity
- Storage
- Retention and Disposition
- Classification and Protection

References

American Gas Association (AGA) XK0101, "Purging Principles and Practice," 3rd Edition, 2006

Code of Safe Practices (CSP), Section 13, "Gas Distribution and Transmission Systems"

Exponent Research Report, "Purge Simulations," 2018

Exponent Research Report, "Air Mover Testing and Performance Correlations," 2018

Exponent Research Report, "Analysis for Purging Pipeline Stubs," 2018

Gas Research Institute GRI-97/0104, "Pipeline Purging Principles and Practices Research," 1997

Gas Design Standard A-36, "Design and Construction Requirements for Gas Pipelines"

Gas Design Standard A-38.1, "Installation and Operation of Air Movers"

Gas Design Standard A-38.3, "Temporary Vent Stacks"

Gas Design Standard A-93.3, "Excess Flow Valves"

Gas Design Standard M-58, "Leak Survey and Leak Investigation Tools and Equipment"

National Fire Protection Association (NFPR) 56, "Standard for Fire and Explosion Prevention During Cleaning and Purging of Flammable Gas Piping Systems," 2012 Edition, 2012

Utility Operations (UO) Standard S4414, "CGT Confined Space Entry Program."

Utility Procedure TD-4170P-01, "Static Electricity Control for Polyethylene PE) Pipe

Utility Procedure TD-4441P-01, "System New Clearances for Gas Distribution Facilities"

Utility Procedure TD-4441P-04, "Emergency Clearances for Gas Distribution Facilities"

Utility Procedure TD-4441P-10, "System New Clearances for Gas Transmission Facilities"

References (continued)

Utility Procedure TD-6100P-07, “Meter Set Installation for New Business”

Utility Procedure TD-9500P-16, “Abandonment of Underground Gas Facilities”

Appendices

NA

Attachments

Attachment 1, “Purge Plan Checklist and Examples”

Attachment 2, “Distribution Gas Clearance Purge Plan”

Form A-38-F01, “Purge Calculation Worksheet”

Job Aid A-38-JA01, “Purge Calculation Worksheet Instructions”

Job Aid A-38-JA02, “Purging Plastic Pipe With CrazeWeld Purge Stand”

Revision Notes

Revision 1h has the following changes:

1. Updated reference to Utility Procedure TD-4170P-01, “Static Electricity Control for Polyethylene PE) Pipe. Formerly, Utility Work Procedure WP4170-01, “Grounding Polyethylene (PE) Pipe to Control Static Electricity” (canceled).
2. Added new Job Aid A-38-JA02, “Purging Plastic Pipe With CrazeWeld Purge Stand.”
3. Corrected title of GDS A-36 from “Design and Construction Requirements Gas Lines and Related Facilities,” to “Design and Construction Requirements for Gas Pipelines.”
4. In Safety section, moved 1.G.1 to new 1.H.

Revision 1g (Publication Date: 10/19/2022, Effective Date: 01/01/2023) has the following changes:

1. Updated purge calculator worksheet in Form A-38-F01 to include 3 inch pipe size for both plastic and steel pipe.

Revision 1f has the following changes:

1. Added new section 1G with guidance to refer to Utility Work Procedure WP4170-01 when purging plastic pipe.
2. Added new section Purge Planning 1D to include a reference to Attachment 2, “Distribution Gas Clearance Purge Plan,” for gas distribution purge plans.
3. Updated Purge Monitoring 2.A, to add guidance to sample source to determine minimum percent gas reading at end of clearance. Added new Table 9 to provide percent gas concentration at different system operating pressures.

Revision Notes (continued)

4. Updated Purge Monitoring 2.B, to add instruction to call the Gas Quality On Call Page for source gas with low odorant or percent gas readings below 91.5%.

5. Added Attachment 2, “Distribution Gas Clearance Purge Plan.”

Revision 1e (Publication Date: 08/18/2021, Effective Date: 11/01/2021) has the following changes:

1. Added “Printed copies …” boilerplate to the footers.

2. In the “General Information” section, Step 3, rearranged step and added substeps to reference Utility Procedure TD-6100P-07, “Meter Set Installation for New Business,” when purging meter set risers.

3. Added record retention boilerplate to the “Compliance Requirement / Regulatory Commitment” section.

4. Added reference to Utility Procedure TD-6100P-07, “Meter Set Installation for New Business,” in the “References” section.

Revision 1d (Publication Date: 03/17/2021, Effective Date: 06/17/2021) has the following changes:

1. Throughout, replaced all forms of “retire” with “abandon” (retirement to abandonment, etc.)

2. In General Information 2, added clarification that the system is depressurized.

3. In General Information 3, added sub-step A about purging low-pressure mains and services.

4. In Purge Routing and Segmentation 1, Added Caution note for check valves

5. In Injecting Compressed Natural Gas, Air, or Nitrogen 1.C, added statement to make sure the ground is metal on metal contact.

6. In Purge Monitoring, added reference to TD-4570P-03 and replaced reference to M-53 with reference to M-58.

7. In Purge Sequence and Guidelines, added new step 6 to verify vents are open and precautions are in place.

Revision 1c (Publication Date 07/17/2019, Effective Date 07/26/2019) has the following changes:

1. Purge Routing and Segmentation, 1.: Added guidance on looped networked grids.

2. Purge Routing and Segmentation, 2.: Added guidance on closing and opening separation points.

3. Purge Driving, 3 A: Expanded and added guidance on purging through ½-inch and 1-inch pigtails and 1-inch and 2-inch Save-a-Valves.

Revision Notes (continued)

4. Updated Attachment 1, Form A-38-F01, and Job Aid A-38-JA01 to reflect the changes made to this GDS.

Revision 1b (Publication Date: 06/19/2019, Effective Date: 07/26/2019) has the following changes:

1. Effective date extended to 07/26/2019.

Revision 1a (Publication Date: 03/20/2019, Effective Date: 06/20/2019) has the following changes:

1. Safety Section: Added “Fire extinguishers must be present and easily and immediately available at all gas release areas during purging activities. Fire extinguishers must be at least 20 pounds, type ABC.”

2. Safety Section: Added “Signs must be posted in all gas release areas in advance of any gas release, with the following text: ‘DANGER, FLAMMABLE GAS. Keep Fire or Flame Away. NO SMOKING.’ Signs are available via the ARIBA S&S online catalog, under part #2821672.”

3. This revision supersedes Bulletin TD-A-38B-001.

4. This revision’s effective date supersedes Revision 1’s effective date.

Revision 01 (Publication Date: 02/20/2019, Effective Date: 08/20/2019) has the following changes:

1. Updated title from “Procedures for Purging Gas Facilities” to “Purging Gas Facilities.”

2. Incorporated the latest industry standards and best practices based upon the AGA 2006, “Purging Principles and Practice.”

3. Incorporated Exponent research reports, “Purge Simulations,” “Air Mover Testing and Performance Correlations,” and “Analysis for Purging Pipeline Stubs.”

4. Changed the recommended purge rate of 2 minutes per mile to 1000 feet per minute for small-bore pipe sizes and 440 feet per minute for large-bore pipe sizes. These new purge rates are well above the minimum required rates to minimize mixing of gases and are achievable by using standard purging equipment currently used by PG&E crews.

5. Added guidance and requirements for purge planning.

6. Added guidance on purge routing and segmentation.

7. Added guidance on purging stubbed services.

8. Updated Table 1 with new inlet driving pressures based upon the new purge rates.

9. Added Table 2 to provide inside diameter and friction factors used to determine equivalent pipe length for purging multi-diameter pipes.

Revision Notes (continued)

10. Added Table 3 to provide maximum induced flow required. This new table helps determine the appropriate gas flow or equipment sizing needed to meet the required purge rates.
11. Added guidance and information for purging through Save-a-Valves or other small-diameter inlets and outlets.
12. Added guidance on purging multi-diameter pipelines.
13. Added guidance on purging looped network grids.
14. Added guidance on when stubs do not need to be purged individually.
15. Added guidance on purging low-pressure systems.
16. Added guidance on calculating the estimated duration of a purge.
17. Added guidance on estimating the amount of gas released into the atmosphere.
18. Added new purge calculation worksheet with job aid to help determine purge information quickly.
19. Added new purge checklist and examples to aid in purge review.
20. Reevaluated when a nitrogen slug is required.
21. Added guidance on purge monitoring.
22. Added guidance on purging sequence and guidelines.

Asset Type: Gas Transmission pipelines, Gas Distribution mains and services

Function: Gas Design and Operations

Document Contact: Gas Design Standard Responsibility List

Purging Gas Facilities

Attachment 1, Purge Plan Checklist and Examples

Instructions: Reference this attachment as a quick method of reviewing your purge plan for completeness. The attachment is not meant to replace the need to understand and comply with the complete instruction of GDS A-38.

PIPE/PROJECT INFORMATION		
Line #:	MP:	MAOP:
Clearance #:	PLAT:	PM:

	SAFETY
☐	Buildings, equipment, overhead electric lines, wind direction, aircraft landing patterns, and other obstructions or sources of ignition were considered when determining the locations for venting gas.

	PURGE PLANNING Drawing, map, or sketch of the facility to be purged includes the following information (see examples on pages 2 and 3):
☐	Point of isolation
☐	Point of segmentation
☐	Route of purge flow
☐	Location of drivers
☐	Location of inlet, outlet, and monitoring points

	PURGE ROUTING AND SEGMENTATION
☐	Inlet and vent locations are at extreme ends of the segment to be purged.
☐	Side taps greater than 30 pipe diameters in length can be isolated (recommended) and purged separately.
☐	All top and bottom taps can be purged separately.
☐	If multi-diameter pipeline, the diameters of each segment differ by less than 50%.
☐	Sections to be purged do not include any pressure-restricting features.
☐	Elevation change in any segment is less than 500 feet.

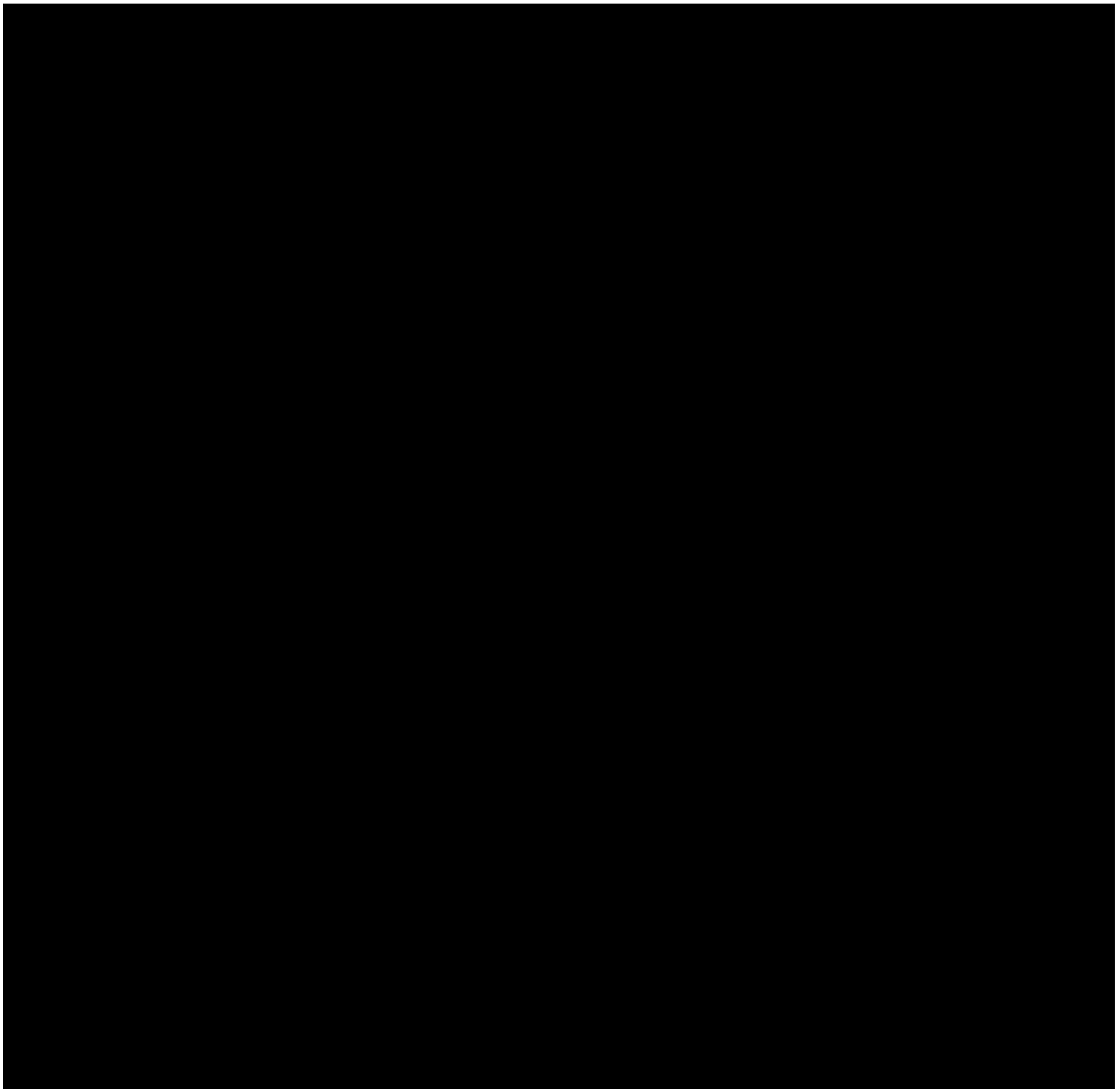
	PURGE DRIVING
☐	Inlet and outlet piping is a minimum of $^{1}/_{3}$ of the mainline pipe size, less than 100 feet in length, and contains minimal restrictive fittings.
☐	For steel pipe, if purging through a Save-a-Valve, refer to Table 3 for specific purge information.
☐	For plastic pipes, If purging through a ½-inch or 1-inch pigtail, refer to Table 4 for specific purge information.
☐	The purge pressure does not exceed the minimum MAOP of the system
☐	The gas system can supply the pressure and flows required to purge all segments at the minimum required velocity.
☐	Air compressors (185 cfm or 375 cfm) can supply the required pressure and flows needed to meet the minimum velocity.
☐	Air movers listed in GDS A-38.1 are capable of supplying the required pressure and flows needed to meet the minimum velocity.

	NITROGEN SLUG REQUIREMENT REVIEW
☐	Purge drivers are not sufficient to meet purge rates.
☐	Pyrophoric materials are suspected to exist in the pipeline.
☐	Purging gas gathering pipelines.

Purging Gas Facilities

Purging Gas Facilities

Attachment 1, Purge Plan Checklist and Examples



Purging Gas Facilities

Attachment 1, Purge Plan Checklist and Examples

Segment	Segment Color	Gas Source	Purge Control Point (PCP #)	Vent, Monitoring Points (PP #)	PCP Removal & Relocation After Segment Purged	
					Remove	Move To
1	Pink	S1	1, 2, 3, 4, 5	5	S1	PCP 6
2	Blue	PCP 1	-	1	PCP 1	PCP 7
3	Light Blue Dashed	PCP 4	-	4	PCP 4	PCP 8
4	Green	PCP 3	-	3	PCP 3	PCP 9
5	Green Dashed	PCP 5	6, 7, 8, 9	7	PCP 5	PCP 10
6	Orange Dashed	PCP 7	-	6	PCP 7	PCP 11
7	Blue Dashed	PCP 8	10, 11	8	PCP 8	PCP 12
8	Yellow	PCP 6	9, 11, 12	9	PCP 6	PCP 13
	Yellow	-	-	-	PCP 9	PCP 14
	Yellow	-		-	PCP 11	PCP 15
9	Light Blue	PCP 10	13, [illegible], 15, 2	10, 2	PCP 10	PCP 16
	Light Blue	[illegible]	-	-	PCP 2	PCP 17
10	Orange	PCP 14	16	11	PCP 14	-
11	Yellow Dashed	PCP 15	12, 13, 16, 17	12	PCP 15	-
	Yellow Dashed	[illegible]	-	-	PCP 13	-
	Yellow Dashed	-	-	-	PCP 12	-
	Yellow Dashed	-	-	-	PCP 16	-
12	Pink Dashed	PCP 17	-	13	PCP 17	-

Figure 3. Purge Plan Example - Complex Distribution Sequence of Operations

REVISION NOTES

Where?	What Changed?
Purge Driving	Changed “For steel pipe, if purging through a Save-a-Valve, it is at minimum 1/6 of the diameter of the mainline pipe size” to “For steel pipe, if purging through a Save-a-Valve, refer to Table 3 for specific purge information.”
Purge Driving	Changed “For plastic pipes, the inlet and outlet is, at a minimum, ¼ of the mainline pipe size and the piping is less than 10 feet” to “If purging through a ½-inch or 1-inch pigtail, refer to Table 4 for specific purge information.”
Figure 1	Updated to incorporate the new required and recommended isolation points.
Revision 0	Published 02/20/2019
NA	This is a new attachment.

Purge Calculation Worksheet Instructions

Guidance Document References:

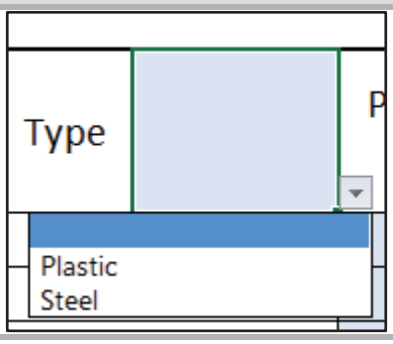
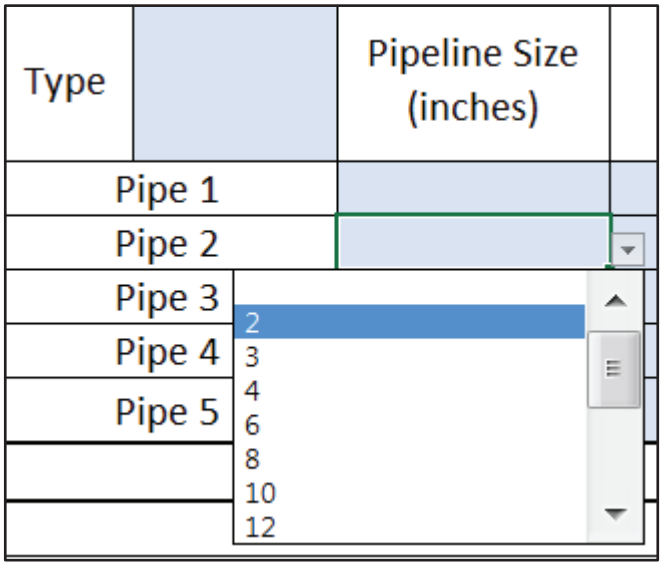
- Gas Design Standard (GDS) A-38, “Purging Gas Facilities”
- Form A-38-F01, “Purge Calculation Worksheet”

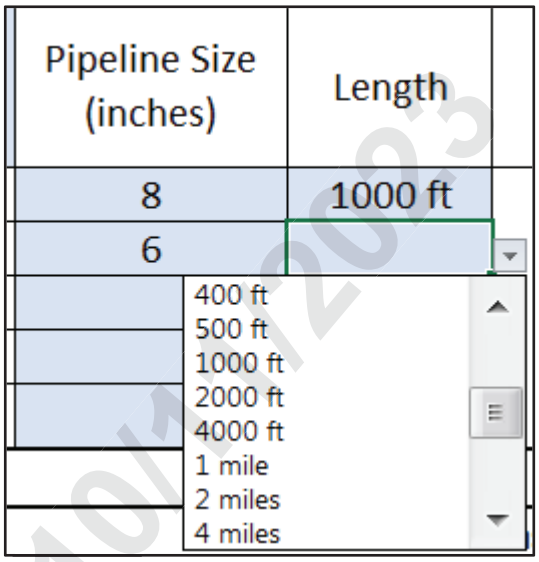
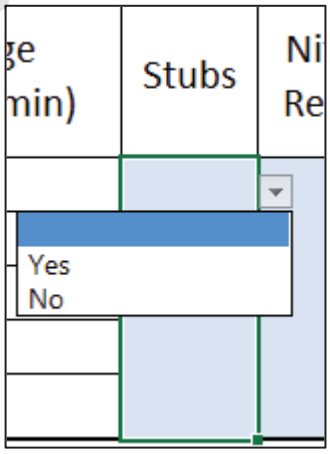
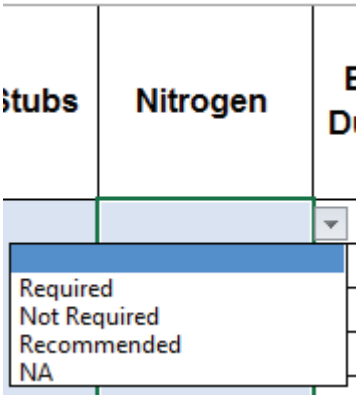
Level of Use:

☒ Information

☐ Reference

☐ Continuous

Steps	Images
1 **Open Form A-38-F01, “Purge Calculation Worksheet.”** Open the Purge Calculation Worksheet. For each segment to be purged, enter the appropriate information into the fillable blue cells. The following information is required: 1. Pipe material (plastic or steel) 2. Pipe diameter (size in inches) 3. Length of each pipe diameter (feet or miles) 4. Whether stubs will be purged with mainline 5. Nitrogen slug requirement	
2 **Type (Pipe Material)** Use the drop-down list to select the pipe material to be purged: Plastic or Steel.	
3 **Pipeline Size (inches)** Use the drop-down list to select the diameter for all pipe sizes being purged in this segment.	

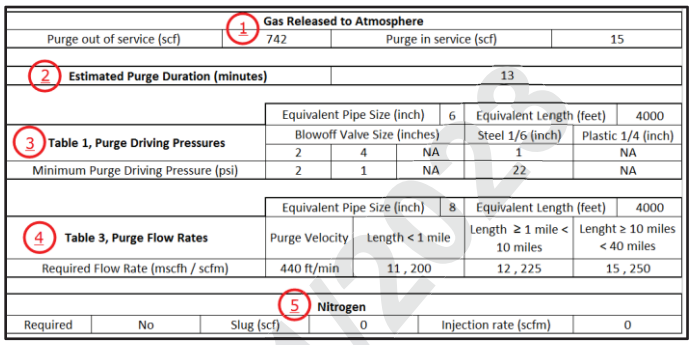
Steps	Images
4 **Length** For each pipe diameter, select the length of pipe to be purged from the drop-down list.	
5 **Stubs** Select Yes from the drop-down list, if side-tapped stubs less than 30 pipe diameters in length will be purged with the mainline pipe. Selecting Yes adds 5 minutes to the total purge duration to clear the stub after the mainline has been cleared. Otherwise, select No.	
6 **Nitrogen Required** Use the drop-down menu to select the appropriate response.	

Steps	Images

7 Purge Results

Based on the inputs selected above, the following information is provided to aid in creating a purge plan:

1. Gas Released Into Atmosphere
2. Estimated Purge Duration
3. Purge Driving Pressure (See GDS A-38, Table 1, “Minimum Purge Driving Pressures”)
4. Purge Flow Rates (See GDS A-38, Table 6, “Purge Flow Rates”)
5. Nitrogen Slug and Injection Rate



1 Gas Released to Atmosphere			
Purge out of service (scf)	742	Purge in service (scf)	15
2 Estimated Purge Duration (minutes)			13
3 Table 1, Purge Driving Pressures	Equivalent Pipe Size (inch)	6	Equivalent Length (feet) 4000
	Blowoff Valve Size (inches)		Steel 1/6 (inch) / Plastic 1/4 (inch)
	2 / 4 / NA		1 / NA
Minimum Purge Driving Pressure (psi)	2 / 1 / NA		22 / NA

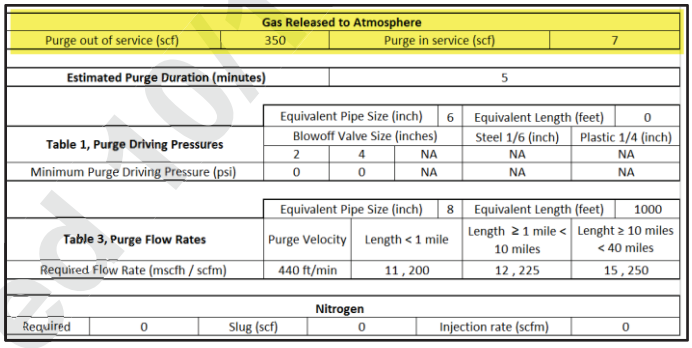
4 Table 3, Purge Flow Rates	Equivalent Pipe Size (inch) 8	Equivalent Length (feet) 4000	
	Purge Velocity	Length < 1 mile	Length ≥ 1 mile < 10 miles / Lenght ≥ 10 miles < 40 miles
Required Flow Rate (mscfh / scfm)	440 ft/min	11 , 200	12 , 225 / 15 , 250

5 Nitrogen					
Required	No	Slug (scf)	0	Injection rate (scfm)	0

8 Gas Released Into Atmosphere

Gas released into the atmosphere while purging a pipeline out of service is equal to the internal volume of the pipe.

The gas released into the atmosphere when purging a pipe into service is equal to 2% of the entire pipe volume. (See GDS A-38, Equation 6, “Estimated Volume of Gases Expected to Mix”)



Gas Released to Atmosphere			
Purge out of service (scf)	350	Purge in service (scf)	7
Estimated Purge Duration (minutes)			5
Table 1, Purge Driving Pressures	Equivalent Pipe Size (inch)	6	Equivalent Length (feet) 0
	Blowoff Valve Size (inches)		Steel 1/6 (inch) / Plastic 1/4 (inch)
	2 / 4 / NA		NA / NA
Minimum Purge Driving Pressure (psi)	0 / 0 / NA		NA / NA

Table 3, Purge Flow Rates	Equivalent Pipe Size (inch) 8	Equivalent Length (feet) 1000	
	Purge Velocity	Length < 1 mile	Length ≥ 1 mile < 10 miles / Lenght ≥ 10 miles < 40 miles
Required Flow Rate (mscfh / scfm)	440 ft/min	11 , 200	12 , 225 / 15 , 250

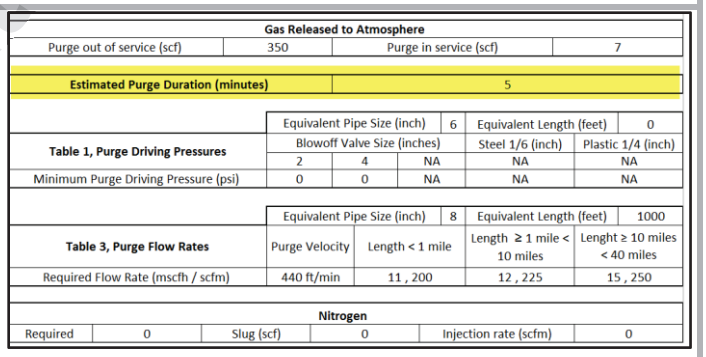
Nitrogen					
Required	0	Slug (scf)	0	Injection rate (scfm)	0

9 Estimated Purge Duration

Estimated purge duration is determined from GDS A-38, Equation 3, “Estimated Duration of the Purge,” and Equation 4, “Estimated Duration of Purge Through Smaller Segments of Multi-Diameter Pipelines.” If purging through a Save-a-Valve or pigtail the purge rate to be used in determining the estimated purge duration is provided in GDS A-38, Tables 3, 4, or 5.

If stubs are purged with the main pipeline, an additional 5 minutes is added to the purge time.

An additional 2 minutes is added to the overall purge duration as a safety buffer.



Gas Released to Atmosphere			
Purge out of service (scf)	350	Purge in service (scf)	7
Estimated Purge Duration (minutes)			5
Table 1, Purge Driving Pressures	Equivalent Pipe Size (inch)	6	Equivalent Length (feet) 0
	Blowoff Valve Size (inches)		Steel 1/6 (inch) / Plastic 1/4 (inch)
	2 / 4 / NA		NA / NA
Minimum Purge Driving Pressure (psi)	0 / 0 / NA		NA / NA

Table 3, Purge Flow Rates	Equivalent Pipe Size (inch) 8	Equivalent Length (feet) 1000	
	Purge Velocity	Length < 1 mile	Length ≥ 1 mile < 10 miles / Lenght ≥ 10 miles < 40 miles
Required Flow Rate (mscfh / scfm)	440 ft/min	11 , 200	12 , 225 / 15 , 250

Nitrogen					
Required	0	Slug (scf)	0	Injection rate (scfm)	0

10 Purge Driving Pressures

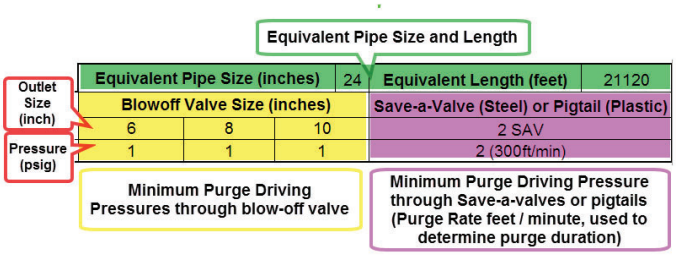
For the given pipe size and length, the minimum purge-driving pressures are listed for each available blow-off valve size in GDS A-38, Table 1.

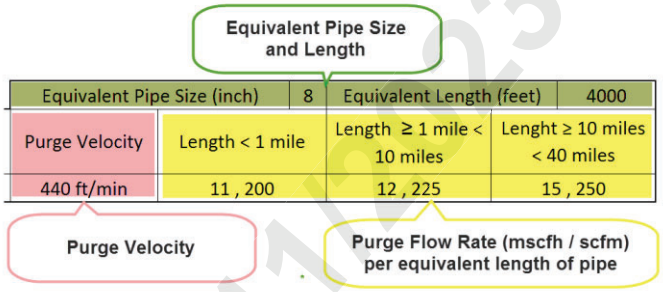
The minimum outlet size is listed along with the required purge-driving pressure needed.

For multi-diameter segments, the smallest mainline pipe diameter is used as the pipe size.

GDS A-38, Equation 1, “Equivalent Length of Pipeline for Multi-Diameter Pipelines,” is used to determine the length of each pipeline diameter.

The equivalent pipe size and length is listed.



Steps	Images
11 **Purge Flow Rates** For the given pipe size, the purge flow rates are listed in GDS A-38, Table 6. For multi-diameter segments, the largest mainline pipe diameter is used as the equivalent pipe size. The equivalent pipe length is the sum of all pipe lengths. The equivalent pipe size and length is listed.	 Equivalent Pipe Size (inch) 8 Equivalent Length (feet) 4000 Purge Velocity | Length < 1 mile | Length ≥ 1 mile < 10 miles | Lenght ≥ 10 miles < 40 miles 440 ft/min | 11 , 200 | 12 , 225 | 15 , 250
12 **Nitrogen Requirement** The volume of nitrogen slug given in standard cubic feet (scf) and the required injection rate are listed based on GDS A-38, Table 7, “Nitrogen Required for Inert Slug.” For multi-diameter segments, the largest mainline pipe diameter is used as the equivalent pipe size. The equivalent pipe length is the sum of all pipe lengths. The equivalent pipe size and length is the same as listed in GDS A-38, Table 6.	**Gas Released to Atmosphere** Purge out of service (scf) 350 Purge in service (scf) 7 **Estimated Purge Duration (minutes)** 5 Equivalent Pipe Size (inch) 6 Equivalent Length (feet) 0 **Table 1, Purge Driving Pressures** | Blowoff Valve Size (inches) 2 | 4 | NA | Steel 1/6 (inch) NA | Plastic 1/4 (inch) NA Minimum Purge Driving Pressure (psi) 0 | 0 | NA | NA | NA Equivalent Pipe Size (inch) 8 Equivalent Length (feet) 1000 **Table 3, Purge Flow Rates** | Purge Velocity | Length < 1 mile | Length ≥ 1 mile < 10 miles | Lenght ≥ 10 miles < 40 miles Required Flow Rate (mscfh / scfm) 440 ft/min | 11 , 200 | 12 , 225 | 15 , 250 **Nitrogen** Required 0 Slug (scf) 0 Injection rate (scfm) 0

Purging Plastic Pipe With CrazeWeld Purge Stand

A-38-JA02
Publication Date: 04/12/2023
Effective Date: 07/01/2023
Rev. 0

Tools:

- Fire Extinguisher
- Grounding Cables
- Grounding Device
- Natural Fiber Rags
- Soap Solution
- Spray Applicator
- CrazeWeld Purge Stand (S&S number SRM3027615)
- CGI

Guidance Document References:

- Gas Design Standard A-38, “Purging Gas Facilities”
- Utility Procedure TD-4170P-01, “Static Electricity Control for Polyethylene (PE) Pipe”

PPE:

- See the Gas Ops PPE Matrix for minimum PPE requirements.
- Leather gloves are recommended.

Level of Use:

☒ Information

☐ Reference

☐ Continuous

Steps

1 **Assemble purge stand in desired location outside of excavation.**

Legs can be adjusted and extended for added stability on uneven ground.

Install extensions to extend purge end a minimum of 6 feet above grade.

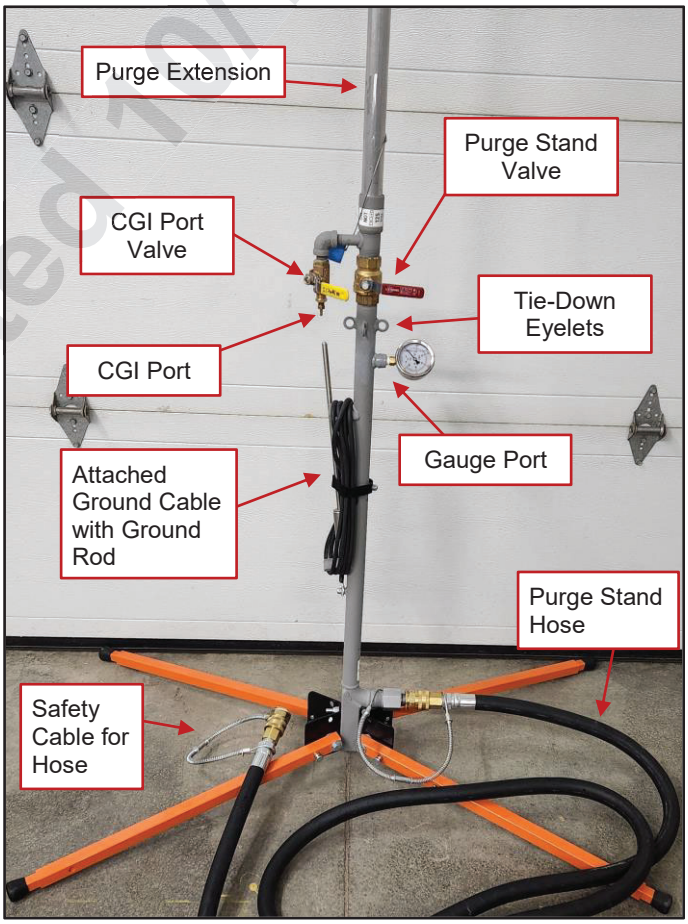
Secure in place if needed using tie-down eyelets.

Ground purge stand using attached ground cable with ground rod.

Close all valves on purge stand.

(Optional) Install pressure gauge into gauge port.

Images

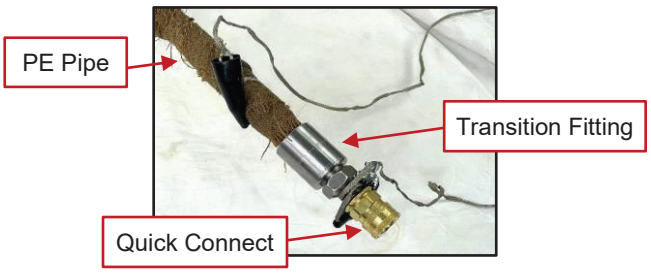


2 **Connect transition fitting to purge end of PE pipe.**

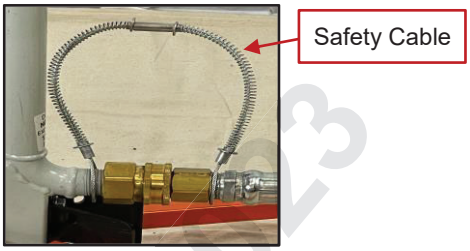
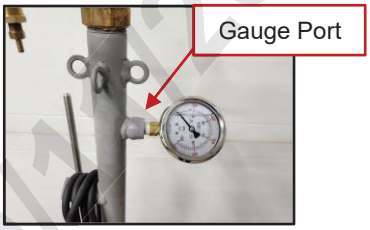
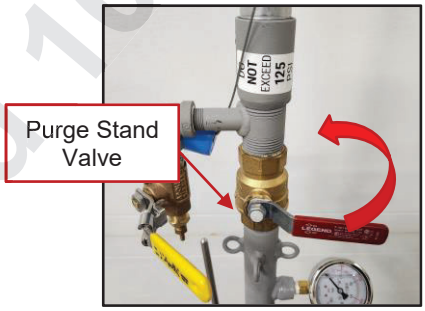
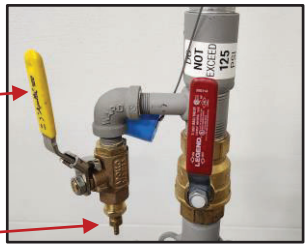
Install transition fitting on purge end of PE pipe.

Apply static electricity controls on plastic pipe as described in Utility Procedure TD-4170P-01.

Metallic end of transition must be grounded.



Purging Plastic Pipe With CrazeWeld Purge Stand

Steps	Images
3 **Connect purge stand hose to transition fitting and purge stand.** Use supplied quick-connect fittings from purge stand. Secure with safety cable.	
4 **Release flow control on plastic pipe to introduce pressure to purge stand.** If desired, verify line pressure with PG&E-approved gauge at gauge port (gauge pictured is for illustration purpose only).	
5 **When ready to purge, open purge valve to begin purge operation.** Confirm the purge stand is secure, by slowly opening purge stand valve. The purge stand is designed to function with the purge stand valve fully open for the duration of purge.	
6 **Continue purge operation until required percent gas mixture is achieved.** Verify completion with CGI at CGI Port by fully opening the CGI port valve. Purge stand valve must remain fully open while using the CGI to get an accurate reading. Refer to GDS A-38 for purge completion guidance.	
7 **After purge is complete, perform as follows:** Close valves on purge stand. Control flow on plastic pipe. Relieve remaining line pressure at purge stand valve. **WARNING:** To avoid the potential for static shock, a soapy solution must be applied to the portions of rubber hose that will be handled during disassembly. Disconnect hose, transition fitting, and disassemble purge stand. Proceed to post purge construction operations.	

Frequently Asked Questions

A-38, "Purging Gas Facilities," Rev. 1c

Complex Distribution Systems

Q1. What is a considered a complex distribution system?

If the pipeline system being put into or taken out of service loops onto itself, it is considered a complex distribution system. A purge plan must be included with the clearance.

Loops and Laterals

Q2. When purging a looped networked grid, do the loops have to be isolated?

Yes, if a pipeline loops back onto itself, it has to be isolated per Figure 1 below.

Isolation points are required to prevent the gas and air mixing back into each other. The isolation points create a predictable one-directional flow in the pipe which can be used to systematically remove and replace one gas with another. In the example below, the pockets of air are being systematically moved to vent locations where it can be removed from the pipeline. If a pipeline cannot be isolated per the example below, there is no systematic approach to ensure all air is removed from system.

A volume of nitrogen equal to the volume of the pipe can be injected into the system before starting the purge, to remove the concern of the air and gas mixing and causing a flammable mixture. However, there would still be no method to ensure all air or nitrogen is removed from the system, which would result in lower gas quality, or a possible air or nitrogen pocket that could result in a loss of gas event. In such cases, the project team needs to work with the appropriate lines of business to perform additional analysis, such as gas flow modeling, or determining the amount of air that could be left in the system, and if it is acceptable, to determine an alternate purge plan.

Isolation points are referred to as Purge Control Points (PCP) in Figure 1. For more information on the recommended isolation point between the main and the lateral, refer to question 4.

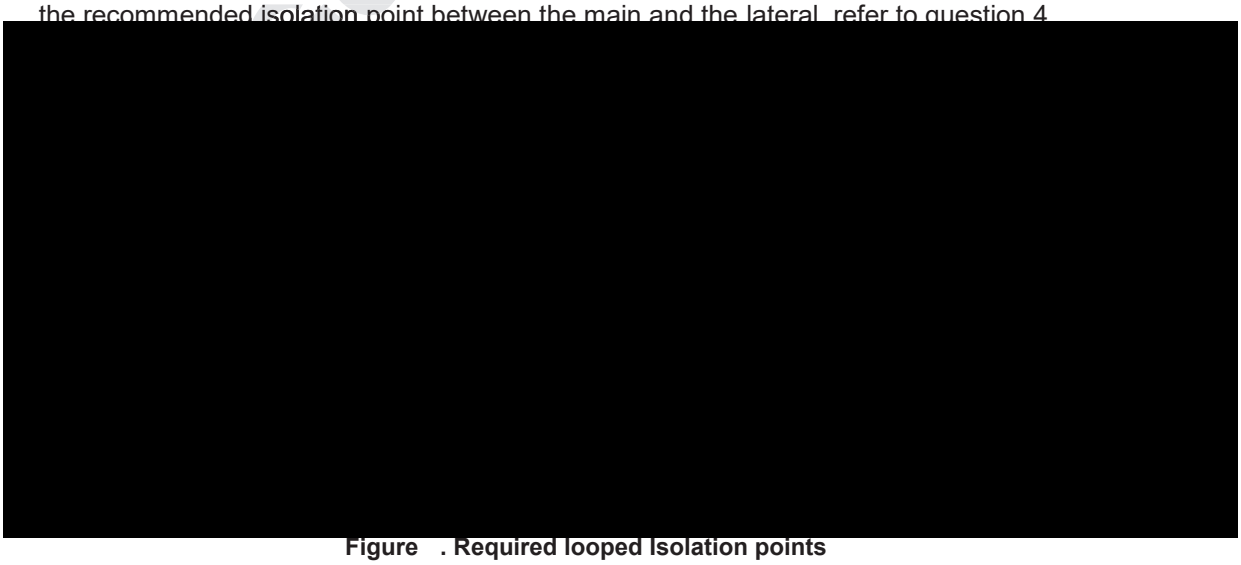


Figure . Required looped Isolation points

Q3. Where should isolation points be applied on looped networks that cannot be isolated at the main?

It is recommended the isolation points be within 30 pipe diameters of the in-line tee. This means the short stub is effectively cleared during the purging of the main. However, when such locations are not easily accessible, the isolation point can be moved to any optimal location on the looped

Q4. When purging a main with laterals, does each lateral have to be isolated from the main?

It depends on the type of connection.

1. Connections coming off the top or bottom of the main pipeline do not have to be isolated, but have to be purged individually, promptly after the mainline purge.
2. Connections coming off the side of the main pipeline and less than 30 pipe diameters in length do not have to be isolated; they clear during the purging of the main.
3. Connections coming off the side of the main pipeline should be isolated whenever possible, but isolation is not required. These laterals have to be purged individually, promptly after the mainline purge. See Figure 2.

If the optimum isolation points are not accessible (as in, for example, an applicant-installed new business tract whose piping was installed months ago, which has already been paved, and whose concrete has been poured; an existing system that must be evacuated during an emergency event; or even just a main out in the middle of the street that is part of a clearance) the project and clearance teams have to weigh the pros and cons of accessing and isolating each lateral against the following concerns.

One of the primary reasons for isolating long laterals is to break a complex system into simple point A to point B purges. During a purging operation, only the inlet pressure, purge time, and vent constituents can be monitored. The guidance in this standard can provide consistent and predictable results. If something were to be forgotten or missed, the clearance team should be able to realize that there is a problem before putting the system into operation or allowing someone to work on the piping.

In addition to leaving more room for error, not isolating laterals can increase the likelihood of the following:

- Increase in duration of purging
- Increase in the flammable mixture region within the pipeline
- Increase in the release of greenhouse gases to atmosphere
- Lower gas quality

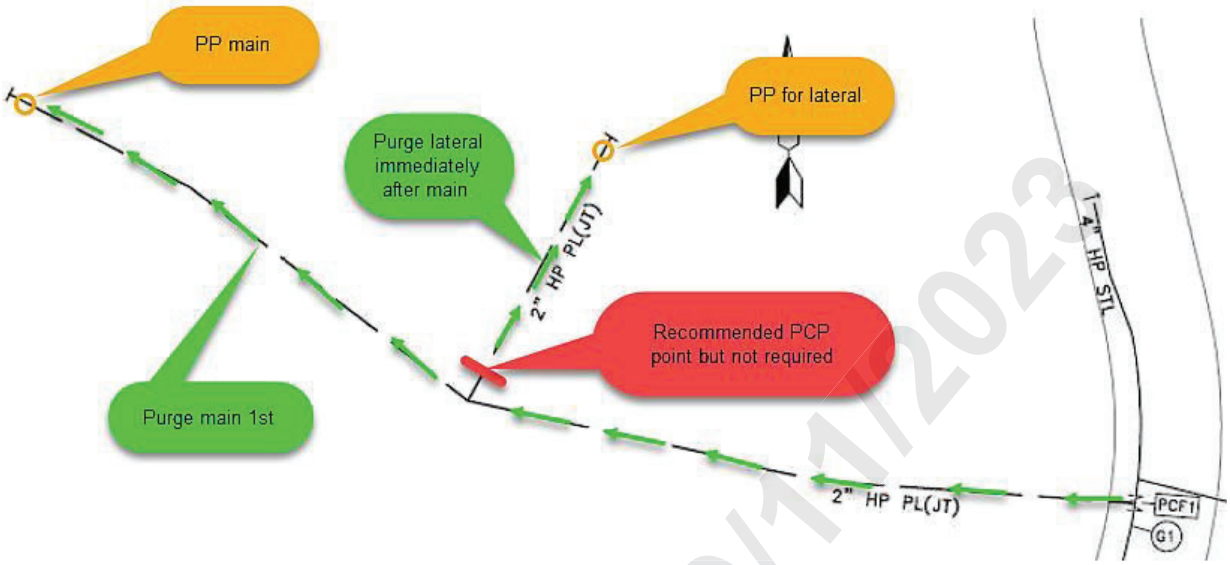


Figure 3. Recommended lateral isolation points

Q5. Can a lateral be purged at the same time as the main?

Yes, if it can be confirmed that the minimum velocity will be achieved in all legs of the system, laterals can be purged concurrently with the main.

Deactivating Mains

Q6. When deactivating a main with short lengths of capped services, do the capped services have to be purged separately?

Yes, because the gas in the top-tapped services does not clear during the purging of the main and slowly diffuses into the air in the main over time. If it is not feasible to purge each capped service individually after the purging of the main, consider the following alternatives.

1. **Option #1**

   Confirm that the volume of gas left in the services will not lead to a mixture in the system whose LEL is over 20%. 20% LEL is equivalent to 1% gas by volume in the system.

   Example:

   - 10 feet of ½ -inch service for every 120 feet of 1¼-inch main will lead to a mixture of 0.94% gas.
   - 10 feet of ½-inch service for every 50 feet of 2-inch main will lead to a mixture of 0.98% gas.
   - 5 feet of 1-inch service for every 120 feet of 2-inch main will lead to a mixture of 0.90%.

   To determine the volume of the pipe and percent gas by volume in the system, use the equations below.

$$Volume\ of\ main\ (ft^3) = 0.005454 \times (ID\ of\ pipe\ in\ inches)^2 \times Overall\ Main\ Length\ in\ feet$$

$$Volume\ of\ services\ (ft^3) = 0.005454 \times (ID\ of\ pipe\ in\ inches)^2 \times Overall\ Service\ Length\ in\ feet$$

$$\%\ Gas\ by\ volume = \frac{Volume_{service}}{Volume_{service} + Volume_{main}} \times 100$$

2. **Option #2**

   Purge with nitrogen and leave atmospheric nitrogen in the deactivated line,

   or

   After the completion of the air purge, inject nitrogen equal to the volume of the system to mix with or replace the air.

   A standard bottle of nitrogen typically contains 220 cubic feet of nitrogen at atmospheric pressure, which is enough to fill approximately 2 miles of 2-inch plastic pipeline.

Q7. How long is an "extended period" when determining whether to fill gas facilities with moisture-free nitrogen?

Generally, greater than 3 months, gas facilities must be filled with moisture-free nitrogen to minimize internal corrosion. Less than 3 months, gas facilities can be left flat or filled with moisture-free nitrogen. The internal corrosion risks of a purged and capped flat line for less than 3 months are negligible. Moisture is a time-dependent threat, and will start to create corrosion issues at greater than 3 months.

Estimated Duration of the Purge

Q8. When I follow the purge pressures provided in Table 1, the actual purge time is less than the estimate provided by A-38. Why is that?

The calculations in A-38 are based on purge velocities of 440 feet per minute for pipes larger than 4-inch, and 1000 feet per minute for 4-inch and smaller. The estimated purge duration is based on these purge velocities.

For example, purging a 24-inch pipe, 1 mile long, at 440 feet/minute will take about 12 minutes.

$$\left(\frac{5240\ feet}{440\ {feet}/{minute}} = 11.9\ minutes\right)$$

However, based on the exact inlet/outlet pipe size, length, number of fittings, and their configurations, each individual system requires a unique purge driving pressure to maintain the 440 feet/minute or 1000 feet/minute velocities. In addition, the actual required purge driving pressure is a fraction and has been rounded up for simplicity. Also, the purge driving pressure during a purge is always fluctuating and must be constantly controlled and, in many instances, is above the pressures in Table 1. Due to all these factors, in many instances, the purge velocity in the pipe is higher than what is recommended in A-38, which leads to shorter actual purge durations.

If using the Purge Calculation Worksheet, 2 minutes is added to the duration as a buffer, and if stubs are selected, the duration is increased by 5 minutes.

If purging at a pressure higher than what is listed in Table 1, A-38, Equation 5 can be used to adjust the estimated duration of the purge.

$$T_B = T_A \sqrt{\frac{P_A(P_B + 14.7)}{P_B(P_A + 14.7)}}$$

Equation 5. Estimated Duration of Purge if Using Higher-Driving Pressure

Where: T_B = new purge duration (minutes)
T_A = original purge duration (minutes)
P_A = original purge-driving pressure (psig)
P_B = new purge-driving pressure (psig)

Pack and Purge

Q9. When purging into service, should the facility be pressurized before purging?

No. The purging procedures in A-38 are based on the pipe being depressurized (see A-38, "General Information," item 2). The research upon which the AGA purging practices are based shows that the critical factor to minimize mixing is the velocity of the gas/air interface flowing in the pipe. Pressure is irrelevant, because the density difference between the gas and air stays constant no matter the pressure. What does change with pressure is the volume of gasses to deal with. By packing first, for example to 60 psig, to maintain the same flow velocity, you would need to push 5 times the volume of gas/air through the pipe as you would need with the system depressurized (at around 15 pounds per square inch absolute [psia]). The higher volume would result in noisier venting, more potential for dust and debris flow, and greater releases of greenhouse gas.

Another difficulty with packing first is being able to calculate an estimated purge duration. Estimating the duration of a purge not only helps with work planning, but it is also a layer of safety. If the actual purge takes significantly more or less time than estimated, it indicates that something is not as planned (an unmapped cross-tie, a flow restriction, etc.). To calculate a purge duration for a packed system, you would need to predict and track how much the throttling valve at the end of the vent is open, which would be quite difficult. A throttling valve on the upstream end of the purge is easier to control and monitor by measuring the pressure in the pipe just downstream of it.

When tying in a plastic system with a squeezer as the upstream control point, do not use the squeezer to throttle the driving flow. Recommendation: after making the tie-in connection, but before opening the squeezer, install a temporary bypass around the squeezer with a valve for throttling and a pressure gauge downstream. Partially open the valve and use it to throttle flow to maintain the proper driving pressure in the main to be purged. After purging is complete, open the squeezer and remove the bypass.

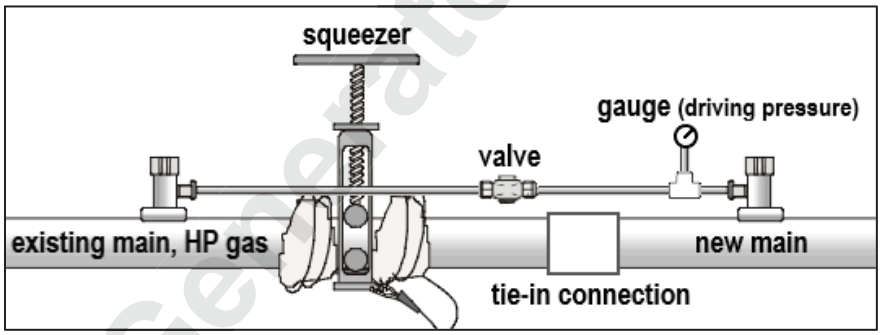


Figure 4. Temporary bypass around squeezer for throttling purge

Cut and Cap Stubs

Q10. In reference to the "Purge Routing and Segmentation" section in A-38, do the short stubs of cut and capped main need to be purged?

When a section of plastic main needs to be squeezed, cut, and capped, the short-capped stub will retain a small volume of air. In certain circumstances in small piping it may be infeasible to purge that de minimis volume of air, and it may be allowable for that air to blend into the rest of the gas in the system. Note, however, that stubs on low pressure systems always need to be purged of air (see GDS C-37, "Tapping, Bagging, Tieing-in, and Cutting-off LP or SHP Gas Lines"), and when using a PCF for a cut and cap on a steel system, the procedures for retracting stoppers in PCFs (such as TD-4150P-222) always call for the air to be purged from the stopped off section of pipe.

When cut and capped, the short stub of main between the squeezer and the cap remains full of air at atmospheric pressure. That air is compressed when the squeezer is withdrawn, so at full system pressure only a percentage of the volume of the stub is air. This table shows what percentage of the volume of the stub is air after being compressed with gas at a few various system pressures:

System pressure	Percentage of air in stub
7″ water column (LP)	98.3% air
25 psig (SHP)	36.7% air
50 psig (HP)	22.5% air

PG&E's gas quality limit for nitrogen is 4% and oxygen is 0.1%. That oxygen limit would equate to a maximum of 0.5% air in the gas. The volume of air in a cut and capped stub needs to mix with a much larger volume of gas in order to meet the gas quality limits.

There are a few mixing mechanisms for the trapped air and gas:

- Jet-stir mixing as squeezer is withdrawn – mixing diminishes after pressure equalizes.
- Buoyancy-driven exchange – trapped air will flow to bottom of the pipe.
- Convective mixing – air that is warmer than the gas will tend to rise, then fall again as it cools.
- Molecular diffusion – without the other mixing mechanisms, it could take days for the air to fully diffuse into the gas in smaller piping.

Although within the stub the air may mix relatively quickly with gas as the squeezer is removed, further mixing into the larger volume of gas back upstream will take much longer. If there are any branches, services, or other ways the gas could flow just upstream from the stub, some partially mixed air could get carried away as a slug and cause hazards, outages, or other problems. Therefore, to guarantee the trapped air is fully mixed and diffused into the gas to an acceptable degree, ensure there is a minimum length of main upstream of the squeezer completely free of branches and taps (attached stub services or other stubbed branches are OK) before determining the location to cut and cap.

In general, for trapped air to diffuse to below 0.5% volume in HP distribution (45-60 psig) systems, there needs to be at least 50′ of branch and tap free main upstream of the squeezer location for every 1′ of cut & capped stub downstream of squeezer. This table shows the minimum length of branch and tap free main for various sizes of HP main assuming the stub length is 3× the size of the main as typical:

Main size	Branch & tap free main
2″ plastic main (6″ long stub)	25′ of clear upstream main
4″ plastic main (12″ long stub)	50′ of clear upstream main
6″ plastic main (18″ long stub)	75′ of clear upstream main

Double the length of branch and tap free upstream main for SHP (15-45 psig) systems

Minor Revision Guidance Document Analysis (MRGDA)
Purging Gas Facilities
A-38, Rev. 1h

Document Type	Gas Design Standard (GDS)
Workflow	Minor Revision

1. What is Changing and Why?

Due to a natural gas ignition incident, an employee was burned during a routine purging operation. The methods for purging polyethylene pipe were determined to be inconsistent across the Company's service territories. A purge stand was identified and that provides the field personnel with a tool that allows for a safe, uniform, and consistent method to purge polyethylene pipelines. The CrazeWeld Purge Stand was evaluated and approved through a pilot variance EDRS 2022-34873.

Section/Step	What to Change/Add/Delete	Driver/Reason
Safety 1.G and References	Update reference to Utility Procedure TD-4170P-01, "Static Electricity Control for Polyethylene PE) Pipe	Utility Work Procedure WP4170-01, "Grounding Polyethylene (PE) Pipe to Control Static Electricity" has been canceled and replaced with Utility Procedure TD-4170P-01, "Static Electricity Control for Polyethylene PE) Pipe.
Safety 1.G	Add substep to 1.G: For ordering information and guidance for use of the CrazeWeld purge stand to purge plastic facilities, refer to Job Aid A-38 JA02, "Purging Plastic Pipe With CrazeWeld Purge Stand."	To provide reference to Job Aid A-38-JA02.
Safety 1.G.1	Move 1.G.1 to new 1.H	To correct misaligned steps.
Purge Driving, 3.C	Delete: During a "hot-cut" operation (as detailed in Utility Procedure TD-4100P-01, "Hot and Cold Work Methods for Natural Gas Transmission Pipeline Shutdown and Tie-In"), the air source inlet is a window cut in the mainline pipe. Since purging will operate in both directions from the window, the opening needs to be at least ⅔ of the mainline pipe diameter. Refer to GDS A-38.1, "Installation and Operation of Air Movers," for recommended hole cut sizes.	Cutting in an air source window is no longer a common practice. In addition, Utility Procedure TD-4100P-01 was canceled.
References	Delete canceled Utility Procedure TD-4100P-01, "Hot and Cold Work Methods for Natural Gas Transmission Pipeline Shutdown and Tie-In."	Utility Procedure TD-4100P-01 was canceled and replaced with Utility Procedure TD-4441P-21, "Tie-In Construction Methods for Gas Clearance."

Section/Step	What to Change/Add/Delete	Driver/Reason
Working on Facilities That Have Been Purged Out of Service, and in References section	Correct document title: Refer to GDS A-36, "Design and Construction Requirements for Gas Pipelines ~~Lines and Related Facilities~~."	To correct title of cross-referenced GDS A-36.
JA-02	Add new job aid - Purging Plastic Pipe With CrazeWeld Purge Stand	To provide guidance to the field for the safe operation on the CrazeWeld purge stand.

2. <u>Major</u> New Risks or Changes to Existing Mitigated Risks (such as Process Safety risks)

None

3. Stakeholders

Table 1. Stakeholder Reviewers

Department / Work Center	Title (and Role if applicable)	Name (LAN ID)	Date Provided	Gave Input ?
Work Practices & Innovations	Expert Specialist, Document Steward	[redacted]	02/23/2023	Yes
Standards Engineering	Expert Specialist, Document Coordinator		02/23/2023	Yes
Standards Engineering	Principal, Lead Engineer		02/23/2023	Yes
Gas Transmission & Distribution	Director, Document Approver		02/23/2023	Yes
Distribution Integrity Management (DIMP)	Principal Engineer		02/23/2023	Yes
Standards Engineering	Senior Gas Engineer		02/23/2023	Yes
Process Safety Process-safety@pge.com	Principal, Process Safety Engineer		02/27/2023	Yes
Gas M&C	Supervisor		02/27/2023	Yes
Gas M&C	Supervisor		02/27/2023	Yes
Gas M&C	Crew Leader-Arc, 1st Responder		02/27/2023	Yes
Gas M&C	Operator		02/27/2023	No
GC Gas	Operator		02/27/2023	Yes
GC Gas	Working Foreman B		02/27/2023	Yes
PG&E Academy	Expert Technical Training Instructor		02/27/2023	No
Safety	Supervisor		02/27/2023	No
Quality Management	Supervisor		02/27/2023	Yes
Quality Management	Specialist		02/27/2023	Yes
Quality Management	Specialist		02/27/2023	Yes
Quality Management	Specialist		02/27/2023	Yes
GC Gas Inspection	Supervisor		02/27/2023	Yes
Various	Various	Plastic Tech Team	03/02/2023	Yes

4. Electronic Document Routing System (EDRS) Reviewers and Approvers

Approvers: [redacted]

EDRS Routing Number: 2023-12005

5. Cost Information

A Capital Tool purchase request has been submitted for 55 system purge kits totaling $379,000.

6. Schedule Information

Effective Date: Default effective date (07/01/2023)

Communications email will be sent to affected personnel, and supervisors will discuss the changes with their teams.

7. Cancellations

NA

8. Manuals ☒ No Change to Manuals

9. Document Properties

Functional Area

☒ CNG-LNG	☒ Compression and Processing	☒ Customer Connected Equipment	☒ Distribution Mains
☒ Distribution Services	☒ Measurement and Control	☒ Storage	☒ Transmission Pipe

Target Audiences

☐ Asset Strategy	☐ Facility Integrity Management	☒ Leak Repair	☐ R&D and Innovation
☒ Associate Distribution Engineers	☒ GPOM (I&R)	☐ Leak Survey	☐ Records and Information Management
☒ Compliance and Risk	☐ Gas Control Strategy and Support	☐ Locate and Mark	☒ Regulatory Compliance
☒ Contract Management	☐ Gas Distribution Control Center	☐ Mapping (Transmission and Distribution)	☐ Risk Management
☒ Corrosion Mechanics	☐ Gas Emergency Preparedness	☐ Metering Plant	☐ Service Planning
☐ Corrosion Services	☐ Gas Operations Leadership	☐ Picarro	☐ Sourcing
☐ Data Quality	☐ Gas Service Representatives	☒ Pipeline Engineering	☐ Super Gas Ops
☐ Dispatch and Scheduling	☐ Gas Transmission Control Center	☐ Pipeline Safety Enhancement Plan Engineering	☐ System Planning
☒ Distribution Construction	☒ General Construction	☐ Program Management (Transmission and Distribution)	☐ Technology and Tools
☒ Distribution Engineering	☒ Hydrotesting	☒ Project Management (Transmission and Distribution)	☒ Transmission Construction
☐ Distribution Integrity Management	☐ Investment Planning	☐ Qualifications	☒ Transmission Engineering
☒ Estimating	☒ LNG|CNG Operations	☐ Quality and Improvement	☐ Transmission Integrity Management

Business Processes (GODOCS)

CONSTRUCTION	ENGINEERING	MAINTENANCE & OPERATIONS	EMERGENCY / ADMIN
☐ As-Builts	☒ Applicant Design Manual	☐ Corrosion Control	☐ Dispatch and Scheduling
☐ Coatings	☐ Asset Knowledge Management	☐ Damage Prevention (indicate subtype)[1]	☐ Emergency Plans
☒ Construction Methods	☐ Distribution Engineering	☐ Field Services (GSRs)	☐ Gas Guidance Document Process
☐ Environmental and Safety	☐ Engineering for Integrity Management	☒ Gas Control and Clearances	☐ Gas Operations Quality Management
☐ Excavation	☐ Engineering Material Specifications	☐ Integrity Management (IM)	☐ Gas Safety Excellence
☒ Gas Design Standards for Construction	☒ Gas Design Standards	☐ Leak Survey and Response	☐ Operator Qualifications (OQ)
☐ Inspection and Operation	☐ Process Safety	☐ Major Stations	
☐ Plastic	☐ System Planning	☐ Measurement and Regulation (M&R)	
☐ Steel Pressure Control	☐ Transmission Engineering	☐ Steel Pipeline Maintenance and Repair	
☐ Strength Testing and Commissioning		☐ Valve Maintenance	
☐ Welding and Nondestructive Examination (NDE)			

1. Damage Prevention subtypes: Locate and Mark, Patrolling, Public Awareness

Document Type	Gas Design Standard (GDS)
Workflow	Revision

1. Why is the guidance document being revised?

The previous revision (Rev. 0) of GDS A-38 was based upon the 1975 American Gas Associated (AGA) document, "Purging Principles and Practice." This revision updates the GDS to reflect the latest industry standards and best practices based on the 2006 update of the same AGA document. This revision also incorporates Corrective Action Program (CAP) issues, suggestions, comments, and gaps identified by the affected lines of business.

2. Is the guidance document new or revised? If it is revised, what will change? If new, what is the topic?

Revised.

- Updated title from "Procedures for Purging Gas Facilities" to "Purging Gas Facilities."
- Incorporated the latest industry standards and best practices based upon the AGA 2006, "Purging Principles and Practice."
- Incorporated Exponent research reports, "Purge Simulations," "Air Mover Testing and Performance Correlations," and "Analysis for Purging Pipeline Stubs."
- Changed the recommended purge rate of 2 minutes per mile to 1000 feet per minute for small-bore pipe sizes and 440 feet per minute for large-bore pipe sizes. These new purge rates are well above the minimum required rates to minimize mixing of gases and are achievable by using standard purging equipment currently used by Pacific Gas and Electric Company (PG&E) crews.
- Added guidance and requirements for purge planning.
- Added guidance on purge routing and segmentation.
- Added guidance on purging stubbed services.
- Updated Table 1 with new inlet driving pressures based upon the new purge rates.
- Added Table 2 to provide inside diameter and friction factors used to determine equivalent pipe length for purging multi-diameter pipes.
- Added Table 3 to provide maximum induced flow required. This new table helps determine the appropriate gas flow or equipment sizing needed to meet the required purge rates.
- Added guidance and information for purging through Save-a-Valves or other small-diameter inlets and outlets.
- Added guidance on purging multi-diameter pipelines.
- Added guidance on purging looped network grids.
- Added guidance on when stubs do not need to be purged individually.
- Added guidance on purging low-pressure systems.
- Added guidance on calculating the estimated duration of a purge.
- Added guidance on estimating the amount of gas released into the atmosphere.
- Included new purge calculation worksheet with job aid to help determine purge information quickly.
- Included new purge checklist and examples to aid in purge review
- Reevaluated when a nitrogen slug is required.
- Added guidance on purge monitoring.
- Added guidance on purging sequence and guidelines.

3. Does this project introduce any <u>major</u> new risks or change existing mitigated risks, such as Process Safety risks?

No.

4. Stakeholder Identification

Table 1. Technical Stakeholder Reviewers (required to be considered)

Department / Work Center	Role	[redacted]	Review Date
Pipeline Services	Document Steward		11/2018
Standards Engineering	Document Coordinator		11/2018
Standards Engineering	Document Coordinator		11/2018
Standards Engineering	Lead Engineer/Document Approver		11/2018
Gas Pipeline Operations and Maintenance (GPOM)	EDRS Approver		11/2018
Maintenance and Construction (M&C)	EDRS Approver		11/2018
General Construction (GC)	EDRS Approver		11/2018
GC	EDRS Approver		11/2018
TPCO	EDRS Approver		11/2018
Engineering GT	EDRS Approver		11/2018
Distribution Integrity Management Program (DIMP)	EDRS Approver		11/2018
System Planning	EDRS Approver		11/2018
Gas Distribution Inspection	EDRS Approver		11/2018
Operator Qualification	Supervisor, Gas Qualification		10/2018
Process Safety	Senior Process Safety Engineer		10/2018
Quality Management	NA – No QM associated with document		
Gas Strategy and Solutions	NA – Not associated with document		
Regulatory Compliance	NA – Not associated with document		
PG&E Academy	NA – Not associated with document		
As-Built Records	NA – Does not affect as-built documents		

Table 2. Target Audience Usability Review (stakeholders that may review)

Department / Work Center	Role	Name	Review Date
Gas Quality and Measurement	Supervisor	[redacted]	10/2018
Transmission Engineering	Gas Engineer, Principal		10/2018
Gas Clearance Coordinators	Supervisor		10/2018
Central Distribution Design	Gas Distribution Engineer, Senior		10/2018
			10/2018
Corrective and Compliance	Manager, Gas Distribution Engineering		10/2018
WRO Intake	Supervisor, Gas Distribution Engineering		10/2018
Abandonments	Gas Distribution Engineer, Senior		10/2018
CGI Compliance Operations	Supervisor Gas Transmission and Distribution		10/2018
Services	Supervisor, Gas Distribution Engineering		10/2018
Applicant Design	Associate Distribution Engineer, Gas		10/2018
Applicant Design	Senior Engineering Estimator, Gas		10/2018
Gas System Planning	Gas System Planning Engineer, Expert		10/2018
Planning	Gas Distribution Engineer		10/2018
Gas Construction	Supervisor, Distribution		10/2018
Gas Construction	Supervisor, Gas Transmission and Distribution		10/2018
Gas Construction	Supervisor Gas Transmission and Distribution (T&D) Construction		10/2018

Department / Work Center	Role	Name	Review Date
Gas Distribution GC Field Engineering	Field Engineering Tech	[redacted]	10/2018
Gas Distribution GC Field Engineering	Superintendent GD GC Field Engineering North		10/2018
General Construction	Supervisor		10/2018
General Construction	Working leader		10/2018
GPOM	Superintendent		10/2018
M&C	Gas Crew Leader		10/2018
Pipeline Field Services, TPCO	Supervisor		10/2018
GT GC Field Engineering	Superintendent		10/2018
GTGC Inspection	Supervisor		10/2018
GT General Construction	Working Leader		10/2018
GT General Construction	Working Leader		10/2018
Pipeline Field Services, TPCO	Supervisor		10/2018
Pipeline Engineering and Design	Gas Engineer, Senior		10/2018
Facility Engineering	Gas FIMP Engineer		10/2018
Station Engineering	Supervisor		10/2018
Services	Gas Distribution Engineer, Senior		10/2018
Pipeline Field Services	Supervisor, Clearance Writers		10/2018
Station Engineering	Gas Distribution Engineer, Senior		10/2018
Station Engineering	Gas Distribution Engineer, Senior		10/2018
Station Engineering	Gas Distribution Engineer, Senior		10/2018
Pipeline Field Services	Gas Clearance Coordinator, Senior		10/2018
Pipeline Field Services	Construction Manager, Expert		10/2018
Pipeline Engineering and Design	Supervisor		10/2018
Pipeline Engineering and Design	Supervisor		10/2018
Pipeline Engineering and Design	Supervisor		10/2018
Pipeline Engineering and Design	Supervisor		10/2018
Hydrotesting	Manager		10/2018
Hydrotesting	Supervisor		10/2018
Hydrotesting	Supervisor		10/2018
Plant Engineering and Design	Manager		10/2018

Department / Work Center	Role	Name	Review Date
Plant Engineering and Design	Supervisor	[redacted]	10/2018
Plant Engineering and Design	Supervisor		10/2018
Plant Engineering and Design	Supervisor		10/2018
Central Distribution Design	Manager		10/2018
Engineering GC	Supervisor		11/2018
GC	Director		11/2018
Transmission Integrity Management Program (TIMP)	Gas Pipeline Engineer, Expert		11/2018
Transmission Integrity Management Program (TIMP)	Director		02/2018

5. Electronic Document Routing System (EDRS) Reviewers and Approvers

Approvers [redacted]

6. Detail any needed cost or schedule information

Effective Date: 08/20/2019

7. How often will the guidance document be reviewed?

At least once every 5 calendar years, not to exceed 63 months, to the date.

Guidance Tailboard

DOCUMENT NAME: Purging Gas Facilities

DOCUMENT NUMBER: GDS A-38, Rev. 1

TAILBOARD ISSUED: 02/20/2019 TAILBOARD BY: NA

What is changing?

This revision includes the following changes:

- Updated title from “Procedures for Purging Gas Facilities” to “Purging Gas Facilities.”
- Incorporated the latest industry standards and best practices based upon the AGA 2006, “Purging Principles and Practice.”
- Incorporated Exponent research reports, “Purge Simulations,” “Air Mover Testing and Performance Correlations,” and “Analysis for Purging Pipeline Stubs.”
- Changed the recommended purge rate of 2 minutes per mile to 1000 feet per minute for small-bore pipe sizes and 440 feet per minute for large-bore pipe sizes. These new purge rates are well above the minimum required rates to minimize mixing of gases and are achievable by using standard purging equipment currently used by Pacific Gas and Electric Company (PG&E or Company) crews.
- Added guidance and requirements for purge planning.
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- Updated Table 1 with new inlet driving pressures based upon the new purge rates.
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- Included new purge calculation worksheet with job aid to help determine purge information quickly.
- Included new purge checklist and examples to aid in purge review
- Reevaluated when a nitrogen slug is required.
- Added guidance on purge monitoring.
- Added guidance on purging sequence and guidelines.

Why does it matter?

The previous version of GDS A-38 was based upon the 1975 AGA document, “Purging Principles and Practice.” This revision updates the GDS to reflect the latest industry standards and best practices. Incorporated into this update are Corrective Action Program (CAP) issues, suggestions, comments, and gaps identified by the affected lines of business.

Required Action

Target audience must review and become familiar with the contents of this gas design standard.

Tools and Training

NA

Timeline

Date	Activity
02/20/2019	Publication Date
06/20/2019	Effective Date