Gas Information Sheet No. 14

Purging Natural Gas Installation volumes between 0.03 m³ to 1.0 m³

Introduction
This information sheet has been prepared to assist gasfitters purge natural gas (NG) installations with volumes from 0.03 m³ to 1.0 m³.

Note
For installation volumes up to 0.03 m³ refer to AS 5601: 2013, Appendix D Purging.

For installation volumes exceeding 1.0 m³, purging may be based on this procedure but a Schedule 8 submission, as shown in Gas Safety (Gas Installation) Regulations 2008, describing the proposed testing and purging procedure must be provided to ESV for “complex gas installations” along with the ESV Start Work and Compliance Notice.

Purging
Purging is carried out to avoid the possibility of an explosive air/gas mixture existing or forming in consumer piping, appliances or confined spaces.

Purging is defined as:
• the displacement of air, or an inert gas, by a fuel gas; or
• the displacement of a fuel gas by air, or an inert gas.

Purging to displace air or inert gas with a combustible gas must take place immediately following a successful gas tightness test.

Note: Nitrogen is the preferred inert gas for purging.

Installation volumes from 0.03 m³ to 1.0 m³
Because of concerns regarding the environmental impact of methane (a major component of natural gas) in the atmosphere, the amount of vented gas should be controlled and kept to a minimum.

Ensure that the pipe work is gastight and all open ends are sealed before allowing gas to enter.

The pressure created during purging should not exceed the design operating pressure, and must not exceed the pressure to which the pipe has been tested.

Pipe work being permanently taken out of service must be isolated physically by removing a section of pipe work or by spading.

 Decommissioned pipe work must be left purged with inert gas.

The purging of the billing meter is normally a matter for the gas distribution company.

Preparation before purging
A plan of the pipe work system must be available and its accuracy checked.

The purging procedure must be planned carefully including the number of persons required to safely carry out the purge.

No other work on the installation is to take place during the purging operation.

Purge points are to be located at the end of the main run and the end of each branch.

A gas detector capable of measuring all ranges, percentage LEL (lower explosive limit) to 100% gas will be required when purging to gas or from gas to an inert gas. (Minimum 95% gas required for complete purge to gas).

NG is lighter than air and has a flammability range of between 5% and 14% gas in air.
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Site preparation
Do not commence purging until a purge area has been defined, made safe and has been cleared of all ignition sources (e.g. naked flames, pilot lights, electrical switchgear and so on). Also do not allow smoking in or near the purge area and use appropriate signage to indicate this. Inform persons concerned that gas purging will take place.

A sufficient number of suitable fire extinguishers should be provided and situated near the venting point. Personnel should be familiar with their use.

*All electronic communication equipment must be intrinsically safe for use in hazardous areas.*

Design and location of purging equipment
Purged gas should be vented to the outside atmosphere and away from any buildings, air intakes or electrical ignition sources. To do this, a purge stack or a purge bucket may be required. Refer to Appendix 1 for a description of a typical purging kit.

Select a location where purged gases will be dispersed quickly and will not give rise to complaints about a smell of gas.

Purging hoses must be suitable for containing the gas, be gastight and properly secured. Hose materials, such as polyethylene, could generate static electricity and must not be used.

ESV does not recommend the flaring of purged gases. If flaring is to be undertaken, special precautions such as the fitting of a flame arrester will be required.

Replacing air with natural gas (Commissioning pipe work)
This procedure is suitable for use with consumer piping having a diameter of up to and including DN 100, provided that no vessels, such as surge tanks for gas engines, are involved.

This procedure also applies to any consumer piping being commissioned for natural gas which has previously been purged with an inert gas.

*Note:* For pipe lengths exceeding those listed in AS 5601: 2013, Appendix D Table D2, an Inert Gas Purge is required.

Purging a gas meter
On large commercial industrial installations, the meter is normally purged by the gas company. For small meters or sub-meters allow five times the volume of gas held in the meter by observing the test dial. This will ensure that no trace of gas, air or inert gas remains inside the gas meter body. The cyclic capacity of a meter is shown on its badge plate.

Purging the installation
1. Calculate the volume of the main run of pipe before commencing the purge (refer to Table 1 and the worked example in Appendix 2). Observing the volume passing through the meter will indicate when gas is expected to flow through the purge stack or the purge bucket.
2. Note the meter test dial position.
3. Connect the purge stack or the purge bucket to the furthest point on the main run.
4. Open the control valves and commence the purge.
5. Ensure the maximum purging pressure is not exceeded.
6. Continue to purge through the purge stack or purge bucket until natural gas starts to emerge.
7. Take a sample from the purge stack or purge bucket sampling point using a suitable gas detector (minimum acceptable reading 95% gas). An indication that the purging of natural gas is nearing completion is seen when a mass of bubbles lift off and float away from the purge bucket.
8. Continue purging and testing until an acceptable reading is obtained.
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9. When the correct test result is obtained, the purge of this section of the installation will be complete.
10. Relieve the pressure in the purge hose by opening the purge stack main valve.
11. Disconnect the purge hose and the hose inlet valve from the installation, capping off immediately to avoid gas escaping and air re-entering the line.
12. Transfer the purge stack or purge bucket and hose to the end of the branch nearest the meter and repeat the procedure.
13. Continue purging all branches, moving away from the meter, until the whole installation is filled with gas.

Purging through an appliance

1. Turn on one burner until gas is detected.
2. Let the gas flow for a few seconds, then turn off and allow time for accumulated gas to disperse.
3. Turn on one gas control valve again and apply a continuous burning flame at the burner until the gas is alight and the flame is stable.
4. Continue to purge each branch.

Purging through an appliance fitted with a flame safeguard system

1. It may be necessary to break the appliance connection until gas is detected. This should be carried out in a controlled manner and with extreme care. The use of a bonding strap is advised.
2. When purging to an appliance with the flame safeguard requiring disconnection (from the appliance), care must be taken to prevent an accumulation of NG that could lead to an explosive mixture igniting. Purging to outside will ensure hazards are minimised.
3. When gas is detected, reconnect the appliance and allow time for any gas to disperse.
4. Follow the manufacturer’s lighting instructions until ignition is successful and the appliance is operating satisfactorily.

Replacing air or natural gas with an inert gas (De-commissioning)

Where required, this procedure is suitable for totally displacing all air or natural gas from a gas installation.

Nitrogen is the preferred inert gas for purging.

This procedure must be carried out where:

- Any consumer piping being commissioned has a diameter exceeding those listed in AS 5601: 2013, Table D2.
- Consumer piping, regardless of length or diameter, is being de-commissioned and a hazard may be created. For example when welding or cutting into the gas line.
- Consumer piping, regardless of length or diameter and containing a vessel (for example a surge tank), is being commissioned or de-commissioned.

Notes

- When part of the consumer piping is being taken out of service, isolate the gas meter or the section of consumer piping not being purged by means of an effective spade. The nitrogen should be injected at that point.
- Special care should be taken where pressure vessels are involved. Consider using an appropriate specialist company to assist in planning the purge and to analyse the gas samples.
- For extremely large volume installations, where a full inert gas purge is not economically viable, seek further advice from ESV prior to commencement of the purge.

Volume of nitrogen required

The procedure for determining the volume of nitrogen gas required for a purge is as follows:

1. Use Table 1 in Appendix 2 to determine the volume of pipe in a main run of consumer piping, i.e. from the meter to the furthest point and the volume of pipe in each branch.
2. Add together all volumes calculated in Step 1 and multiply by a factor of 1.5. This gives the total volume of nitrogen required to carry out the purge.

3. Refer to Table 2 in Appendix 2 for the appropriate size of nitrogen cylinder required. (An extra cylinder may be ordered as a precaution).

**Important**

When a nitrogen purge is carried out all branches on the section involved, regardless of length or diameter, must be purged. Refer to Table 3 in Appendix 2 to calculate the volume of nitrogen by pressure drop when purging smaller volumes of branch pipe work.

**Nitrogen set pressures**

The setting pressure of the cylinder regulator is 600 kPa.

The second stage regulator is to be set to provide a flowing pressure of 3 kPa with a lock up pressure of approximately 6 kPa.

**Preparation before purging**

Ensure that the purging and inert gas equipment is correctly installed and that all valves are closed.

**Purging the installation**

1. Record the reading of the cylinder pressure gauge.
2. Slowly open the valve at the outlet of the line pressure gauge.
3. Leak test all connections and fittings between the nitrogen cylinder and the consumer piping. Open the valve to purge the hose and check the purge stack connections for leaks.
4. Slowly open the main valve on the purge stack. As this valve is opened the sound of flowing gas should be heard. If desired, a manometer may be connected to the purge stack to determine if gas flow is occurring.
5. Continue purging until the required volume of nitrogen has been injected.
6. Turn off the main valve on the purge stack.
7. Disconnect the purge hose and the hose inlet valve from the installation, capping off immediately to avoid gas escaping and air re-entering the line.
8. Transfer the purge stack and hose to the end of the branch nearest the meter and repeat the procedure.
9. Continue purging all branches, moving away from the meter, until the whole installation is filled with gas.

**Testing for completion of purge**

**Commissioning (air to nitrogen)**

Field analysis to prove the completion of an air to nitrogen purge is not practical. Therefore it is important to ensure that a sufficient volume of nitrogen has been used for a complete and successful purge.

**De-commissioning (gas to nitrogen)**

**Gas Sample Test Method:** Use a suitable gas detector able to read 0.5% gas (10% of LEL) or less to ensure the fuel gas has been eliminated.

**Note:** NG has a flammability range between 5% and 14% gas in air.

**Further information**

For further information about purging contact Energy Safe Victoria Technical Information Line on 1800 652 563.
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Appendix 1

Recommended purging kit

The recommended purging kit, shown here, has been designed to assist in purging to the outside atmosphere.

The hose diameter should be compatible with the purge stack; 25 mm is recommended. Smaller diameters may result in a slower purge.

Poly pipe should be avoided as it may be subject to sparking from static electricity.

It is advisable also to provide suitable ‘NO SMOKING’ signs and witches hats to cordon off the purge area. There must be no ignition sources within 6 m of the purge area.

The use of a flame arrester is optional. If a flame arrester is used, ensure that it is not unduly restrictive to the flow of gas and that it is cleaned prior to use. If a flame arrester is not used, then the velocity of the purging gas must be such that any “light back” is prevented.

If further information is required, please phone the Energy Safe Victoria Technical Information Line on 1800 652 563.
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### Appendix 2

### Table 1 – Pipe volume (m³ per metre length)

<table>
<thead>
<tr>
<th>Pipe diameter (DN)</th>
<th>Copper (Type B) to AS 1432</th>
<th>Steel (Medium) to AS 1074</th>
<th>Polyethylene (SDR 11) to AS 4130</th>
<th>UPVC Class 100 Types 1, 2, &amp; 3 to AS 1464</th>
</tr>
</thead>
<tbody>
<tr>
<td>15 (16 PE)</td>
<td>0.0001</td>
<td>0.0002</td>
<td>0.0001</td>
<td></td>
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<tr>
<td>20</td>
<td>0.0002</td>
<td>0.0003</td>
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</tr>
<tr>
<td>25</td>
<td>0.0004</td>
<td>0.0006</td>
<td>0.0003</td>
<td></td>
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<tr>
<td>32</td>
<td>0.0006</td>
<td>0.0010</td>
<td>0.0005</td>
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<td>0.0010</td>
<td>0.0014</td>
<td>0.0009</td>
<td>0.0013</td>
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<tr>
<td>50</td>
<td>0.0018</td>
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</tr>
<tr>
<td>65 (63 PE)</td>
<td>0.0030</td>
<td>0.0037</td>
<td>0.0022</td>
<td></td>
</tr>
<tr>
<td>80 (90 PE)</td>
<td>0.0040</td>
<td>0.0052</td>
<td>0.0043</td>
<td>0.0050</td>
</tr>
<tr>
<td>100 (110 PE)</td>
<td>0.0075</td>
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<td>0.0064</td>
<td>0.0084</td>
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<tr>
<td>125</td>
<td>0.0110</td>
<td>0.0130</td>
<td>0.0083</td>
<td></td>
</tr>
<tr>
<td>150 (160 PE)</td>
<td>0.0167</td>
<td>0.0190</td>
<td>0.0130</td>
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<tr>
<td>200</td>
<td>0.0310</td>
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<td>0.0210</td>
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</table>

### Table 2 – Nitrogen cylinder volumes (full)

<table>
<thead>
<tr>
<th>Cylinder Size</th>
<th>Cylinder volume (m³) (NTP)</th>
</tr>
</thead>
<tbody>
<tr>
<td>D</td>
<td>1.3</td>
</tr>
<tr>
<td>E</td>
<td>3.2</td>
</tr>
<tr>
<td>G</td>
<td>6.4</td>
</tr>
</tbody>
</table>
## Appendix 2

### Table 3 – Cylinder pressure drop Vs Volume of nitrogen

<table>
<thead>
<tr>
<th>Cylinder Pressure Drop (kPa)</th>
<th>Equivalent nitrogen volume in m³ (Normal temperature and pressure)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Size D Cylinder</td>
</tr>
<tr>
<td>1 000</td>
<td>0.09</td>
</tr>
<tr>
<td>2 000</td>
<td>0.18</td>
</tr>
<tr>
<td>3 000</td>
<td>0.27</td>
</tr>
<tr>
<td>4 000</td>
<td>0.36</td>
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<td>5 000</td>
<td>0.45</td>
</tr>
<tr>
<td>6 000</td>
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<td>7 000</td>
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<tr>
<td>8 000</td>
<td>0.72</td>
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<td>9 000</td>
<td>0.81</td>
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<td>10 000</td>
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</tr>
<tr>
<td>11 000</td>
<td>0.99</td>
</tr>
<tr>
<td>12 000</td>
<td>1.08</td>
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<tr>
<td>13 000</td>
<td>1.17</td>
</tr>
<tr>
<td>14 000</td>
<td>1.30</td>
</tr>
</tbody>
</table>
Appendix 2

Example for calculating the total volume of nitrogen required to purge the gas pipe network below (Refer to Tables 1, 2 and 3).

Example using copper pipe
(Refer to Table 1)

**Main run (A-D)**
Main run pipe volume = (A-B) + (B-C) + (C-D)
= (50 x 0.0167) + (70 x 0.0075) + (35 x 0.0040)
= 0.835 + 0.525 + 0.140
= 1.500 m³

Volume of nitrogen for the main run (A-D)
= 1.500 x 1.5 = 2.250 m³

**Branch (B-G)**
Branch pipe volume = (B-F) + (F-G)
= (20 x 0.0040) + (15 x 0.0018)
= 0.080 + 0.027
= 0.107 m³

Volume of branch (B-G)
= 0.107 x 1.5 = 0.161 m³

**Branch (C-E)**
Branch pipe volume = (C-E)
= (20 x 0.0018)
= 0.036 m³

Volume of branch (C-E)
= 0.036 x 1.5 = 0.054 m³

**Total amount of nitrogen required**
(A-D) + (B-G) + (C-E)
= 2.250 + 0.161 + 0.054
= 2.465 m³

Therefore according to Table 2, two size D cylinders, or one size E cylinder, would be required. This allows some spare capacity.

Determining amount of nitrogen used

To ensure a complete purge, it is important that the whole consumer piping is filled with nitrogen. To purge the previous example, a total of 2.465 m³ of nitrogen is required. If Size D cylinders are used, two full cylinders will provide 2.6 m³. See Table 2.

Referring to Table 3, for a Size D cylinder, 0.18 m³ is equivalent to a pressure drop of almost 2000 kPa on the cylinder gauge. This allows the correct volume of nitrogen to be calculated for each branch.
Appendix 3

Purging LPG

Note: This information is to be used in conjunction with the procedures outlined for purging natural gas.

When purging LP Gas special consideration must be given to the increased hazards involved.

A risk assessment should be carried out to identify special hazards associated with purging LP Gas.

Note: LPG is a heavier than air gas and has a flammability limit of between 2% and 10% gas in air.

Gas Sample Test Method

Purging LP Gas to inert gas:

Use a suitable gas detector able to read 0.2% gas (10% of LEL) or less to ensure the fuel gas has been eliminated.

Warning

Special care is to be taken to ensure that LP Gas, which is heavier than air and accumulates in low places, is fully dispersed before applying an ignition source. Do not purge into a combustion chamber or other confined space.

For an open air purge using LP Gas consideration needs to be given to:

- Proximity of purge gas to potential ignition sources.
- Drains and openings into buildings such as doors, wall vents, air intakes and so on.
- Ensuring that the area is sufficient to allow effective ground level dispersion.
- Checking the prevailing wind direction.
- Identifying low areas; the gradient of the purge area needs to be taken into account to ensure gas will not accumulate in a confined area.

It is recommended that a purge stack be used to allow a more effective dispersion of gas and a gas analyser should be used to ensure a complete purge is achieved safely (minimum 95% gas).

When an open air purge is not practical it may be advisable to use a gas flare in conjunction with a gas analyser.

If a flare is to be used a Schedule 8 submission, as shown in Gas Safety (Gas Installation) Regulations 2008, describing the purge procedure and purge equipment must be provided to ESV for approval prior to commencement of the purge. A flame trap or arrester is required when using a flare.

Purging to an appliance fitted with a flame safeguard device may require disconnection of the appliance. Care must be taken to prevent an accumulation of LP Gas which could lead to an explosive mixture igniting. Purging to outside will ensure hazards are minimised.

Purging through an appliance burner should be done with a continuous flame positioned at the burner to ensure no hazardous LPG gas accumulation can result.

For further information about purging contact Energy Safe Victoria Technical Information Line on 1800 652 563.