



## GUIDE ON

(1) CONDUCT OF REPAIR WORKS, AND  
(2) TESTING, COMMISSIONING,  
DECOMMISSIONING AND RECOMMISSIONING  
OF INSTALLATIONS



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## 1.0 Objective

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- 1.1 This guide was developed by the Energy Commission (“ST”) for the following purposes:
- 1.1.1 To protect distribution pipelines, piping systems, properties in the vicinity of the said pipelines and piping systems, workers and most importantly the public from dangers arising during the carrying out of works on new and existing installations, or in the vicinity of live distribution pipelines or piping systems.
  - 1.1.2 To guide Gas Contractors and competent persons, building owners, operators of installations, licensees and third party contractors in matters covered under these guide.

## 2.0 Scope

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- 2.1 This guide applies to distribution pipelines and piping systems owned by distribution licensees, retail licensees or private gas licensees.

## 3.0 Definitions and Interpretations

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- 3.1 In these guide, the following terms shall bear the following meanings:

“AHJ” means authority having jurisdiction and refers to an organisation, office, or individual responsible for enforcing the requirements of a code or standard, or for approving building, equipment, materials, an installation, or a procedure.

“CCC” means the completion certificate of compliance issued by an AHJ.

“CF” means the certificate of fitness issued by an AHJ.

“CFO” means the certificate of fitness for occupation issued by an AHJ.

“cold work” means repair work which is carried out on an existing installation which does not contain any gas.

“combustible gas” means either natural gas or liquefied petroleum gas.

“commissioning” refers to the process where combustible gas is gradually injected into a piping system to replace the nitrogen therein until the relevant gas detector equipment shows a content reading of 100% combustible gas in the said piping system.

“decommissioning” refers to the process where combustible gas is purged from a piping system by flaring and injection of nitrogen until the relevant gas detector equipment shows an LEL reading of 0% combustible gas in the said piping system.

“flaring” is a part of the commissioning or decommissioning process where unused mixture of combustible gas and nitrogen is burnt.

“hot work” means repair work which is carried out on an existing installation which contains gas.

“hydrostatic test” refers to the way of testing the performance of a piping system where the test medium to be used is water, with the purpose of proving the strength and discovering leaks of a piping system at a specified test pressure.

“JSA” means job safety analysis and refers to a procedure which helps integrate accepted safety and health principles and practices into a particular task or job operation.

“LEL” means lower explosions limit and refers to the lowest limit at which a combination of fuel and oxygen mixture shall ignite.

“NDT” means non-destructive test and refers to the process of inspecting, testing, or evaluating material, components or assemblies for discontinuities, or difference in characteristics without destroying the serviceability of a part or system.

“pressure test” refers to the way of testing the performance of a piping system where the medium to be used is nitrogen, water or air, with the purpose of proving the strength and discovering leaks of a piping system at a specified test pressure. It is an operation performed to verify the integrity of a piping system following its installation or modification.

“pneumatic test” refers to the way of testing the performance of a piping system, where the test medium to be used is air or nitrogen, with the purpose of proving the strength and discovering leaks of a piping system at a specified test pressure.

“purging” refers to the process of completely removing the contents of a piping system or installation.

“repair work” means an activity involving physical effort of fixing or mending something to achieve a purpose on an existing installation.

“safety representative” means a person who is appointed to carry out duties as a safety representative and registered with the Director General Department of Occupational Safety and Health to carry out their duties as a safety representative.

“SAT” means site acceptance test and refers to the setting up of a relevant equipment or system to be ready for operation and the carrying out of a performance test or simulation test to prove that the said equipment or system was installed on site in accordance with specifications set by the owner of the equipment or system.

- 3.2 Subject to paragraph 3.1 and unless expressly indicated to the contrary or unless the context otherwise requires, terms adopted and used in these guide shall bear the same meaning as they are defined in the Gas Supply Act 1993 and/or the Gas Supply Regulations 1997, as amended from time to time.**

## **4.0 Repair Works**

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### **4.1 General Requirements**

- 4.1.1 No person shall commence any work on an existing installation without first notifying ST and all the relevant licensees.
- 4.1.2 Such work shall be fully supervised in accordance with Regulation 21 of the Gas Supply Regulations 1997.
- 4.1.3 Contractors who intend to carry out any repair work shall comply with Regulation 103 and Regulation 104 of the Gas Supply Regulations 1997, and workers shall comply with Regulation 81 of the Gas Supply Regulations 1997.

### **4.2 General Safety Requirements**

- 4.2.1 It is the responsibility of a competent person to ensure general safety requirements are complied with, including but not limited to the following:
- (a) The relevant Permit to Work is secured.
  - (b) The procedures and JSA for said repair work are approved and endorsed.
  - (c) All equipment is in good condition and safe to be used.
  - (d) All personnel are thoroughly on safety matters, their duties and their responsibilities.
  - (e) All personnel must wear appropriate protective clothing, helmets, goggles, or other garments or equipment designed to protect the wearer’s body from injury or infection.

- 4.2.2 Only authorised personnel are allowed to enter a site where work is being carried out.
- 4.2.3 An adequate warning sign must be placed at designated areas and such areas must be barricaded.
- 4.2.4 All work can only be commenced and carried out under the supervision of a competent person.

### 4.3 Cold Works

- 4.3.1 Before any cold work can be commenced, the affected section of the piping system must be isolated by shutting off the upstream and downstream valves, and tagging must be done accordingly.
- 4.3.2 The affected section then must be decommissioned in accordance with paragraph 5.6.
- 4.3.3 The affected section will be first cut by using a cold cutting method. Then, a gas detector shall be used and an oxygen cutter may be used when the gas detector shows zero (0) LEL reading.
- 4.3.4 All gas fitting and equipment which are intended to be installed must be tested before installation and ensured to be in good working condition.
- 4.3.5 When cold work is completed:
  - (a) The integrity of any welding work must be tested by using the NDT method.
  - (b) A pressure test for the affected section must be carried out in accordance with paragraph 5.4
- 4.3.6 After a successful pressure test, the affected section will be packed with two (2) psig nitrogen in preparation for commissioning.
- 4.3.7 Commissioning will be carried out in accordance with paragraph 5.5.

### 4.4 Hot Works

- 4.4.1 Before any hot work is commenced, the relevant personnel must ensure that the surrounding area does not contain any flammable gas and is safe from any leakage by using a gas detector. The LEL reading of the gas detector must be zero (0)



- 4.4.2 Where new gas fitting or equipment is to be connected to the affected section, a pressure test must be conducted on the new gas fitting or equipment before the connection is made.
- 4.4.3 After successful connection, the affected section, including the new gas fitting or equipment, must be commissioned in accordance with paragraph 5.5.
- 4.4.4 A leak test to identify any gas leaks must be carried out after completion of any hot work.

## 5.0 Pressure Test, Commissioning, Decommissioning and Re-commissioning of Installations

### 5.1 Tools and Equipment

- 5.1.1 All equipment used, including but not limited to the following, shall be calibrated prior to use:

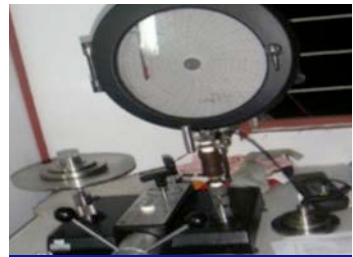
- (a) Pressure gauge.
- (b) Pressure recorder.
- (c) Portable combustible gas detector.
- (d) Dew-point meter.
- (e) Temperature recorder.
- (f) Dead weight tester.
- (g) Oxygen meter.



Pressure Gauge



Gas Detector



Dead Weight Tester with Pressure Recorder

5.1.2 Tools and equipment used, including but not limited to the following, shall be in good condition prior to and during use:

- (a) Air pressure pump.
- (b) Fire extinguisher.
- (c) Flaring torch or stove or gas burner
- (d) Gun lighter.
- (e) Soapy water solution or an appropriate gas leak detector.
- (f) Approved flexible gas hose.
- (g) Explosion-proof walkie-talkie or mobile telecommunication system.
- (h) Nitrogen cylinder/pallet.
- (i) Warning or safety signboard.
- (j) Cold cutter.
- (k) Air blower.

5.1.3 For commissioning work, only non-spark tools shall be used.

## 5.2 General Safety Requirements

5.2.1 It is the responsibility of a competent person to ensure general safety requirements are complied with, including but not limited to the following:

- (a) The JSA and any related procedures are endorsed accordingly.
- (b) All equipment is in good condition and safe to be used.
- (c) All personnel are thoroughly on safety matters, their duties and their responsibilities.
- (d) All personnel must wear appropriate protective clothing, helmets, goggles, or other garments or equipment designed to protect the wearer's body from injury or infection (PPE).
- (e) All fire extinguishers are placed within reaching distance.

- 5.2.2 The competent person must also take into consideration the direction of the wind flow especially during flaring, strategic placement of warning signs and barricading of designated areas.
- 5.2.3 Only authorised personnel are allowed to enter the site.
- 5.2.4 An adequate warning signboard shall be placed at designated areas and such area must be barricaded.
- 5.2.5 All work can only be commenced and carried out under the supervision of a competent person.

### 5.3 Purging and Flaring

- 5.3.1 Main line piping or tubing systems shall be purged outdoors. However, piping after gas meters can be purged indoors.
- 5.3.2 The purging point shall not be less than three (3) meters from a building or air intake or any opening of a building.
- 5.3.3 The surrounding designated area for purging must have adequate ventilation.
- 5.3.4 Wind flow direction must be considered especially during flaring.
- 5.3.5 The purging process shall be under the constant supervision of a competent person.
- 5.3.6 The valve used to release the gas during purging shall not be less than 1.5 meters from the purging point.
- 5.3.7 During the purging, smoking anywhere near the vicinity of the purging point is strictly prohibited.
- 5.3.8 The competent person must ensure that adequate precaution is taken to either remove or shut off any source or potential source of ignitions prior to commencing the purge.
- 5.3.9 Outdoor flaring, which is mainly used for main piping system, must be conducted by using an appropriate burner or flaring stack.



5.3.10 Indoor flaring, which is commonly used after a consumer's gas meter, is conducted by using portable burners or appliances.

5.3.11 Gun lighters shall be used as an ignition source.

## 5.4 Pressure Test

### 5.4.1 General

- (a) Prior to the commencement of testing of a completed installation, a Gas Contractor shall ensure that the installation complies with the specifications set out by the owner of the installation, applicable codes and standards, and the requirements of the relevant AHJ.
- (b) All NDT results of the welding joints must be tested and be reviewed by a qualified radiographic interpreter and approved by a third-party inspector. The traceability record shall be verified and approved by a competent person before a pressure test is commenced.
- (c) If, due to any restriction, the piping system cannot be tested as a complete unit and instead must be tested in separate section, the tie-in-point shall be tested with soapy solution after combustible gas has been introduced to ensure that there are no leakages.
- (d) Connected equipment shall be disconnected during the pressure test. Under no circumstance shall a valve in line be used as bulkhead between combustible gas in one section of the installation and test medium in an adjoining section.
- (e) In order to ensure that the pressure test operates within the acceptable limits, the pressure applied during a pressure test must take into consideration the effect of a temperature drop on the pressure.
- (f) The piping system shall be visually inspected by a competent person to ensure that the installation is intact and installed correctly.
- (g) Test headers and pipe fittings used for testing should have pressure ratings greater than the applicable test pressure.



#### 5.4.2 Test Medium

The test medium shall be water, air or nitrogen. **Oxygen must never be used.** If water has been used as a test medium, immediately after pressure test deemed successfully, the pressure need to be depressurised and the installation need to be dry at minimum dew point -10 C.



#### 5.4.3 Test Pressure

- (a) The test pressure shall be in accordance with Table 1 (Page 19) and Table 2 (Page 20).
- (b) The test pressure shall be measured and recorded with a calibrated pressure and recorder measuring device with suitable pressure range.

#### 5.4.4 Test Duration

Test duration shall not be less than 0.5 hours and shall be in accordance with MS 930 standard and ASME B31.8

#### 5.4.5 Test Procedure

- (a) An adequate number of calibrated pressure gauges shall be installed.
- (b) Each gauge must be installed in a position that makes it clearly visible and enables close observation in order to ensure that the test pressure complies with Table 1 and Table 2.
- (c) The system shall be slowly pressurised in stages with air or nitrogen until it reaches the test pressure specified in Table 1 and Table 2
- (d) All test procedures must be reviewed and approved by a competent person.

#### 5.4.6 Detection of Leak and Defects

- (a) An installation must be able to withstand the test pressure specified without showing any evidence of leakage or other defects. Any reduction of test pressure as indicated by pressure gauges shall be deemed to indicate presence of a leak unless such reduction can be readily attributed to some other causes.

- (b) When leakage or other defects are detected and located, the affected portion of piping shall be repaired and then retested.

#### 5.4.7 Testing Process

- (a) Before testing is commenced, all testing personnel must ensure all tubing and hose connections to the equipment to be tested are intact.
- (b) The pressure shall be raised slowly in stages until it reaches the test pressure specified in Table 1 and Table 2. During this process, the pressure must be allowed to be stabilised. Testing personnel must inspect all joint and potential leak points to ensure system integrity before a pressure test is commenced.
- (c) The test period shall be a minimum of 0.5 hours and in accordance with the requirements set out in Table 1 and Table 2.
- (d) A pressure test is deemed satisfactory when a piping system is able to sustain the test pressure for the corresponding test duration mentioned in Table 1 and Table 2.
- (e) Immediately after a pressure test is deemed satisfactory, the isolation valve to the chart recorder must be shut off and its pressure reduced to zero immediately. The pressure in the piping system shall be reduced slowly in a safe manner. If the test medium is air the pressure should be reduced to zero (0) and the installation shall be nitrogen packing at two (2) psig, and if the test medium is nitrogen the pressure must be kept at two (2) psig.
- (f) After completion of a pressure test, all test equipment must be disconnected and the competent person will sign and endorse all test reports and certificates.

## 5.5 Commissioning

### 5.5.1 General

- (a) Commissioning shall be commenced when the relevant Approval to Operate is obtained and the premises has obtained the necessary CF or CCC from the relevant AHJ. In addition, the JSA for commissioning must also be approved by a safety representative.
- (b) The piping system to be commissioned shall be initially filled with nitrogen at two (2) psig which contains less than 2% oxygen.

- (c) The commissioning procedure shall contain a detailed method statement and such numbers of commissioning checklists as may be necessary to ensure that each stage in the commissioning is carried out correctly. The commissioning procedure must be approved and endorsed by the competent person.
- (d) An adequate number of commissioning personnel shall be present at the premises at all times during the commissioning process with the required tools and all necessary equipment.

#### 5.5.2 Process for Pre-Commissioning and Commissioning

##### (a) Pre-Commissioning Process

- i. SAT is successfully carried out for all equipment and systems, as evidenced by the SAT records.
- ii. Leak test is conducted on the piping system to be commissioned and the results show that all systems are intact.

##### (b) Commissioning Process

- i. Process displacement of nitrogen with combustible gas.
- ii. Leak test is conducted by using soap solution and gas detector when the piping system is pressurised with combustible gas to the operating pressure.

#### 5.5.3 Commissioning Steps

- (a) Before any commissioning work is commenced, the competent person shall ensure that all pre-commissioning process in paragraph 5.5.2 (a) have been carried out.
- (b) To start commissioning, the mixed gas in the piping system must be purged and flared, in accordance with the process specified in paragraph 5.3.
- (c) During the displacement of nitrogen with combustible gas, all outlet valves must be shut off and tagged accordingly to indicate commissioning-in-progress and/or plugged, as appropriate.
- (d) A final check must be carried out by the competent person to confirm that all valves are positioned in accordance with the commissioning procedure.

- (e) The competent person must ensure all commissioning personnel are ready. The supply valve must be slowly opened and venting must start at the outlet of flaring torch / burner.
- (f) At the outlet of the flaring torch/burner, using a gas detector, check the percentage mix of combustible gas and nitrogen.
- (g) When the gas detector shows a minimum content of 300ppm (0.4% LEL), combustible gas that means nitrogen has been purged and the combustible gas has reached the outlet point.
- (h) To start the flaring, ignite the flaring torch using a gun lighter, and continuously flare until the colour of the flame changes from yellow to blue.
- (i) Stop flaring and check contents of combustible.
- (j) If the content of combustible gas has not reached a minimum of 80% combustible gas volume, repeat steps (h) and (i) until it does reach.
- (k) For each branch of the piping system, repeat steps (g) to (j) until the whole piping system has been commissioned.
- (l) During flaring, cordon off the flaring area. Only the competent person and relevant commissioning personnel are allowed within such area.

## 5.6 Decommissioning and Recommissioning

### 5.6.1 General

- (a) Decommissioning is carried out in order to make a piping system safe for the purposed of carrying out works such as maintenance or modification to a piping system and other emergency work or for the purposed of termination of gas supply
- (b) Decommissioning can only be commenced once all of the following have been fulfilled or carried out:
  - i. All requisite approvals from the relevant AHJ have been obtained.
  - ii All downstream customers have been notified of any gas supply disruptions and the sections to be decommissioned have been isolated properly and inspected by a competent person.



- iii. The JSA for decommissioning has been approved by a safety representative and verified by a competent person.
- (c) The decommissioning process shall contain a detailed method statement and such numbers of decommissioning checklists as may be necessary so as to ensure that each stage in the decommissioning is carried out correctly by the competent person.

#### 5.6.2 Decommissioning Steps

- (a) Before decommissioning is commenced, the section of the piping system affected should be isolated by shutting off the upstream and downstream valve and tagged accordingly.
- (b) The gas in the isolated piping system then must be purged and flared, taking into account the requirements of paragraph 5.3.
- (c) To start flaring, slowly open the valve at the flaring torch and ignite the flaring torch using gun lighter. Continuously flare until the flare is extinguished.
- (d) Flush the section of the piping system that is being decommissioned with nitrogen and check the presence of combustible gas using a gas detector. Work can only be continued if the gas detector shows an LEL reading of 0%. If the LEL reading does not show 0%, continue to flush nitrogen.
- (e) The cutting of the sections of the affected piping systems needs to be done by cold cutting method.
- (f) When the maintenance or modification work has been completed and accepted according to applicable codes and standards, the affected sections need to be packed with nitrogen at 2 psig with less than 2% oxygen content.
- (g) Where there is a re-commissioning following a decommissioning:
  - i. The re-commissioning can only be commenced when the relevant Approval to Operate is obtained from the ST and the relevant work permit(s) is/are issued by the respective authority(ies).
  - ii. Save for the above, the re-commissioning process must be in accordance with paragraph 5.6.
  - iii. Upon successful completion of re-commissioning, downstream customers will be notified accordingly and all tagging will be removed.

## 6.0 Records

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- 6.1 All inspection and testing works shall be recorded properly, and witnessed, approved and endorsed by a competent person and available at all times for the purpose of inspection, verification, recertification process and audit.
- 6.2 Test records shall indicate the testing section of the piping system, test pressure, test duration, date and time of commencement of testing.
- 6.3 When an entire piping system or section was commissioned, that section shall be recorded and as built drawing shall be produced and endorsed by a competent person. The document shall be used as reference for future maintenances and recertification work.
- 6.4 The testing and commissioning records shall be kept by the owner of the piping system and shall be produced when required by the relevant AHJ.
- 6.5 When separate tests are conducted for separate sections, records must be generated for each test.

**Table 1: LPG piping system pressure / leak test requirement  
(Source: MS 930-Table 7)**

Scope	Maximum Operating Pressure kPa (psi)	Type of Test		Test Pressure kPa (psi)	Test Duration (hour)		Equipment			
		Test	Medium		Above ground	Buried	Pressure gauge	Pressure Chart Recorder	Soapy water solution	Gas detector
From tank/manifold up to 1 <sup>st</sup> Stage Regulator	Up to 860 (125)	Pneumatic / leak	Nitrogen	1900 (275)	1		✓	✓	✓	
		Leak (during commissioning)	LPG	Operating Pressure					✓	✓
From 1 <sup>st</sup> Stage Regulator up to 2 <sup>nd</sup> Stage Regulator	Above 140 (20)	Pneumatic / leak	Nitrogen	345 (50)	1	24	✓	✓	✓	
			Air							
		Leak (during commissioning)	LPG	Operating Pressure			✓		✓	✓
After 2 <sup>nd</sup> Stage Regulator	Up to 7 (1)	Pneumatic / leak (appliances disconnect)	Nitrogen	140 (20)	0.5	24	✓	✓	✓	
			Air							
		Leak (during commissioning)	LPG	Operating Pressure			✓		✓	✓

**Table 2: NG piping system pressure / leak test requirement**  
 (Source: MS 930-Table 8)

Scope	Operating Pressure kPa (psi)	Type of Test		Test Pressure kPa (psi)	Test Duration (hour)		Equipment						
		Test	Medium		Above ground	Buried	Pressure gauge	Pressure Chart Recorder	Soapy water solution	Gas detector			
From service station, up to 2 <sup>nd</sup> stage Regulator / meter	Above 140 (20)	Hydrostatic	Water	1.5 x MAOP	1	24	✓	✓					
		Pneumatic / leak	Nitrogen		1								
			Air			24	✓	✓	✓				
From service / area station up to 2 <sup>nd</sup> stage Regulator / meter	Up to 140 (20)	Hydrostatic	Water	345 (50)	1	24	✓	✓					
		Pneumatic / leak	Nitrogen									✓	
			Air										
		Leak (during commissioning)	Natural gas	Operating Pressure				✓		✓			
After 2 <sup>nd</sup> Stage Regulator / meter	Up to 7 (1)	Pneumatic / leak (appliances disconnect)	Nitrogen	140 (20)	0.5	24	✓	✓	✓				
			Air										
		Leak (during commissioning)	Natural gas	Operating Pressure				✓		✓			

## Notes

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