**Training Package** 

TP 15/15

## **Pre-fill Inspection of Gas Cylinders**



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#### **Pre-fill Inspection of Gas Cylinders**

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## Introduction

- During routine use, cylinders and bundles may be subjected to irregular treatment, mechanical damage, fire damage or contamination. A pre-fill inspection of cylinder package is necessary to ensure that the cylinder is safe to fill.
- Pre-fill inspection guidelines as established and are contained in various cylinder codes and regulations are not adhered to by fillers
- Several incidents have occurred due to inadequate pre-fill inspection.



## Scope

- General Pre-fill inspection guidelines for cylinders and bundles.
- Specific requirements of Aluminium and composite cylinders.
- These guidelines do not cover Acetylene cylinders.



## Why to check?

- Each gas cylinder needs to be inspected at the time of filling
- □ to ensure that it has no visible defects which render it
  - unsafe for filling
  - unsafe for use
- to ensure Cylinder complies with regulatory requirements with regard to national colour coding, marking, labeling and accessories (fittings like valve protection, etc.)
- to ensure that the valve is functional and is correct for the gas service (both valve and the outlet specific to gas being filled)



## **Pre-fill Inspection checks**

Pre-fill checks can be broadly divided into five steps:

- General visual checks
- Cylinders external checks (composite cylinders additional checks)
- Checks for internal contaminants
- Valve checks
- Cylinders accessories & attachments



## **Pre-fill Inspection checks**

- Refillable & non refillable
- Leaking cylinders/valves
- Strangers/own cylinders
- Ownership, test status, service pressure and gas service
- External cylinder damage checks
- Cylinder internal general
- Valve checks
- Check labels
- Safety device checks
- Special checks for aluminum & composite cylinders
- Residual liquid/tare weight checks for liquefied compressed gases



### **General checks**

- Type of Cylinders: Refillable or non-refillable
- Steel, Aluminum or composite cylinders
  - Additional checks required for composite cylinders
- Extra caution is needed for private / stranger cylinders.
- Repaired cylinders
- Leaking valves

#### Warning:

Non refillable cylinders must not be re-filled



#### Examples of Nonrefillable cylinders



## **Cylinder- External checks**

Check cylinder markings & colour code (if any) to verify:

- Ownership
- Cylinder number
- Test status (some companies use Test date rings)
- Test station mark (recognized marking?)
- Service pressure and Test pressure
- Gas service
- Specification
- Approved to fill in the country
- Banned / restricted cylinders
- Manufacturer





# Typical Stamp Marking of ISO standard (UN) cylinders





# Examples of Restricted / Banned cylinders & valves

Some countries have established lists of specific cylinder types and valves that are no longer considered safe for their original design conditions.

\*IGC Doc 86/09 gives Negative Cylinders and Valve lists by country

Any Safety Alerts issued by the manufactures, Regulatory authorities for recalls or withdrawals should be followed.



## Cylinder- External checks Contamination/damage

- Contamination
  - Grease, oil, dirt, bitumen, concrete, paint etc
- Cylinder body damage
- Fire & heat damage
- Weld mark/arc burn
- Neck rings/collar checks

Do not fill the cylinders with these damages: Must be inspected and approved by the Test shop/Competent person



- Cylinders with any of the defects shall not be filled and shall be sent to the test shop for further checks and decision.
- Never fill any cylinder if you have any doubt about its condition.



## Cylinder body damage examples





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### Cylinder body damage examples





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## Cylinder body damage – Specifications removed









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# Cylinder- External checks - fire or heat damage

Look out for

- Blistered, charred or burnt paint
- Burn marks on the cylinder (the burn area of a steel cylinder may be masked by the evidence of rust)
- Soot over paint
- Dull oxidized appearance of the metal or painted surface
- Burnt, cracked, or discolored label
- Deformed hand wheel, valve guard or carrying handle
- Discolored, melted or missing: plastic collar, test date ring or heat indicators





#### Unauthorized modification- examples (refer to EIGA Safety Alert SA-05)





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### **Cylinder Hammer Test**

#### Some regulations require hammer test

- Hammer test should be done before filling cylinders to test cylinder integrity
- A hammer test is not required for aluminum cylinders and cylinders filled with liquefied compressed gases.
- Strike the side of the cylinder at approximately mid height with a light tap using a ½ lb. ball peen hammer or similar tool.
- □ A Clear bell-like tone that gradually fades indicates that the cylinder is free of contaminants and corrosion.
- A dull thud indicates that the cylinder may contain corrosion products, or liquid or solid contaminants. If you hear a dull thud, tag the cylinder, and send it to the Test Shop.
- Note: The hammer test is effective for detecting significant quantities of contaminants and severe corrosion. The test will not detect small quantities of these impurities.





## **Odour test**

#### Some regulations require odour test

- If specifically required, this test is done only on Oxygen, Medical O2 and breathing/diving grade of air gases
- At facilities where a local regulation prohibits this test for health reasons, a properly calibrated on-line or portable hydrocarbon analyzer may be substituted.
- Odour Test must not be done on any special gases, flammable gases and any gas that may present a health hazard.
- Never place your nose directly on the gas stream.
- Crack open the valve for a very brief time and reclose it
- If there is no sufficient gas in the cylinder, introduce a small amount oil free Nitrogen and carry out test
- Refer to CGA P-15 for further details.



## Valve checks

- Ensure that the valve is of correct type for the gas service.
- Check valves to ensure they are straight and not damaged. A bent valve may fail under filling pressures
- Check that there is no evidence of valve tampering, missing cassette, loose back plugs, incorrect hand wheel or twisted/rounded spindle.
- Check that valves are free of oil, dirt, grit, or other contaminants.
- Outlet threads are to be clean and free from tape, threads not worn out.







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### Valve checks

#### Twisted square drive spindle



#### Valve contamination





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# Valve checks – Thread engagement with cylinders

- Check the extent of valve thread entry into the cylinder neck visually
- □ Taper thread valves have some threads visible, typically
  - 1 to 3 threads for 25E/BS 1 inch
  - 3-6 threads for <sup>3</sup>/<sub>4</sub> NGT threads
- Parallel threads : No threads Visible

Tapered Threads		
Code	Thread Designation	Origin
17E	17,4 ISO/DIS 11116	Europe
25E	25,8 ISO/DIS 10920.2	Europe
V1	20 X 14 JIS B 8246	Japan
V2	28 X 14 JIS B 8246	Japan
V3	28 X 14 JIS B 8246 (reduced length)	Japan
W6	0.6-14 AS2473	Australia
W71	0.715-14 AS2473	Australia
W1	1-14 AS2473	Australia
Straight Threads		
Code	Thread Designation	Origin
18P	M18 X 1,5	Europe
25P	M25 X 2	Europe
30P	M30 X 2	Europe
Note: Commas designate decimals in ISO standards.		
Table 3 - Select International Thread Codes		



Figure 2 - Thread Designation Codes



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### **Residual Pressure Valve checks**

Residual pressure valve (RPV) keeps some product inside the cylinder. An RPV reduces the risk of internal corrosion and product contamination. It is important to check if the this valve is not defective:

- Using a suitable mechanical tool, disengage the RPV, and listen for pressure release.
- If no positive pressure is observed, the RPV mechanism is not working.
- Warning: Do not fill cylinders with defective RPV valves.





## **Checks on Pressure Relief Devices**

Some cylinders are fitted with valves having pressure relief devices like burst discs, fusible plugs or combination devices.

- Check externally for corrosion, damage, plugging of flow channels.
- Check for leakages, extrusion of fusible metal through the flow passages.
- Check for mechanical damages like bent, distorted or tampered

#### Warning:

Do not fill cylinders with defective or damaged Relief Devices.





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## **Collars / accessories checks**

- Check for loose / damaged neck rings. Corrosion on the shoulder
- Broken valve guards







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### Aluminium cylinders – special requirements

- Only fill compatible gases/chemicals in Aluminum cylinders. Refer to ISO 11114-1 (examples: HCL shall not be filled in Aluminum cylinders)
- When the cylinders are exposed to heat/fire and cooled, mechanical properties might change without any visible burn marks on the metal surface.
  - Inspect of labels, paint or any other material damage/deformation



- Aluminium cylinders should be fitted with high temperature exposure indicators or heat sensitive indicator to identify cylinders exposed to high temperatures
- Some Aluminum Alloy Cylinders are prone to Sustained Load Cracking (SLC), example: AA6351/6082. Refer to IGC Doc 57/11/E

**Warning:** Filling aluminum cylinders that have no means to identify whether or not were exposed to heat/fire may lead to cylinder failure/rupture.



# Pre-fill inspection criteria for Composite cylinders

These cylinders are subjected to the same pre-fill criteria as other cylinders.

- External visual Inspection : To look for mechanical, chemical damage- normally clearly visible to the naked eye. Do not fill if any of the below defects are noted-Send to the retest station for further examination.
  - Abrasion
  - Cuts
  - Impact damage
  - Fire damage
  - Chemical damage

Do not fill the cylinders with these damages: Must be inspected and approved by the Test shop/Competent person



# External damage on Composite cylinders- Abrasion



Figure 1a: Level 1 abrasion damage — Superficial abrasion



Level 2 abrasion damage — Depth of abrasion between 5 % and 15 % of thickness (fully wrapped cylinder)



Level 3 abrasion damage — Severe abrasion over 15 % of thickness



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# Composite cylinders, damage from cuts







Level 2 damage from cuts — Depth of cut between 10 % and 30 % of thickness (hoop wrapped cylinder)



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#### **External damage due to impact**





Level 1 impact damage — Superficial impact damage

Level 3 impact damage — Depth of damage over 15 % of thickness (fully wrapped cylinder)



### **De-lamination**



Figure 4: De-lamination damage greater than Level 2 .4.1.5



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# Heat or fire, structural damage and chemical attack



Level 1 – Heat Damage-Surface charring



Level 3 – Heat or Fire Damage



**Structural Damage** 





**Chemical attack** 



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## Checks on cylinder bundles

- Ownership
- Cylinder test status
- Gas Service
- Frames and manifold damage
- Valves
- Cylinders
- Tare weight for liquefied gases must be legible





## References

- CGA C-15: Filling of Industrial and Medical Non-Flammable Compressed Gas Cylinders. standard by Compressed Gas Association
- IGC Doc 86/09: Gas cylinders and valves with restricted use in the EU
- ISO 24431:2006: Gas cylinders -- Cylinders for compressed and liquefied gases (excluding acetylene) -- Inspection at time of filling
- ISO 11114-1: Gas Cylinders Compatibility of cylinder and Valve with gas Contents Part 1: Metallic elements



#### Thank you website: http://www.asiaiga.org

