

AIGA 2007 MEETING

PACKAGED GASES SAFETY



Asia Industrial Gases Association

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Assessing Fitness For Service For Gas Cylinders

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Scope

- Inspection and re-qualification requirements and best practices for high pressure cylinders in compressed and liquefied gas service



Inspection at Time of Filling

- Ensure no evidence of defects that make the cylinder:
 - ✓ Unsafe for filling
 - ✓ Unsafe for use
- Ensure Cylinder complies with regulatory requirements
- Ensure valve functions and is correct for the gas service

Responsibility

- The filler is responsible to ensure cylinders:
 - ✓ are safe for filling and use
 - ✓ meet regulatory requirements
- Inspection of cylinders shall only be carried out by people who are trained and competent in the activity

Responsibility

- If there is any doubt about the serviceability of a cylinder it should be rejected
- Cylinders that do not meet requirements shall be identified, quarantined and removed from service

Inspection Prior to Filling

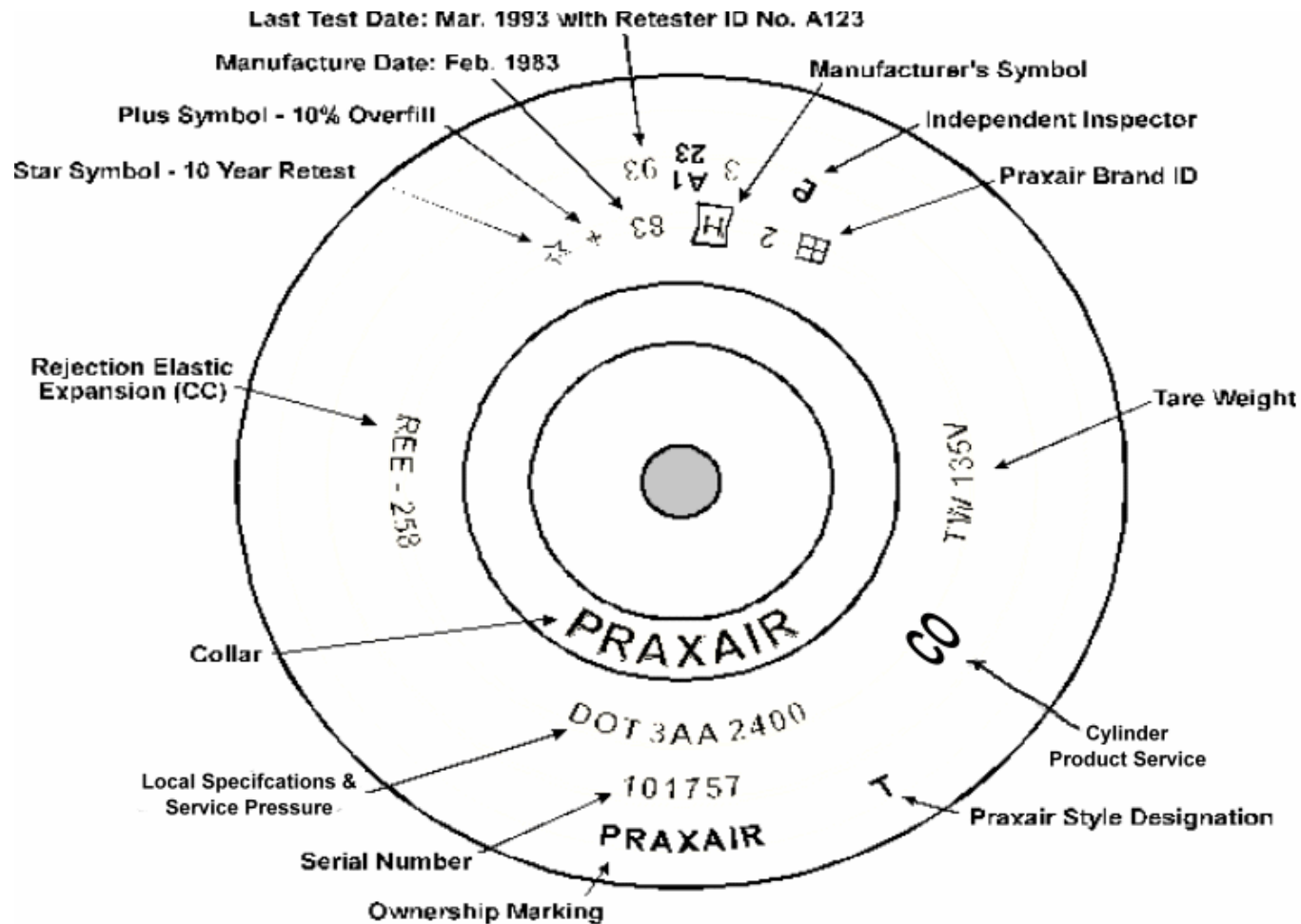
- Verify serviceable condition
- Verification of cylinder pressure
- Identification of owner
- Verification of tare weight
- Verification of internal condition
- Verification of permanent attachments
- Verification of valve integrity & suitability

Cylinder Markings

- Cylinder markings can tell you:
 - ✓ If it is permitted for filling in the country
 - ✓ The specification
 - ✓ The manufacture
 - ✓ The pressure rating
 - ✓ The test date
 - ✓ The serial number
 - ✓ Other information



Cylinder Markings



Ownership

- Cylinders should only be filled by the owner or with the consent of the owner
- Check or confirm ownership of cylinder
 - ✓ Check for ownership markings or symbols on cylinder

External Condition

- Ensure surface is clean, free of foreign material and excessive paint
- Check for abnormalities such as:
 - ✓ Arc burns
 - ✓ Bulging
 - ✓ Cuts, Digs, Gouges, Dents
 - ✓ Corrosion
 - ✓ Customer Modifications

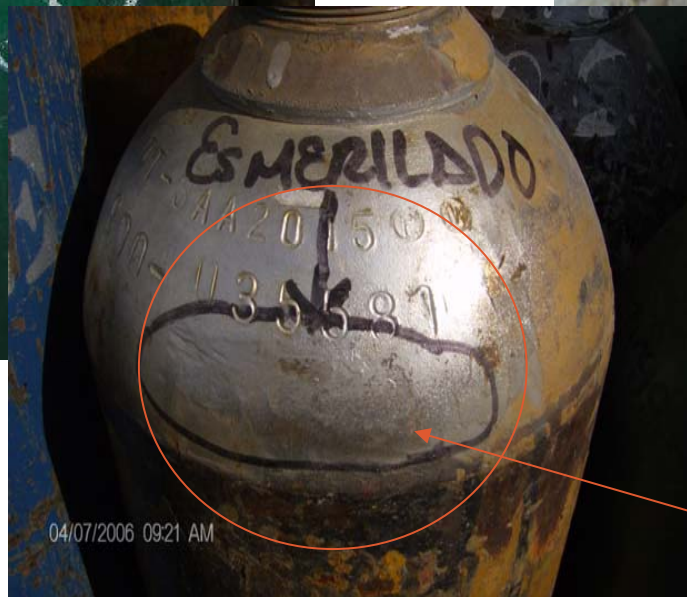
External Inspection



Arc Burn



Cut



**Markings
Removed**

External Condition

■ Check for evidence of:

- ✓ Fire damage
- ✓ Heat exposure (aluminum cylinders)

Gas Suitability

- Ensure cylinder is suitable for intended gas
- Labeling and color correct for gas and meets regulatory requirements
- Pressure rating of cylinder suitable for final fill pressure, lading and filling equipment
- Odor test for internal contaminants
 - ✓ Not recommended for industrial inert, CO₂, N₂O, corrosive, toxic, and flammable gases

Tare Weight Check

- Required for cylinders filled by weight (such as liquefied gases)
- Not required if can guarantee no contamination exists in cylinder
- Tare weight calculation should include weight of cylinder and all permanent attachments (i.e. valve, bolted on valve guards, etc.)
- Should be stamped on cylinder package

Internal Inspection

- Carbon steel cylinders can experience high rates of corrosion in CO₂ or CO₂ mixes
- Check for excessive corrosion, liquid or foreign material contamination:
 - ✓ Dead Ring Test
 - ✓ Weight Check
- Check for residual pressure



Internal Inspection

- Cylinders shall be inspected internally when:
 - ✓ Failed dead ring (hammer) test
 - ✓ After internal cleaning of cylinders
 - ✓ Prior to each hydrostatic test cycle
 - ✓ Every time the valve is removed
 - ✓ Deviations in tare or mass weight
 - ✓ Suspected foreign contamination, deposits, or internal corrosion.

Internal Inspection

- Inspect internal condition for:
 - ✓ Corrosion and pitting
 - ✓ Loose scale or rust
 - ✓ Foreign debris

Internal Inspection

- Aluminum cylinders:
 - ✓ Inspect neck for cracks
 - ✓ Look for folds, valleys in the neck and crown



Attachments

- Neck ring threads in good condition
- Neck ring, foot ring, shrouds secure



Attachments

Valve protection

- ✓ Caps are vented
- ✓ Well secured to cylinder
- ✓ No contaminants
- ✓ Adequate to protect valve
- ✓ Meets regulatory requirements

Valve

- Correct valve for gas service
- Outlet and seating surface in good condition
- Operates properly
- Inlet connection correct for gas service and there is proper neck thread engagement
- No loose, broken, or missing parts
- Free of contamination

Pressure Relief Devices (PRD)

■ Pressure relief device (if required):

- ✓ Appropriate type
- ✓ Correct rating
- ✓ Not damaged
- ✓ Free of debris

During Filling

- Ensure valve is not blocked
- Ensure valve and PRD do not leak
- Use a leak detector compatible with the gas and valve material



Bundles

■ Best practices:

- ✓ All cylinders should have same pressure rating and test date
- ✓ Information visible
- ✓ Valves, manifolds protected

■ Inspect:

- ✓ Cylinders not loose
- ✓ Frame not damaged



Cylinder Re-qualification

- The periodic re-qualification of gas cylinders is an essential requirement to ensure safe continued use of the cylinder
- In many countries, cylinder re-qualification is a legal requirement

Retest Intervals

- Test periods are defined by national bodies and vary from country to country
- Typical intervals are 5 to 10 years and maybe specific by product or age of cylinder

Re-qualification Methods

■ Different methods:

- ✓ Hydraulic Pressure Test
- ✓ Ultrasonic Examination
- ✓ Acoustic Emission
- ✓ External Visual Inspection

■ Not all methods approved in every country

Re-test Facilities

■ Ensure that:

- ✓ Operators are trained and qualified
- ✓ Facility is registered (if applicable) and complies with local regulations
- ✓ Facility has adequate equipment and tools
- ✓ Facility has access to applicable standards
- ✓ Tests are documented

Hydrostatic Pressure Test

■ Methods:

- ✓ Water Jacket
- ✓ Direct Expansion
- ✓ Proof Pressure

■ Include an external and internal verification of cylinder

■ Ensure cylinders are well dried after test

Hydrostatic Test Methods

Water Jacket

Direct Expansion



Scrapping

- Ensure cylinder cannot be filled
- The following methods can be used:
 - ✓ Obliterate threads
 - ✓ Remove marking
 - ✓ Cut in Half
 - ✓ Drill hole through sidewalls
 - ✓ Crush

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THANK YOU!