GALISO Incorporated

Presents

Cylinder Re-Qualification Hazmat Training 2

Must you have CGA pamphlets on hand?

- The CFR requires that you have on hand *the information* contained in applicable CGA pamphlets…..
- Such as….

Compressed Gas Association, Inc., 4221 Walney Road, 5th Floor, Chantilly, Virginia 20151 Pamphlets:

(See complete list in CFR Title 49 § 171.7 Reference material.)…

CGA Pamphlet C–3, Standards for Welding on Thin-Walled Steel Cylinders, 1994

178.47; 178.50; 178.51; 178.53; 178.55; 178.56; 178.57; 178.58; 178.59; 178.60; 178.61; 178.65; 178.68; 180.211.

CGA C–5, Cylinder Service Life—Seamless Steel High Pressure Cylinders, 1991 (reaffirmed 1995)

173.302a.

CGA Pamphlet C–6, Standards for Visual Inspection of Steel Compressed Gas Cylinders, 1993

173.3, 173.198, 180.205, 180.209, 180.211, 180.411, 180.519.

CGA Pamphlet C–6.1, Standards for Visual Inspection of High Pressure Aluminum Compressed Gas Cylinders, 2002, Fourth Edition

180.205; 180.209

CGA Pamphlet C–6.2, Guidelines for Visual Inspection and Requalification of Fiber Reinforced High Pressure Cylinders, 1996, Third Edition

180.205.

CGA Pamphlet C–6.3, Guidelines for Visual Inspection and Requalification of Low Pressure Aluminum Compressed Gas Cylinders, 1991

180.205; 180.209.

CGA C–7, Guide to Preparation of Precautionary Labeling and Marking of Compressed Gas Containers, Appendix A, issued 2004 (8th Edition)

172.400a.

CGA Pamphlet C–8, Standard for Requalification of DOT-3HT Cylinder Design, 1985

180.205; 180.209.

…

If a cylinder is hydrostatically tested, is a visual inspection required?

§ 180.205 General requirements for requalification of specification cylinders.

…(f) ***Visual inspection***. Except as otherwise provided in this subpart, each time a cylinder is pressure tested, it must be given an internal and external visual inspection.

(1) **The visual inspection must be performed in accordance with the following CGA Pamphlets:** **C–6** for steel and nickel cylinders (IBR, see §171.7 of this subchapter); **C–6.1** for seamless aluminum cylinders (IBR, see §171.7 of this subchapter); **C–6.2** for fiber reinforced composite special permit cylinders (IBR, see §171.7 of this subchapter); **C–6.3** for low pressure aluminum cylinders (IBR, see §171.7 of this subchapter); **C–8 for DOT 3HT cylinders** (IBR, see §171.7 of this subchapter); and **C–13** for DOT 8 series cylinders (IBR, see §171.7 of this subchapter).

(2) For each cylinder with a coating or attachments that would inhibit inspection of the cylinder, the coating or attachments must be removed before performing the visual inspection.

(3) Each cylinder subject to visual inspection must be approved, rejected, or condemned according to the criteria in the applicable CGA pamphlet.

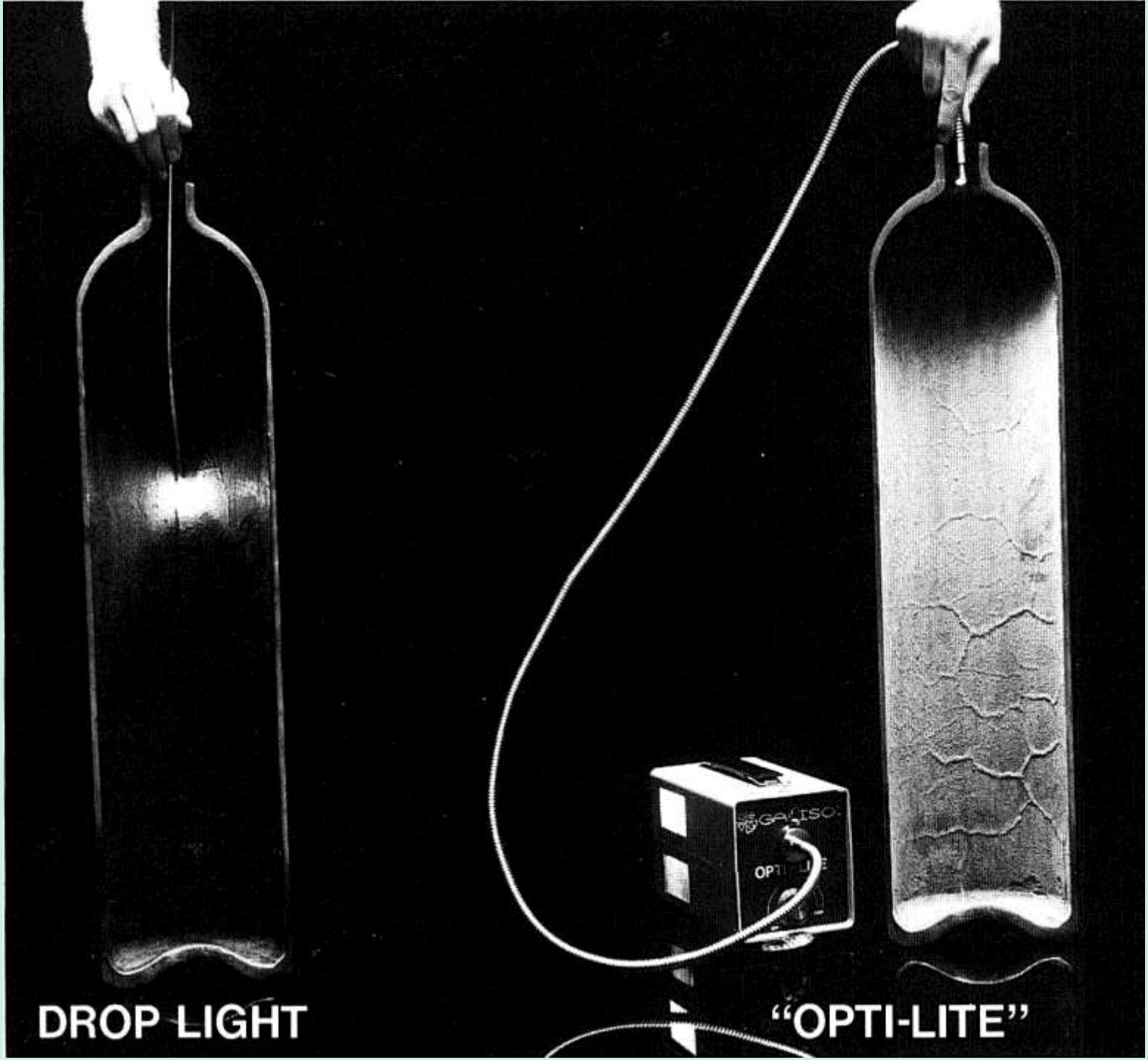
For safety and productivity, and to comply with the CFR, a visual inspection is required…

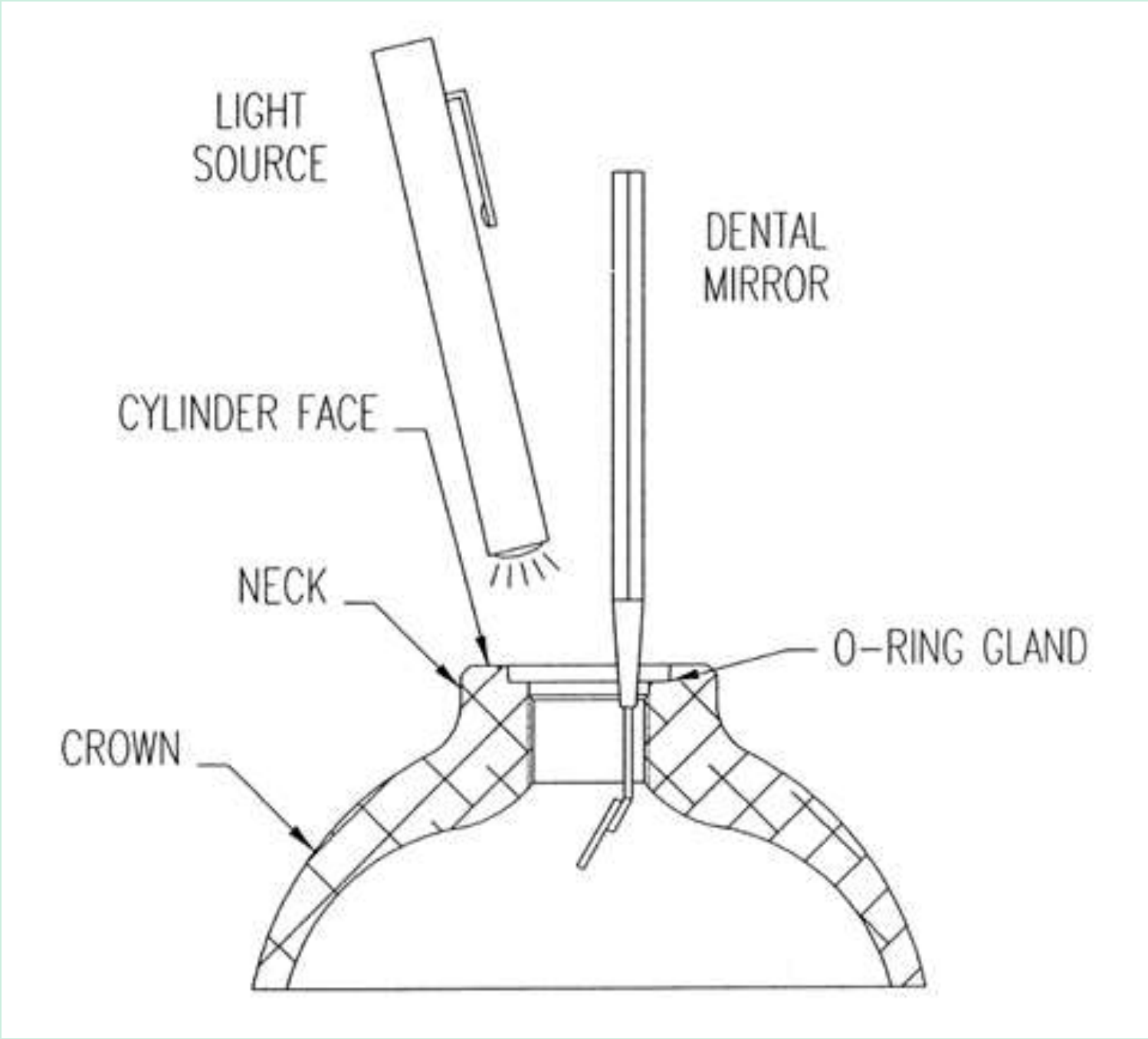
When? Prior to the Hydrostatic Test.

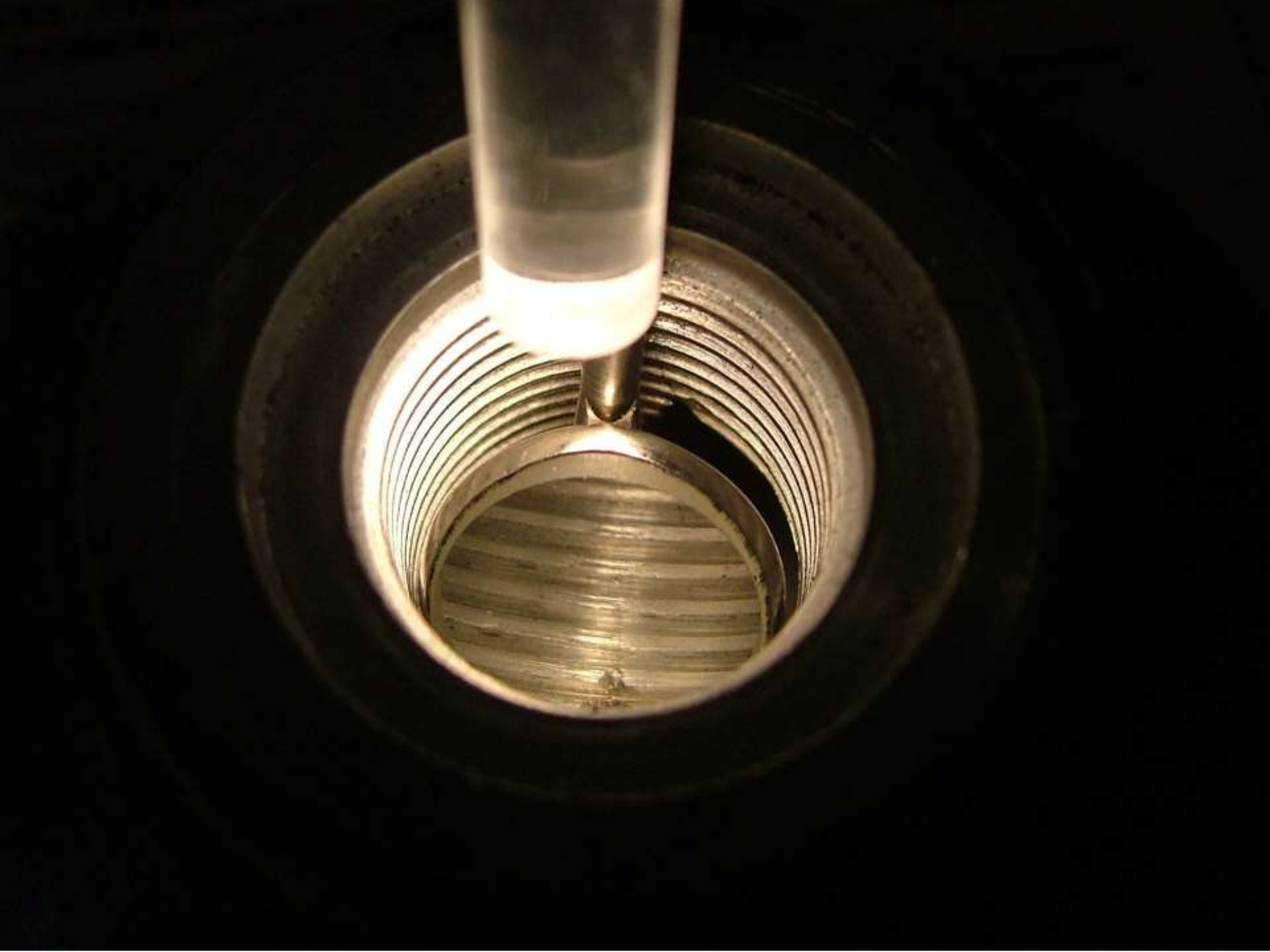
What are some useful tools for the visual inspection?

Inspection light (Fiber Optic)

Depth gauges, Mirror, Probe, and so forth.


DROP LIGHT
"OPTI-LITE"


LIGHT
SOURCE
DENTAL
MIRROR
CYLINDER FACE
NECK
O-RING GLAND
CROWN

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Must cylinder attachments ever be removed as part of requalification?

An how about rust or coatings?

Does moisture play a role?

§ 180.205 General requirements for requalification of specification cylinders….

(f) *Visual inspection.* Except as otherwise provided in this subpart, each time a cylinder is pressure tested, it must be given an internal and external visual inspection. ..

(2) For each cylinder with a coating or attachments that would inhibit inspection of the cylinder, the coating or attachments must be removed *before* performing the visual inspection.

(3) Each cylinder subject to visual inspection must be approved, rejected, or condemned according to the criteria in the applicable CGA pamphlet.

Galiso's understanding of CGA C-6, 5.3.1 regarding exterior inspection of cylinders is:

- When a cylinder is being re-qualified, it is not properly prepared for inspection until every bit of rust, scale, caked paint and caked coatings are first removed from the outside surface of the cylinder.

Galiso's understanding of CGA C-6, 5.3.9.2 is:

Cylinders must receive special attention if they have permanent attachments (foot rings, neck rings etc.). The cylinder must be carefully checked for the presence of moisture under the attachments.

And, adhesive attachments need to be removed if there is reason to believe that their seal has been broken.

At what temperature will an aluminum cylinder be considered to have been overheated?

How about a steel cylinder?

§ 180.203 Definitions.

…

Over-heated means a condition in which the temperature of any portion of an aluminum cylinder has reached 176 °C (350 °F) or higher, or in which the temperature of any portion of a steel or nickel cylinder has reached 343 °C (650 °F) or higher.

Look for signs of overheating…

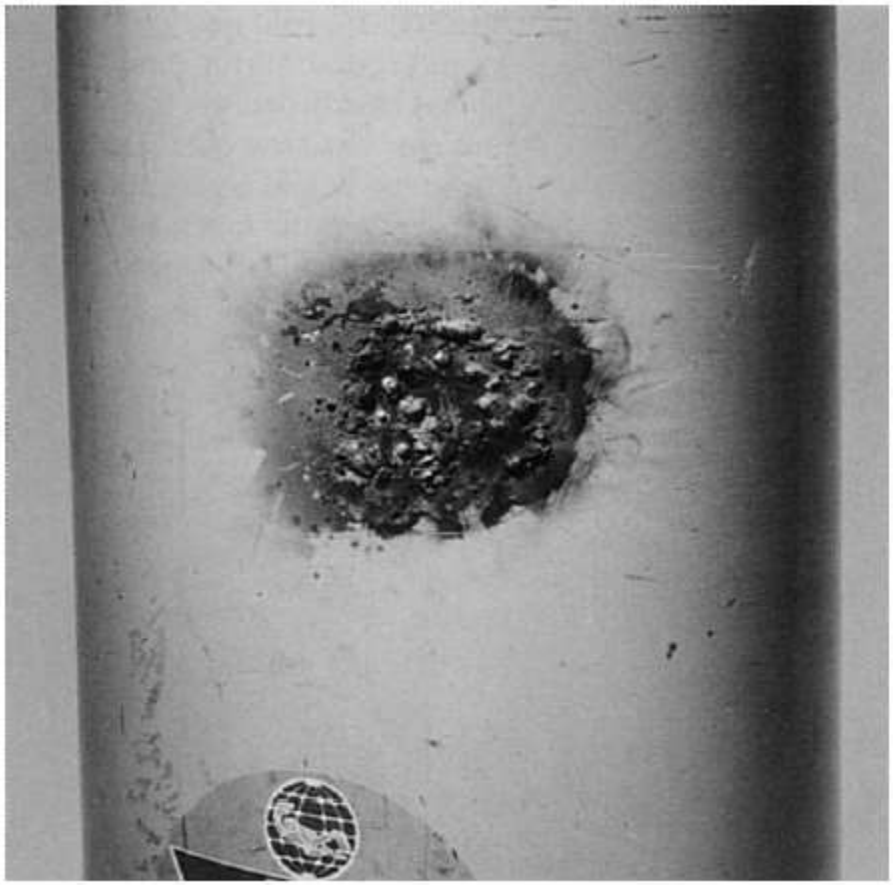


PHOTO 14. Appearance of fire or welding damage done to a cylinder.

When must a cylinder be rejected because of a dent?

Can a dent ever be tolerated? Does appearance play a factor?

Galiso's understanding of CGA Pamphlet C-6, 3.2.2.2 regarding dents away from welds is:

… When a dent in a cylinder does not involve a weld, the cylinder does not need to be rejected if the depth of the dent is less than one-tenth of the greatest measurement of the dent.

Galiso's understanding of CGA Pamphlet C-6, 5.3.2 regarding dents is:

…a dented deformation in a cylinder is reason to carefully evaluate the dent. There are certain dented cylinders which need to be condemned.

Galiso's understanding of CGA Pamphlet C-6, 5.3.4 regarding dents is:

…Dents can be permitted when the cylinder wall is not extremely deformed.

The appearance of the dent plays a significant role when evaluating them.

Common industry practice is to accept a dent up to 1/16 inch in depth for a 9 inch diameter x 51 inch long cylinder.

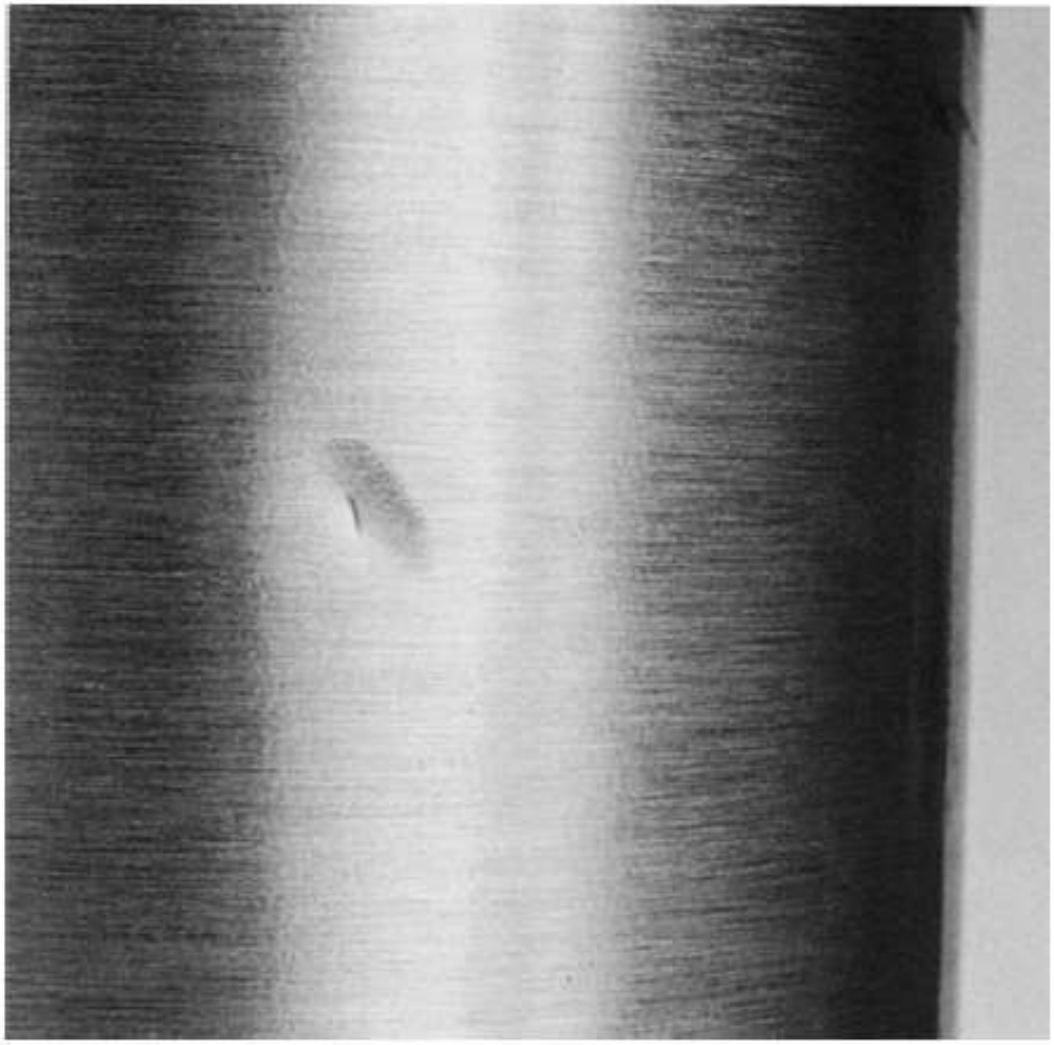


PHOTO 1. Dented cylinder.
This cylinder has a 'brushed finish' with a clear coating.

What is the allowable in terms of depth and area of corrosion and associated pit limits?

Corrosion and Pitting

- CGA pamphlet C-6 sets forth:
- minimum allowable wall thickness for low pressure cylinders
- Minimum allowable wall thickness for DOT 3A and 3AA high pressure cylinders.
- Rejection criteria for isolated pitting

Galiso's understanding of CGA Pamphlet C-6, 5.2.1 regarding Interior Inspection and Corrosion is:

A cylinder must be condemned when:

- it is clear that corrosion in the cylinder has caused pitting of the walls.

A cylinder need not be condemned when:

- insignificant corrosion causes mere change in color of the interior walls and there is no pitting involved.

Galiso's understanding of CGA Pamphlet C-6, 5.2.1 regarding general corrosion limits is:

When the wall thickness of a cylinder is unknown:

- the allowable corrosion depth is 1/32 in.

When the wall thickness is known:

- the allowable corrosion depth is 15% of the minimum design wall thickness.

Corrosion must not involve more than 25% of the cylinder surface, internally or externally.

Galiso's understanding of CGA Pamphlet C-6, 5.2.2 regarding isolated pit limits is:

When the wall thickness is unknown:

the allowable depth of pitting is 1/16 in.

When the wall thickness is known:

the allowable depth of pitting is 30% of the minimum design wall thickness.

In some instances, a cylinder with a known wall thickness may be allowed a pit depth which is more than the allowable pit depth for a cylinder with an unknown design wall thickness.

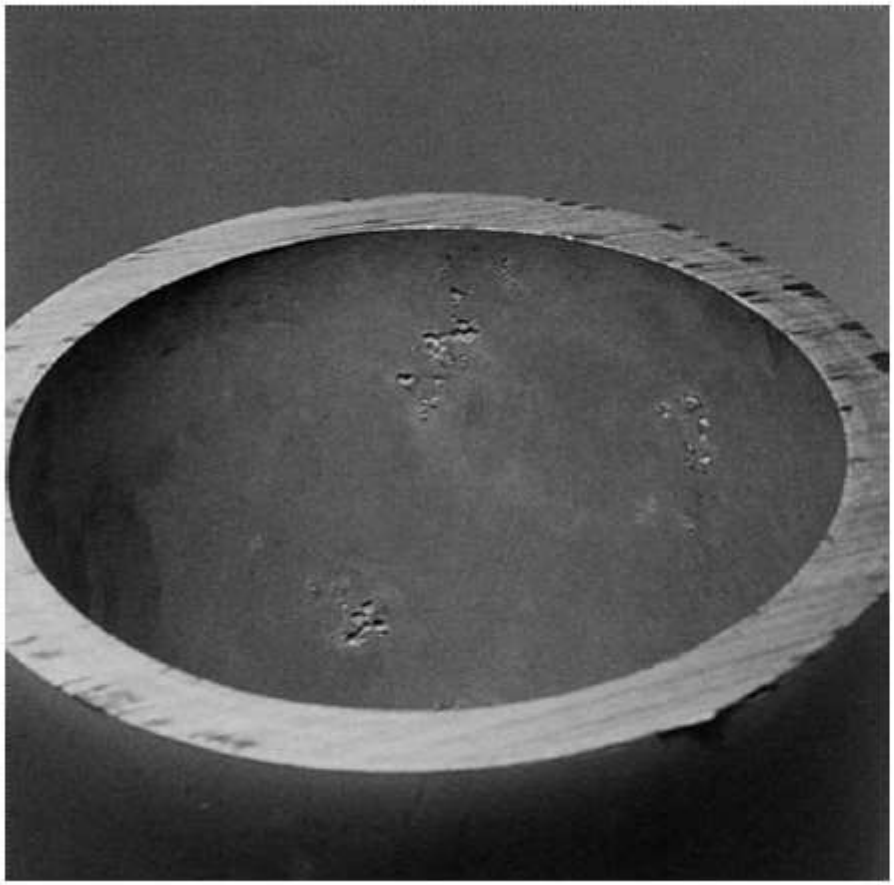
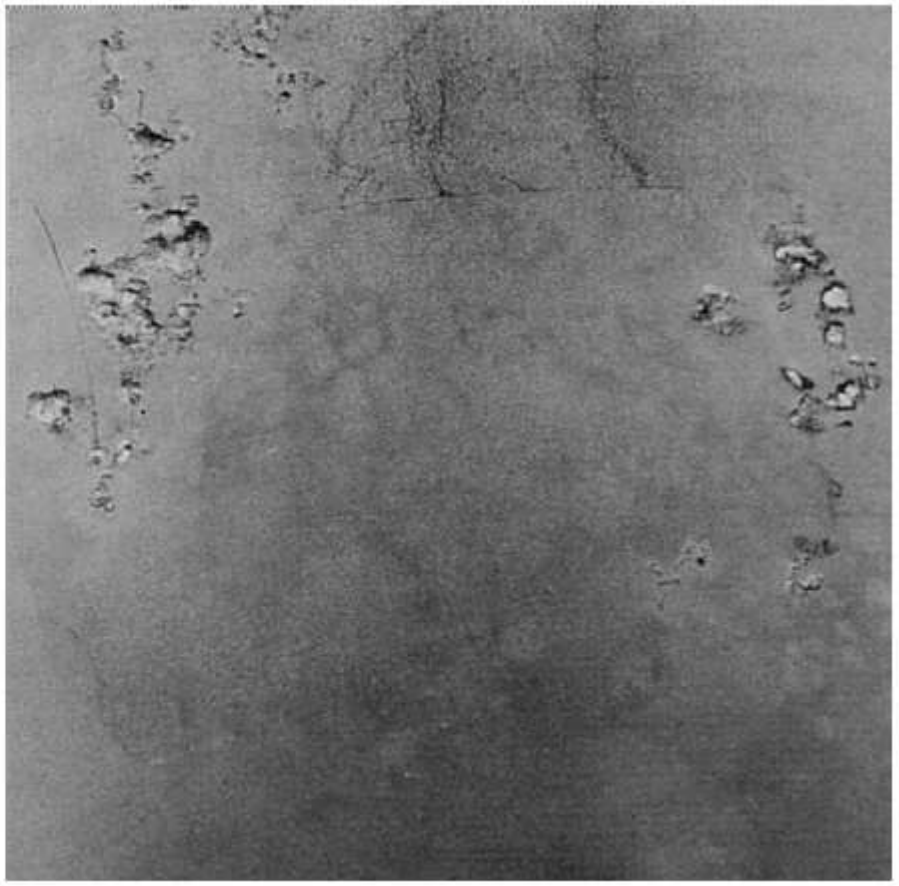


PHOTO 11. Pit corrosion in the cylinder sidewall distant view.

PHOTO 12. Close up of pit corrosion from PHOTO 11.



Is repair by removal of any pits by polishing or sanding permissible?

And if so, when?

How about bulged cylinders?

Galiso's understanding of CGA Pamphlet C-6, 5.3.1 regarding External Inspection and Corrosion is:

Removal of pits to repair the exterior of a cylinder by polishing or sanding is allowed.

All such repair must be completed before a hydrostatic test.

Galiso's understanding of CGA Pamphlet C-6, 5.3.2 regarding cuts, digs, gouges and bulges is:

Whenever a cylinder's wall thickness is reduced below the design minimum, the cylinder must be condemned.

Cuts, digs and gouges that have not caused a reduction below the minimum design thickness need to be removed by polishing, sanding or filling.

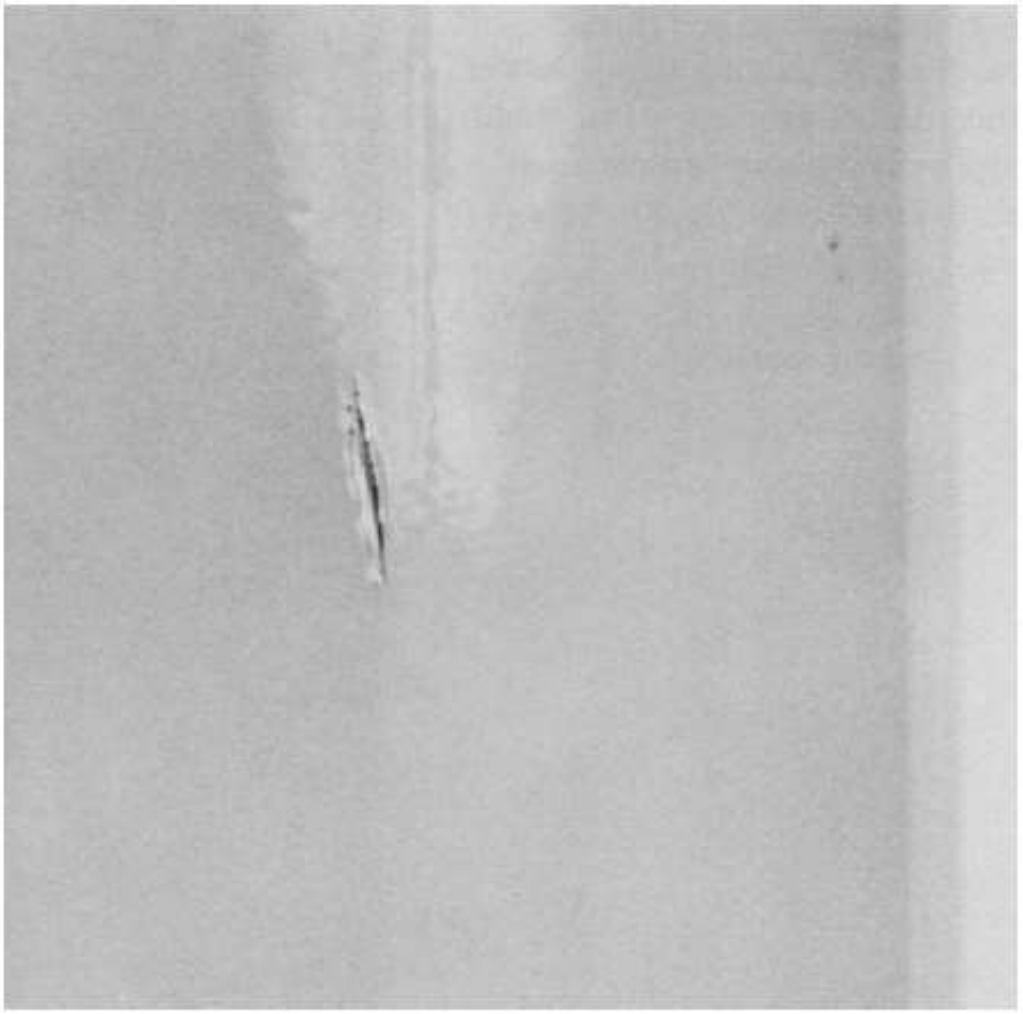
Cylinders which have bulges must be condemned.

FIGURE 11: Bulged Cylinder

FIGURE 11: Bulged Cylinder

A bulge is an extremely rare, dangerous condition. Bulged cylinders must be immediately condemned and removed from service. Unlike a bow, which is usually slight and sometimes difficult to see, a bulge is generally very pronounced and obvious, even to the naked eye. Bulges occur in cylinders that have been overheated or in cylinders with sidewalls thinned by severe corrosion. There are two basic types of bulges. A long, convex bulge protrudes outward noticeably on one side or around the entire circumference of the cylinder (as in the yellow cylinder shown above on the left); such a bulge occurs when an entire cylinder has been exposed to high heat. A smaller, "goose-egg-shaped" bulge (cylinder at right, above) usually indicates localized overheating, which is the result of "spot annealing."

PHOTO 2. Gouged cylinder.



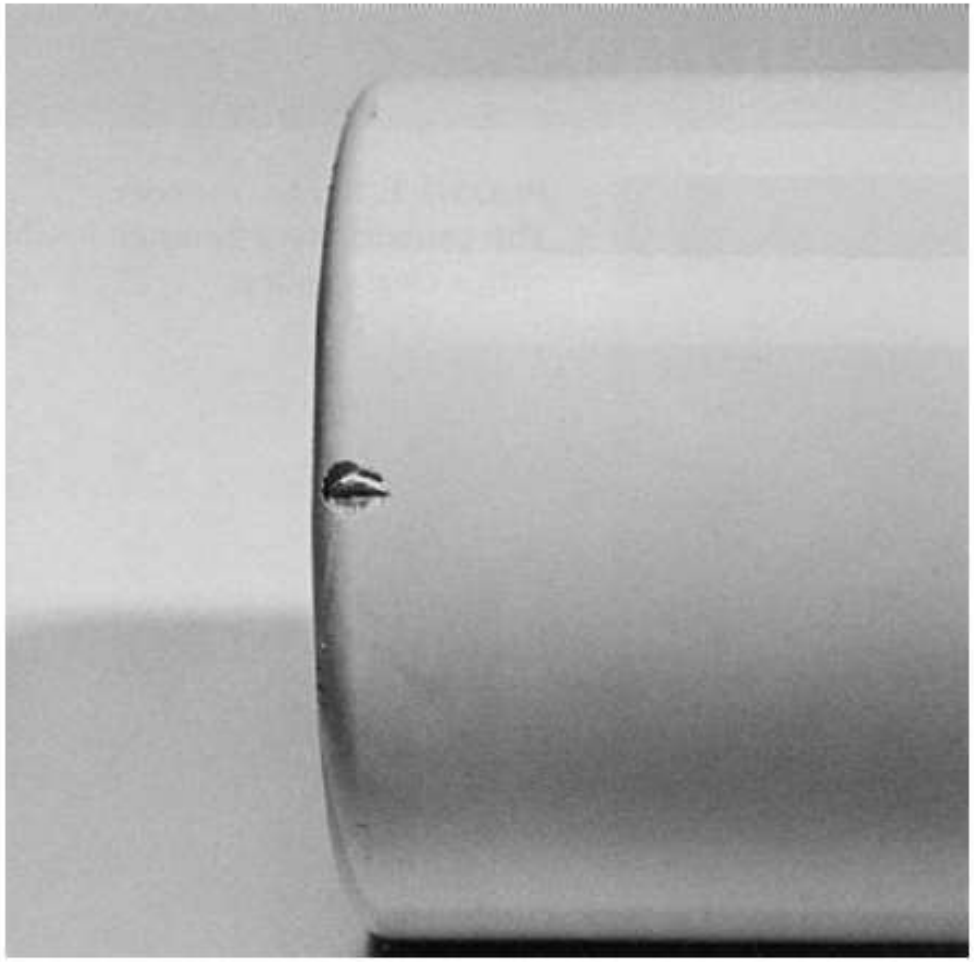


PHOTO 3. Cylinder shows signs of having been in an accident or dropped. May have been struck or fallen. The inspector, seeing an obvious deviation on an otherwise uniform cylinder should ask the owner if he/she is aware of any cause for such a mark.

How are High or Low Pressure cylinders defined?

Galiso's understanding of CGA Pamphlet C-6's definition of High and Low Pressure Cylinders is:

High pressure cylinders:

- Have a service pressure of 900 psi or greater.

Low pressure cylinders:

- Have a service pressure less than 900 psi.

Where is Visual Inspection of Steel Cylinders set forth?

CGA Pamphlet C-6

Thin wall vs. Thick, High Pressure vs. Low Pressure

Note: Improper Stamping (Serial number on side wall)

3HT: CGA Pamphlet C-8

§ 180.205 General requirements for requalification of specification cylinders.

…(f) ***Visual inspection***. Except as otherwise provided in this subpart, each time a cylinder is pressure tested, it must be given an internal and external visual inspection.

(1) **The visual inspection must be performed in accordance with the following CGA Pamphlets:** **C–6** for steel and nickel cylinders (IBR, see §171.7 of this subchapter); **C–6.1** for seamless aluminum cylinders (IBR, see §171.7 of this subchapter); **C–6.2** for fiber reinforced composite special permit cylinders (IBR, see §171.7 of this subchapter); **C–6.3** for low pressure aluminum cylinders (IBR, see §171.7 of this subchapter); **C–8 for DOT 3HT cylinders** (IBR, see §171.7 of this subchapter); and **C–13** for DOT 8 series cylinders (IBR, see §171.7 of this subchapter).

(2) For each cylinder with a coating or attachments that would inhibit inspection of the cylinder, the coating or attachments must be removed before performing the visual inspection.

(3) Each cylinder subject to visual inspection must be approved, rejected, or condemned according to the criteria in the applicable CGA pamphlet.

§ 178.35 General requirements for specification cylinders.

(a) *Compliance.* Compliance with the requirements of this subpart is required in all details.

(b) *Inspections and analyses.* Chemical analyses and tests required by this subchapter must be made within the United States, unless otherwise approved in writing by the Associate Administrator, in accordance with subpart I of part 107 of this chapter. Inspections and verification must be performed by—

(1) An independent inspection agency approved in writing by the Associate Administrator, in accordance with subpart I of part 107 of this chapter; or

(2) For DOT Specifications 3B, 3BN, 3E, 4B, 4BA, 4D (water capacity less than 1,100 cubic inches), 4B240ET, 4AA480, 4L, 8, 8AL, 4BW, 39 (marked service pressure 900 p.s.i.g. or lower) and 4E manufactured in the United States, a competent inspector of the manufacturer.

(c) *Duties of inspector.* The inspector shall determine that each cylinder made is in conformance with the applicable specification.

Cracks, folds and other flaws in cylinders…

Can neck cracks be repaired?

How do tool stop marks differ from neck cracks?

Do aluminum cylinders require special inspection for sustained load cracking?

Galiso's understanding of CGA Pamphlet C-6, 5.8 regarding neck defects is:

Cylinder necks must be inspected for cracks, folds, and other defects.

All aluminum cylinders must be internally inspected (electronic devices are allowed) and cylinders with neck cracks must be condemned. Repair of neck cracks is not permitted.

A distinction must be made between tool stop marks and a neck crack. Cylinders with a tool stop mark are allowed to be placed into service.

Aluminum cylinders made of 6351 alloy might display "sustained load cracking" (SLC) over time. Such cylinders require careful inspections when they are re-qualified.

CGA Pamphlet C-6.1 & **Aluminum Cylinders:**

Special inspection is required for neck cracks.

Exemptions:

6498, 7042, 8107, 8364, 8422

CFR Title 49 173.23(c)

Compressed Gas Association, Inc., 4221 Walney Road, 5th Floor, Chantilly, Virginia 20151 Pamphlets:

(See complete list in CFR Title 49 § 171.7 Reference material.)…

CGA Pamphlet C–3, Standards for Welding on Thin-Walled Steel Cylinders, 1994

178.47; 178.50; 178.51; 178.53; 178.55; 178.56; 178.57; 178.58; 178.59; 178.60; 178.61; 178.65; 178.68; 180.211.

CGA C–5, Cylinder Service Life—Seamless Steel High Pressure Cylinders, 1991 (reaffirmed 1995)

173.302a.

CGA Pamphlet C–6, Standards for Visual Inspection of Steel Compressed Gas Cylinders, 1993

173.3, 173.198, 180.205, 180.209, 180.211, 180.411, 180.519.

CGA Pamphlet C–6.1, Standards for Visual Inspection of High Pressure Aluminum Compressed Gas Cylinders, 2002, Fourth Edition

180.205; 180.209

CGA Pamphlet C–6.2, Guidelines for Visual Inspection and Requalification of Fiber Reinforced High Pressure Cylinders, 1996, Third Edition

180.205.

CGA Pamphlet C–6.3, Guidelines for Visual Inspection and Requalification of Low Pressure Aluminum Compressed Gas Cylinders, 1991

180.205; 180.209.

CGA C–7, Guide to Preparation of Precautionary Labeling and Marking of Compressed Gas Containers, Appendix A, issued 2004 (8th Edition)

172.400a.

CGA Pamphlet C–8, Standard for Requalification of DOT-3HT Cylinder Design, 1985

180.205; 180.209.

…

Galiso's understanding of CGA Pamphlet C-6, 5.8 regarding neck defects is:

Cylinder necks must be inspected for cracks, folds, and other defects.

All aluminum cylinders must be internally inspected (electronic devices are allowed) and cylinders with neck cracks must be condemned. Repair of neck cracks is not permitted.

A distinction must be made between tool stop marks and a neck crack. Cylinders with a tool stop mark are allowed to be placed into service.

Aluminum cylinders made of 6351 alloy might display "sustained load cracking" (SLC) over time. Such cylinders require careful inspections when they are re-qualified.

§ 180.205 General requirements for requalification of specification cylinders.

(f) *Visual inspection.* Except as otherwise provided in this subpart, each time a cylinder is pressure tested, it must be given an internal and external visual inspection.

(4) In addition to other requirements prescribed in this paragraph (f), each specification cylinder manufactured of aluminum alloy 6351–T6 and used in self-contained underwater breathing apparatus (SCUBA), self-contained breathing apparatus (SCBA), or oxygen service must be inspected for sustained load cracking in accordance with Appendix C of this part at the first scheduled 5-year requalification period after January 1, 2007, and every five years thereafter.

…

PHOTO 4. Damaged threads. Notice that, looking down on the threads, this damage is not readily apparent without the use of a dental mirror.

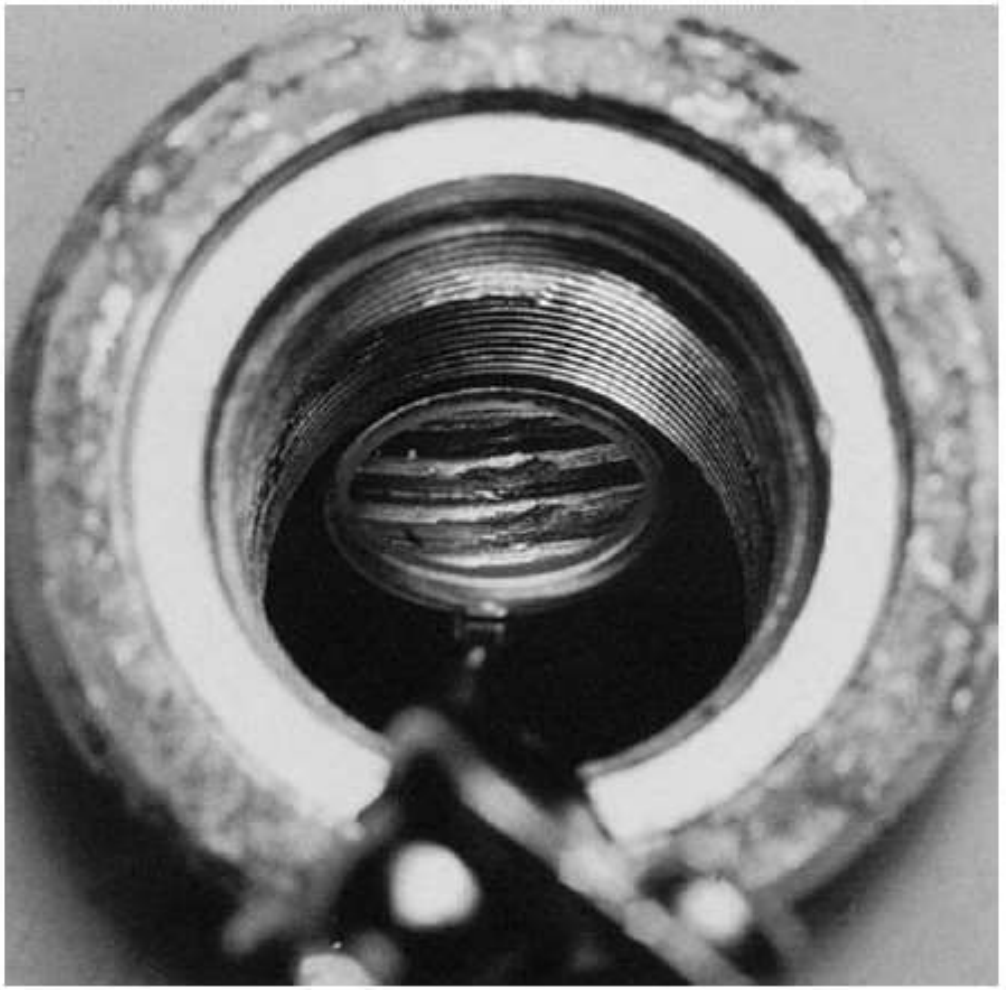
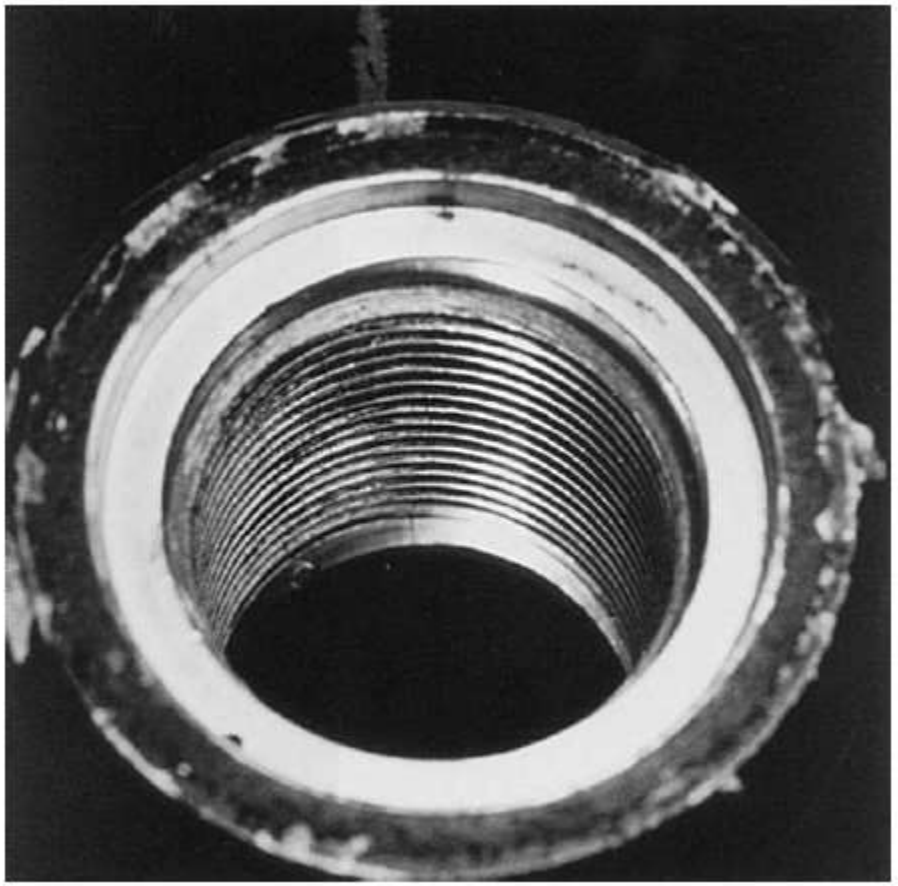


PHOTO 5. Damaged threads. This damage is easily seen with the naked eye, but the thread area is dirty and first needs cleaning before proceeding with the visual inspection of the thread area.

PHOTO 6. Cracked thread. This is a very subtle, hair-line crack through most of the threads. Hard to see with the naked eye. It is usual for the crack to be jagged, rather than straight.



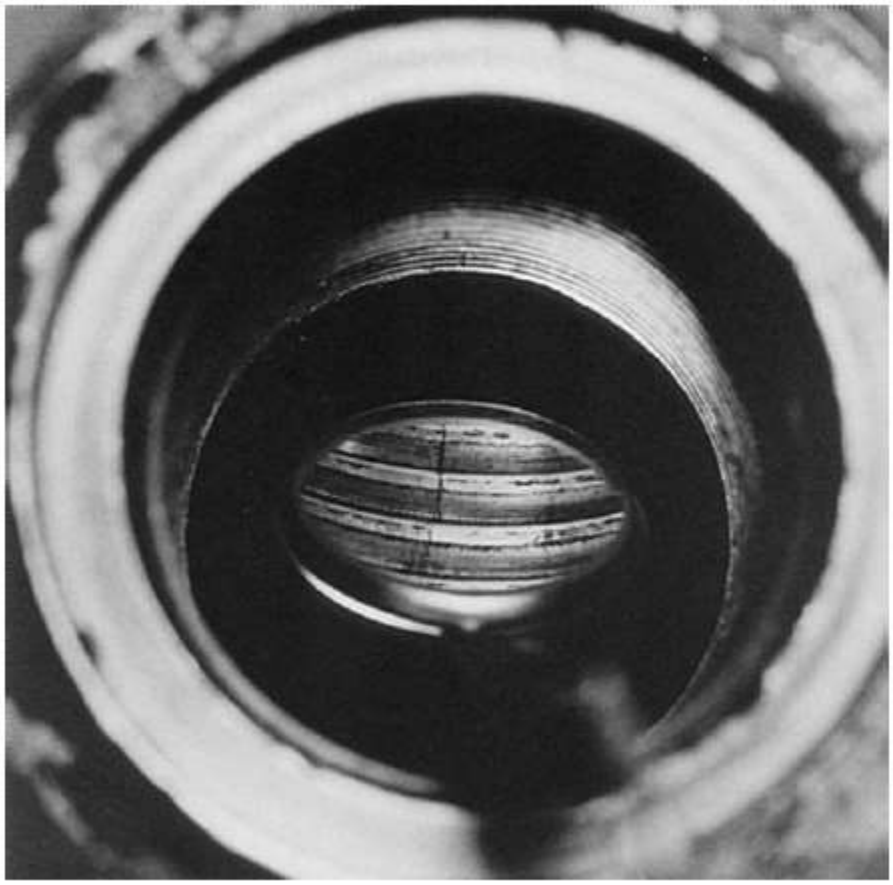


PHOTO 7. A crack in the threads found by the use of a dental mirror.

PHOTO 8. A crack in dirty threads. Threads need to be cleaned before the visual inspection begins.

PHOTO 9. A crack easily seen with the naked eye, near the top or O-ring gland. A quick cleaning should be done, enough to verify that it is a crack.

PHOTO 10. Example of a tool stop mark. Tool stop marks may appear to be like a crack, but the inspector will note that the tool stop is straight, through most of the threads, and is more like a wide smudge and contains no depth or opening. Careful inspection is important. Cracked cylinders are to be condemned; cylinders with tool stop marks that pass all other inspection criteria should be returned to service.

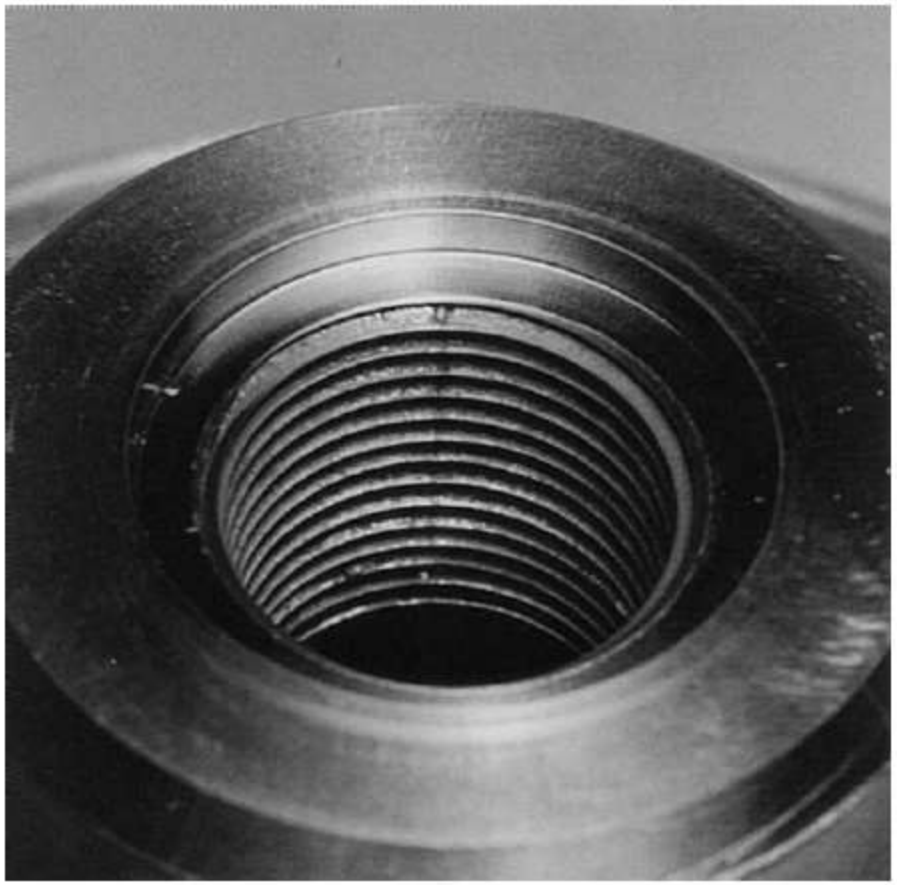


PHOTO 14. Inside view (looking from the inside towards the crown) of a fold near the threads.

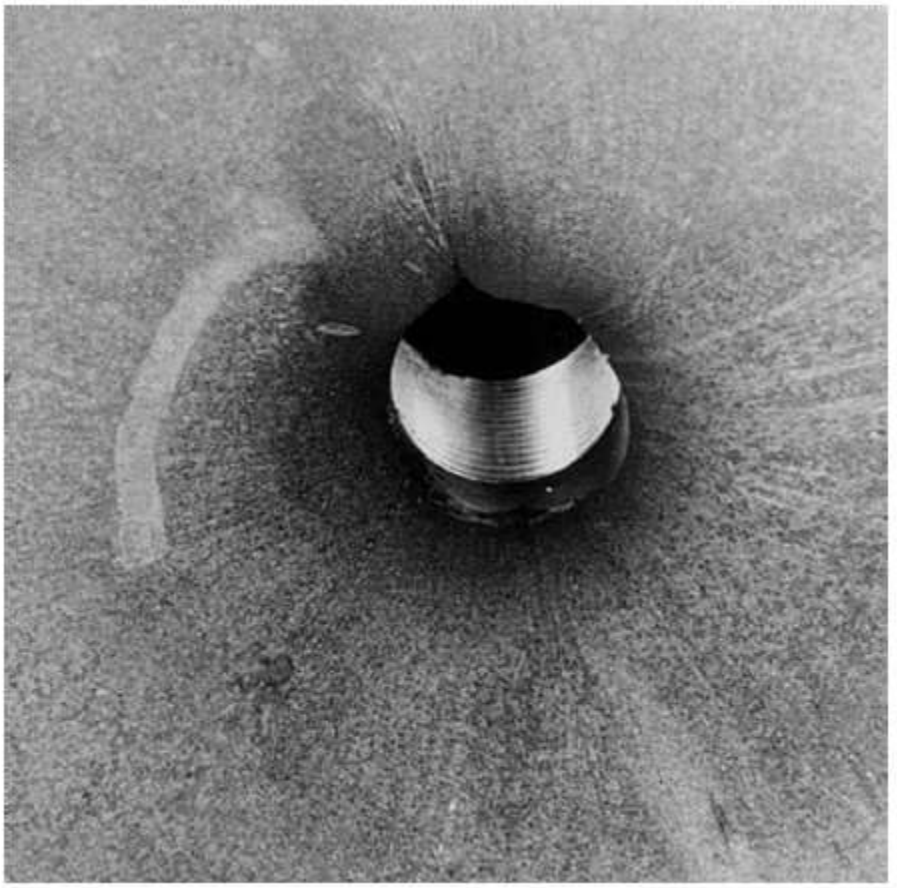


PHOTO 18. Cylinder with bow or "banana." The bow shows easily with a straight edge placed along the length of the cylinder (see FIGURE 11 of a bow 'from the other side').

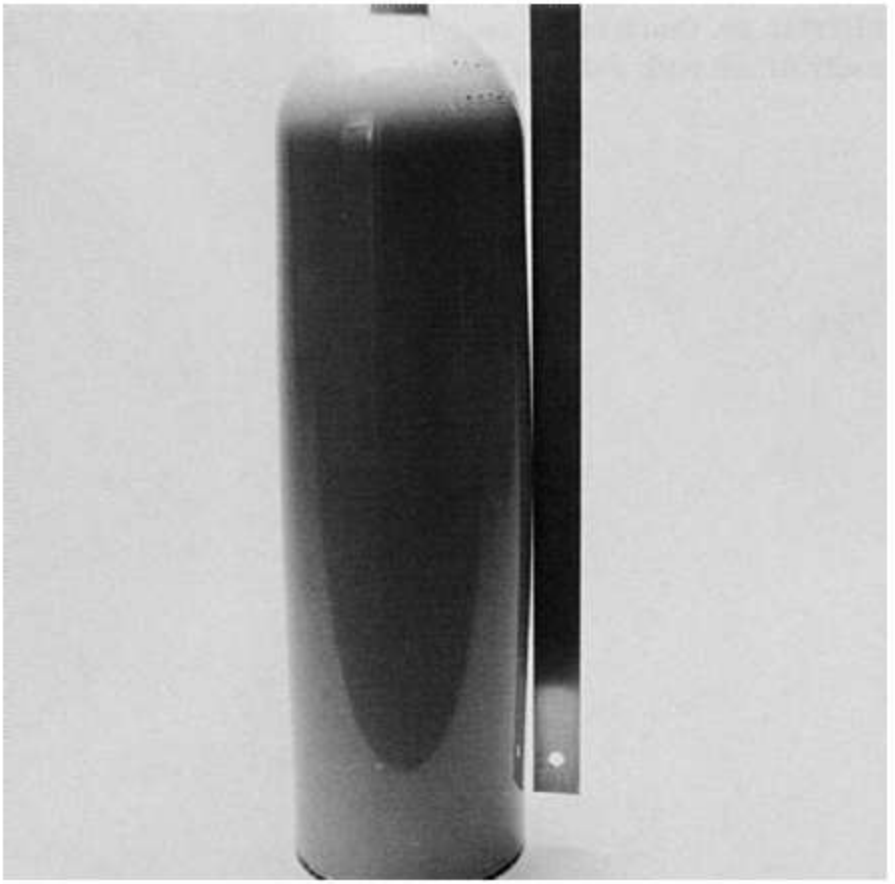
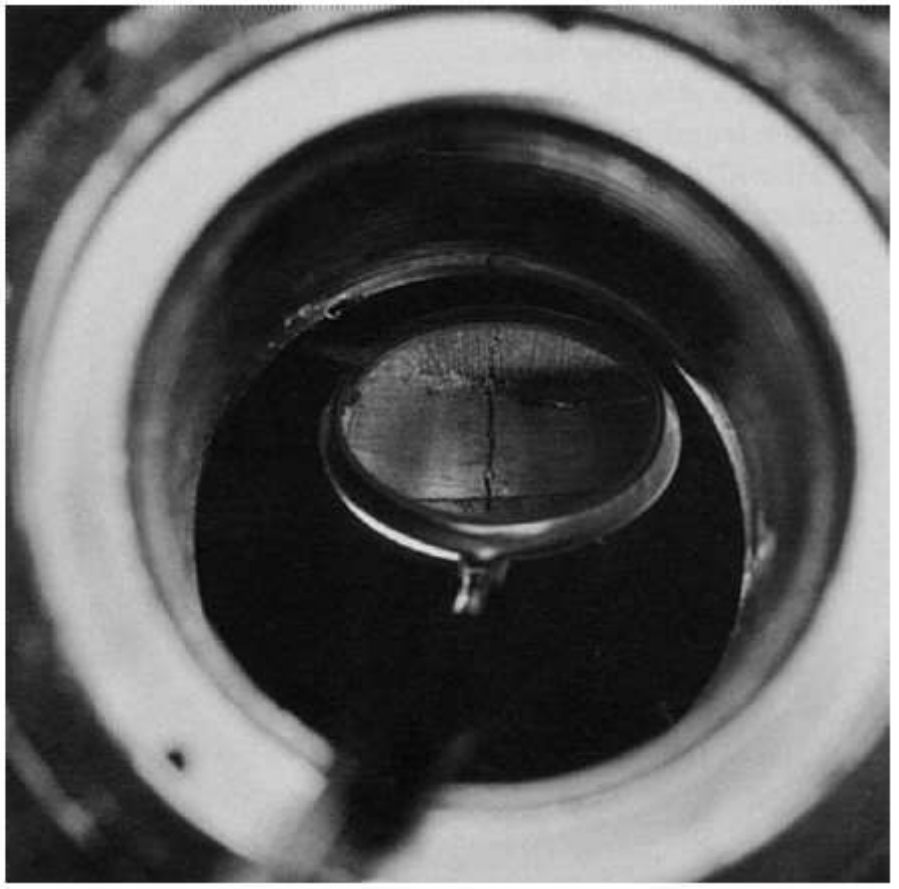


PHOTO 19. Dirty and worn threads. The threads at the bottom are worn and not as 'sharp' as the threads near the top. The threads need to be cleaned before counting the good threads (starting from the top).

PHOTO 20. Crack in the crown, easily found with a dental mirror.



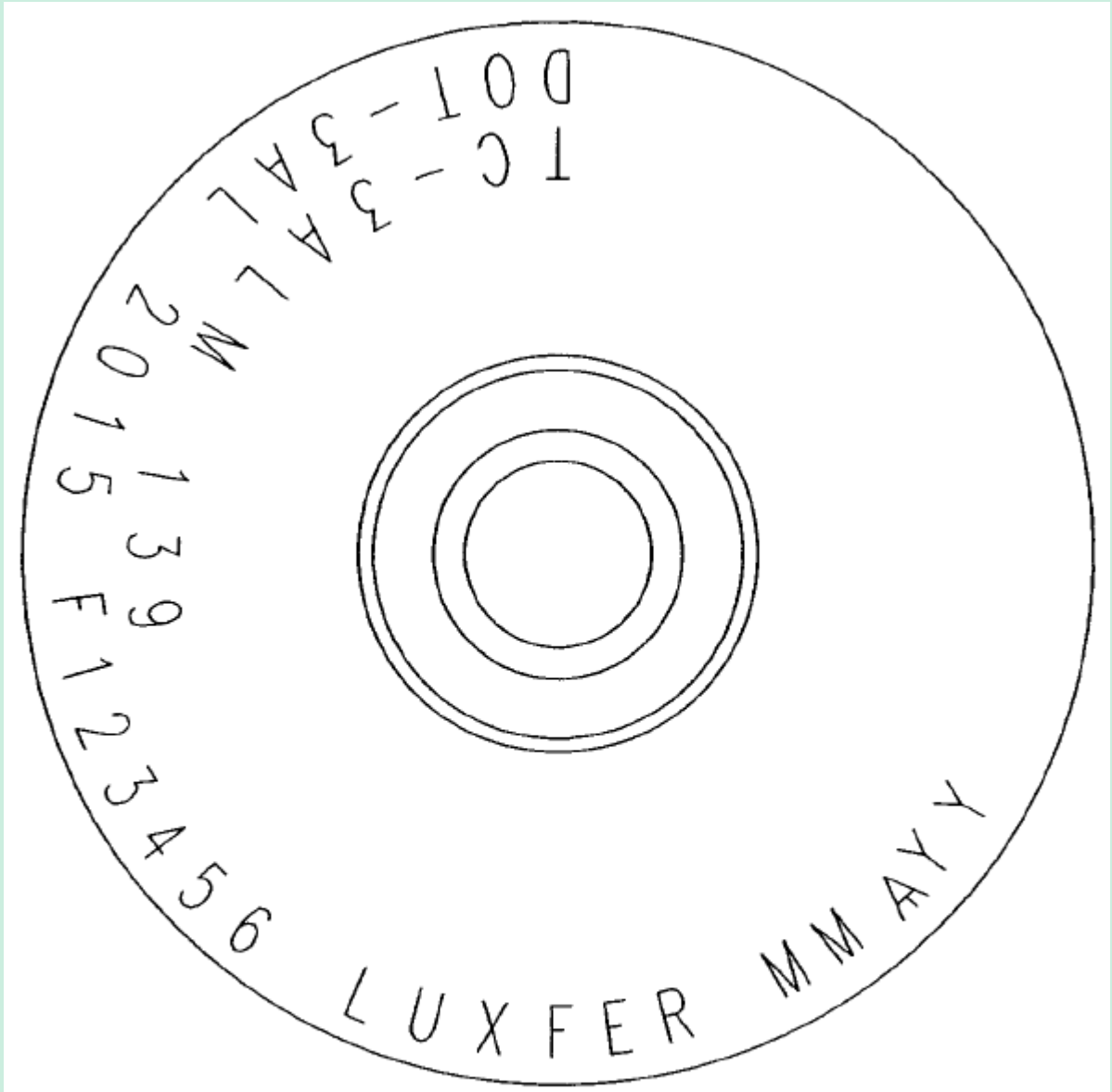
§ 173.23 Previously authorized packaging.

(a) When the regulations specify a packaging with a specification marking prefix of “DOT,” a packaging marked prior to January 1, 1970, with the prefix of “ICC” may be used in its place if the packaging otherwise conforms to applicable specification requirements.

(b) [Reserved]

(c) After July 2, 1982, a seamless aluminum cylinder manufactured in conformance with and for use under DOT special permit (SP) or exemption (E) 6498, 7042, 8107, 8364 or 8422 may be continued in use if marked before or at the time of the next retest with either the specification identification “3AL” immediately above the special permit or exemption number, or the DOT mark (e.g., DOT 3AL 1800) in proximity to the special permit or exemption marking.

…



TOP VIEW OF CYLINDER

- Top view of cylinder:

How about cylinder threads?

Cracking?

Leaks?

Folds and Valleys?

§ 178.46 Specification 3AL seamless aluminum cylinders.

(D) Other straight threads conforming to other recognized standards may be used provided that the requirements in paragraph (e)(5)(iv) of this section are met.

(iv) All straight threads must have at least 6 engaged threads, a tight fit, and a factor of safety in shear of at least 10 at the test pressure of the cylinder. Shear stress must be calculated by using the appropriate thread shear area in accordance with NBS Handbook H–28. **…**

From Luxfer's Guide to Scuba Cylinder Visual Inspections:

Inspect clean cylinder threads with and without a dental mirror and light…

- RECORD the location of all thread imperfections (damaged, missing, and cross
- threads).
- Count the number of continuous full threads starting at the top, that do not have any
- imperfection. RECORD this number of good threads on THE FORM.
- Review the cylinder's recorded service pressure and then:
- CONDEMN all 2015 to 3000 psig cylinders that have less than **eight continuous**
- full threads without imperfection, counting from the top.
- CONDEMN all 3100 to 3300 psig cylinders that have less than **nine continuous**
- full threads without imperfection, counting from the top.
- CONDEMN all 3400 to 3500 psig cylinders that have less than **ten continuous full**
- threads without imperfection, counting from the top.

TABLE 2. Thread Requirements			
Thread Type	**Service Pressure (psig)**		
	2216	3000	4500
	Minimum Required Threads		
0.750-16UNF-2B	6	7	10
0.750-14NSPM-2B	6	8	12
0.875-14UNF-2B	6	7	10
1.125-12UNF-2B	6	8	12

CONDEMN all cylinders with corrosion in a thread that is a continuous full thread required and defined above.

Luxfer's SCBA Guide Volume 2

Galiso's understanding of CGA Pamphlet C-6, 5.8 regarding neck defects is:

Cylinder necks must be inspected for cracks, folds, and other defects.

All aluminum cylinders must be internally inspected (electronic devices are allowed) and cylinders with neck cracks must be condemned. Repair of neck cracks is not permitted.

A distinction must be made between tool stop marks and a neck crack. Cylinders with a tool stop mark are allowed to be placed into service.

Aluminum cylinders made of 6351 alloy might display "sustained load cracking" (SLC) over time. Such cylinders require careful inspections when they are re-qualified.

5C CRACKED CYLINDER THREADS

Inspect all cylinder threads for cracking with and without a dental mirror and light. See PHOTOS 6 - 9. In addition to a visual inspection using the naked eye, the use of an Non-destructive Testing (NDT)[6] device, such as Visual Plus[B&C] is also recommended to detect thread cracks.

Remove the O-ring. Inspect the O-ring gland and cylinder face[P5/6] for cracking. Follow the SCBA or respirator manufacturer's recommendation on when to replace the O-ring.

NOTE: SCBA components, like the O-ring, are certified by regulatory agencies in the USA. DO NOT replace components without following the SCBA manufacturer's instructions. Replace components with parts that are authorized by the SCBA manufacturer.

CONDEMN all cylinders that show evidence of cracking in more than one continuous full thread.[6] Contact Luxfer[7] with this information and findings.

CONDEMN all cylinders with O-ring gland or face cracks. Contact Luxfer[7] with this information and findings.

CONDEMN all cylinders with O-ring gland or face damage.

RETURN TO SERVICE all cylinders with tool stop marks [P10] on otherwise acceptable threads, with acceptable glands and faces.

§ 180.209 Requirements for requalification of specification cylinders.

(m) *DOT–3AL cylinders manufactured of 6351–T6 aluminum alloy.* In addition to the periodic requalification and marking described in §180.205, each cylinder manufactured of aluminum alloy 6351–T6 used in self-contained underwater breathing apparatus (SCUBA), self-contained breathing apparatus (SCBA), or oxygen service must be requalified and inspected for sustained load cracking in accordance with the non-destructive examination method described in the following table. Each cylinder with sustained load cracking that has expanded into the neck threads must be condemned in accordance with §180.205(i). This provision does not apply to cylinders used for carbon dioxide, fire extinguisher or other industrial gas service.

Requalification and Inspection of DOT–3AL Cylinders Made of Aluminum Alloy 6351–T6

Requalification requirement Examination procedure[1] Sustained Load Cracking Condemnation Criteria[2]
Requalification period (years) Eddy current examination combined with visual inspection Eddy current—In accordance with Appendix C of this part
Visual inspection—In accordance with CGA Pamphlet C–6.1 (IBR; see §171.7 of this subchapter) Any crack in the neck or shoulder of 2 thread lengths or more 5

[1]The requalifier performing eddy current must be familiar with the eddy current equipment and must standardize (calibrate) the system in accordance with the requirements provided in Appendix C to this part.

[2]The eddy current must be applied from the inside of the cylinder's neck to detect any sustained load cracking that has expanded into the neck threads.

§ 180.205 General requirements for requalification of specification cylinders.

(i) *Cylinder condemnation.* (1) A cylinder must be condemned when—

(i) The cylinder meets a condition for condemnation under the visual inspection requirements of paragraph (f) of this section.

(ii) The cylinder leaks through its wall.

(iii) Evidence of cracking exists to the extent that the cylinder is likely to be weakened appreciably.

(iv) For a DOT specification cylinder, other than a DOT 4E aluminum cylinder or a special permit cylinder, permanent expansion exceeds 10 percent of total expansion.

(v) For a DOT 3HT cylinder—

(A) The pressure test yields an elastic expansion exceeding the marked rejection elastic expansion (REE) value.

(B) The cylinder shows evidence of denting or bulging.

(C) The cylinder bears a manufacture or an original test date older than twenty-four years or after 4380 pressurizations, whichever occurs first. If a cylinder is refilled, on average, more than once every other day, an accurate record of the number of rechargings must be maintained by the cylinder owner or the owner's agent.

....

Galiso's understanding of CGA Pamphlet C-6, 5.2.2 regarding isolated pit limits is:

When the wall thickness is unknown:

the allowable depth of pitting is 1/16 in.

When the wall thickness is known:

the allowable depth of pitting is 30% of the minimum design wall thickness.

In some instances, a cylinder with a known wall thickness may be allowed a pit depth which is more than the allowable pit depth for a cylinder with an unknown design wall thickness.

Galiso's understanding of CGA Pamphlet C-6, 5.2.3 regarding general corrosion limits is:

When the wall thickness of a cylinder is unknown:

- the allowable corrosion depth is 1/32 in.

When the wall thickness is known:

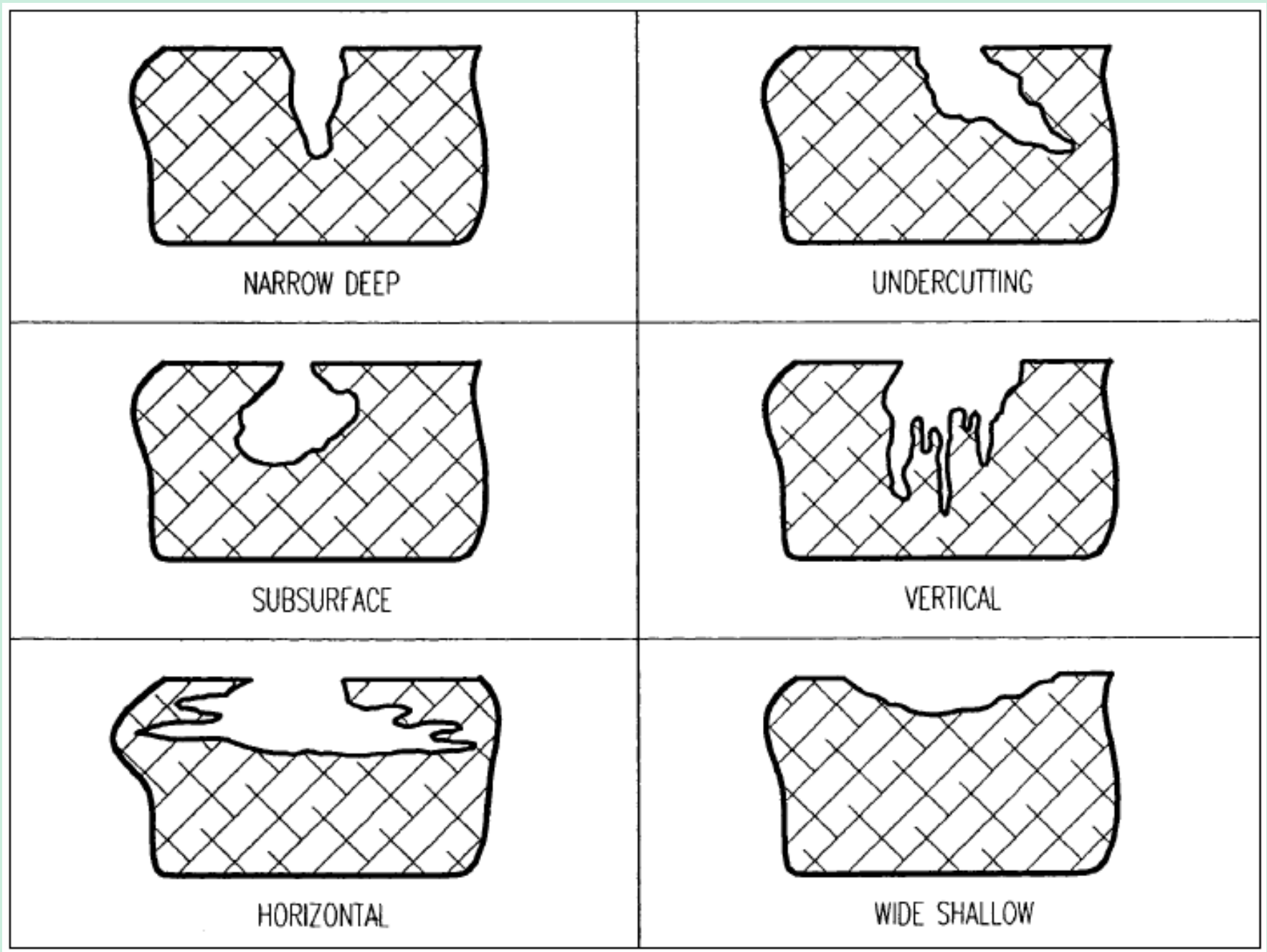
- the allowable corrosion depth is 15% of the minimum design wall thickness.

The length of a line of corrosion must be less than 6 inches.

- In the following slide, the various shapes of pits are shown from a cross sectional view of the sidewall, base or crown section of the cylinder. The gap section of the pits represents where the sidewall, base or crown metal was, before pitting began.

- All cross sections are greatly magnified.

Pits shown from a cross sectional view (Luxfer's Scuba Guide):



Galiso's understanding of CGA Pamphlet C-6, 5.8.2 regarding folds is:

When you give an internal visual inspection to the neck of a cylinder, a fold might appear to be a crack.

Cylinders must be condemned which have folds involving more than one unbroken full neck thread.

Galiso's understanding of CGA Pamphlet C-6, 5.8.3 regarding valleys is:

A cylinder with one or more valleys may be returned to service IF the valley(s) does not involve more than the smallest allowable number of required threads.

Galiso's understanding of CGA Pamphlet C-6, 5.9 regarding threads and valving:

Whenever a gas-tight seal cannot be obtained when replacing a valve because the required number of threads have been reduced by galling, wearing, corrosion, breaking, cracking, damage from an incorrect valve having been forced into the threads or the like, cylinders must be rejected.

Galiso's understanding of CGA Pamphlet C-6, 5.9.1 regarding an O-ring gland is:

An O-ring which is not clean and smooth should be considered damaged .

Damaged O-rings must be replaced.

Replacement O-rings need to be obtained from the SCBA unit manufacturer when placed into cylinders used in certified SCBA service, such as those used by fire fighters and emergency response teams.

A cross sectional diagram of a valley is featured in the following slide. This is followed by slides with photos depicting a valley – from Luxfer's Scuba guide.

The valley has a rounded effect in the metal flow.

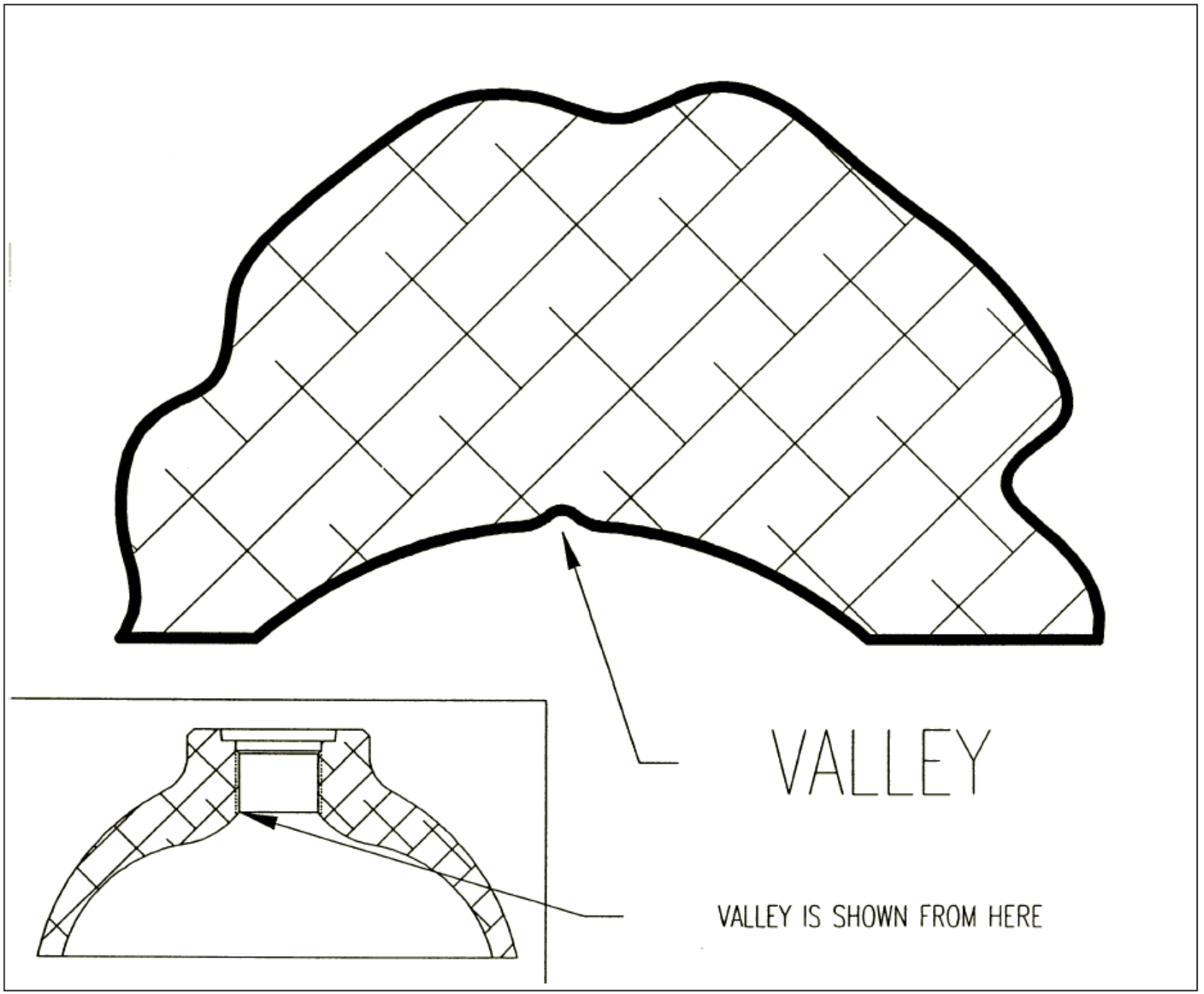

VALLEY
VALLEY IS SHOWN FROM HERE

PHOTO 16. Inside view (looking from the inside towards the crown) of a valley.

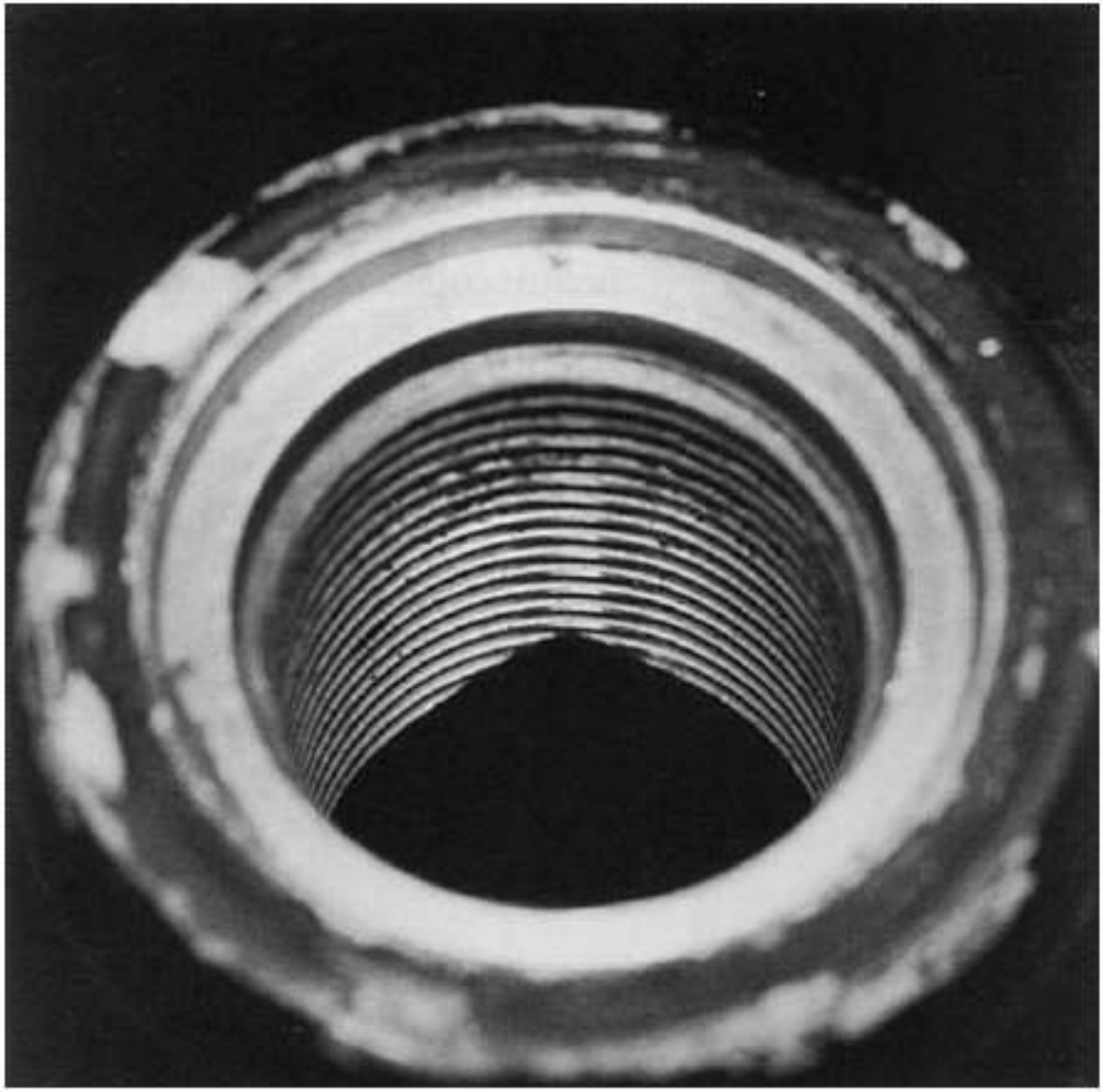
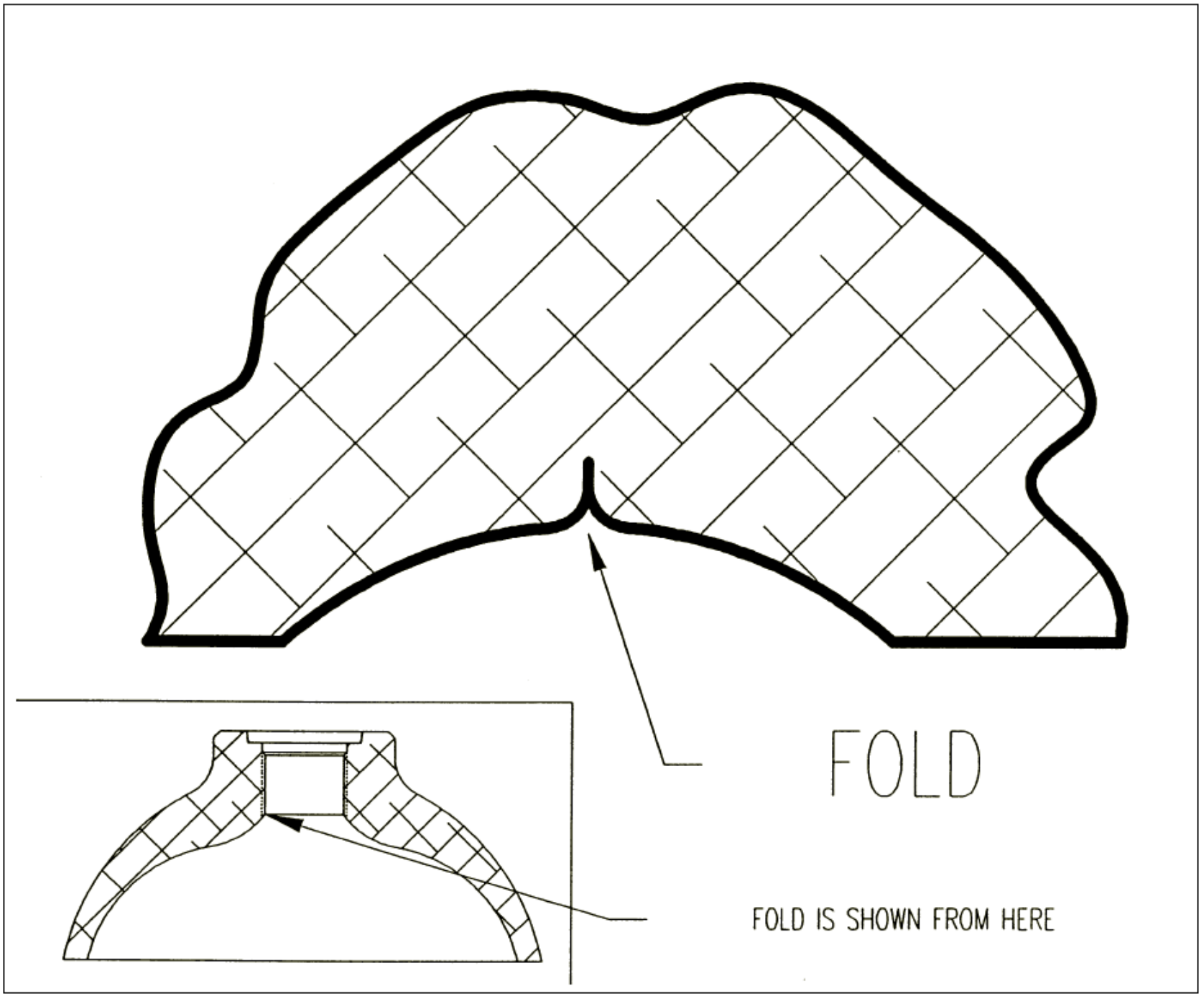


PHOTO 17. The appearance of a valley, looking into the cylinder at an angle.

A cross sectional diagram of a fold is featured in the following slide, shown from a cross sectional view of the bottom of the threaded area. This is followed by slides with photos depicting a fold – from Luxfer's Scuba guide.

The fold has a definite flow back into the shoulder.


FOLD
FOLD IS SHOWN FROM HERE

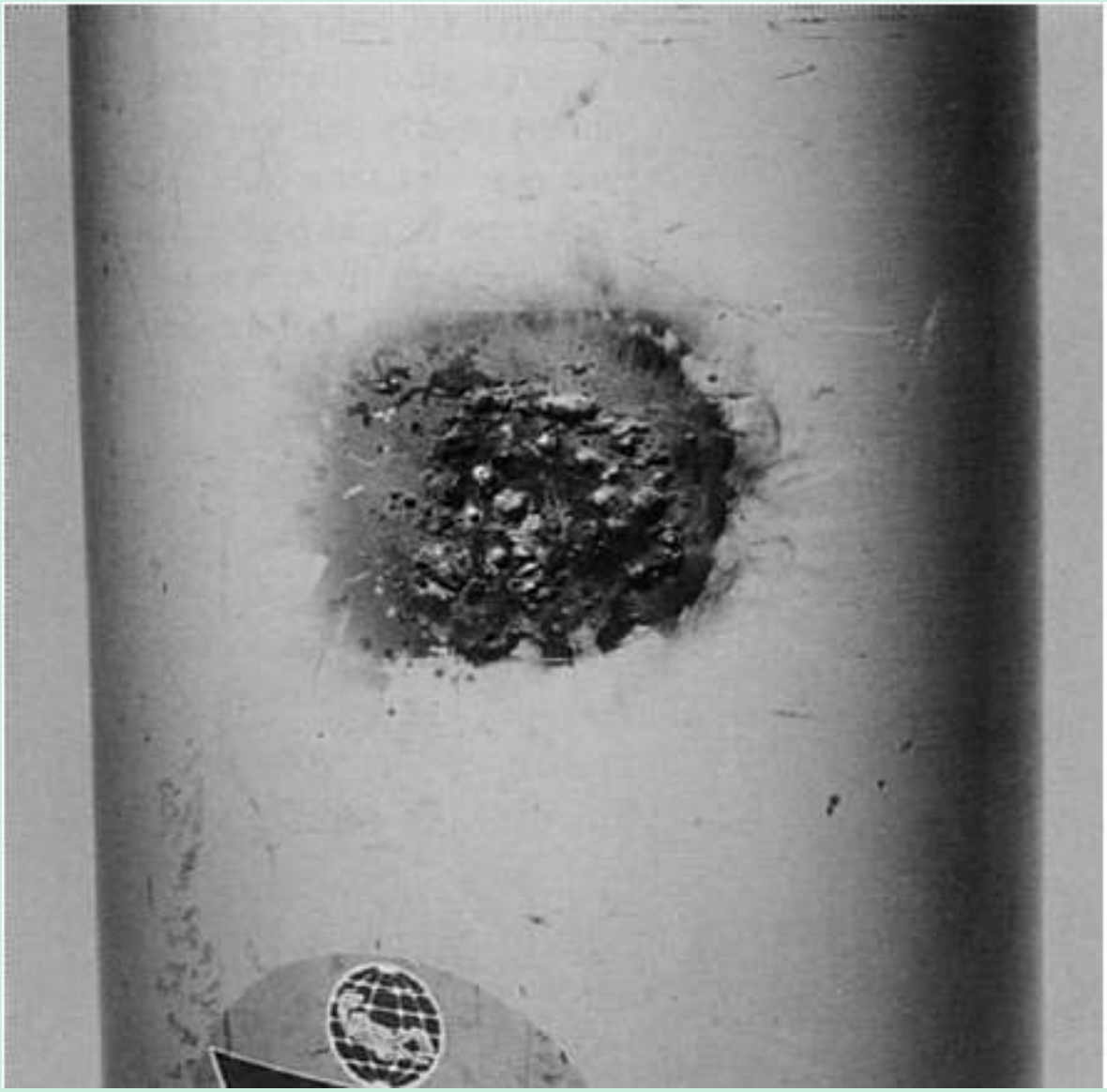


PHOTO 14. Appearance of fire or welding damage done to a cylinder.

PHOTO 14. Inside view (looking from the inside towards the crown) of a fold near the threads.

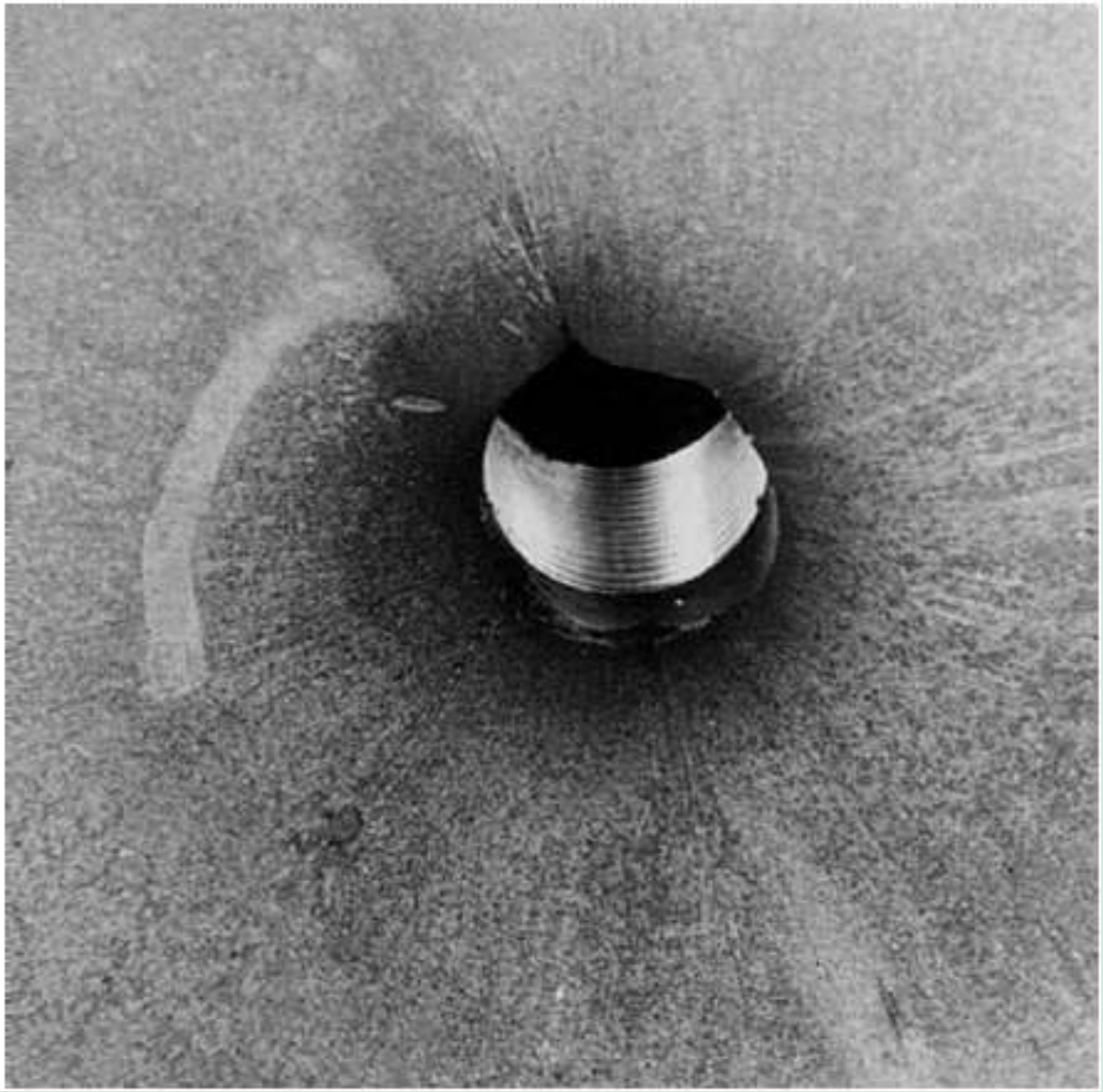


PHOTO 15. Fold near the thread region. Mirror view shows clearly that the fold does not enter into the full-thread area. This type of fold is acceptible if the depth of the fold is estimated to be less than 0.060 inch (1.53 mm).

5D FOLDS AND VALLEYS IN THREADS

Inspect cylinder threads near the bottom of the threads, with a dental mirror and light[8] for folds and valleys (for visual illustrations, see FIGURES 6 - 8 and PHOTOS 14 - 17) that enter into the thread area.

RECORD the findings on THE FORM.

CONDEMN all cylinders with valleys that reduce the number of defect-free, continuous full threads below the minimum (according to the limits defined in section 5B.), counting from the top. Contact Luxfer Gas Cylinders[7] with this information and findings.

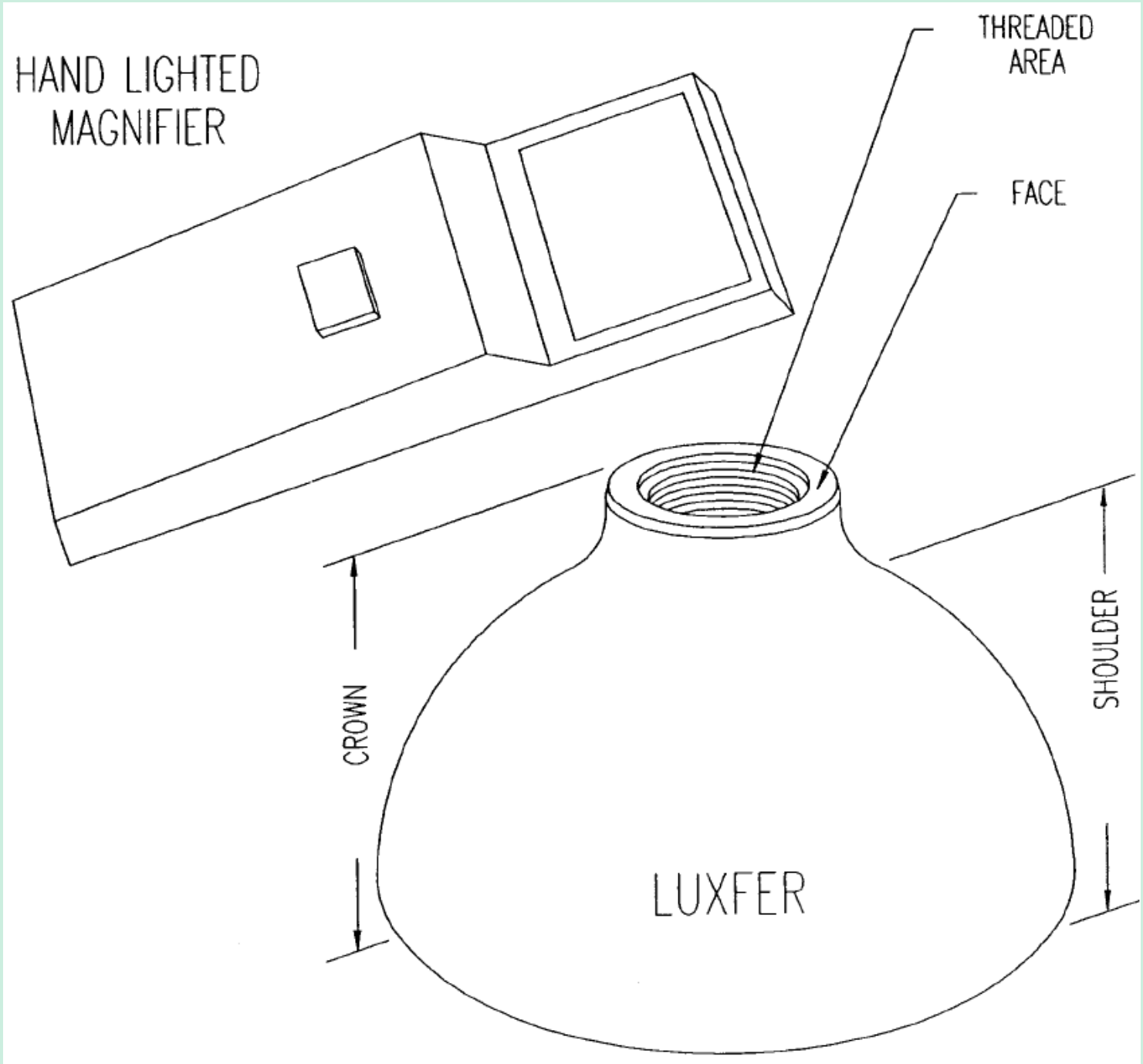
CONDEMN all cylinders with a fold which enters into more than one thread. Contact Luxfer Gas Cylinders[7] with this information and findings.

5E THREAD IMPERFECTIONS

Inspect cylinder threads for any other imperfections (see '**imperfection**'.[6] Check for corrosion (on cylinder thread as well as valve thread, if valve is available). RECORD on THE FORM any observation of thread imperfections.

CONDEMN all cylinders with thread imperfections which reduce the number of continuous full threads below the limits defined in section 5B above.

CONDEMN all cylinders with corrosion in any thread that is a required continuous full thread identified in section 5B above.


HAND LIGHTED
MAGNIFIER
THREADED
AREA
FACE
CROWN
SHOULDER
LUXFER

Aluminum Cylinders

§ 173.40 General packaging requirements for toxic materials packaged in cylinders.

When this section is referenced for a Hazard Zone A or B hazardous material elsewhere in this subchapter, the requirements in this section are applicable to cylinders used for that material.

(a) *Authorized cylinders.* (1) A cylinder must conform to a DOT specification or a UN standard prescribed in subpart C of part 178 of this subchapter, except that acetylene cylinders and non-refillable cylinders are not authorized. The use of UN tubes and MEGCs is prohibited for Hazard Zone A materials.

(2) The use of a specification 3AL cylinder made of aluminum alloy 6351–T6 is prohibited for a Division 2.3 Hazard Zone A material or a Division 6.1 Hazard Zone A material.

Aluminum Cylinders

173.192 Packaging for certain toxic gases in Hazard Zone A.

When §172.101 of this subchapter specifies a toxic material must be packaged under this section, only the following cylinders are authorized:

(a) Specification 3A1800, 3AA1800, 3AL1800, 3E1800, or seamless UN cylinders with a minimum test pressure in accordance with P200 of the UN Recommendations (IBR, see §171.7 of this subchapter).

(1) Specification 3A, 3AA, or 3AL cylinders may not exceed 57 kg (125 lb) water capacity (nominal).

(2) Specification 3AL cylinders may only be offered for transportation or transported by highway and rail.

Aluminum Cylinders

§ 173.23 Previously authorized packaging.

(a) When the regulations specify a packaging with a specification marking prefix of “DOT,” a packaging marked prior to January 1, 1970, with the prefix of “ICC” may be used in its place if the packaging otherwise conforms to applicable specification requirements.

(b) [Reserved]

(c) After July 2, 1982, a seamless aluminum cylinder manufactured in conformance with and for use under DOT special permit (SP) or exemption (E) 6498, 7042, 8107, 8364 or 8422 may be continued in use if marked before or at the time of the next retest with either the specification identification “3AL” immediately above the special permit or exemption number, or the DOT mark (e.g., DOT 3AL 1800) in proximity to the special permit or exemption marking.

Eddy Current Examination now required for SCUBA, SCBA, and Oxygen cylinders made from 6351 alloy Aluminum

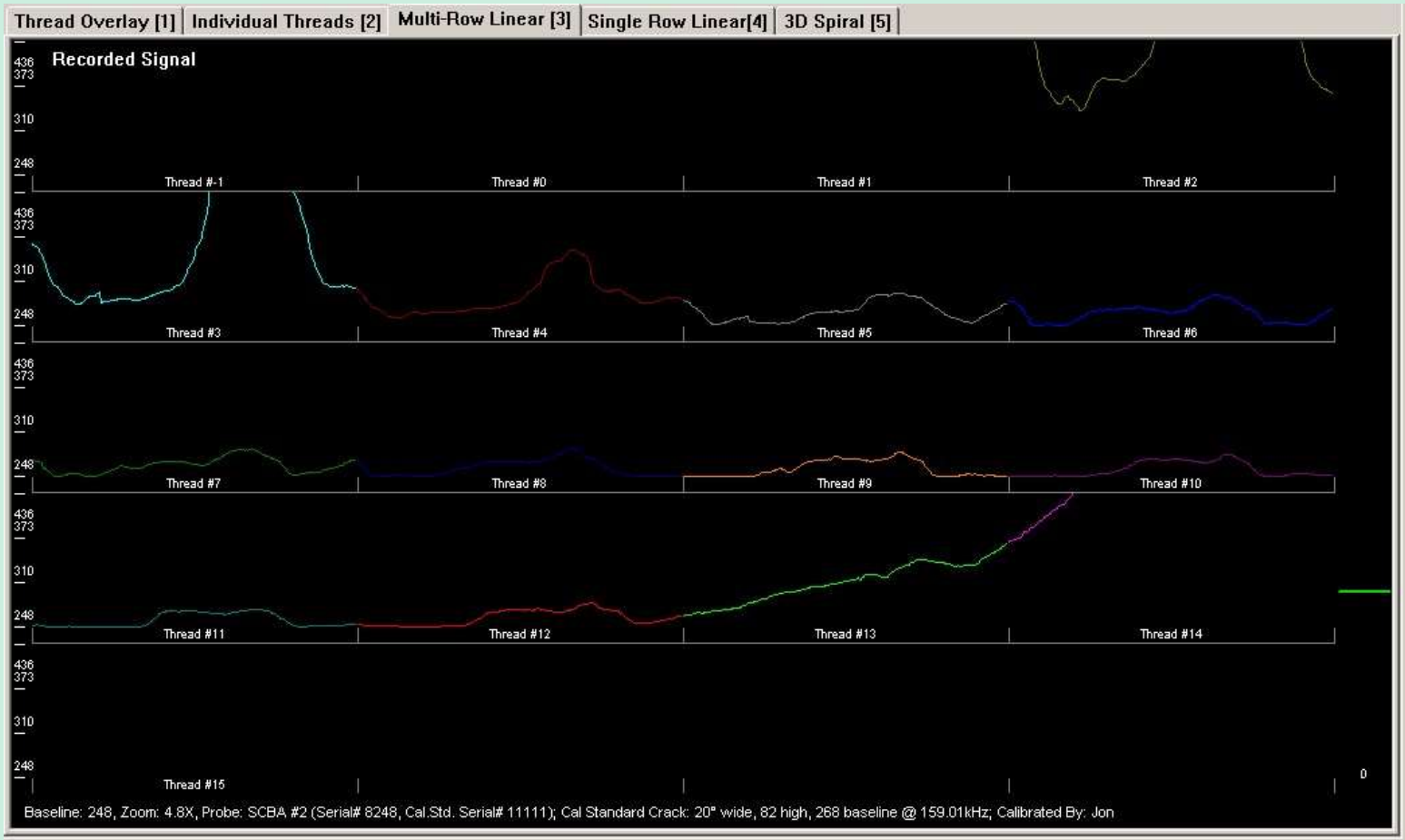
§ 180.209 Requirements for requalification of specification cylinders.

(m) *DOT–3AL cylinders manufactured of 6351–T6 aluminum alloy.* In addition to the periodic requalification and marking described in §180.205, each cylinder manufactured of aluminum alloy 6351–T6 used in self-contained underwater breathing apparatus (SCUBA), self-contained breathing apparatus (SCBA), or oxygen service must be requalified and inspected for sustained load cracking in accordance with the non-destructive examination method described in the following table. Each cylinder with sustained load cracking that has expanded into the neck threads must be condemned in accordance with §180.205(i). This provision does not apply to cylinders used for carbon dioxide, fire extinguisher or other industrial gas service.

Requalification and Inspection of DOT–3AL Cylinders Made of Aluminum Alloy 6351–T6

Requalification requirement Examination procedure[1] Sustained Load Cracking Condemnation Criteria[2] Requalification period (years) Eddy current examination combined with visual inspection Eddy current—In accordance with Appendix C of this part Visual inspection—In accordance with CGA Pamphlet C–6.1 (IBR; see §171.7 of this subchapter) Any crack in the neck or shoulder of 2 thread lengths or more 5

- [1]The requalifier performing eddy current must be familiar with the eddy current equipment and must standardize (calibrate) the system in accordance with the requirements provided in Appendix C to this part.
- [2]The eddy current must be applied from the inside of the cylinder's neck to detect any sustained load cracking that has expanded into the neck threads.



Analysis Results: Found 0 cracks in recorded data that are at least 3 threads long.
Please verify analysis accuracy by viewing results and performing visual inspection.

Instrument #A000125
Firmware: 0.1.9.2
Software: 3.5.0.9

Customer: Galiso

Serial #: R63649 | DOT Spec/Exempt: 3AL

Inspected by: Jon

Original Manufacturing Date: 07/1998

Last Hydro: 07/1998

Last VISPlus: 10/2007

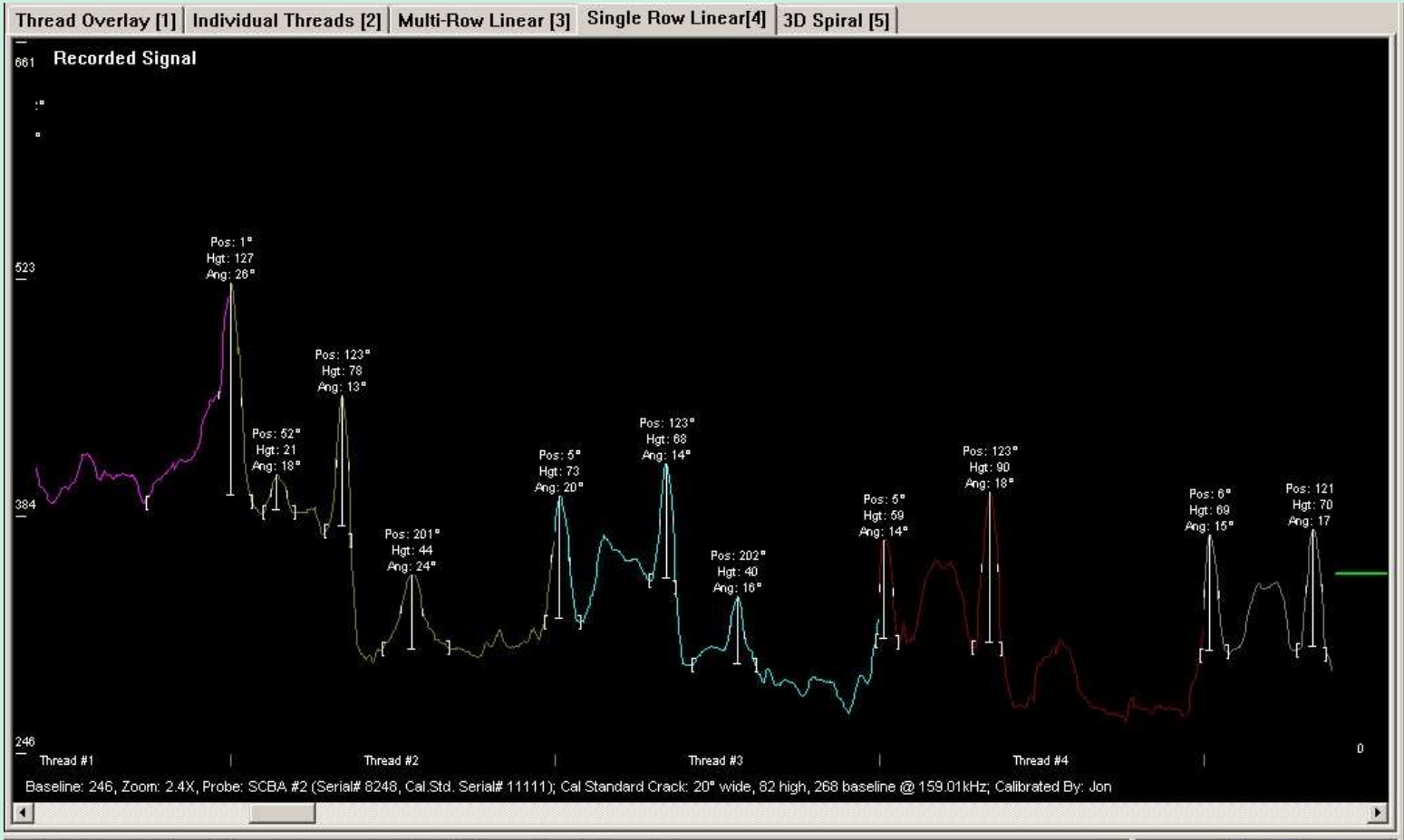
Manufacturer: Catalina

Inspection Results: Not determined | Alloy: 6061

Inspection Date: 02/Oct/2007, 09:35AM

Short Cut Keys

Calibration Wizard	F4
Start Recording	F6
Stop Recording	F7
Pass Inspection	F10
Fail Inspection	F11
New File	F5
Open File	Ctrl-O
Save File	F8
Print	Ctrl-P
Zoom In	Page Up
Zoom Out	Page Dn
Increase Baseline	Home
Decrease Baseline	End
Switch View	F2



Customer: Galiso

Serial #: E46529 DOT Spec/Exempt.: 3AL

Inspected by: Jon

Original Manufacturing Date: 09/1983

Last Hydro: 10/1994

Last VISPlus: 10/2007

Manufacturer: Luxfer

Inspection Results: Failed Alloy: 6351

Inspection Date: 02/Oct/2007, 08:22AM

Short Cut Keys

Calibration Wizard	F4
Start Recording	F6
Stop Recording	F7
Pass Inspection	F10
Fail Inspection	F11
New File	F5
Open File	Ctrl-O
Save File	F8
Print	Ctrl-P
Zoom In	Page Up
Zoom Out	Page Dn
Increase Baseline	Home
Decrease Baseline	End
Switch View	F2

Analysis Results: Found 3 cracks in recorded data that are at least 2 threads long.
Please verify analysis accuracy by viewing results and performing visual inspection.
Group of indications at position 34°, height: 76, width: 16°, first thread: 0, last thread: 12
Group of indications at position 123°, height: 74, width: 16°, first thread: 1, last thread: 11
Group of indications at position 201°, height: 42, width: 20°, first thread: 2, last thread: 3

Instrument #A000125
Firmware: 0.1.9.2
Software: 3.5.0.9

Composite Cylinders:

CGA Pamphlet C-6.2

Internal Inspection: CGA C6 or C6.1

Acceptable limits of damage

Repairs: Must be followed by Hydrostatic Test

Compressed Gas Association, Inc., 4221 Walney Road, 5th Floor, Chantilly, Virginia 20151 Pamphlets:

(See complete list in CFR Title 49 § 171.7 Reference material.)…

CGA Pamphlet C–3, Standards for Welding on Thin-Walled Steel Cylinders, 1994

178.47; 178.50; 178.51; 178.53; 178.55; 178.56; 178.57; 178.58; 178.59; 178.60; 178.61; 178.65; 178.68; 180.211.

CGA C–5, Cylinder Service Life—Seamless Steel High Pressure Cylinders, 1991 (reaffirmed 1995)

173.302a.

CGA Pamphlet C–6, Standards for Visual Inspection of Steel Compressed Gas Cylinders, 1993

173.3, 173.198, 180.205, 180.209, 180.211, 180.411, 180.519.

CGA Pamphlet C–6.1, Standards for Visual Inspection of High Pressure Aluminum Compressed Gas Cylinders, 2002, Fourth Edition

180.205; 180.209

CGA Pamphlet C–6.2, Guidelines for Visual Inspection and Requalification of Fiber Reinforced High Pressure Cylinders, 1996, Third Edition

180.205.

CGA Pamphlet C–6.3, Guidelines for Visual Inspection and Requalification of Low Pressure Aluminum Compressed Gas Cylinders, 1991

180.205; 180.209.

CGA C–7, Guide to Preparation of Precautionary Labeling and Marking of Compressed Gas Containers, Appendix A, issued 2004 (8th Edition)

172.400a.

CGA Pamphlet C–8, Standard for Requalification of DOT-3HT Cylinder Design, 1985

180.205; 180.209.

…

Galiso's understanding of CGA Pamphlet C-6.2, 8.3 - regarding visual inspection of composite cylinders is:

After the hydrotest, examine the interior of the neck for cracking, and inspect the interior with a highly concentrated light, exercising care due to the thinner nature of composite cylinder liners as opposed to all metal cylinders.


1 litre
carbon
full wrap
2 litre
carbon
full wrap
3 litre
carbon
full wrap
0.6 litre
carbon
full wrap

U.S. Department
of Transportation
**Research and
Special Programs
Administration**

400 Seventh St., S.W.
Washington, D.C. 20590

MAY 11 2001

DOT-E 10915
(EIGHTH REVISION)

EXPIRATION DATE: April 30, 2003

(FOR RENEWAL, SEE 49 CFR § 107.109)

1. GRANTEE: Luxfur Gas Cylinders
Riverside, California
(Former Grantee: Luxfer USA Limited)

2. PURPOSE AND LIMITATIONS:

This exemption authorizes the manufacture, mark, sale and use of a non-DOT specification fully wrapped carbon-fiber reinforced aluminum lined cylinder for the transportation in

Region	Direction of fiber damage	Maximum length of damage
Cylinder sidewall and domes	Transverse to fiber direction (longitudinal direction)	20% of the length of the straight sidewall section of the cylinder
Cylinder sidewall and domes	In the direction of the fiber (circumferential direction)	20% of the length of the straight sidewall section of the cylinder

(5) Cylinders with damage that meet the Level 2 criteria must be rejected. Contact the cylinder manufacturer in the event that damage is questionable based on this criteria. Repair of rejected cylinders is authorized for Level 2 type damage. Repairs must be made in accordance with CGA pamphlet C-6.2, prior to the hydrostatic pressure test. Repairs must be evaluated after the hydrostatic test.

(6) Cylinders that have direct fiber damage that penetrates through the outer fiberglass layer and into the carbon layer, or that have a measured damage depth of greater than the Level 2 maximum stated in (5)(a) above are considered to have Level 3 type damage. Cylinders that have damage with depth meeting Level 2, but length exceeding the Level 2 maximum are considered to have Level 3 type damage. Cylinders with Level 3 type damage are not authorized to be repaired, and must be condemned.

b. TESTING: Each cylinder must be reinspected and hydrostatically retested at least every five years, in accordance with § 173.34(e) and the latest edition of CGA pamphlet C-6.2 "Guidelines for Visual Inspection and Re-qualification of Fiber Reinforced High Pressure Cylinders", except as specifically noted herein:

(1) Cylinders must be volumetrically tested by the water jacket method suitable for the determination of the cylinder expansion for a minimum test time of one minute.

(2) A maximum permanent expansion to total expansion ratio does not apply. The cylinder must be condemned if the elastic expansion exceeds the rejection elastic expansion (REE) as marked on the cylinder.

(7) A hydrostatic retest may be repeated as provided for in § 173.34(e)(4), only two such retests are permitted. Pressurization prior to the official hydrostatic test for the purpose of a systems check must not exceed 85% of the required test pressure.

OPERATIONAL CONTROLS -

(1) Cylinders manufactured under this exemption are not authorized for use fifteen (15) years after the date of manufacture.

- Maximum allowable defects for fully wrapped composite cylinders are set forth in CGA pamphlet C-6.2

Composites…

- Make sure you have copies of the exemption
- 3-5 yr retest,
- 15 yr service life,
- 5% permanent expansion or REE
- No stamping them !!!

Steel Cylinders

3A and 3AA

Plus and Star

REE

3HT - DOT 49 CFR 180.205(i)(v)
CGA Pamphlet C-8

4B, 4BA, 4BW, 4E
Modified Hydrostatic Test - (“Proof Pressure Test”)
DOT 49 CFR 180.209(e), (f), (g)

Fire Extinguishers 180.209(j)
12 lbs. or less 180.209(j)(1)(i), greater than 12lbs. 180.209(j)(1)(ii)

When is a "Proof Pressure Test" appropriate?

May certain cylinders be tested at lengthier intervals?

How about fire extinguishers and cylinders containing poisonous materials?

DOT 49 CFR 180.209(e)

(e) "Proof Pressure Test"

Proof pressure test - A cylinder made in conformance with specifications DOT 4B, 4BA, 4BW, or 4E used exclusively for: liquefied petroleum gas that meets the detail requirement limits in Table I of ASTM D 1835, "Standard Specification for Liquefied Petroleum (LP) Gases" (IBR see §171.7 of this subchapter) or an equivalent standard containing the same limits; anhydrous dimethylamine; anhydrous methylamine; anhydrous trimethylamine; methyl chloride; methylacetylene-propadiene stabilized; or dichlorodifluoromethane, difluoroethane, difluorochloroethane, chlorodifluoromethane, chlorotetrafluoroethane, trifluorochloroethylene, or mixture thereof, or mixtures of one or more with trichlorofluoromethane; and commercially free from corroding components and protected externally by a suitable corrosion-resistant coating (such as galvanizing or painting) may be requalified by volumetric expansion testing every 12 years instead of every five years. As an alternative, the cylinder may be subjected to a proof pressure test at least two times the marked service pressure, but this latter type of test must be repeated every seven years after expiration of the first 12-year period. When subjected to a proof pressure test, the cylinder must be carefully examined under test pressure and removed from service if a leak or defect is found.

Water Jacket	***Proof Test***
12-year Requalification	7-year Requalification
	“S” Stamp for 7-year alternative test

DOT 49 CFR 180.209 (f)

Poisonous materials. A cylinder conforming to specification DOT 3A, 3AA, 3B, 4BA, or 4BW having a service pressure of 300 psig or less and used exclusively for methyl bromide, liquid; mixtures of methyl bromide and ethylene dibromide, liquid; mixtures of methyl bromide and chlorpicrin, liquid; mixtures of methyl bromide and petroleum solvents, liquid; or methyl bromide and nonflammable, nonliquefied compressed gas mixtures, liquid; commercially free of corroding components, and protected externally by a suitable corrosion resistant coating (such as galvanizing or painting) and internally by a suitable corrosion resistant lining (such as galvanizing) may be tested every 10 years instead of every five years, provided a visual internal and external examination of the cylinder is conducted every five years in accordance with CGA Pamphlet C–6. The cylinder must be examined at each filling, and rejected if a dent, corroded area, leak or other condition indicates possible weakness.

DOT 49 CFR 180.209(g)

(g) *Visual inspections.* A cylinder conforming to a specification listed in the table in this paragraph and used exclusively in the service indicated may, instead of a periodic hydrostatic test, be given a complete external visual inspection at the time periodic requalification becomes due. External visual inspection must be in accordance with CGA Pamphlet C–6 or C–6.3, as applicable (IBR, see §171.7 of this subchapter). When this inspection is used instead of hydrostatic pressure testing, subsequent inspections are required at five-year intervals after the first inspection. After May 31, 2004, inspections must be made only by persons holding a current RIN and the results recorded and maintained in accordance with §180.215. Records must include: date of inspection (month and year); DOT specification number; cylinder identification (registered symbol and serial number, date of manufacture, and owner); type of cylinder protective coating (including statement as to need of refinishing or recoating); conditions checked (*e.g.,* leakage, corrosion, gouges, dents or digs in shell or heads, broken or damaged footring or protective ring or fire damage); disposition of cylinder (returned to service, returned to cylinder manufacturer for repairs or condemned). A cylinder passing requalification by the external visual inspection must be marked in accordance with §180.213.

Fire Extinguishers 180.209(j)

(j) *Cylinder used as a fire extinguisher.* Only a DOT specification cylinder used as a fire extinguisher and meeting Special Provision 18 in §172.102(c)(1) of this subchapter may be requalified in accordance with this paragraph (j).

(1) A DOT 4B, 4BA, 4B240ET or 4BW cylinder may be tested as follows:

(i) For a cylinder with a water capacity of 5.44 kg (12 lb) or less, by volumetric expansion test using the water jacket method or by proof pressure test. A requalification must be performed by the end of 12 years after the original test date and at 12-year intervals thereafter.

(ii) For a cylinder having a water capacity over 5.44 kg (12 lb)—

(A) *By proof pressure test.* A requalification must be performed by the end of 12 years after the original test date and at 7-year intervals; or

(B) *By volumetric expansion test using the water jacket method.* A requalification must be performed 12 years after the original test date and at 12-year intervals thereafter.

(2) A DOT 3A, 3AA, or 3AL cylinder must be requalified by volumetric expansion test using the water jacket method. A requalification must be performed 12 years after the original test date and at 12-year intervals thereafter.

Cylinders used as a Fire Extinguisher		
	4B Type with H2O Capacity 12 lbs. or less	4B Type with H2O Capacity over 12 lbs.
TEST	*Water Jacket OR Proof Test every 12 years*	*Water Jacket every 12 years OR Proof Test every 7 years*

	3A, 3AA, or 3AL Cylinders
TEST	*Water Jacket ONLY every 12 years*

Fire Extinguishers 172.102

18 This description is authorized only for fire extinguishers listed in §173.309(b) of this subchapter meeting the following conditions:

a. Each fire extinguisher may only have extinguishing contents that are nonflammable, non-poisonous, non-corrosive and commercially free from corroding components.

b. Each fire extinguisher must be charged with a nonflammable, non-poisonous, dry gas that has a dew-point at or below minus 46.7 °C (minus 52 °F) at 101 kPa (1 atmosphere) and is free of corroding components, to not more than the service pressure of the cylinder.

c. A fire extinguisher may not contain more than 30% carbon dioxide by volume or any other corrosive extinguishing agent.

d. Each fire extinguisher must be protected externally by suitable corrosion-resisting coating.

Fire Extinguishers Marking: 180.213

(c) *Requalification marking method.* The depth of requalification markings may not be greater than specified in the applicable specification. The markings must be made by stamping, engraving, scribing or other method that produces a legible, durable mark.

(1) A cylinder used as a fire extinguisher (§180.209(j)) may be marked by using a pressure sensitive label.

(2) For a DOT 3HT cylinder, the test date and RIN must be applied by low-stress steel stamps to a depth no greater than that prescribed at the time of manufacture. Stamping on the sidewall is not authorized.

(3) For a composite cylinder, the requalification markings must be applied on a pressure sensitive label, securely affixed in a manner prescribed by the cylinder manufacturer, near the original manufacturer's label. Stamping of the composite surface is not authorized.

by the original specification. Requalification markings may be placed on any portion of the upper end of the cylinder excluding the sidewall, as provided in this section. Requalification and required specification markings that are illegible may be reproduced on a metal plate and attached as provided by the original specification.

(2) Previous requalification markings may not be obliterated, except that, when the space originally provided for requalification dates becomes filled, additional dates may be added as follows:

(i) All preceding requalification dates may be removed by peening provided that—

(A) Permission is obtained from the cylinder owner;

(B) The minimum wall thickness is maintained in accordance with manufacturing specifications for the cylinder; and

(C) The original manufacturing test date is not removed.

(ii) When the cylinder is fitted with a footring, additional dates may be marked on the external surface of the footring.

be marked plainly and permanently into the metal of the cylinder in accordance with location requirements of the cylinder specification or on a metal plate permanently secured to the cylinder in accordance with paragraph (b) of this section. An example of the markings prescribed in this paragraph (d) is as follows:

$$9\ \frac{A1}{32}\ 98\ X$$

Where:
"9" is the month of requalification,
"A123" is the RIN,
"98" is the year of requalification, and
"X" represents the symbols described in paragraphs (f)(2) through (f)(7) of this section.

(1) Upon a written request, variation from the marking requirement may be approved by the Associate Administrator.

(2) *Exception.* A cylinder subject to the requirements of §173.301(l) of this subchapter may not be marked with a RIN.

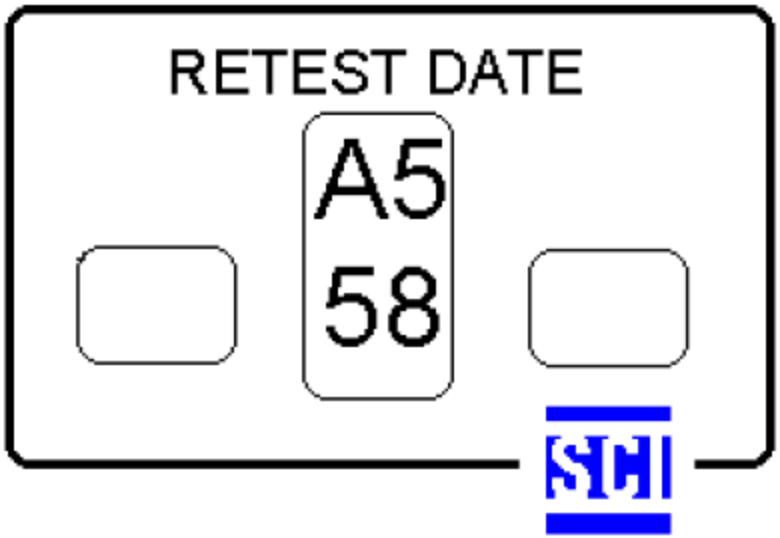
(e) *Size of markings.* The size of the

CAUTION: Do not attempt to stamp re-test markings in the composite.

ANY CYLINDER WITH STAMPED MARKINGS IN THE COMPOSITE SHALL BE CONDEMNED!

SCI recommends use of an aluminum foil label, (covered with a 5 minute epoxy), as shown in Figure 1. The labels may be ordered through SCI.

Figure 1



Fire Extinguishers Marking: 180.213

(2) Exception. A cylinder subject to the requirements of §173.301(l) of this subchapter may not be marked with a RIN.

(e) *Size of markings.* The size of the markings must be at least 6.35 mm (1/4in.) high, except RIN characters must be at least 3.18 mm (1/8in.) high.

Other Cylinders…

§ 173.301 General requirements for shipment of compressed gases and other hazardous materials in cylinders, UN pressure receptacles and spherical pressure vessels.

(a) *General qualifications for use of cylinders.* Unless otherwise stated, as used in this section, the term "cylinder" includes a UN pressure receptacle. As used in this subpart, filled or charged means an introduction or presence of a hazardous material in a cylinder. A cylinder filled with a Class 2 hazardous material (gas) and offered for transportation must meet the requirements in this section and §§173.301a through 173.305, as applicable.

(1) Compressed gases must be in UN pressure receptacles built in accordance with the UN standards or in metal cylinders and containers built in accordance with the DOT and ICC specifications and part 178 of this subchapter in effect at the time of manufacture, and requalified and marked as prescribed in subpart C in part 180 of this subchapter, if applicable. The DOT and ICC specifications authorized for use are as follows:

Other Cylinders…

§ 180.207 Requirements for requalification of UN pressure receptacles.

(a) *General.* (1) Each UN pressure receptacle used for the transportation of hazardous materials must conform to the requirements prescribed in paragraphs (a), (b) and (d) in §180.205.

(2) No pressure receptacle due for requalification may be filled with a hazardous material and offered for transportation in commerce unless that pressure receptacle has been successfully requalified and marked in accordance with this subpart. A pressure receptacle may be requalified at any time during or before the month and year that the requalification is due. However, a pressure receptacle filled before the requalification becomes due may remain in service until it is emptied.

(3) No person may requalify a UN composite pressure receptacle for continued use beyond its 15-years authorized service life. A pressure receptacle with a specified service life may not be refilled and offered for transportation after its authorized service life has expired unless approval has been obtained in writing from the Associate Administrator.

(b) *Periodic requalification of UN pressure receptacles.* (1) Each pressure receptacle that is successfully requalified in accordance with the requirements specified in this section must be marked in accordance with §180.213. The requalification results must be recorded in accordance §180.215.

What are the accuracy requirements for pressure indicating devices within a test system?

System Pressure Requirements

§ 180.205 General requirements for requalification of specification cylinders.

(g) 2) The pressure indicating device of the testing apparatus must permit reading of pressures to within 1% of the minimum prescribed test pressure of each cylinder tested, except that for an analog device, interpolation to ½ of the marked gauge divisions is acceptable. The expansion-indicating device of the testing apparatus must also permit incremental reading of the cylinder expansion to 1% of the total expansion of each cylinder tested or 0.1 cc, whichever is larger. Midpoint visual interpolation is permitted.

(g)(3) Each day before retesting, the retester shall confirm, by using a calibrated cylinder or other method authorized in writing by the Associate Administrator, that:

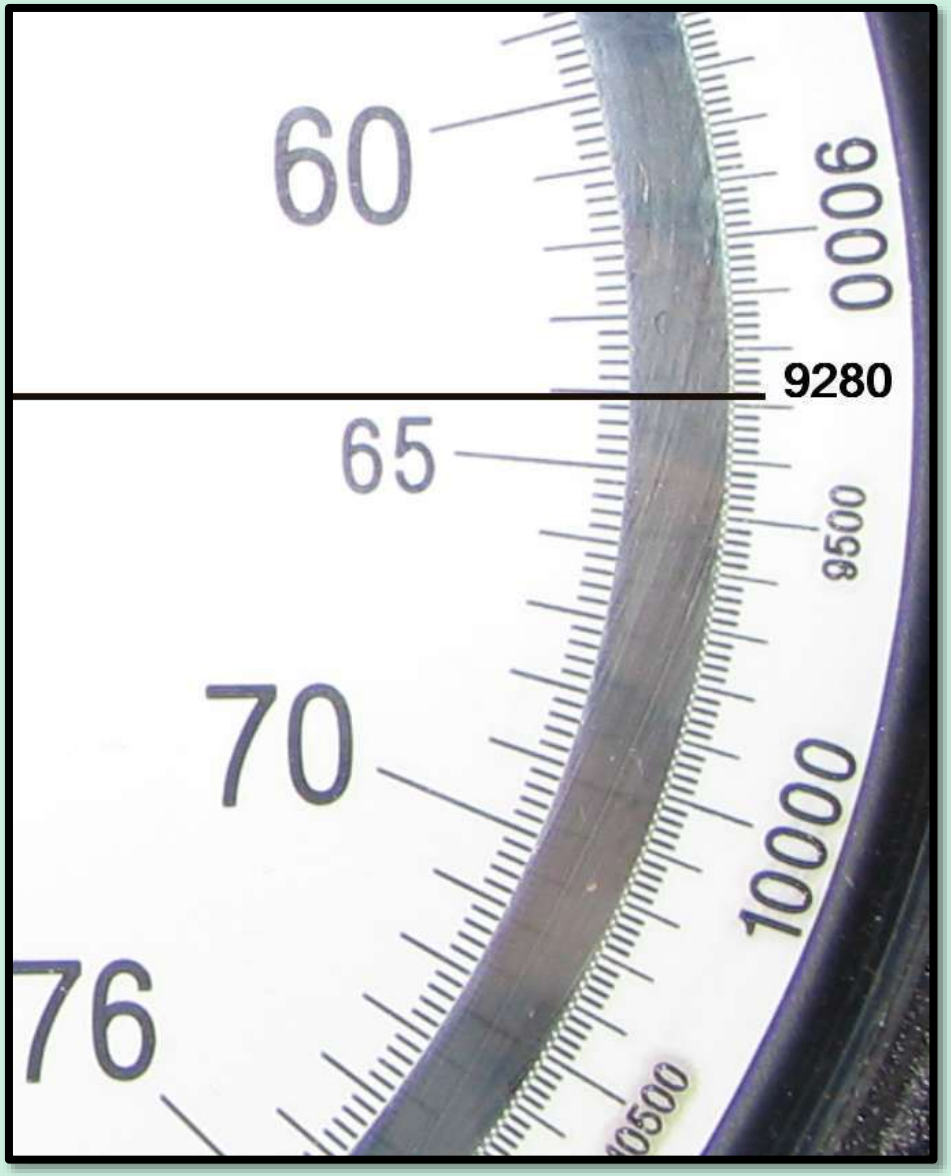
(i) The pressure-indicating device, as part of the retest apparatus, is accurate within ±1.0% of the prescribed test pressure of any cylinder tested that day. The pressure indicating device, itself, must be certified as having an accuracy of ±0.5%, or better, of its full range, and must permit readings of pressure from 90%-110% of the minimum prescribed test pressure of the cylinder to be tested. The accuracy of the pressure indicating device within the test system can be demonstrated at any point within 500 psig of the actual test pressure for test pressures at or above 3000 psig, or 10% of the actual test pressure for test pressures below 3000 psig.

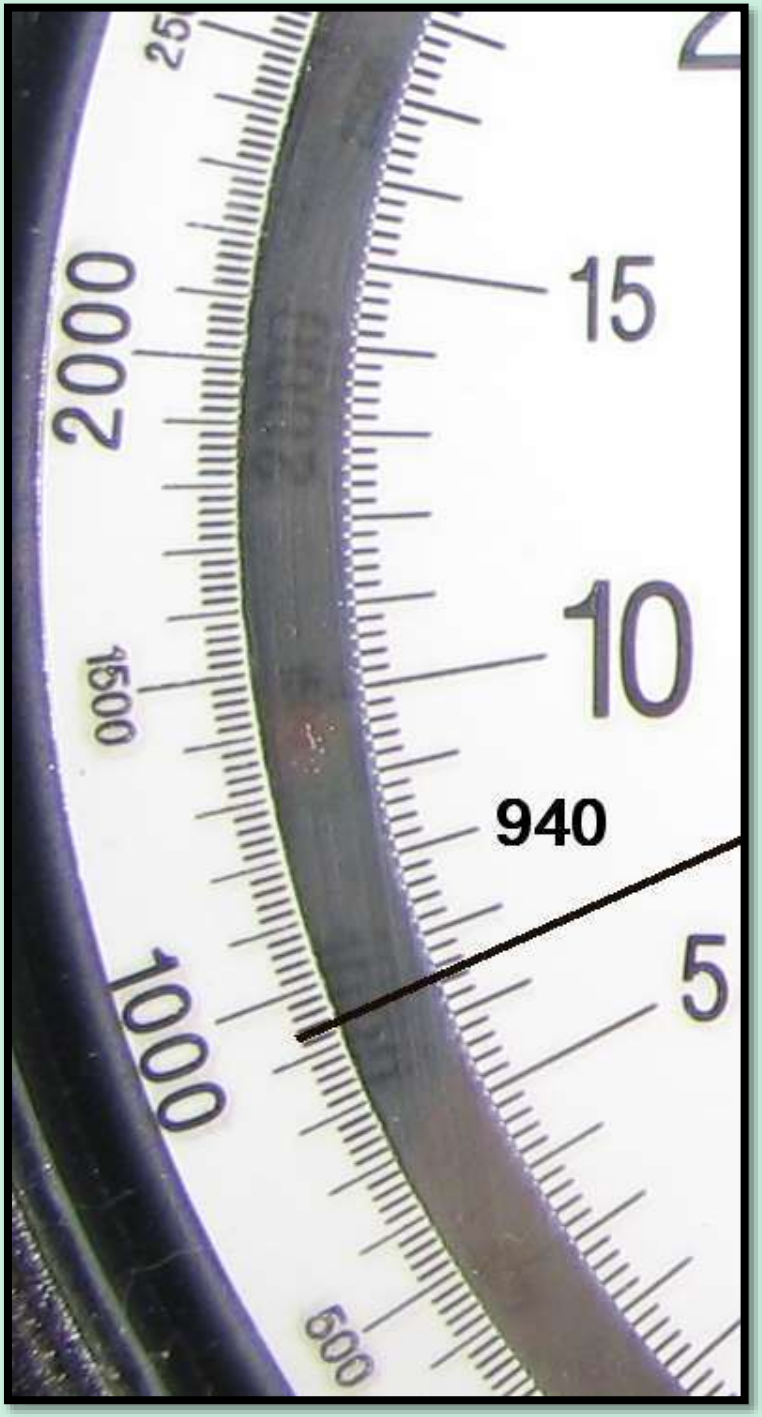
of each cylinder tested, except that for an analog device, interpolation to ½ of the marked gauge divisions is acceptable. The expansion-indicating device of the testing apparatus must also permit incremental reading of the cylinder expansion to 1% of the total expansion of each cylinder tested or 0.1 cc, whichever is larger. Midpoint visual interpolation is permitted.

(3) Each day before retesting, the retester shall confirm, by using a calibrated cylinder or other method au-

The calibrated cylinder must show no permanent expansion. The retester must demonstrate calibration in conformance with this paragraph (g) to an authorized inspector on any day that it retests cylinders. A retester must maintain calibrated cylinder certificates in conformance with § 180.215(b)(4).

(5) Minimum test pressure must be maintained for at least 30 seconds, and as long as necessary for complete expansion of the cylinder. A system


60
65
70
76
9000
9280
9500
10000
0500


2000
1500
1000
600
15
10
5
940

interpolation is permitted.

(3) Each day before retesting, the retester shall confirm, by using a calibrated cylinder or other method authorized in writing by the Associate Administrator, that:

(i) The pressure-indicating device, as part of the retest apparatus, is accurate within ±1.0% of the prescribed test pressure of any cylinder tested that day. The pressure indicating device, itself, must be certified as having an accuracy of ±0.5%, or better, of its full range, and must permit readings of pressure from 90%-110% of the minimum prescribed test pressure of the cylinder to be tested. The accuracy of the pressure indicating device within the test system can be demonstrated at

(5) Minimum test pressure must be maintained for at least 30 seconds, and as long as necessary for complete expansion of the cylinder. A system check may be performed at or below 90% of test pressure prior to the retest. In the case of a malfunction of the test equipment, the test may be repeated at a pressure increased by 10% or 100 psig, whichever is less. This paragraph (g) does not authorize retest of a cylinder otherwise required to be condemned under paragraph (i) of this section.

(h) *Cylinder rejection*. A cylinder must be rejected when, after a visual inspection, it meets a condition for rejection under the visual inspection requirements of paragraph (f) of this section.

(1) Except as provided in paragraphs


Test Press: 6000
5400 - 6600
4000
4500
5000
5500
6000
6500
7000
7500
8000
25
30
35
40
45
50
TEST GAUGE
TEMPERATURE COMPENSATED

of each cylinder tested, except that for an analog device, interpolation to ½ of the marked gauge divisions is acceptable. The expansion-indicating device of the testing apparatus must also permit incremental reading of the cylinder expansion to 1% of the total expansion of each cylinder tested or 0.1 cc, whichever is larger. Midpoint visual interpolation is permitted.

(3) Each day before retesting, the retester shall confirm, by using a calibrated cylinder or other method authorized in writing by the Associate Administrator, that:

(i) The pressure-indicating device, as part of the retest apparatus, is accurate within ±1.0% of the prescribed test pressure of any cylinder tested that day. The pressure indicating device, itself, must be certified as having an accuracy of ±0.5%, or better, of its full range, and must permit readings of pressure from 90%-110% of the minimum prescribed test pressure of the cylinder to be tested. The accuracy of the pressure indicating device within

The calibrated cylinder must show no permanent expansion. The retester must demonstrate calibration in conformance with this paragraph (g) to an authorized inspector on any day that it retests cylinders. A retester must maintain calibrated cylinder certificates in conformance with § 180.215(b)(4).

(5) Minimum test pressure must be maintained for at least 30 seconds, and as long as necessary for complete expansion of the cylinder. A system check may be performed at or below 90% of test pressure prior to the retest. In the case of a malfunction of the test equipment, the test may be repeated at a pressure increased by 10% or 100 psig, whichever is less. This paragraph (g) does not authorize retest of a cylinder otherwise required to be condemned under paragraph (i) of this section.

(h) *Cylinder rejection.* A cylinder must be rejected when, after a visual inspection, it meets a condition for rejection under the visual inspection requirements of paragraph (f) of this section.


TEST GAUGE
TEMPERATURE COMPENSATED
GALISO INC.
Montrose, CO
0.2 MPa subd
20 psi subd
Accuracy
Grade 3A
0.25 %
MADE IN USA
Monel K500 tube
Monel 400 socket
Welded
MPa
psi

cc, whichever is larger. Midpoint visual interpolation is permitted.

(3) Each day before retesting, the retester shall confirm, by using a calibrated cylinder or other method authorized in writing by the Associate Administrator, that:

(i) The pressure-indicating device, as part of the retest apparatus, is accurate within ±1.0% of the prescribed test pressure of any cylinder tested that day. The pressure indicating device, itself, must be certified as having an accuracy of ±0.5%, or better, of its full range, and must permit readings of pressure from 90%-110% of the minimum prescribed test pressure of the cylinder to be tested. The accuracy of the pressure indicating device within the test system can be demonstrated at any point within 500 psig of the actual test pressure for test pressures at or above 3000 psig, or 10% of the actual test pressure for test pressures below 3000 psig.

(ii) The expansion-indicating device, as part of the retest apparatus, gives a stable reading of expansion and is accurate to ±1.0% of the total expansion of any cylinder tested or 0.1 cc, whichever is larger. The expansion-indicating device itself must have an accuracy of ±0.5%, or better, of its full scale.

§180.215(b)(4).

(5) Minimum test pressure must be maintained for at least 30 seconds, and as long as necessary for complete expansion of the cylinder. A system check may be performed at or below 90% of test pressure prior to the retest. In the case of a malfunction of the test equipment, the test may be repeated at a pressure increased by 10% or 100 psig, whichever is less. This paragraph (g) does not authorize retest of a cylinder otherwise required to be condemned under paragraph (i) of this section.

(h) *Cylinder rejection.* A cylinder must be rejected when, after a visual inspection, it meets a condition for rejection under the visual inspection requirements of paragraph (f) of this section.

(1) Except as provided in paragraphs (h)(3) and (h)(4) of this section, a cylinder that is rejected may not be marked as meeting the requirements of this section.

(2) The requalifier must notify the cylinder owner, in writing, that the cylinder has been rejected.

(3) Unless the cylinder is requalified in conformance with requirements in §180.211, it may not be filled with a hazardous material and offered for transportation in commerce where use of a specification packaging is re-

5/1/2008

GALISO

Cylinder Calibration Certificate

Sales Order Number: N/A

Company Name: Galiso

Cylinder Information:

Cylinder Manufacturer: Taylor Wharton

Mfg. Serial Number: TWE03-623000

Galiso Serial Number: SCC0403-0732C

Temperatures:

Jacket: 0 F

Cylinder: 0 F

Air: 0 F

To ensure accuracy, the temperature of the water in the test jacket should be as close as possible to the temperature of the water in the cylinder and the ambient air temperature. Accuracy may be affected by temperature changes as slight as 2 degrees Fahrenheit. All temperatures must be held as stable as possible, and with 5 degrees of each other.

Expansion in cubic centimeters vs. Pressure in psi:

PSI	CC's	Tolerance (+/-)	Acceptable Range: Low to High	
3,000	**55.9**	0.5	55.4	56.4
4,000	**74.6**	0.7	73.9	75.3
5,000	**93.5**	0.9	92.6	94.4
6,000	**112.4**	1.1	111.3	113.5
7,000	**131.5**	1.3	130.2	132.8
8,000	**150.8**	1.5	149.3	152.3
9,000	**170.5**	1.7	168.8	172.2

of each cylinder tested, except that for an analog device, interpolation to ½ of the marked gauge divisions is acceptable. The expansion-indicating device of the testing apparatus must also permit incremental reading of the cylinder expansion to 1% of the total expansion of each cylinder tested or 0.1 cc, whichever is larger. Midpoint visual interpolation is permitted.

(3) Each day before retesting, the retester shall confirm, by using a calibrated cylinder or other method authorized in writing by the Associate Administrator, that:

(i) The pressure-indicating device, as part of the retest apparatus, is accurate within ±1.0% of the prescribed test pressure of any cylinder tested that day. The pressure indicating device, itself, must be certified as having an accuracy of ±0.5%, or better, of its full

The calibrated cylinder must show no permanent expansion. The retester must demonstrate calibration in conformance with this paragraph (g) to an authorized inspector on any day that it retests cylinders. A retester must maintain calibrated cylinder certificates in conformance with § 180.215(b)(4).

(5) Minimum test pressure must be maintained for at least 30 seconds, and as long as necessary for complete expansion of the cylinder. A system check may be performed at or below 90% of test pressure prior to the retest. In the case of a malfunction of the test equipment, the test may be repeated at a pressure increased by 10% or 100 psig, whichever is less. This paragraph (g) does not authorize retest of a cylinder otherwise required to be condemned under paragraph (i) of this section.

the test system can be demonstrated at any point within 500 psig of the actual test pressure for test pressures at or above 3000 psig, or 10% of the actual test pressure for test pressures below 3000 psig.

(ii) The expansion-indicating device, as part of the retest apparatus, gives a stable reading of expansion and is accurate to ±1.0% of the total expansion of any cylinder tested or 0.1 cc, whichever is larger. The expansion-indicating device itself must have an accuracy of ±0.5%, or better, of its full scale.

(4) The test equipment must be verified to be accurate within ±1.0% of the calibrated cylinder's pressure and corresponding expansion values. This may be accomplished by bringing the pressure to a value shown on the calibration certificate for the calibrated cylinder used and verifying that the resulting total expansion is within ±1.0% of the total expansion shown on the calibration certificate. Alternatively, calibration may be demonstrated by bringing the total expansion to a known value on the calibration certificate for the calibrated cylinder used and verifying that the resulting pressure is within ±1.0% of the pressure shown on the calibration certificate.

(1) Except as provided in paragraphs (h)(3) and (h)(4) of this section, a cylinder that is rejected may not be marked as meeting the requirements of this section.

(2) The requalifier must notify the cylinder owner, in writing, that the cylinder has been rejected.

(3) Unless the cylinder is requalified in conformance with requirements in §180.211, it may not be filled with a hazardous material and offered for transportation in commerce where use of a specification packaging is required.

(4) A rejected cylinder with a service pressure of less than 900 psig may be requalified and marked if the cylinder is repaired or rebuilt and subsequently inspected and tested in conformance with—

(i) The visual inspection requirements of paragraph (f) of this section;

(ii) Part 178 of this subchapter and this part;

(iii) Any exemption covering the manufacture, requalification, and/or use of that cylinder; and

(iv) Any approval required under §180.211.

(i) *Cylinder condemnation.* (1) A cylinder must be condemned when—

3000 psig.

(ii) The expansion-indicating device, as part of the retest apparatus, gives a stable reading of expansion and is accurate to ±1.0% of the total expansion of any cylinder tested or 0.1 cc, whichever is larger. The expansion-indicating device itself must have an accuracy of ±0.5%, or better, of its full scale.

(4) The test equipment must be verified to be accurate within ±1.0% of the calibrated cylinder's pressure and corresponding expansion values. This may be accomplished by bringing the pressure to a value shown on the calibration certificate for the calibrated cylinder used and verifying that the resulting total expansion is within ±1.0% of the total expansion shown on the calibration certificate. Alternatively, calibration may be demonstrated by bringing the total expansion to a known value on the calibration certificate for the calibrated cylinder used and verifying that the resulting pressure is within ±1.0% of the pressure shown on the calibration certificate.

(2) The requalifier must notify the cylinder owner, in writing, that the cylinder has been rejected.

(3) Unless the cylinder is requalified in conformance with requirements in §180.211, it may not be filled with a hazardous material and offered for transportation in commerce where use of a specification packaging is required.

(4) A rejected cylinder with a service pressure of less than 900 psig may be requalified and marked if the cylinder is repaired or rebuilt and subsequently inspected and tested in conformance with—

(i) The visual inspection requirements of paragraph (f) of this section;

(ii) Part 178 of this subchapter and this part;

(iii) Any exemption covering the manufacture, requalification, and/or use of that cylinder; and

(iv) Any approval required under §180.211.

(i) *Cylinder condemnation.* (1) A cylinder must be condemned when—

Calibration

Pressure: ± 0.5%

Expansion: ± 0.5%

Total: ± 1%

Calibration

DOT 49 CFR 180.205(g)(3) & (4)

At or above 3000 psi – within 500 psi of actual test pressure

Below 3000 psi – within 10% of actual test pressure

interpolation is permitted.

(3) Each day before retesting, the retester shall confirm, by using a calibrated cylinder or other method authorized in writing by the Associate Administrator, that:

(i) The pressure-indicating device, as part of the retest apparatus, is accurate within ±1.0% of the prescribed test pressure of any cylinder tested that day. The pressure indicating device, itself, must be certified as having an accuracy of ±0.5%, or better, of its full range, and must permit readings of pressure from 90%-110% of the minimum prescribed test pressure of the cylinder to be tested. The accuracy of the pressure indicating device within the test system can be demonstrated at any point within 500 psig of the actual test pressure for test pressures at or above 3000 psig, or 10% of the actual test pressure for test pressures below 3000 psig.

(ii) The expansion indicating device, as part of the retest apparatus, gives a stable reading of expansion and is accurate to ±1.0% of the total expansion of

(5) Minimum test pressure must be maintained for at least 30 seconds, and as long as necessary for complete expansion of the cylinder. A system check may be performed at or below 90% of test pressure prior to the retest. In the case of a malfunction of the test equipment, the test may be repeated at a pressure increased by 10% or 100 psig, whichever is less. This paragraph (g) does not authorize retest of a cylinder otherwise required to be condemned under paragraph (i) of this section.

(h) *Cylinder rejection.* A cylinder must be rejected when, after a visual inspection, it meets a condition for rejection under the visual inspection requirements of paragraph (f) of this section.

(1) Except as provided in paragraphs (h)(3) and (h)(4) of this section, a cylinder that is rejected may not be marked as meeting the requirements of this section.

(2) The requalifier must notify the cylinder owner, in writing, that the cylinder has been rejected.

(3) Unless the cylinder is requalified in conformance with requirements in

(ii) The expansion-indicating device, as part of the retest apparatus, gives a stable reading of expansion and is accurate to ±1.0% of the total expansion of any cylinder tested or 0.1 cc, whichever is larger. The expansion-indicating device itself must have an accuracy of ±0.5%, or better, of its full scale.

(4) The test equipment must be verified to be accurate within ±1.0% of the calibrated cylinder's pressure and corresponding expansion values. This may be accomplished by bringing the pressure to a value shown on the calibration certificate for the calibrated cylinder used and verifying that the resulting total expansion is within ±1.0% of the total expansion shown on the calibration certificate. Alternatively, calibration may be demonstrated by bringing the total expansion to a known value on the calibration certificate for the calibrated cylinder used and verifying that the resulting pressure is within ±1.0% of the pressure shown on the calibration certificate.

cylinder owner, in writing, that the cylinder has been rejected.

(3) Unless the cylinder is requalified in conformance with requirements in §180.211, it may not be filled with a hazardous material and offered for transportation in commerce where use of a specification packaging is required.

(4) A rejected cylinder with a service pressure of less than 900 psig may be requalified and marked if the cylinder is repaired or rebuilt and subsequently inspected and tested in conformance with—

(i) The visual inspection requirements of paragraph (f) of this section;

(ii) Part 178 of this subchapter and this part;

(iii) Any exemption covering the manufacture, requalification, and/or use of that cylinder; and

(iv) Any approval required under §180.211.

(i) *Cylinder condemnation.* (1) A cylinder must be condemned when—

of each cylinder tested, except that for an analog device, interpolation to ½ of the marked gauge divisions is acceptable. The expansion-indicating device of the testing apparatus must also permit incremental reading of the cylinder expansion to 1% of the total expansion of each cylinder tested or 0.1 cc, whichever is larger. Midpoint visual interpolation is permitted.

(3) Each day before retesting, the retester shall confirm, by using a calibrated cylinder or other method authorized in writing by the Associate Administrator, that:

The calibrated cylinder must show no permanent expansion. The retester must demonstrate calibration in conformance with this paragraph (g) to an authorized inspector on any day that it retests cylinders. A retester must maintain calibrated cylinder certificates in conformance with § 180.215(b)(4).

(5) Minimum test pressure must be maintained for at least 30 seconds, and as long as necessary for complete expansion of the cylinder. A system check may be performed at or below 90% of test pressure prior to the retest.

Safety Relief Devices:

CFR Title 49 180.205(c)(4) / 173.301(f)

+0 / -10% of Test Pressure
Other than Div. 2.2 gases

(First requalification after Dec. 31, 2003)

CFR 49 180.205(c)(4)

(3) For DOT specification cylinders, the marked service pressure may be changed upon approval of the Associate Administrator and in accordance with written procedures specified in the approval.

(4) For a specification 3, 3A, 3AA, 3AL, 3AX, 3AXX, 3B, 3BN, or 3T cylinder filled with gases in other than Division 2.2, from the first requalification due on or after December 31, 2003, the burst pressure of a CG–1, CG–4, or CG–5 pressure relief device must be at test pressure with a tolerance of plus zero to minus 10%. An additional 5% tolerance is allowed when a combined rupture disc is placed inside a holder. This requirement does not apply if a CG–2, CG–3 or CG–9 thermally activated relief device or a CG–7 reclosing pressure valve is used on the cylinder.

(d) *Conditions requiring test and inspection of cylinders.* Without regard to any other periodic requalification requirements, a cylinder must be tested and inspected in accordance with this section:

Class 8 material.

(f) *Visual inspection.* Except as otherwise provided in this subpart, each time a cylinder is pressure tested, it must be given an internal and external visual inspection.

(1) The visual inspection must be performed in accordance with the following CGA Pamphlets: C–6 for steel and nickel cylinders (IBR, see §171.7 of this subchapter); C–6.1 for seamless aluminum cylinders (IBR, see §171.7 of this subchapter); C–6.2 for fiber reinforced composite exemption cylinders (IBR, see §171.7 of this subchapter); C–6.3 for low pressure aluminum cylinders (IBR, see §171.7 of this subchapter); C–8 for DOT 3HT cylinders (IBR, see §171.7 of this subchapter); and C–13 for DOT 8 series cylinders (IBR, see §171.7 of this subchapter).

(2) For each cylinder with a coating or attachments that would inhibit inspection of the cylinder, the coating or attachments must be removed before performing the visual inspection.

Assignment of Hazard Zones?

Definitions

173.115 Definitions

Div. 2.1: Flammable Gas

Div. 2.2: Nonflammable, Nonpoisonous Gas

Div. 2.3: Poisonous Gas

Hazard Zones (A,B,C,D): 171.8, 173.116(a), 173.133(a)

Hazard Zone A: A material that is poisonous by inhalation in lethal concentrations (LC50) less than or equal to 200 ppm. Designated by Special Provision 1 in column 7 of the Table of Hazardous Materials, 172.101

§ 173.115 Class 2, Divisions 2.1, 2.2, and 2.3—Definitions.

(a) ***Division 2.1 (Flammable gas).*** For the purpose of this subchapter, a *flammable gas* (Division 2.1) means any material which is a gas at 20 °C (68 °F) or less and 101.3 kPa (14.7 psi) of pressure (a material which has a boiling point of 20 °C (68 °F) or less at 101.3 kPa (14.7 psi)) which— (1) Is ignitable at 101.3 kPa (14.7 psi) when in a mixture of 13 percent or less by volume with air; or (2) Has a flammable range at 101.3 kPa (14.7 psi) with air of at least 12 percent regardless of the lower limit.	(b) ***Division 2.2 (non-flammable, nonpoisonous compressed gas***—*including compressed gas, liquefied gas, pressurized cryogenic gas, compressed gas in solution, asphyxiant gas and oxidizing gas).* For the purpose of this subchapter, a nonflammable, nonpoisonous compressed gas (Division 2.2) means any material (or mixture) which— (1) Exerts in the packaging an absolute pressure of 280 kPa (40.6 psia) or greater at 20 °C (68 °F), and (2) Does not meet the definition of Division 2.1 or 2.3.	(c) ***Division 2.3 (Gas poisonous by inhalation).*** For the purpose of this subchapter, a *gas poisonous by inhalation* (Division 2.3) means a material which is a gas at 20 °C (68 °F) or less and a pressure of 101.3 kPa (14.7 psi) (a material which has a boiling point of 20 °C (68 °F) or less at 101.3 kPa (14.7 psi)) and which— (1) Is known to be so toxic to humans as to pose a hazard to health during transportation, or (2) In the absence of adequate data on human toxicity, is presumed to be toxic to humans because when tested on laboratory animals it has an LC50 value of not more than 5000 ml/m3 (see § 173.116(a) of this subpart for assignment of Hazard Zones A, B, C or D).

§ 173.116 Class 2—Assignment of hazard zone.

(a) The hazard zone of a Class 2, Division 2.3 material is assigned in column 7 of the §172.101 table. There are no hazard zones for Divisions 2.1 and 2.2. When the §172.101 table provides more than one hazard zone for a Division 2.3 material, or indicates that the hazard zone be determined on the basis of the grouping criteria for Division 2.3, the hazard zone shall be determined by applying the following criteria:

Hazard zone	Inhalation toxicity
A	LC_{50} less than or equal to 200 ppm.
B	LC_{50} greater than 200 ppm and less than or equal to 1000 ppm.
C	LC_{50} greater than 1000 ppm and less than or equal to 3000 ppm.
D	LC_{50} greater than 3000 ppm or less than or equal to 5000 ppm.

(b) The criteria specified in paragraph (a) of this section are represented graphically in §173.133, Figure 1.

Required markings on cylinders?

Reporting and Recordkeeping requirements?

Marking CFR Title 49 180.213

Characters must be at least ¼” high, except RIN must be at least ⅛” high

9 $\frac{A1}{32}$ 98 XX (Month, RIN-A123, Year, Symbols)

‘‘X’’ represents the symbols described in paragraphs (f)(2) - (7) of this section.

Such as: **+** (110% fill); **five point star**(10 year retest); **S** (Proof Test); **E** (Visual Inspection)

180.213(c)(1) Fire Extinguishers can be marked with a sticker (must follow pattern)

180.213(b)(2)(i) Previous retest marks may be removed to make room for new ones

§ 178.35 General requirements for specification cylinders.

…

(4) **Unless otherwise specified in the applicable specification, the markings on each cylinder must be stamped plainly and permanently on the shoulder, top head, or neck.**

(5) The size of each marking must be at least 0.25 inch or as space permits.

(6) **Other markings** are authorized provided they are made **in low stress areas other than the side wall** and are not of a size and depth that will create harmful stress concentrations. Such marks may not conflict with any DOT required markings.

(g) *Inspector's report.* Each inspector shall prepare a report containing, at a minimum, the applicable information listed in CGA Pamphlet C–11 (IBR, see §171.7 of this subchapter) or, until October 1, 1997, in accordance with the applicable test report requirements of this subchapter in effect on September 30, 1996. Any additional information or markings that are required by the applicable specification must be shown on the test report. The signature of the inspector on the reports certifies that the processes of manufacture and heat treatment of cylinders were observed and found satisfactory.

clearly and legibly with the word "RE-THREAD" on the shoulder, head, or neck. No cylinder may be re-threaded more than one time without approval of the Associate Administrator.

[70 FR 34077, June 13, 2005]

§180.213 Requalification markings.

(a) *General.* Each cylinder requalified in accordance with this subpart with acceptable results must be marked as specified in this section. Required specification markings may not be altered or removed.

(b) *Placement of markings.* Each cylinder must be plainly and permanently marked on the metal of the cylinder as the applicable specification. The markings must be made by stamping, engraving, scribing or other method that produces a legible, durable mark.

(1) A cylinder used as a fire extinguisher (§180.209(j)) may be marked by using a pressure sensitive label.

(2) For a DOT 3HT cylinder, the test date and RIN must be applied by low-stress steel stamps to a depth no greater than that prescribed at the time of manufacture. Stamping on the sidewall is not authorized.

(d) *Requalification markings.* Each cylinder that has successfully passed requalification must be marked with the RIN set in a square pattern, between

by the original specification. Requalification markings may be placed on any portion of the upper end of the cylinder excluding the sidewall, as provided in this section. Requalification and required specification markings that are illegible may be reproduced on a metal plate and attached as provided by the original specification.

(2) Previous requalification markings may not be obliterated, except that, when the space originally provided for requalification dates becomes filled, additional dates may be added as follows:

(i) All preceding requalification dates may be removed by peening provided that—

(A) Permission is obtained from the cylinder owner;

(B) The minimum wall thickness is maintained in accordance with manufacturing specifications for the cylinder; and

(C) The original manufacturing test date is not removed.

(ii) When the cylinder is fitted with a footring, additional dates may be marked on the external surface of the footring.

be marked plainly and permanently into the metal of the cylinder in accordance with location requirements of the cylinder specification or on a metal plate permanently secured to the cylinder in accordance with paragraph (b) of this section. An example of the markings prescribed in this paragraph (d) is as follows:

$$9\ \frac{A1}{32}\ 98\ X$$

Where:
"9" is the month of requalification,
"A123" is the RIN,
"98" is the year of requalification, and
"X" represents the symbols described in paragraphs (f)(2) through (f)(7) of this section.

(1) Upon a written request, variation from the marking requirement may be approved by the Associate Administrator.

(2) *Exception.* A cylinder subject to the requirements of §173.301(l) of this subchapter may not be marked with a RIN.

(e) *Size of markings.* The size of the

(2) Previous requalification markings may not be obliterated, except that, when the space originally provided for requalification dates becomes filled, additional dates may be added as follows:

(i) All preceding requalification dates may be removed by peening provided that—

(A) Permission is obtained from the cylinder owner;

(B) The minimum wall thickness is maintained in accordance with manufacturing specifications for the cylinder; and

(C) The original manufacturing test date is not removed.

(ii) When the cylinder is fitted with a footring, additional dates may be marked on the external surface of the footring.

(c) *Requalification marking method.* The depth of requalification markings may not be greater than specified in

$$9\ \frac{A1}{32}\ 98\ X$$

Where:
"9" is the month of requalification,
"A123" is the RIN,
"98" is the year of requalification, and
"X" represents the symbols described in paragraphs (f)(2) through (f)(7) of this section.

(1) Upon a written request, variation from the marking requirement may be approved by the Associate Administrator.

(2) *Exception.* A cylinder subject to the requirements of §173.301(l) of this subchapter may not be marked with a RIN.

(e) *Size of markings.* The size of the markings must be at least 6.35 mm (¼ in.) high, except RIN characters must be at least 3.18 mm (⅛ in.) high.

(f) *Marking illustrations.* Examples of required requalification markings for DOT specification and exemption cylinders are illustrated as follows:

(1) For designation of the 5-year volumetric expansion test, 10-year volumetric expansion test for cylinders conforming to §180.209(f) and (h), or 12-year volumetric expansion test for fire extinguishers conforming to §173.309(b) of this subchapter and cylinders conforming to §180.209(e) and §180.209(g), the marking is as illustrated in paragraph (d) of this section.

(2) For designation of the 10-year volumetric expansion test for cylinders conforming to §180.209(b), the marking is as illustrated in paragraph (d) of this section, except that the "X" is replaced with a five-point star.

(3) For designation of special filling limits up to 10% in excess of the marked service pressure for cylinders conforming to §173.302a(b) of this subchapter, the marking is as illustrated in paragraph (d) of this section, except that the "X" is replaced with a plus sign "+".

(4) For designation of the proof pressure test, the marking is as illustrated in paragraph (d) of this section, except that the "X" is replaced with the letter "S".

(5) For designation of the 5-year external visual inspection for cylinders conforming to §180.209(g), the marking is as illustrated in paragraph (d) of this section, except that the "X" is replaced with the letter "E".

(6) For designation of DOT 8 series cylinder shell requalification only, the

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- For designation of the DOT 8 series, the x is replaced with the letters “FS”.
- The x is replaced with the letters “AE” for acoustic emission or “UE” for ultrasonic examination.
- For designation of the eddy current examination combined with a visual inspection, the letter x is replaced with the letters “VE”.

Recordkeeping

- 180.215
  - Requalification Records
  - Calibration Records

§ 180.215 Reporting and record retention requirements.

(a) *Facility records.* A person who requalifies, repairs or rebuilds cylinders must maintain the following records where the requalification is performed:

(1) Current RIN issuance letter;

(2) If the RIN has expired and renewal is pending, a copy of the renewal request;

(3) Copies of notifications to Associate Administrator required under §107.805 of this chapter;

(4) Current copies of those portions of this subchapter applicable to its cylinder requalification and marking activities at that location;

(5) Current copies of all special permits governing exemption cylinders requalified or marked by the requalifier at that location; and

(6) The information contained in each applicable CGA or ASTM standard incorporated by reference in §171.7 of this subchapter applicable to the requalifier's activities. This information must be the same as contained in the edition incorporated by reference in §171.7 of this subchapter.

§ 180.215 Reporting and record retention requirements.

....

(b) *Requalification records.* Daily records of visual inspection, pressure test, and ultrasonic examination if permitted under a special permit, as applicable, must be maintained by the person who performs the requalification until either the expiration of the requalification period or until the cylinder is again requalified, whichever occurs first. A single date may be used for each test sheet, provided each test on the sheet was conducted on that date. Ditto marks or a solid vertical line may be used to indicate repetition of the preceding entry for the following entries only: date; actual dimensions; manufacturer's name or symbol, if present; owner's name or symbol, if present; and test operator. Blank spaces may not be used to indicate repetition of a prior entry. The records must include the following information:

....

§ 180.215 Reporting and record retention requirements.

….

(1) Calibration test records. *For each test* to demonstrate calibration, the date; serial number of the calibrated cylinder; calibration test pressure; total, elastic and permanent expansions; and legible identification of test operator. The test operator must be able to demonstrate that the results of the daily calibration verification correspond to the hydrostatic tests performed on that day. The daily verification of calibration(s) may be recorded on the same sheets as, and with, test records for that date.

….

§ 180.215 Reporting and record retention requirements.

….

(2) *Pressure test and visual inspection records.* The date of requalification; serial number; DOT specification or special permit number; marked pressure; actual dimensions; manufacturer's name or symbol; owner's name or symbol, if present; result of visual inspection; actual test pressure; total, elastic and permanent expansions; percent permanent expansion; disposition, with reason for any repeated test, rejection or condemnation; and legible identification of test operator. For each cylinder marked pursuant to §173.302a(b)(5) of this subchapter, the test sheet must indicate the method by which any average or maximum wall stress was computed. Records must be kept for all completed, as well as unsuccessful tests. The entry for a second test after a failure to hold test pressure must indicate the date of the earlier test.

….

§ 180.215 Reporting and record retention requirements.

....

(3) *Wall stress.* Calculations of average and maximum wall stress pursuant to §173.302a(b)(3) of this subchapter, if performed.

(4) *Calibration certificates.* The most recent certificate of calibration must be maintained for each calibrated cylinder.

(c) *Repair, rebuilding or reheat treatment records.* (1) Records covering welding or brazing repairs, rebuilding or reheat treating shall be retained for a minimum of fifteen years by the approved facility.

(2) A record of rebuilding, in accordance with §180.211(d), must be completed for each cylinder rebuilt.

....

§ 180.215 **Reporting and record retention requirements.**

(a) *Facility records.* A person who requalifies, repairs or rebuilds cylinders must maintain the following records where the requalification is performed:

(1) Current RIN issuance letter;

(2) If the RIN has expired and renewal is pending, a copy of the renewal request;

(3) Copies of notifications to Associate Administrator required under §107.805 of this chapter;

(4) Current copies of those portions of this subchapter applicable to its cylinder requalification and marking activities at that location;

(5) Current copies of all exemptions governing exemption cylinders requalified or marked by the requalifier at that location; and

(6) The information contained in each applicable CGA or ASTM standard incorporated by reference in §171.7 of this subchapter applicable to the requalifier's activities. This information must be the same as contained in the edition incorporated by reference in §171.7 of this subchapter.

(b) *Requalification records.* Daily

incorporated by reference in §171.7 of this subchapter.

(b) *Requalification records.* Daily records of visual inspection, pressure test, and ultrasonic examination if permitted under an exemption, as applicable, must be maintained by the person who performs the requalification until either the expiration of the requalification period or until the cylinder is again requalified, whichever occurs first. A single date may be used for each test sheet, provided each test on the sheet was conducted on that date. Ditto marks or a solid vertical line may be used to indicate repetition of the preceding entry for the following entries only: date; actual dimensions; manufacturer's name or symbol, if present; owner's name or symbol, if present; and test operator. Blank spaces may not be used to indicate repetition of a prior entry. The records must include the following information:

(1) *Calibration test records.* For each test to demonstrate calibration, the date; serial number of the calibrated cylinder; calibration test pressure; total, elastic and permanent expansions; and legible identification of test operator. The test operator must be able to demonstrate that the results of the daily calibration verification correspond to the hydrostatic tests performed on that day. The daily verification of calibration(s) may be recorded on the same sheets as, and with, test records for that date.

(2) *Pressure test and visual inspection records.* The date of requalification; serial number; DOT specification or exemption number; marked pressure; actual dimensions; manufacturer's name or symbol; owner's name or symbol, if present; result of visual inspection; actual test pressure; total, elastic and permanent expansions; percent permanent expansion; disposition, with reason for any repeated test, rejection or condemnation; and legible identification of test operator. For each cylinder marked pursuant to §173.302a(b)(5) of this subchapter, the test sheet must indicate the method by which any average or maximum wall stress was computed. Records must be kept for all completed, as well as unsuccessful tests. The entry for a second test after a failure to hold test pressure must indicate the date of the earlier test.

(3) *Wall stress.* Calculations of aver-

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a failure to hold test pressure must indicate the date of the earlier test.

(3) *Wall stress.* Calculations of average and maximum wall stress pursuant to §173.302a(b)(3) of this subchapter, if performed.

(4) *Calibration certificates.* The most recent certificate of calibration must be maintained for each calibrated cylinder.

(c) *Repair, rebuilding or reheat treatment records.* (1) Records covering welding or brazing repairs, rebuilding or reheat treating shall be retained for a minimum of fifteen years by the approved facility.

(2) A record of rebuilding, in accordance with §180.211(d), must be completed for each cylinder rebuilt. The record must be clear, legible, and contain the following information:

(i) Name and address of test facility, date of test report, and name of original manufacturer;

(ii) Marks stamped on cylinder to include specification number, service pressure, serial number, symbol of manufacturer, inspector's mark, and other marks, if any;

(iii) Cylinder outside diameter and length in inches;

(iv) Rebuild process (welded, brazed, type seams, *etc.*);

(v) Description of assembly and any attachments replaced (*e.g.*, neckrings, footrings);

(vi) Chemical analysis of material for the cylinder, including seat and Code No., type of analysis (ladle, check),

weld data, tensile data, name of inspector);

(vii) Results of proof pressure test on cylinder, including test method, test pressure, total expansion, permanent expansion, elastic expansion, percent permanent expansion (permanent expansion may not exceed ten percent (10%) of total expansion), and volumetric capacity (volumetric capacity of a rebuilt cylinder must be within ± 3% of the calculated capacity);

(viii) Each report must include the following certification statement: "I certify that this rebuilt cylinder is accurately represented by the data above and conforms to all of the requirements in Subchapter C of Chapter I of Title 49 of the Code of Federal Regulations.". The certification must be signed by the rebuild technician and principal, officer, or partner of the rebuild facility.

[67 FR 51660, Aug. 8, 2002, as amended at 68 FR 24664, May 8, 2003]

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