NOTE: On October 30, 1998, the Research and Special Programs Administration (RSPA) published a notice of proposed rulemaking (NPRM) under Docket HM-220 (63 FR 58460), proposing to change the current cylinder regulations. Cylinder design as well as requalification would have been effected by this change.

Following are my comments to the DOT back in 1998.

Here's what follows in my comments:

Item 1:	Requalification by UT
Item 2:	Metric marked cylinders
Items 4-9:	Standards for UT Inspection
Item 10:	Correction to Star Stamping of cylinders (STILL NOT ADDRESSED!!)
Item 11:	Reasons not to incorporate CGA C-1 into the CFR
Item 12:	*"HEY, you left out the 3HT section!!!"*

Comments to:
RSPA 98-3684 (HM-220)

The following comments are respectfully submitted by Darrell Garton, Vice President of Galiso Inc.

1. Proposed: 180.207 and 180.209, Requirements for requalification of metric and non-metric marked cylinders.

The proposed requirement is attempting to change the current method of requalifying cylinders from the Hydrostatic Test to Ultrasonic Inspection (UT).

Comment:

This change is unwarranted and irresponsible. Hydrostatic testing of cylinders has enjoyed a long history of safety in this industry (over 80 years). Ultrasonic Inspection has been marred by 5 years of failure. Hydrostatic Testing directly measures the strength and ductility of a cylinder. UT is incapable of measuring either of these cylinder attributes. It must be recognized that with this proposal the industry will lose the very mechanisms that have kept it safe for the better part of this century. UT is incapable of determining the pass/fail criteria that the Hydrostatic test is based upon. This is not an improvement.

Before any such change to the regulations, there should be a study conducted whereby cylinders are inspected by UT, followed by a visual inspection and Hydrostatic test, and the rejection results compared. This is the only way that the technology can be properly assessed and evaluated as to its viability in this industry. The current exemption for UT has been sorely mismanaged, and consequently, does not offer the data necessary to substantiate the proposed change.

Ultrasonic inspection does **not** improve safety. On the contrary, during the past 5 years of exemption experience, UT has identified and condemned fewer cylinders than are

typically found in current Hydrostatic retest operations. According to the most experienced exemption holder, FIBA, only 0.7% of the cylinders inspected have failed. Typical Hydrostatic retest operations will condemn 1.5% to 2% of the cylinders inspected.

RPSA is in possession of documents showing the inadequacy of the current systems. The following data is extracted from the DOT Docket for UT exemption E-10922, and represents only a small sampling of the errors. The numbers shown are the wall thickness measurements for calibration shells, used to verify system calibration. Cylinder testing was performed after each of the listed "calibrations", although the system was clearly out of calibration and incapable of performing valid inspections.

Data from E-10922:

Cal. Cyl. #2502	Daily calibration readings from .200" to .260"
Cal. Cyl. #1014	Daily calibration readings from .140" to .181"
Cal. Cyl. #461751	Specified .198", actual readings were .133", .227", and 0.0".
Cal. Cyl. #48780	Specified .223", actual reading .180".
Cal. Cyl. #1951	Daily calibration readings of .260", .117", and .075".
Cal. Cyl. #236510	Specified .315", actual reading .114".

These numbers clearly indicate a failure of the system and the personnel involved. The errors are not simply an excursion from the standard 1% accuracy required for Hydrostatic systems, but display a complete failure of the equipment and inspection procedure.

This calls into question all of the cylinders requalified under the E-10922 exemption (approximately 500,000). Since 1.5% to 2% would have been rejected by the current method of visual inspection and Hydrostatic test, and only 0.7% were identified by UT, it would indicate that between 0.8% and 1.3% of the 500,000 cylinders that were requalified should have been condemned, but were instead put back into service for another 5 to 10 years. This means that there are between 4,000 and 6,500 cylinders that have been erroneously requalified for service, and now pose significant risk to public safety. However, instead of a recall, RSPA is proposing across the board authorization of the technology. This move defies logic, and threatens to negate the 80 years of safety performance enjoyed by this industry.

RSPA is also in possession of a cylinder that was confiscated in the fall of 1998 in Miami, FL, which had two 7/16" holes drilled into the sidewall, and still passed a UT examination without being identified for condemnation. It must be noted that the Level II UT operator believed that the system was properly calibrated. There is not a Hydrostatic test machine in the world that would pass such a cylinder – in or out of calibration. Any level of common sense would tell us that this is an unacceptable situation, and that this technology is being misapplied.

At an increased cost of over 10 times that of Hydrostatic test systems, this requirement is altogether unfair to an industry comprised primarily of small businesses. Currently, a manual Hydrostatic test system can be put in place for under $10,000. A UT system

capable of performing valid inspections, and able to keep up with automated Hydrostatic testing rates of ~25 cylinders per hour will cost in excess of $160,000. The figures used in the preamble, XII(B)(2), of $50,000 to $80,000 are incorrect. These numbers represent the price of the substandard systems currently giving erroneous results as shown above. A system capable of performing a valid UT inspection with the error trapping necessary to prevent erroneous readings is over twice the price stated in the preamble, and is still incapable of determining the strength and ductility characteristics of the cylinder.

Strength and ductility measurements become especially significant in the requalification of aluminum cylinders. Due to much lower heat treatment temperatures, aluminum cylinders suffer embrittlement and loss of their strength characteristics at temperatures of 300º F to 350º F. This temperature is commonly exceeded in fires and powder coating operations, leading to catastrophic failure of the cylinder if not identified. UT inspection is not able to determine this strength characteristic, and therefore threatens to lower the existing level of safety.

The preamble, in XII(B)(2), states that there are *"approximately 1400 businesses currently engaged in the periodic requalification of high-pressure cylinders"*. This number of 1,400 retesters is false. RSPA has in its database 2,896 retesters, 2,156 of which have been recertified since 1993, making them current.

The preamble states that *"at least 90% of these requalifiers are small businesses"*. That is a true statement, and this rulechange has the potential to put them out of business. The simple truth is that the average small business cannot consider a capital outlay of this magnitude with no increase in revenue to justify it. The suggestion that those retesters who cannot afford to upgrade to UT can continue to Hydrostatically test non-metric cylinders is not valid. The first truck load of mixed metric / non-metric cylinders that shows up at a non-UT facility and has to be turned away will be the last load of cylinders that will be shipped to that facility.

This rulechange directly threatens the livelihood of 1,940 small businesses (90% of the retesters) in America for ***NO REASON***. There is no proven benefit of increased safety, and there is no economic benefit. In section *XI Summary of Regulatory Changes by Section, Section 180.205,* the preamble states that UT *"reduces inspection and labor costs"*. Any anticipated reduction of labor will be quickly consumed by substantially increased salaries for the Level II and Level III (SRT) UT operators as required in Appendix B to Subpart C of 178 (e). The salary increases necessary would double or triple the current rates required for Hydrostatic test operators. One could expect annual salaries of $35,000+ and $50,000+, respectively, for Level II and Level III UT technicians. These are a dramatic departure from the average $10.00/hr. Hydrostatic test operator.

Furthermore, there has been no evidence presented that Hydrostatic testing does not provide a valid means of performing the requalification function. This proposal therefore represents a restriction of trade, and contradicts the direction given in the Regulatory Flexibility Act, 5 USC 603(c) and 603(c)(3).

This is not to say that UT is without merit. If properly applied, UT can offer enhanced localized defect detection, and wall thickness measurement. Combined with the Hydrostatic test, the two technologies together offer a level of inspection that would, in

fact, improve safety. However, UT by itself does not offer an equivalent level of safety, let alone a higher level, as proven by the reduced number of cylinders identified for condemnation under the current exemption, E-10922.

It is therefore suggested that Hydrostatic testing continue as the standard for requalifying cylinders. UT may be considered for: 1. A possible alternative inspection method for the high strength series of cylinders in specific gas services only (other than poisonous, flammable, or corrosive); and/or 2. To be used in conjunction with the Hydrostatic Test as a means of qualifying for an extension of the requalification period.

2. Proposed: 178.69(k)(3) Required Markings on Cylinders

Test Pressure in bar.

Comment:

The requirement for test pressure to be marked in bar goes against all current industry practices. This change will cause confusion, unnecessary expense, and could lead to disaster.

This unit of measure (bar) is not commonly used in the U.S., and will confuse users. Although fill operators may use tables for temperature correction during filling, Americans are not accustomed to bar, and this change will cause confusion. Gauges will have to be added or replaced in order to include the bar scale, and all tables and documentation will have to be duplicated as companies try to simultaneously fill non-metric cylinders in psi and metric cylinders in bar.

This change is unjustified. It will cause a tremendous financial burden to the industry with no benefit to domestic shippers in the U.S. The only justification presented is to be in conformance with practices *"in most European countries"*. If metric units are to be added to cylinder markings, then they should be added to, not replace, psi.

Marking the test pressure on a cylinder instead of the service pressure will only further confuse the issue. There will be cases of accidental fills to test pressure instead of service pressure, which will lead to premature cylinder fatigue and eventual catastrophic failure. Furthermore, if these cylinders are to be requalified using UT instead of Hydrostatic testing, the test pressure becomes meaningless to anyone except the manufacturer (who will never see the cylinder again).

This proposal will only add confusion and expense. There is no benefit, either economic or safety related, to domestic users. It is therefore suggested that the current standard of marking service pressure in psi remain a part of the cylinder marking.

3. Proposed: Table II to 180.207 and Table II of 180.209

"Rejectable pit size: 3 mm diameter x 1/3 Design Wall Thickness"

Comment:

The tables do not offer proper pass/fail criteria for cylinder inspection. The criteria specified could possibly be used to define system requirements for verification of calibration and resolution, but do not adequately define cylinder rejection criteria.

For example, according to the tables, a 2 mm diameter hole in the sidewall of a cylinder would be acceptable and pass the test. Since the rejection criteria for a pit is 3 mm diameter x 1/3 Design Wall Thickness, any pit less than 3 mm diameter is acceptable, no matter how deep.

A proper rejection criteria would simply state that any pit deeper than 1/3 Design Wall Thickness is rejectable. There is no need to specify diameter.

The current criteria would also allow a cylinder with a pinhole leak to be returned to service. Should such a cylinder be filled with poisonous, pyrophoric, or flammable gas, the results would be disastrous. Such cylinders are currently identified by a pressure loss during the Hydrostatic test. If the UT inspection is not required to identify pinhole leaks, this technology does **not** offer an equivalent level of safety.

4. Proposed: **Table II to 180.207 and Table II of 180.209**

"Coverage area -- 100% of Sidewall".

Comment:

This specification does not address the following issues:

* Sidewall to Base Transition (SBT) cracking or line corrosion.
* Neck and shoulder cracking in Aluminum cylinders.

There is substantial evidence that these issues are a major factor in cylinder requalification. Although Hydrostatic testing does not directly measure these defects, they are in fact identified during the current requalification process. Visual inspection does currently identify and condemn cylinders for these defects, and cylinders have ruptured during the Hydrostatic test due to these defects. Since the Hydrostatic test is performed at an increased pressure of 5/3 to 2 times the service pressure, there is a likelihood that cylinders with any of these defects will fail during the test, instead of during the fill.

Although Appendix B to Subpart C of 178 in (a)(2) specifies that the equipment must be capable of inspecting the sidewall to base transition area, it is not detailed as a requirement of the inspection. If not detailed as an inspection requirement, it is not a requirement for requalification.

There is also no mention of inspecting the neck and shoulder region in aluminum

cylinders. Current requirements reference CGA C-6.1, which states in Para. 4.8, "Neck Defects. Cylinder necks shall be examined for cracks, folds, and other flaws."

Eliminating the requirement to inspect these areas will lead to a decrease in the level of safety. Unless the regulations require that UT inspection includes these areas during the examination, the proposed method does **not** achieve an equivalent level of safety.

5. Proposed: Appendix B to Subpart C of 178

(a)(2) "…A proper search unit must be selected to obtain a *good resolution*…"

Comment:

Resolution is a number. It is not "good" or "bad". Given that the sentence goes on to say *"…and a minimum accuracy of +/-5% of the defect depth"*, a good starting place would be +/-5% of the defect depth. If the system cannot resolve at least to the accuracy level specified, the accuracy of the system cannot be determined to meet the specification.

The term *"defect depth"* does not properly specify a calibration standard. A more proper term would be "1/3 of the Design Wall Thickness of any cylinder inspected".

It is therefore suggested that the text be amended to require a minimum resolution of +/-5% of 1/3 Design Wall Thickness of any cylinder inspected, or .025 mm (.001"), whichever is larger.

6. Proposed: Appendix B to Subpart C of 178

(b) Calibration Standard.

Comment:

This paragraph does not specify wall thickness or defect depth of the calibration cylinder. Without such criteria, one calibration shell could be used to verify inspection for all cylinders of the same diameter with service pressures from 1800 psi to 6000 psi. This would not be an acceptable verification. Accuracy must be demonstrated to be within +/-5% of the defect depth for any cylinder tested. This standard does not clearly define such a requirement.

For example, a 9" dia. 3AA6000 calibration shell might be used for verification of system calibration. The required defect depth for verification of this shell according to the applicable pass/fail criteria identified in Table II of 180.209 would be .184". The system accuracy requirement for this defect depth would be +/-5% of .184", or +/-.009". Therefore, a measured reading of .192" might be taken, and the system declared within calibration (+.008", i.e. within the +/-.009" requirement). Testing might then include a 9" dia. 3AA1800 cylinder, whose rejectable defect depth is only .055", which would require an accuracy of +/-.0027" to be within the required +/-5% system accuracy. The system

has not been proven accurate to within +/-5% of this defect depth. The defect depth of the calibration standard was over 3 times larger than the rejection criteria of the cylinder tested. Therefore, accuracy has not been demonstrated to be within +/-5% of the defect depth of this cylinder, as required in paragraph 2 of this same section.

It is therefore recommended that the following wording be included: "The calibration standard must be capable of demonstrating system accuracy of +/-5% or better of the rejectable defect depth for any cylinder tested."

7. Proposed: Appendix B to Subpart C of 178

(b) …"The calibration cylinder must be machined with features that simulate defects such as pits, fatigue cracks, and reduced wall thickness."

Comment:

The specification must define the calibration standard. This paragraph does not give adequate definition to create calibration standards that are the same throughout the industry. The defect detail should be clearly defined as to the number of defect features and their size, with the location and attitude of each feature specified. Without such definition, there is no standard, and enforcement of the regulations will be impossible.

This paragraph should clearly define the requirements of the calibration standard, such that the calibration shell(s) used at each inspection facility will be virtually identical. Without such definition, the Approvals and Enforcement departments will be crippled, as each entity is forced to evaluate the validity of every facility's calibration standard. Acceptability then becomes a matter of individual interpretation, rather than conformance to a clearly defined standard.

8. Proposed: Appendix B to Subpart C of 178

(b) "… The size of the defect feature shall be *approximately* the same as the applicable pass/fail criteria identified in Table II of 180.207…and 180.209…"

Comment:

The term "approximately" does not define a calibration standard. A calibration standard must identify, within specified limits, the dimensions of the defect feature. A calibration standard should be clearly specified, so that every inspection facility is bound by the same standards. (See Comment 7, above.)

9. Proposed: Appendix B to Subpart C of 178

No required Pulse Density

Comment:

There is no requirement established for the pulse density of the UT equipment.

With current systems ranging anywhere from high densities of 1/50th inch to other systems that jump over 7/16th inch holes (see comment #1, above), it is imperative that this requirement be established. Currently there are some inferior systems which utilize a "multi-sync" type of input which reads only one transducer at a time. Although the system seemingly has a given pulse density (overall), in a 5 transducer system, the stated density is actually 5 times overstated, since each transducer is only read once out of every five pulses.

It is recommended that a minimum pulse density of 1/16th inch be established, and that Appendix B clearly specify that this requirement is inclusive of all transducers.

10. Proposed: 180.209(b)(2) "If, since the last required requalification,…"

Comment:

This section includes an error that was identified by the author during the comment period of the 1995-96 rewrite, but still has not been corrected. Following is the comment submitted to RSPA in 1995:

This paragraph allows a loophole for a cylinder whose wall stress has exceeded the wall stress limitation from 173.302(c)(3) to be marked with the star and allowed a 10 year requalification. This is a potentially dangerous situation, and clearly not in accordance with the intent of this paragraph.

For example, a cylinder that was previously used in CO2 service may be changed to helium service. At time of retest, the cylinder may have excessive elastic expansion, thereby disqualifying the cylinder from a 10 year requalification. However, 5 years later, when the cylinder comes back for retest, if it *has* been used exclusively in helium service for the past 5 years, according to this paragraph, the cylinder could now be stamped with a star, and allowed a 10 year requalification, even though it exceeds the wall stress limits.

This paragraph should simply state, *"If the cylinder has not been used exclusively for the gases specifically identified…"*, it must meet the criteria prescribed by 173.302(c)(2), (3), and (4). The words *"…,since the last required requalification,…"* should be removed.

11. Proposed: 171.7, 178.69(i)(13), 180.205(g), 180.211(d)(2)(ii), and 180.215(b)(2)

Incorporation of CGA pamphlet C-1 to replace current specifications for the volumetric expansion test.

Comment:

This move is a step backward from the current regulations. C-1 was not deemed

acceptable to be incorporated into the CFR in the 1996 rewrite. Since C-1 has not been modified since 1996, it is still not adequate to replace the existing specifications.

Examples of problems with C-1:
***** Section 4.2.1. There is no 1% accuracy requirement for the expansion measurement system, as currently required in 173.34(e)(4)(iii)(B).
***** Paragraph 4.2.2.2. It is recommended that pressure indicating devices be operated within the middle third of their range. This is an old stipulation that current gauge manufacturers now reject. The readability has already been established at 90% to 110% of the range. This recommendation would impose unnecessary burden on the industry.
***** Note 3 to paragraph 4.4 is not understandable. The words are garbled and make no sense. Items 1 and 3 of this note are self contradictory, and item 3 contradicts the current requirement in 173.34(e)(4)(A).
***** Figure 7 on page 15 is not correct. This table shows the compressibility factors for water at various pressures and temperatures. The table indicates linear performance of these variables. This is not correct. Since a large contributor to the compressibility of water is the entrained air, as the air is fully compressed (at or above 2000 psi), there should be a curve in the line. No such curve exists, and therefore this table is useless above 1500 to 1800 psi. This theory has been proven empirically, using cylinders calibrated with the water jacket method, and comparing results with the table. The numbers do not correspond.
These and other factors are why C-1 was not, and should not be, incorporated into the CFR. Replacing the current regulations with this document would precipitate confusion, errors, and a decrease to the level of safety now provided by CFR 173.34.

12. Proposed: 180.209(???)3HT Section missing.

Comment:

180.209(i) is referenced in Table I of 180.209 as the paragraph containing information for 3HT cylinders, however, that paragraph [180.209(i)] references DOT 8 series cylinders, not 3HT. This information is currently found in paragraph 173.34(e)(15). The information from this paragraph has obviously been left out in error, and should be corrected.