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

JUN 20 2003

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

Mr. John L. Hoffer
5104 - 97th Street, S.W.
Mukilteo, WA 98275

Reference No. 03-0011

Dear Mr. Hoffer:

This is in reference to your inquiry concerning the requirements for marking a plus sign (+) on DOT 3A and 3AA cylinders as specified in §173.302a(b) of the Hazardous Materials Regulations (HMR; 49 CFR Parts 171-180). I apologize for the delay in responding.

A DOT cylinder 3A or 3AA may be marked with a plus sign (+) and filled with a listed gas to 10 percent above its marked service pressure if all requirements for testing and evaluation contained in §173.302a(b) are met. The plus sign is required to be marked on any cylinder, including a new cylinder, when charged to 110 percent. Only a plus sign after the last (most recent) test or retest date applies. That is, as stated in your Interpretation A, the cylinder must have the plus sign stamped after each requalification retest if it is be filled to 110 percent. The requalification retest must be performed using the water jacket method.

With regard to the differences in wall stress limits, the wall stress limits prescribed in § 178.37(f)(2) for the DOT 3AA cylinder must be met by the cylinder manufacturer at the time of construction. The wall stress limits prescribed in § 173.302a(b)(3) must be met at the time of each requalification retest. The HMR contain no limitations on the number of times a cylinder that meets the requirements in § 173.302a(b) may be marked with a plus sign.

I hope you find this information responsive and helpful. If you have further questions, please do not hesitate to contact this office.

Sincerely,

Hattie L. Mitchell

Hattie L. Mitchell, Chief
Regulatory Review and Reinvention
Office of Hazardous Materials Standards

030011

173.302a (b)

Webb
§173.302a(b)
Cylinders
03-0011

5104 – 97th Street S.W.
Mukilteo, WA 98275
January 7, 2002

Mr. Edward T. Mazzullo, Director
Office of Hazardous Materials Standards
U.S. DOT/RSPA (DHM-10)
400 Seventh Street S.W.
Washington, D.C. 20590-0001

Re: SCUBA tank pressure ratings

Dear Mr. Mazzullo:

I am a SCUBA diver with questions about the use of SCUBA diving tanks. I posed these questions on behalf of myself. However, I intend to widely disseminate your answers, as I believe the dive industry suffers from much misinformation on this topic. Toward that end, your response may be posted on the world-wide-web and reproduced or quoted in diving magazines or other periodicals.

1. Background.

Steel cylinders for use in SCUBA diving frequently have a "+" symbol stamped on the cylinder adjacent to the service pressure. For example, many cylinders are stamped with "2400 +" which in the dive industry are referred to as "low pressure steel tanks" to distinguish them from steel tanks that have higher service pressures such as 3000 or 3500 pounds per square inch (psi).

These cylinders are subject to hydrostatic testing at least every five years. After the initial hydrostatic test, these cylinders are typically *not* stamped with the "+" symbol when they pass hydrostatic tests.

The "+" stamp permits these cylinders to be "overfilled" with compressed gas by 10% above the service pressure. 49 C.F.R. §173.302a(b).

It is "common knowledge" in the dive industry that tanks that do not have the "+" stamp may not be overfilled by 10%.

It is also "common knowledge" in the dive industry that tanks may not be stamped with the "+" symbol after the initial five-year period after purchase. According to this "common knowledge," a cylinder stamped "2400 +" may be filled to 2640 psi only during its first five years. Thereafter, when the cylinder passes another hydrostatic test it may be filled only to 2400 psi.

On account of this "common knowledge," in the example above most dive shops are not willing to fill a six-year old tank to 2640 psi. (There are some exceptions to this practice, primarily in the state of Florida where cave diving is practiced. We need not concern ourselves with those practices for the purposes of this inquiry.)

There is a minority view which holds that a SCUBA tank may receive a "+" stamp after passing hydrostatic testing, even if the test is not the initial test. Because dive shops will not permit any subsequent "+" rating after the initial five years, divers must take their tanks to some place other than a dive shop to have their tanks hydrostatic tested and re-stamped with the "+" symbol.

There is a second minority view, a much smaller minority view, which holds that once a SCUBA tank has been stamped with the "+" symbol, it may be overfilled by 10% so long as it continues to pass the same visual inspection and hydrostatic testing required of all SCUBA tanks. No special testing or stamping is required.

I have called US Department of Transportation (DOT) Info Center Hotline 1-800-467-4922 and was informed that DOT's position is essentially that of the second minority view. Overfills are permitted without regard to subsequent "+" stamping, so long as hydrostatic test is current. I have read on the Internet of others who have received advice from DOT consistent with this interpretation.

2. First Question.

First, assume facts that give your agency jurisdiction to regulate the filling of the cylinder. That is to say, interstate transportation by a common carrier is involved. Dive shops do not know how tanks will be used. As a practical matter they must assume that your agency has jurisdiction to regulate every fill, even if that conclusion is valid only intermittently.

Second, assume that the cylinder is stamped "2400+" because that is the most common tank that presents the issue.

Third, assume that the cylinder has passed visual inspection and hydrostatic testing at the time of its initial retail sale to the end user, a SCUBA diver. Also, assume that it passed such tests again in the fifth year after the retail sale, but no "+" symbol was stamped at that time.

May the cylinder described above legally be filled with compress air or oxygen enriched air to 2640 psi?

Or, to state the question in more generic terms, once a cylinder has been stamped with the "+" symbol, is anything special needed (in the way of inspecting, testing, stamping, or otherwise) to retain the ability to legally overfill the cylinder by 10%?

3. Analysis.

In reviewing the regulations, I note that 49 C.F.R §173.302a(b) permits the 10% overfill. There are five requirements in 49 C.F.R §173.302a(b):

(1) A frangible disc pressure relief device must be installed on the cylinder, which in the dive industry is known as a burst disc. No sane diver uses SCUBA tanks without one.

(2) "The cylinder's elastic expansion was determined at the time of the *last* test or retest by the water jacket method." (Emphasis added.) I believe from information available on the Internet that the water jacket method is used industry wide for hydrostatic testing of SCUBA tanks.

(3) Average or maximum wall stress cannot exceed certain limitations. Compliance with the average wall stress computation may be determined through a variety of methods, including the manufacturer's marked elastic expansion rejection limit (REE) on the cylinder or in accordance with CGA Pamphlet C-5.

(4) The cylinder must pass visual inspection.

(5). A plus sign (+) "is added following the test date marking on the cylinder to indicate compliance with" the other four requirements above. I note that 49 C.F.R §173.34(e)(7) requires date markings on the cylinder after it successfully passes a hydrostatic retest.

Interpretation A: If "the test date marking on the cylinder" in requirement (5) refers to the test date for the instant hydrostatic test, then clearly SCUBA tanks must have the "+" stamped after every hydrostatic test in order to be overfilled 10%.

Interpretation B: If the "test date marking on the cylinder" in (5) refers to the test date of the cylinder's initial hydrostatic test, then SCUBA tanks need *not* have the "+" stamp after every hydrostatic test in order to be overfilled by 10%.

The use of the word "last" in requirement (2) lends support to Interpretation A.

Requirement (3), regarding wall stress, does not clarify when the limitation applies: at the time of the initial hydrostatic test or subsequent retests. Presumably it applies at the time of each hydrostatic test and retest.

49 C.F.R §173.34(e), regarding periodic qualification and marking of cylinders, does not contain limitation concerning wall stress. 49 C.F.R. 178.37(f)(2) contain wall stress limits that differ with those in 49 C.F.R §173.302a(b)(3). Thus, the "+" symbol appears to signify that the different requirements in 49 C.F.R §173.302a(b) concerning wall stress have been met.

I conclude that the "+" symbol must be stamped on the cylinder after every hydrostatic test in order to be overfill the cylinder by 10% because of the different wall stress limitations imposed by 49 C.F.R §173.302a(b)(3). Unfortunately, my conclusion conflicts with the verbal conclusion given to me by your agency via the US Department of Transportation (DOT) Info Center Hotline, 1-800-467-4922.

4. Second Question.

Assuming my conclusion to the first question is correct, is the hydrostatic test used for cylinders to be stamped with the "+" symbol the same hydrostatic test given to all other 3AA cylinders? In other words, are the wall stress limitations (a computations matter) the essential differentiating factor in determining whether the cylinder qualifies for the "+" stamp?

5. Analysis. I could find no regulations describing a different method for hydrostatic testing for cylinders to be stamped with the "+" symbol that are not already used industry wide in the SCUBA industry. The water jacket method is the only method for testing SCUBA tanks of which I am aware. Contrary to "common knowledge," it appears that "+" stamped cylinders are hydrostatic tested the same as other 3AA cylinders used for SCUBA tanks. In the SCUBA industry, no tank will not pass "hydro" unless the burst disc is in place, the tank passes visual inspection, and the tank passes the hydrostatic test described in 49 C.F.R §173.302a(b)(2). Only the wall stress calculations in 49 C.F.R §173.302a(b)(3) differ from the hydrostatic testing for 3AA cylinders. The physical hydrostatic test is the same.

6. Third Question.

Is there any truth to the SCUBA industry's "common knowledge" that no cylinder may be stamped with the "+" symbol after its second hydrostatic testing becomes due?

7. Analysis.

I could find no support in the Code of Federal Regulations for this second proposition. Indeed, all of the regulations discussed above are premised on the proposition that overfilling is permitted indefinitely, so long as the regulations are met.

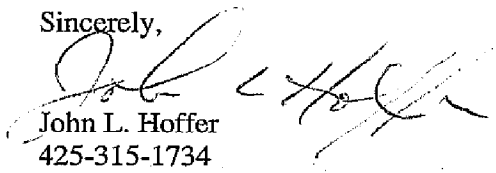
Conclusion.

I am unschooled in DOT regulations and may have misread or incompletely read them. Your opinion addressing these questions would be greatly appreciated. No matter which interpretation you embrace, many in the diving community will be surprised. A definitive answer is sorely needed.

If you have questions, please feel free to contact me.

Thank you for your attention to this matter.

Sincerely,



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