



COMPRESSED GAS ASSOCIATION, INC.

TECHNICAL BULLETIN

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TEST METHODS FOR EVALUATING PAINTS AND COATINGS ON REFILLABLE STEEL COMPRESSED GAS CYLINDERS

Introduction

Compressed gas cylinders used for the transportation and storage of compressed gases for both commercial industry and our military services have progressed over the years from standard sized steel cylinders of one service pressure to cylinders of various sizes, service pressures, methods of manufacture, and materials of construction. There has also been a proliferation in the methods of inspecting, testing, and reconditioning these cylinders. Several types of surface coatings (finishes) have been developed to preserve the cylinders' exterior surfaces. This technical bulletin identifies the primary test methods/procedures that are available to evaluate the durability of these surface coatings and their methods of application.

Purpose and scope

This bulletin identifies several recommended methods/procedures that users, at their discretion, may select and use for testing and evaluating the protective coating on a steel compressed gas refillable cylinder. Each prescribed test method/procedure describes the purpose of the test, the applicable American Society for Testing and Materials (ASTM) procedure, how the test is to be performed, and the expected results.

General

The paint system (cylinder preparation, method of application, and the coating products) should give the equivalent finish of a three process system (pretreatment, primer, and finish coat). The finish coat, consisting of a single or multicolor finish, color bands, and stenciling should be compatible with and adhere firmly to the base coat of paint. The durability of the coating shall be determined by evaluating the results of the prescribed methods of testing. The cylinder owner, at his option, should have the selected durability tests performed by either the cylinder manufacturer or the cylinder requalifier. The results of each successfully completed test should be compiled into a report. This report should completely identify the paint system that was used and should also verify that the paint coating produced meets the requirements of the selected test method or practice. The completed report should be made a matter of record and be available to any customer upon request. Any change in the method of the cylinder preparation, method of product application, or in the coating (paint) products shall constitute the need for requalification of the paint system.

Testing procedures

Test specimen. Each test specimen shall be a standard Department of Transportation (DOT), Transport Canada (TC), or Department of Defense (DOD) specification cylinder or a test coupon from a specification cylinder of the type to be coated (painted).

Material and thickness. Unless otherwise specified, the test specimens shall be manufactured of material conforming to the DOT, TC, or DOD specification to which the production cylinders have or will be manufactured. The wall thickness of the specimen shall be not less than the minimum allowable wall thickness of the cylinders being produced or reconditioned.

Surface preparation. Unless otherwise specified, the specimens shall be cleaned to a near-white metal finish as illustrated in The Society of Protective Coatings, SSPC-SP 10, *Near-White Blast Cleaning*, and as recommended by the finish (coating) manufacturer [1]. The test specimens shall be kept clean and free from all contamination before applying the surface coating.

Methods of application. Unless otherwise specified, the method(s) of applying the surface coating(s) shall be the same as used in the manufacture or reconditioning of the production cylinders.

Durability testing of the exterior coating of compressed gas cylinders from ASTM standards. Select from the following list those durability test methods (procedures) that are desired to be part of the quality verification requirements incorporated in the purchase contract or servicing agreement [2].

1. Salt spray (fog) resistance

ASTM B117, *Standard Practice for Operating Salt Spray (Fog) Apparatus* [2].

Test. Two test specimens shall be prepared, cleaned, coated, and cured per the manufacturer's standard recommendation. In accordance with ASTM B117, the coated specimens shall be supported or suspended between 15 degrees and 30 degrees from the vertical and positioned and exposed to a salt solution consisting of 20% by weight common salt (sodium chloride) and distilled water at a temperature of 95 °F (35 °C) for a minimum exposure time of 240 hr. The pH value of this solution as collected after spraying in the test apparatus is to be between 6.5 and 7.2, and the specific gravity between 1.126 and 1.157 at 95 °F (35 °C).

Results. The coating shall show no rust creepage, blistering, undercutting, or loss of adhesion of the paint beyond 1/8 in (3 mm) of the scribe mark as noted in ASTM B117. All other surfaces of the test specimen shall show no more than a trace of film failure (Rust grade 9 of ASTM D610), with no spot larger than 3/64 in (1 mm) in diameter.

2. Dry film thickness

ASTM D7091, *Standard Practice for Nondestructive Measurement of Dry Film Thickness of Nonmagnetic Coatings Applied to Ferrous Metals and Nonmagnetic, Nonconductive Coatings Applied to Non-Ferrous Metals* [3].

Test. One test specimen shall be examined using Test Method B of ASTM D7091 to determine the total thickness of the film coating applied to the specimen

Results. The examined specimen shall show a minimum of 0.001 in (0.03 mm) total dry film thickness.

3. Impact resistance

ASTM D2794, *Standard Test Method for Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact)* [4].

Test. Two test specimens shall be prepared, coated, and cured as per the manufacturer's standard recommendation. The specimen shall be direct impact tested in accordance with ASTM D2794 using a 4 lb (1.8 kg) weight. The impact cup shall terminate in a hemispherical 5/8 in (16 mm) diameter nose. Backing plates shall not be used.

Results. The cured film coating shall provide a coating that will have a direct impact resistance of not less than 160 in-lb (18.1 Nm) without forming a holiday when inspected with a 67.5 volt detector.

4. Adhesion

ASTM D3359, *Standard Test Methods for Measuring Adhesion by Tape Test* [5].

Test. One test specimen shall be prepared, coated, and tested for adhesion in accordance with ASTM D3359, Method B.

Results. The cured film coating shall have a minimum classification of 4B.

5. Hardness

ASTM D3363, *Standard Test Method for Film Hardness by Pencil Test* [6].

Test. Two test specimens shall be prepared, cleaned, coated, and cured per the manufacturer's standard recommendation. The hardness of the coating shall be determined in accordance with ASTM D3363 [6].

Results. The average of five hardness readings shall have a pencil hardness of not less than H.