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BB-A-106B
April 22, 1971
SUPERSEDING
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May 28, 1963

FEDERAL SPECIFICATION

ACETYLENE, TECHNICAL, DISSOLVED

This specification was approved by the Commissioner, Federal Supply Service, General Services Administration, for the use of all Federal agencies.

1. SCOPE AND CLASSIFICATION

1.1 Scope. This specification covers two technical grades of acetylene dissolved in acetone.

1.2 Classification. The acetylene shall be of the following grades, as specified (see 6.2):

Grade A - 99.5 percent.
Grade B - 98.0 percent.

2. APPLICABLE DOCUMENTS

2.1 The following documents, of the issue in effect on date of invitation for bids or request for proposal, form a part of this specification to the extent specified herein.

Federal Specifications:

O-A-51 - Acetone, Technical.

Federal Standards:

FED. STD. No. 123 - Marking for Domestic Shipment (Civil Agencies).

(Activities outside the Federal Government may obtain copies of Federal Specifications, Standards, and Handbooks as outlined under General Information in the Index of Federal Specifications and Standards and at the prices indicated in the Index. The Index, which includes cumulative monthly supplements as issued, is for sale on a subscription basis by the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402.

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(Single copies of this specification and other Federal Specifications required by activities outside the Federal Government for bidding purposes are available without charge from Business Service Centers at the General Services Administration Regional Offices in Boston, New York, Washington, DC, Atlanta, Chicago, Kansas City, MO, Fort Worth, Denver, San Francisco, Los Angeles, and Seattle, WA.

(Federal Government activities may obtain copies of Federal Specifications, Standards, and Handbooks and the Index of Federal Specification and Standards from Established distribution points in their agencies.)

Military Specifications:

MIL-V-2	- Valve, Cylinder, Gas (for Compressed or Liquefied Gases), General Specification for.
MIL-T-704	- Treatment and Painting of Materiel.
MIL-C-3701	- Cylinders, Compressed Gas: ICC-8 and ICC-8AL; Acetylene, with Valves.

Military Standards:

MIL-STD-101	- Color Code for Pipelines and for Compressed-Gas Cylinders.
MIL-STD-105	- Sampling Procedures and Tables for Inspection by Attributes.
MIL-STD-129	- Marking for Shipment and Storage.
MIL-STD-147	- Palletized and Containerized Unit Loads 40" x 48" Pallets, Skids, Runners, or Pallet-Type Base.

(Copies of Military Specifications and Standards required by contractors in connection with specific procurement functions should be obtained from the procuring activity or as directed by the contracting officer.)

Laws and Regulations:

49 CFR 171-190 - Rules and Regulations for the Transportation of Explosives and other Dangerous Articles.

(The Code of Federal Regulations (CFR) and the Federal Register (FR) are for sale on a subscription basis by the Superintendent of Documents, US Government Printing Office, Washington DC 20402. When indicated, reprints of certain regulations may be obtained from the Federal agency responsible for issuance thereof.)

2.2 Other publications. The following documents form a part of this specification to the extent specified herein. Unless a specific issue is identified the issue in effect on date of invitation for bids or request for proposal shall apply.

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National Bureau of Standards (NBS) Handbook:

H28 - Screw-Thread Standards for Federal Services.

(Application for copies should be addressed to the Superintendent of Documents, Government Printing Office, Washington, D. C. 20402.)

3. REQUIREMENTS

3.1 Material. The acetylene shall conform to table I.

Table I. Properties of Acetylene (see 6.3)

	Grade A	Grade B
	Percent by volume 1/	Percent by volume 1/
Acetylene (C_2H_2)	99.5 minimum	98.0 minimum
Phosphine (PH_3) 2/	0.005 maximum	0.05 maximum
Hydrogen sulfide (H_2S) 2/	0.005 maximum	0.05 maximum

1/ Acetone free basis.
2/ Carbide process acetylene only (see 6.3).

3.2 Cylinders and valves. The acetylene shall be contained in Government-furnished cylinders in accordance with 49 CFR 171-190 and equipped with valves with outlet connections in accordance with Handbook H28. When specified (see 6.2), cylinders shall be furnished by the supplier and shall be in accordance with MIL-C-3701 and shall be equipped with valves in accordance with MIL-V-2. When specified (see 6.2), the acetylene shall be contained in supplier-owned DOT approved cylinders. The cylinders shall contain sufficient acetone as a solvent medium to conform to 49 CFR 171-190 requirements for acetylene cylinders.

3.3 Cylinder maintenance. Government- and supplier-furnished cylinders that require maintenance shall be processed by the supplier for serviceability to meet the requirements of this specification and 49 CFR 171-190 (see 6.5).

3.3.1 Painting. Government-furnished cylinders requiring repainting shall be cleaned, treated, and painted in accordance with MIL-T-704, and shall be color coded and marked in accordance with MIL-STD-101.

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3.3.2 Valves. Unless otherwise specified (see 6.2), replacement valves for defective valves in Government-furnished cylinders shall be supplier-furnished and shall be in accordance with MIL-V-2.

3.3.3 Acetone. Acetone for replenishment of Government-furnished cylinders shall conform to O-A-51.

3.4 Capacity. Cylinders shall be filled to volume capacity on the basis of weight (see 6.6). Cylinders shall be filled in compliance with 49 CFR 171-190; the pressure in the filled cylinder shall not exceed 250 psig at 70° F.

3.5 Leakage. Cylinders and valves shall not leak after being filled.

4. QUALITY ASSURANCE PROVISIONS

4.1 Inspection responsibility. The supplier is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified, the supplier may utilize his own or any other inspection facilities and services acceptable to the Government. The Government reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary to assure that supplies and services conform to prescribed requirements.

4.1.1 Component and material inspection. The supplier is responsible for insuring that components and materials used are manufactured, examined, and tested in accordance with referenced specifications and standards. The supplier shall verify that the production facility will produce acetylene that complies with the percent by volume acetylene purity requirements of 3.1 for the grade supplied. This verification may be by the current analytical records of acetylene from the facility. The analytical records shall be considered current if taken within 180 days preceding the date of contract or purchase order. When current analytical records are not available, or in case of process upset or equipment malfunction which affects the product purity, at least one acetylene sample from the facility shall be tested as specified in 4.4.2.1 prior to starting or continuing production.

4.2 Classification of inspection. Inspection shall be classified as follows:

(a) Quality conformance inspection (see 4.3).
(b) Inspection of preparation for delivery (see 4.5).

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4.3 Quality conformance inspection.

4.3.1 Examination. Each filled cylinder shall be examined as specified in 4.4.1. Presence of one or more defects shall be cause for rejection of the cylinder.

4.3.2 Tests.

4.3.2.1 Individual. Each filled cylinder shall be tested for leakage as specified in 4.4.2.3. Failure of the test shall be cause for rejection of the cylinder.

4.3.2.2 Samples (carbide process acetylene only). Samples selected from each lot of carbide process acetylene shall be tested for phosphine and hydrogen sulfide as specified in 4.4.2.2. Sampling shall be from filled cylinders and shall be in accordance with MIL-STD-105, inspection level S-1. A lot shall be considered to be all cylinders filled from the same source during a consecutive 24-hour period. The AQL shall be 2.5 percent defective.

4.4 Inspection procedure.

4.4.1 Examination. The filled acetylene cylinders shall be examined for the following defects:

101. Cylinder or valve not as specified.
102. Cylinder maintenance not as specified.
103. Capacity not as specified in 3.4.

4.4.2 Tests.

4.4.2.1 Acetylene purity. (This test is only required for verification of the production facility as outlined in 4.1.1.) Compliance with the acetylene purity requirement of 3.1 shall be determined by gas chromatography or other appropriate instrumental method, or by the classical methods utilizing either fuming sulfuric acid or cuprous ammonium chloride as the primary acetylene absorbing reagent. Prior to the test a few cubic feet of gas shall be discharged to purge the sampling lines. The classical method using fuming sulfuric acid shall be conducted as follows:

(a) Apparatus. The apparatus shall be of the type designed for determination of the percentages of gas by volume from the shrinkage in volume because of the absorption of the gas by the reagents used, and the apparatus shall measure with

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an error of not more than plus or minus 0.1 percent. The apparatus shall consist of a burette having a capacity of 100 milliliters (ml), with graduated stems at the upper and lower ends and an ungraduated bulb in the middle. The graduated parts shall each hold about 10 percent of the capacity of the burette. A water jacket enclosing the burette shall be provided. The burette shall be connected to two absorption pipettes by means of a flushing manifold. The pipettes shall be of the bubbler type, made entirely of glass. Flexible rubber bags of such quality as will not be appreciably affected by sulfur trioxide fumes, or additional pipettes containing saturated sodium chloride solution or other suitable liquid, shall be attached to the rear compartment of the pipettes. A vertical support rod for the liquid leveling bottle shall be provided.

(b) Gas-displacement liquid. The gas-displacement liquid shall be mercury, with about 0.1 ml of an aqueous solution of approximately 2 percent of sulfuric acid on the surface of the mercury in the burette for the purpose of clearing up precipitation on the interior of the burette tube.

(c) Reagent. The reagent used in the first pipette shall be fuming sulfuric acid containing 20 percent of free sulfur trioxide. The reagent used in the second pipette shall be sulfuric acid, chemically pure (c.p.), (specific gravity (sp. gr.), 1.700) made by diluting 373 ml of concentrated H_2SO_4 (sp. gr., 1.84) to 500 ml with distilled water.

(d) Test procedure. Flush out the manifold with nitrogen or dry air. Purge the burette with the sample by drawing in and discarding several samples being careful not to displace the nitrogen above the absorption pipette. A measured volume of 100 ml of sample shall be drawn into the burette by means of a leveling bottle. The temperature should be observed and recorded at this time. The sample is then passed into the first absorption pipette containing the fuming sulfuric acid and then back into the burette. This step is repeated until no further change in volume occurs as indicated by successive measurements. The gas in the first pipette is then stored without disturbing the gas in the pipette or in the manifold; the burette is filled with mercury and 5 ml of dry air or nitrogen is drawn in. The residual gas sample, stored in the first pipette, is returned to the burette and mixed with dry air. This gas mixture is again passed several times between the first absorption pipette and the burette until

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two successive volume readings are within 0.1 ml of each other. The gas is then passed into the second pipette containing the dilute sulfuric acid (sp. gr. 1.700) and then back into the burette. This step is repeated until no further change in volume occurs as indicated by two successive volume readings lying within 0.1 ml of each other. Record the final volume. Record the temperature. If the difference between the first and second temperature readings is greater than 2° C., repeat the test.

Calculation: Percent acetylene = 105 - A, where A = final volume reading.

The minimum acetylene content shall be 99.5 percent for grade A and 98.0 percent for grade B. Otherwise compliance of the minimum requirements has not been met and shall constitute failure of this test.

4.4.2.2 Phosphine and hydrogen sulfide (carbide process acetylene only). Compliance of carbide process acetylene with the phosphine and hydrogen sulfide requirements of 3.1 shall be determined qualitatively as specified in 4.4.2.2.1. In case of dispute the acetylene shall be quantitatively analyzed as specified in 4.4.2.2.2. Prior to each test a few cubic feet of gas shall be discharged to purge the sampling lines.

4.4.2.2.1 Qualitative determination. Each qualitative determination shall be conducted as follows:

(a) Grade A. A piece of white filter paper saturated with 5.0 percent solution of silver nitrate shall be placed over the mouth of a funnel and secured with a clamp. The filter assembly shown in figure 1 shall be used in the determination. The filter paper shall be used immediately after saturation. CAUTION: Do not allow the paper to dry or the test will be void. Attach the tygon tubing from the regulator of the acetylene tank to the funnel tip; set the regulator pressure at not more than 3 pounds per square inch (psi). Release the needle valve for 10 seconds. If the silver-nitrate paper remains white or becomes discolored a light yellow, the acetylene is acceptable. If the silver-nitrate paper turns a dark brown or black the acetylene shall have failed the test.

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(b) Grade B. A piece of white filter paper saturated with 0.1 percent solution of silver nitrate shall be placed over the mouth of a funnel and secured with a clamp. The filter assembly shown in figure 1 shall be used in the determination. The filter paper shall be used immediately after saturation. CAUTION: Do not allow paper to dry or the test will be void. Attach the tygon tubing from the regulator of the acetylene tank to the funnel tip. Set the regulator pressure gage at not more than 3 psi. Release the needle valve for 30 seconds. If the silver-nitrate paper remains white or becomes a light yellow, the acetylene shall be acceptable. If the silver-nitrate paper turns a dark brown or black, the acetylene shall have failed the test.

(c) Alternate method (both grades). The qualitative determination for both grade A and grade B acetylene may be made with color detector tubes for phosphine and for hydrogen sulfide (see 6.7). If the indicated percentage of phosphine or of hydrogen sulfide is greater than as specified in 3.1 the acetylene shall have failed the test.

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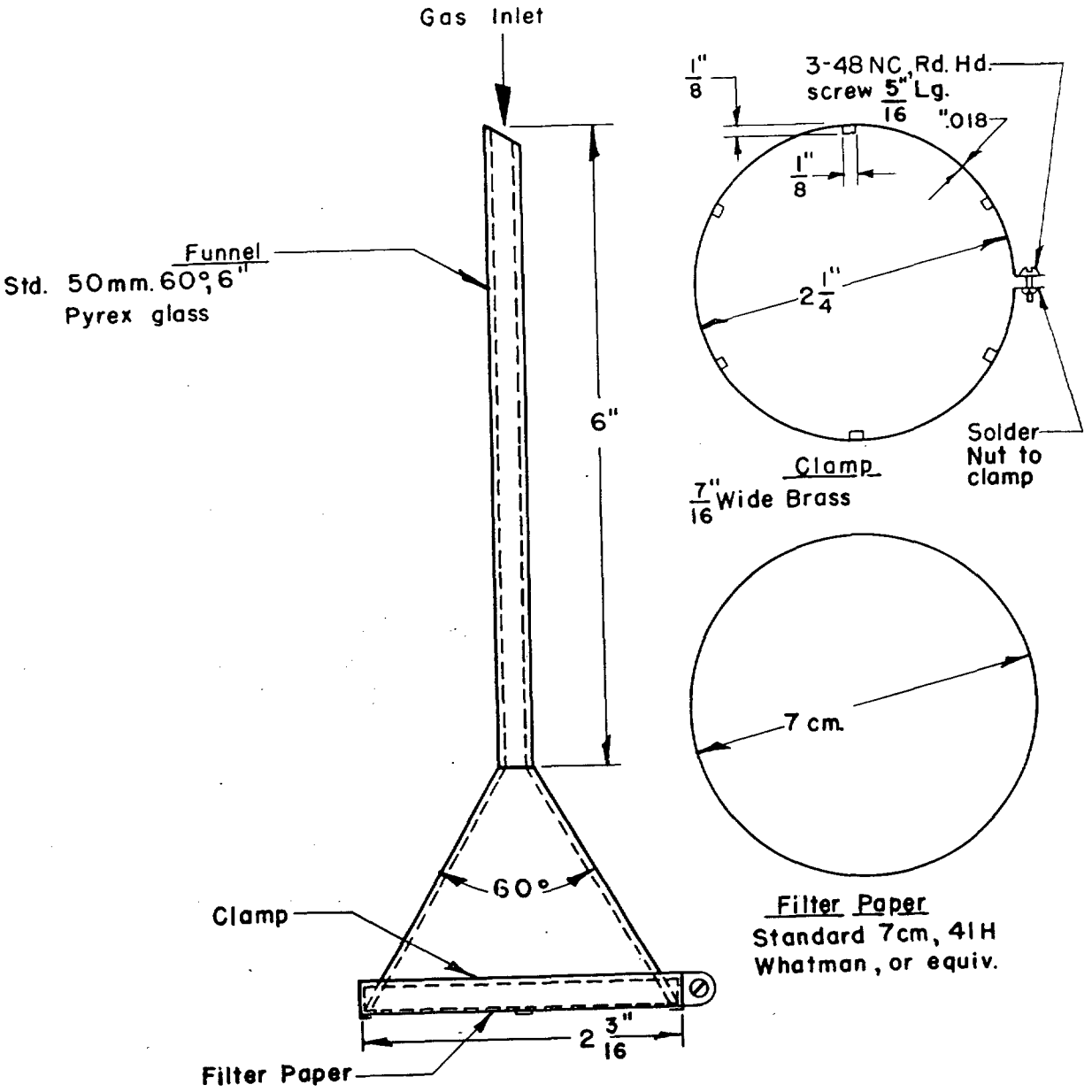

Figure 1.- Filter Assembly

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4.4.2.2.2 Quantitative determination. The quantitative determination of phosphine and of hydrogen sulfide shall be by gas chromatography or other appropriate instrumental method, or by classical method. The classical method shall be conducted as follows:

(a) Reagents.

(1) Two to three percent sodium hypochlorite solution. Make a 1:1 dilution with a 4 - 6 percent solution of sodium hypochlorite commercially available.

(2) Molybdate reagent. Make the molybdate reagent by either method as follows:

Method A. Solution 1: Mix 118 grams of 85 percent molybdic acid with 400 ml of distilled water, add 80 ml concentrated ammonium hydroxide, and filter when solution is complete. Solution 2: Mix 400 ml of concentrated nitric acid with 600 ml of distilled water. Vigorously agitate solution 2 by means of a current of air and add solution 1 very slowly through a tube dipping under the surface of the agitated solution. When all of solution 1 has been added, continue the current of air for 1 to 2 hours. Let stand, filter if necessary, and store in a glass-stoppered bottle.
Method B. Solution 1: Dissolve 100 grams of ammonium molybdate (CP grade) in 400 ml of distilled water and 80 ml of 15N ammonium hydroxide. Filter if necessary. Solution 2: Mix 400 ml of 16M nitric acid with 600 ml of water. For use, mix the necessary amount of solution 1 with twice its volume of solution 2, adding solution 1 to solution 2 slowly with vigorous stirring.

(b) Preparation of sample. Approximately 1 cubic foot of acetylene gas from the sample cylinder shall be passed at a rate of 0.03 cubic foot per minute through two Fisher-Milligan Gas Washer bottles connected in series and each containing 200 ml of the 2 to 3 percent sodium hypochlorite solution. CAUTION: The effluent gas should be vented to outdoor spaces to avoid explosive atmospheres. The volume of gas shall be measured by means of a wet-test meter after the gas has passed through the absorption bottles. At the conclusion of the run, the flow of gas should be shut off and the volume of gas used should be recorded; next, the barometric pressure and the temperature should be recorded. Remove plastic caps from the Fisher-Milligan bottles and rinse down with a few milliliters of distilled water, allowing

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the rinsings to fall into the bottle. Transfer the solutions from both bottles into the same 500-ml volumetric flask. Rinse each bottle and glass with three 10-ml portions of distilled water, transfer rinsings to volumetric flask, and make up to volume with distilled water. Mix the contents thoroughly and pipette 250 ml into a 400-ml beaker. Transfer the remaining solution into a second 400-ml beaker together with rinsings from the flask and pipette.

(c) Analysis for phosphine. To the first beaker of solution obtained as specified in (b) above, add 30 ml of concentrated nitric acid and boil it down to 100 to 125 ml. Transfer the solution to a 300-ml glass-stoppered Erlenmeyer flask, cool, and cautiously add 10 ml concentrated ammonium hydroxide. Adjust the temperature to approximately 40° C. and add 100 ml of the molybdate reagent prepared in accordance with (a) above. Let the solution settle for 10 to 30 minutes. Filter it on a small Gooch crucible, and wash the flask and the crucible with a 1 percent potassium-nitrate solution until they are acid-free as indicated by pH indicating paper. Place the crucible in the flask and add a known volume of standard sodium hydroxide solution until the precipitate is completely dissolved, as indicated by the absence of yellow color. Add a few drops of phenolphthalein indicator solution and then back titrate with standard hydrochloric-acid solution until the indicator color disappears. Record the number of milliliters used. Repeat this procedure, using sodium hypochlorite solution and reagents only, to obtain a blank determination. Record the number of milliliters used. Calculate the percentage by volume of phosphine as follows:

$$1 \text{ mol NaOH} = 1/23 \text{ mol } PH_3 \quad \frac{22.412}{23} \text{liters.}$$

$$1 \text{ milli mol NaOH} = 0.9744 \times 10^{-3} \text{ liters } PH_3,$$

$$\frac{\left[(\text{ml NaOH} \times N - \text{ml HCl} \times N) - B\right] \times 0.9744 \times 10^{-3} \times (273 + T) \times 760 \times 2^{*} \times 100}{V \times P \times 273} =$$

$$\frac{\left[(\text{ml NaOH} \times N - \text{ml HCl} \times N) - B\right] \times (273 + T) \times 0.543}{V \times P}$$

$$= \%PH_3 \text{ (by vol.)},$$

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Where:

B = value obtained in blank determination
T = temperature (° C.) of gas
V = measured volume of acetylene in liters
P = barometric pressure in millimeters
N = normality of respective solutions.

* Factor of "2" introduced because aliquot used represents one half of the original sample.

The maximum allowance for phosphine is 0.005 percent for grade A and 0.05 percent for grade B. Quantities in excess of these respective amounts shall constitute failure of this test.

(d) Analysis for hydrogen sulfide. To the second beaker of solution obtained as specified in (b) above, add 30 ml of concentrated hydrochloric acid and boil down to 100 to 125 ml. Then carefully neutralize with ammonium hydroxide to the methyl orange end point and add 1 ml of concentrated hydrochloric acid. Heat to boiling and add 10 ml of 10 percent barium chloride solution while stirring vigorously. Let stand at the side of a steam bath for 30 minutes. Filter, wash, and ignite to constant weight; record the weight of the remaining barium sulfate in grams. Repeat this procedure, using hypochlorite solution and reagents only, to obtain a blank determination. Record weight of barium sulfate in grams. Calculate the percentage, by volume of hydrogen sulfide as follows:

1 mol $BaSO_4$ = 1 mol H_2S,

$$1 \text{ gram } BaSO_4 = \frac{1 \text{ mol } H_2S}{233.42} = \frac{22.412}{233.42} =$$

0.09602 liter H_2S,

$$(\text{wt. } BaSO_4 - \text{wt. blank}) \times 0.09602 \times \frac{(273 + T) \times 760 \times 2^* \times 100}{V \times P \times 273} =$$

$$\frac{(\text{wt. } BaSO_4 - \text{wt. blank}) \times (273 + T \times 53.5)}{V \times P} = \%\ H_2S \text{ (by vol.)}.$$

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* Factor of "2" introduced because aliquot used represents one half of the original sample.

The maximum allowance for hydrogen sulfide is 0.005 percent for grade A and 0.05 percent for grade B. Quantities in excess of these respective amounts shall constitute failure of this test.

4.4.2.3 Leakage. Each cylinder after filling shall be tested for leakage by applying a soap solution to all portions of the valve, the junction of the valve and cylinder, and the safety device on the cylinder. Care shall be taken to ensure that the solution utilized does not contaminate the valve outlet. Any evidence of leakage of gas as evidenced by bubbling of the soap solution shall constitute failure of this test.

4.5 Inspection of preparation for delivery. All cylinders shall be examined to determine if any marking is missing, illegible, incorrect, or incomplete. Any one defect shall be cause for rejection.

5. PREPARATION FOR DELIVERY

5.1 Packing. Shipment of the cylinders of acetylene shall conform to 49 CFR 171-190.

5.1.1 Palletization. When specified (see 6.2), the acetylene contained in cylinders shall be palletized in accordance with MIL-STD-147.

5.2 Marking. The cylinders shall be marked in accordance with 49 CFR 171-190. Each cylinder shall be stenciled or tagged grade A or grade B as applicable.

5.2.1 Civil agencies. In addition to the marking specified in 5.2, the cylinders shall be marked in accordance with FED. STD. No. 123.

5.2.2 Military agencies. In addition to the marking specified in 5.2, the cylinders shall be marked in accordance with MIL-STD-129.

6. NOTES

6.1 Intended use. Grade A acetylene is used as an illumination gas for navigational lights. Grade B acetylene is for use in cutting and welding.

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6.2 Ordering data. Purchasers should select the preferred options permitted herein and include the following information in procurement documents:

(a) Title, number, and date of this specification.
(b) Grade of acetylene required (see 1.2).
(c) When supplier is to furnish cylinders (see 3.2).
(d) When acetylene is to be contained in supplier-owned cylinders (see 3.2).
(e) When Government-furnished replacement valves are to be utilized (see 3.3.2).
(f) When cylinders are to be palletized (see 5.1.1).

6.3 Acetylene is commercially produced by either of two types of processes:

(a) Carbide process. Acetylene is produced by reaction of calcium carbide and water. The calcium carbide has varying amounts of phosphorus and sulfur contaminants which result in the phosphine and hydrogen sulfide impurities in product acetylene.
(b) Petrochemical processes. Acetylene is produced by the thermal or arc cracking of hydrocarbons, such as the Wulff process or the BASF process; or the partial combustion of methane with oxygen, such as the Montecatini process. Acetylene so produced is sometimes referred to as petrochemical or by-product acetylene. There is no phosphine or hydrogen sulfide contamination.

6.3.1 Acetylene produced by either type of process is commercially considered to meet cutting and welding requirements, which is the intended use of grade B, 98 percent acetylene. Further purification produces grade A, 99.5 percent acetylene, which is often described as purified grade. Generally, it is only carbide process acetylene which is further purified.

6.4 Government-furnished cylinders. The contracting officer should arrange to furnish the cylinders specified in 3.2.

6.5 Maintenance of Government-furnished cylinders. Purchasers should specify the extent to which Government-furnished cylinders that require maintenance should be processed by the gas supplier.

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6.5.1 The gas supplier should furnish at no additional cost all services which are required at each and every filling of a cylinder to comply with applicable regulations and normal good practice. Such services would include, but not be limited to all inspection, testing, evacuation, and handling services required for the gas supplied.

6.5.2 A schedule of allowable fees should be specified by the purchaser for the gas supplier's performance of services such as the replacement of valves, valve parts, and cylinder caps, hydrostatic testing, cleaning, painting, color coding, marking, and handling of unserviceable cylinders as required. All materials and components for these services should be furnished by the gas supplier.

6.6 The basis of purchase should be the cubic foot. A conversion factor of 14.7 cubic feet per pound weight of acetylene should be used. The weight of acetylene supplied in each cylinder is the difference between the filled weight and the tare (unfilled) weight of the cylinder. Acetylene is available in several cylinder sizes ranging from 10 through 380 cubic feet rated capacity. In general, the amount of acetylene in a filled cylinder may vary slightly (up to 3 percent) from the rated volume capacity of the cylinder.

6.7 The color detector tubes specified in 4.4.2.2.1(c) are tubes containing granules impregnated with indicating chemicals. Two color detector tubes would be used for the specified test, one for phosphine and one for hydrogen sulfide. The length of color change in a tube, when a measured volume of acetylene is passed through it, is directly proportional to the to the concentration of the impurity. The tubes and associate apparatus are available from several manufacturers and in several ranges.

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MILITARY INTEREST:

Custodians:

Army - ME
Navy - YD
Air Force - 68

Review activity:

Navy - SH

User activity:

Navy - MC

Preparing activity:

Army - ME

CIVIL AGENCIES INTEREST:

VA, GSA, HEW, COM

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