

PURCHASE DESCRIPTION  
PROPELLANT, DEUTERIUM

1. SCOPE. This purchase description covers the requirements for gaseous deuterium for use in lasers.

2. APPLICABLE DOCUMENTS

2.1 General. The documents listed in this section are specified in Sections 3 and 4 of this purchase description. This section does not include documents in other sections of this purchase description or recommended for additional information or as examples. While every effort has been made to ensure the completeness of this list, document users are cautioned that they must meet all specified requirements documents cited in sections 3 and 4 of this purchase description, whether or not they are listed.

2.2 Government documents.

2.2.1 Specifications, standards, and handbooks. The following standard forms a part of this document to the extent specified herein. Unless otherwise specified, the issue of this document is that listed in the issue of the Department of Defense Index of Specifications and Standards (DoDISS) and supplement thereto, cited in the solicitation.

SPECIFICATIONS

DEPARTMENT OF DEFENSE

MIL-STD-129 – Standard Practice for Military Marking  
MIL-STD-1411 – Inspection and Maintenance of Compressed Gas Cylinders

2.3 Non-Government publications. The following documents form a part of this document to the extent specified herein. Unless otherwise specified, the issues of the documents which are DoD adopted are those listed in the issue of the DoDISS cited in the solicitation. Unless otherwise specified, the issues of documents not listed in the DoDISS are the issues of the documents cited in the solicitation.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM E 29 – Standard Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications  
ASTM F 307 – Standard Practice for Sampling Pressurized Gas for Gas Analysis

(Application for copies should be addressed to the American Society for Testing and Materials, 100 Barr Harbor Drive, West Conshohocken PA 19428-2959.)

Beneficial comments (recommendations, additions, deletions) and any data which may be of use in improving this document should be sent to:

DESC-BP  
Building 1621-K  
2261 Hughes Ave, Ste 128  
Lackland AFB TX 78236-9828

## Compressed Gas Association (CGA)

## CGA G 5.3 - Commodity Specification for Hydrogen

(Application for copies should be addressed to the Compressed Gas Association, Inc., 4221 Walney Road, Chantilly VA 20151-2923)

2.4 Order of precedence. In the event of a conflict between the text of this document and the references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

## 3. REQUIREMENTS

3.1 Chemical and physical properties. The composition of the propellant shall conform to the limits listed in Table I when tested in accordance with the applicable test methods.

Table I – Composition

Property	Limit	Test Paragraph
Purity (D <sub>2</sub> ), % Vol	99.5 min	4.5.6
Hydrogen (H <sub>2</sub> ), % Vol	0.5 max	4.5.1
Water (H <sub>2</sub> O), ppm by Vol	50 max	4.5.2
Total Hydrocarbons as Methane (CH <sub>4</sub> ), ppm by Vol	0.5 max	4.5.3
Nitrogen (N <sub>2</sub> ), ppm by Vol	Report to nearest ppm	4.5.4
Oxygen (O <sub>2</sub> ), ppm by Vol	Report to nearest ppm	4.5.4
Carbon Dioxide (CO <sub>2</sub> ), ppm by Vol	Report to nearest ppm	4.5.4
Carbon Monoxide (CO), ppm by Vol	Report to nearest ppm	4.5.4
Argon (Ar), ppm by Vol	Report to nearest ppm	4.5.4
Hydrogen Deuteride (HD), ppm by Vol	Report to nearest ppm	4.5.5
Specific Activity of Tritium, nanoCuries/gram	2 max	4.5.7

3.2 Limiting values. For purposes of determining conformance with these requirements, an observed value or a calculated value shall be rounded off "to the nearest unit" in the last right-hand digit used in expressing the specified limit according to the rounding-off method of ASTM Practice E 29 for Using Significant Digits in Test Data to Determine Conformance with Specifications.

3.3 Filter. A filter with a 10 micron nominal and 40 micron absolute rating shall be installed between the manufacturer's plant system and the manifold used to fill the gas containers for delivery.

## 4. VERIFICATION

4.1 Responsibility for inspection. Unless otherwise specified in the contract or purchase order, the supplier is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified, the supplier may utilize his own facilities or any commercial laboratory acceptable to the Government. The Government reserves the right to perform any of the inspections set forth in this

purchase description where such inspections are deemed necessary to assure supplies and services conform to prescribed requirements.

4.2 Classification of tests. The inspection and testing of the propellant requirements specified herein are classified as quality conformance tests. (see 4.3)

4.3 Quality conformance tests. The propellant shall be sampled according to 4.3.1 and the samples tested for conformance to the limits of Table I utilizing the procedures described under 4.5.

4.3.1 Sampling plan.

4.3.1.1 Lot. A lot shall consist of one of the following:

a. The propellant produced in not more than 24 consecutive hours from a continuous process which is used to fill shipping containers directly from the process output. A continuous process shall be the production of product by continuous input of raw materials and output of finished product by one manufacturer in one plant with no change in manufacturing conditions or materials.

b. The propellant from individual runs of a batch process that is used to fill shipping containers directly from the process output. A batch process shall be the production of product by single additions of raw materials that are reacted and purified forming the product.

c. The propellant from either or both the continuous and batch processes which is held in a single storage tank and subsequently withdrawn to fill shipping containers. The product shall be homogenous at the time of withdrawal and shall not be added to while being withdrawn. After each addition to the storage tank, the contents shall constitute a separate lot.

4.3.1.2 Sample Size. Each sample shall be of sufficient size to conduct all of the quality conformance tests as specified herein.

4.3.1.3 Sampling Methods. Unless otherwise specified, the propellant shall be sampled in accordance with ASTM F 307. All apparatus used shall be made of suitable materials. Each sample taken for analysis shall be representative of the propellant being sampled.

4.3.1.4 Containers. When more than one container (cylinder or tubes) is filled from the same lot, the number of containers to be sampled from that lot shall be in accordance with Table II. The first and last containers to be filled within a given lot shall be sampled. Other samples may be selected at random. The propellant from each container sampled shall constitute a separate sample.

TABLE II. SAMPLING FOR TEST

Number of Containers in Lot	Number of Containers to be Sampled
1	1
2-40	2
41-70	3
70 and over	4

4.4 Rejection and retest. When any sample of the propellant tested in accordance with 4.3 fails to conform to the requirements specified herein, the entire lot represented by the sample shall be rejected. Rejected material shall not be resubmitted without furnishing full particulars concerning previous rejection and measures taken to overcome defects.

4.5 Test methods. The contractor's own test methods may be used if approved by the procuring activity; however, in case of dispute, the following shall be the referee methods.

4.5.1 Hydrogen. The hydrogen content of the sample shall be determined by mass spectrometry. Hydrogen standards in helium shall be used to calibrate the mass spectrometer

4.5.2 Water. The water content of the sample shall be determined using an electrolytic method as follows: Connect the sample container to a pressure regulator that is attached to the electrolytic moisture apparatus (hygrometer). Open the sample container valve and adjust the pressure to the apparatus in accordance with the manufacturer's recommended value. Allow sufficient time for the indicated moisture content to become stable and read the value obtained while using the most sensitive scale setting possible for the moisture content of the sample. The electrolytic moisture apparatus should be set on a range no greater than ten times the specified maximum moisture content.

4.5.3 Total Hydrocarbons as Methane. The total hydrocarbon content, as methane, of the sample shall be determined by a flame ionization type analyzer. The analyzer is to be calibrated at appropriate intervals by the use of deuterium calibration gas standards. The range used shall not be greater than ten times the specified maximum total hydrocarbon content expressed as methane.

4.5.4 Nitrogen, Oxygen, Carbon Monoxide, Carbon Dioxide, Argon. The analytical procedures described in CGA Specification G-5.3 shall be used for these components.

4.5.5 Hydrogen Deuteride. The hydrogen deuteride content shall be determined by generally accepted industrial practices.

4.5.6 Purity. The deuterium content of the sample shall be calculated by the following formula:

$$\% D_2 = 100 - \sum C_i$$

where,

$\% D_2$  = volume percent of deuterium in the sample.

$\sum C_i$  = the sum of the impurities found in the sample (converted to volume percent) as determined in paragraphs 4.5.1 through 4.5.5.

4.5.7 Specific Activity of Tritium. The specific activity of tritium shall be determined by generally accepted industrial practices.

## 5. PACKAGING.

5.1 Cylinders. Unless otherwise specified in the contract or purchase order, cylinders shall be prepared in accordance with MIL-STD-1411.

5.2 Labeling and Marking. Unless otherwise specified in the contract or purchase order, the packaging and marking requirements shall be in accordance with MIL-STD-129.

## 6. NOTES.

6.1 Intended use. The propellant covered by this purchase description is intended for use as an energy source in laser systems.