

# SEMI C3.46-93

## STANDARD FOR ARGON (Ar), BULK LIQUID, 99.9992% QUALITY

This Standard was technically approved by the Gases Global Technical Committee. This edition was approved for publication by the global Audits and Reviews Subcommittee. Originally published in 1993.

### 1 Description

1.1 Argon is the most abundant member of the rare gas family. It is monatomic and is characterized by its extreme chemical inactivity. Argon is a colorless, odorless and tasteless gas somewhat soluble in water. It is normally delivered and stored as a cryogenic liquid.

### 2 Specifications

2.1 QUALITY: 99.9992%

| <i>Impurities</i>                                          | <i>Maximum Acceptable Level (ppm)<sup>#1</sup></i> |
|------------------------------------------------------------|----------------------------------------------------|
| Carbon monoxide and carbon dioxide (CO + CO <sub>2</sub> ) | 0.5                                                |
| Hydrogen (H <sub>2</sub> )                                 | 1                                                  |
| Nitrogen (N <sub>2</sub> )                                 | 5                                                  |
| Oxygen (O <sub>2</sub> )                                   | 0.5                                                |
| Particles                                                  | <sup>#2</sup>                                      |
| Total Hydrocarbons expressed as Methane (THC)              | 0.5                                                |
| Water (H <sub>2</sub> O) (v/v)                             | 0.5                                                |
| TOTAL SPECIFIED IMPURITIES                                 | 8                                                  |

<sup>#1</sup> An analysis of significant figures has not been considered. The number of significant figures will be based on analytical accuracy and the precision of the provided procedure.

<sup>#2</sup> To be determined between supplier and user.

### 3 Physical Constants (for information only)

|                                                       | <i>Metric Units</i>     | <i>US Units</i>           |
|-------------------------------------------------------|-------------------------|---------------------------|
| Molecular weight                                      | 39.948                  | 39.948                    |
| Boiling point at 1 atm                                | -185.9°C                | -302.6°F                  |
| Density of gas at 21.1°C (70°F) and 1 atm             | 1.656 kg/m <sup>3</sup> | 0.1034 lb/ft <sup>3</sup> |
| Specific gravity of gas at 21.1°C and 1 atm (air = 1) | 1.38                    | 1.38                      |
| Density of liquid at boiling point                    | 139 kg/m <sup>3</sup>   | 8.698 lb/ft <sup>3</sup>  |

### 4 Analytical Procedures (See Notes 1, 2)

4.1 *Carbon Monoxide and Carbon Dioxide* — This procedure is for the determination of carbon monoxide and carbon dioxide in argon using a gas chromatograph with a flame ionization detector and methanizer.

4.1.1 *Detection Limit* — 100 ppb (mole/mole).

#### 4.1.2 Instrument Parameters

##### 4.1.2.1 Column:

- Porapak T or Q, 3 m (9.8 ft.) by 3.2 mm (1/8 in.) OD by 2.2 mm (0.085 in.) ID ss; or
- Chromosorb 102, 2 m (6.6 ft.) by 3.2 mm (1/8 in.) OD by 2.2 mm (0.085 in.) ID ss; or equivalent.

##### 4.1.2.2 Carrier Flow: 30 mL/min helium.

##### 4.1.2.3 Sample Volume: 0.5 to 2.0 mL.

##### 4.1.2.4 Temperatures

- Detector: 280°C.
- Column Oven: 60°C.
- Methanizer: 350°C.

#### 4.1.3 Calibration Standard — 0.2 to 1 ppm (mole/mole) carbon monoxide, 0.2 to 1 ppm (mole/mole) carbon dioxide, balance argon.

#### 4.1.4 Operating Procedure

4.1.4.1 Inject the calibration standard into the column using a gas sampling valve. Record the retention times and peak areas. The order of elution is carbon monoxide, carbon dioxide.

4.1.4.2 Inject the sample to be tested in same manner as the calibration standard. Record the retention times and peak areas.

4.1.4.3 Repeat ¶ 4.1.4.1.

4.1.4.4 Compare the average peak area of the calibration standard to that of the argon sample being tested. Calculate the concentrations of carbon monoxide and carbon dioxide, using the formula below. The results may not exceed the specifications in § 2 of this Standard.

$$\frac{\text{Sample Peak Area}}{\text{Standard Peak Area}} \times \text{Concentration of S standard} = \text{Concentration of Sample}$$

4.2 Hydrogen and Nitrogen — This procedure is for the determination of hydrogen and nitrogen in argon using a gas chromatograph with a helium ionization detector.

4.2.1 Detection Limit — 0.5 ppm (mole/mole).

#### 4.2.2 Instrument Parameters

4.2.2.1 Column: 5A molecular sieve, 65.6 m (20 ft.) by 3.2 mm (1/8 in.) OD by 2.2 mm (0.085 in.) ID ss or equivalent.

4.2.2.2 Carrier Flow: 30 mL/min helium.

4.2.2.3 Sample Volume: 1.0 to 3.0 mL.

##### 4.2.2.4 Temperatures

- Detector: 125°C.
- Column Oven: 25°C.

4.2.3 Calibration Standard — 1 to 5 ppm (mole/mole) hydrogen in argon, 5 to 25 ppm (mole/mole) nitrogen in argon.

#### 4.2.4 Operating Procedure

4.2.4.1 Inject the calibration standard into the column using a gas sampling valve. Record the retention times and peak areas.

4.2.4.2 Inject the sample to be tested in same manner as the calibration standard. Record the retention times and peak areas.