



Standard Practice for Ionization Gage Application to Space Simulators¹

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1. Scope

1.1 This practice provides application criteria, definitions, and supplemental information to assist the user in obtaining meaningful vacuum ionization gage measurements below 10^{-1} N/m² (10^{-3} torr) in space-simulation facilities. Since a variety of influences can alter observed vacuum measurements, means of identifying and assessing potential problem areas receive considerable attention. This practice must be considered informational, for it is impossible to specify a means of applying the vacuum-measuring equipment to guarantee accuracy of the observed vacuum measurement. Therefore, the user's judgment is essential so that if a problem area is identified, suitable steps can be taken to either minimize the effect, correct the observed readings as appropriate, or note the possible error in the observation.

1.2 While much of the discussion is concerned with the application of hot-cathode ionization gages, no exclusion is made of cold-cathode designs. Since a great deal more experience with hot-cathode gages is available and hot-cathode devices are used in the majority of applications, the present emphasis is fully warranted.

1.3 The values stated in inch-pound units are to be regarded as the standard. The metric equivalents of inch-pound units may be approximate.

2. Referenced Documents

2.1 ASTM Standards:²

E297 Test Method for Calibrating Ionization Vacuum Gage Tubes (Withdrawn 1983)³

3. Terminology

3.1 *Definitions*—The following definitions are necessary to understanding meaningful application of ionization-type

vacuum-measurement devices and are useful in differentiating between pressure, density, and flux measuring devices for proper application and interpretation of low-density molecular measurements.

3.1.1 *Blears effect*—the reduction of the partial pressure of organic vapors within the envelope of a tubulated ionization gage below the partial pressure that would prevail in the envelope with a tubulation having infinite conductance.

3.1.2 *controlled-temperature enclosed gage*—an enclosed gage in which the envelope is maintained at nearly uniform constant temperature by suitable means.

3.1.3 *enclosed ionization gage*—an ionization gage for which the ion source region is enclosed over at least $0.95 \times 4\pi$ steradians about the center of the region by an envelope at a known temperature with only a single opening such that all molecules entering the ion source region must have crossed a plane located outside this region.

3.1.4 *equivalent nitrogen concentration*—the quantity obtained when the ion-collector current of a nude gage (in amperes) for the gas in the system is divided by the concentration sensitivity of the gage for nitrogen. This sensitivity is defined as the ratio of gage ion collector current in amperes to molecular concentration in molecules per cubic metre of nitrogen under specified operating conditions.

3.1.5 *equivalent nitrogen flux density*—the quotient of the current output of an enclosed vacuum gage operating under specified conditions divided by the molecular flux sensitivity for nitrogen.

3.1.6 *equivalent nitrogen pressure*:

3.1.6.1 For a nude gage, *equivalent nitrogen pressure* is obtained by multiplying the *equivalent nitrogen concentration* by kT where k is the Boltzmann constant and T is the mean absolute temperature of the walls from which the gas molecules travel to the ionizing region of the gage, averaged as nearly as possible on the basis of relative molecular flux.

3.1.6.2 *standard equivalent nitrogen pressure*—for a nude gage, the value of the equivalent nitrogen pressure is obtained when $T = 296\text{K}$ (or standard ambient temperature) is used in the factor kT .

3.1.6.3 For a tubulated gage, the *equivalent nitrogen pressure* in newton per square metre is obtained by dividing the ion collector current in amperes for a given gas by the pressure

¹ This practice is under the jurisdiction of ASTM Committee E21 on Space Simulation and Applications of Space Technology and are the direct responsibility of Subcommittee E21.04 on Space Simulation Test Methods.

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² For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

³ The last approved version of this historical standard is referenced on www.astm.org.