

SEMI F37-0299 (Reapproved 1104) METHOD FOR DETERMINATION OF SURFACE ROUGHNESS PARAMETERS FOR GAS DISTRIBUTION SYSTEM COMPONENTS

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1 Purpose

1.1 The purpose of this test method is to define a method for determining numerical values for surface roughness parameters measured on gas distribution system components. Application of this method is intended to yield comparable data among users of this method.

2 Scope

2.1 This document will specify methods, measuring equipment, and test conditions for mechanical profile surface roughness measurement of gas distribution system components. This test method will not require nor recommend numerical values for specific surface roughness parameters. This test method is intended for use in quality control and process development for specification of and manufacturing of gas distribution system components.

NOTICE: This standard does not purport to address safety issues, if any, associated with its use. It is the responsibility of the users of this standard to establish appropriate safety and health practices and determine the applicability of regulatory or other limitations prior to use.

3 Limitations

3.1 Numerical values for specific surface roughness parameters obtained using this test method may not provide sufficient information for determining the performance of the component, such as dry down times, corrosion resistance or amount of particle generation. Surface roughness measurement is one of many evaluation techniques for assessing the performance or quality of a surface. This document is not concerned with characteristics such as component design, material, dimensions, appearance, etc. While surface defects traversed by the stylus may be included in the roughness measurement, this method does not govern the evaluation of surface defects. Surface defects may be measured by methods such as SEM and EDX. This test method is intended to measure surface features on the order of 10 μm in size. It is not intended to detect submicron surface features.

4 Referenced Standards

4.1 ASME Standards¹

B46.1 — Surface Texture (Surface Roughness, Waviness, and Lay)

4.2 ASQ Standards²

Z1.9 — Sampling Procedures and Tables for Inspection by Variables for Percent Nonconforming

NOTICE: Unless otherwise indicated, all documents cited shall be the latest published versions.

5 Terminology

5.1 Abbreviations and Acronyms

5.1.1 *EDX* — Energy Dispersive X-Ray Spectroscopy

5.1.2 *SEM* — Scanning Electron Microscopy

5.1.3 *SEM* — Scanning Electron Microscope

5.2 Definitions

5.2.1 *cutoff* — a length selected to limit the spacing of surface irregularities. It separates a surface's roughness from its waviness.

5.2.2 *distinct regions* — visually unique areas of a surface defined by patterns of lay or differences in the appearance of surface roughness. In-line bores of different sizes or orientations and each leg of a shaped component should be considered distinct regions.

5.2.3 *evaluation length* — the actual length over which surface roughness is assessed.

5.2.4 *lay* — the general direction of orientation of surface features.

5.2.5 *skid* — a stylus probe support which acts as both a filter and a datum for probe movements.

1 The American Society of Mechanical Engineers, Three Park Avenue, New York, NY 10016-5990, 800-843-2763, <http://www.asme.org/>

2 American Society for Quality, 600 North Plankinton Avenue, Milwaukee, WI 53203, <http://www.asq.org/>

5.2.6 *skidless* — a type of instrument that does not use an external skid attached to the probe to act as a datum. Instead, it references a datum plane internal to the measurement equipment.

5.2.7 *stylus* — the object which mechanically probes the surface.

5.2.8 *surface roughness* — the finer irregularities of the surface texture, usually including those irregularities that result from the inherent action of the production process, for example traverse feed marks from cutting tools [ASME B46.1-1995].

5.2.9 *surface texture* — repetitive or random deviations from the nominal surface that forms the three-dimensional topography of the surface. Surface texture includes roughness, waviness, lay, and flaws [ASME B46.1-1995].

5.2.10 *waviness* — the more widely spaced component of surface texture. Waviness may result from such factors as machine or workpiece deflections, vibrations, chatter, heat treatment, or warping strains. Roughness may be considered as superimposed on a “wavy” surface.

6 Sampling

6.1 Acceptability criteria should be specified by the user and be developed in accordance with published sampling plans such as ASQ Z1.9, Sampling Procedures and Tables for Inspection by Variables for Percent Nonconforming.

7 Apparatus

7.1 The instrument should be a stylus type as defined by ASME B46.1, Section 2. Due to the limitations of skidded instruments (Type IV and V), a skidless instrument (Type I) is preferable.

7.2 The instrument should be calibrated using standard laboratory practices and manufacturer's recommendations with a roughness metrology standard calibrated by a certified testing laboratory and traceable to NIST³.

7.3 In order to resolve the features of the surface, a stylus with a conical tipped radius of 5 μm (200 μin) should be used.

8 Units of Measure

8.1 Surface roughness should be described by means of the Roughness Average, R_a , as defined per ASME B46.1.

8.2 Measurements should be specified in micro-meters (μm) or microinches (μin).

9 Preparation of Apparatus

9.1 The surface should be clean and free from loose debris before taking a measurement.

9.2 The instrument should be sufficiently isolated from vibrations, which will artificially increase roughness measurements.

9.3 Surfaces inaccessible to the stylus probe may be exposed by sectioning a sample(s). Samples should be sectioned to avoid damage to the surface to be measured and should be cleaned appropriately to remove sectioning debris.

10 Procedure

10.1 Select a single random location for measurement within each distinct region of interest on each component.

10.2 Measurements shall be taken perpendicular to the lay. If this is not practical, measurements may be taken in the direction of process gas flow through the component.

10.3 Instrument cutoff length should be set to 0.800 mm (0.030 in.).

10.4 The evaluation length, or measurement length, should be at least 3.81 mm (0.150 in.) where sufficient length is available.

11 Reporting

11.1 Average R_a is defined as the average of all R_a measurements taken over a population.

11.2 Maximum R_a is defined as the maximum of all R_a measurements taken over a population.

11.3 Both Average R_a and Maximum R_a should be reported for a given population. A population can be defined as:

- a set of single measurements on multiple components
- a set of multiple measurements on a single component
- a set of multiple measurements on multiple components

³ National Institute of Standards and Technology, 100 Bureau Drive, Stop 3460, Gaithersburg, MD 20899-3460, (301) 975-6478, <http://www.nist.gov/>