Designation: B966 – 10

Standard Test Method for Permeability of Powder Metallurgy (PM) Bearings Using Nitrogen Gas[1]

This standard is issued under the fixed designation B966; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This test method covers the determination of the permeability of a PM bearing when subjected to pressurized nitrogen under controlled conditions.

1.2 The values stated in SI units are to be regarded as the standard with the exception of flow rate for which the cm^3/min unit is the industry standard.

1.3 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

B243 Terminology of Powder Metallurgy

E691 Practice for Conducting an Interlaboratory Study to Determine the Precision of a Test Method

2.2 *IEEE/ASTM Standards:*

IEEE/ASTM SI-10 American National Standard for Use of the International System of Units (SI): The Modern Metric System

3. Terminology

3.1 Definitions of powder metallurgy (PM) terms can be found in Terminology B243. Additional descriptive material is available in the Related Materials section of Volume 02.05 of the *Annual Book of ASTM Standards*.

4. Summary of Test Method

4.1 Bearings are sampled and dried.

4.2 A bearing is sealed between two plates and nitrogen is introduced into the inner diameter (ID) of the bearing at a standard pressure.

4.3 Nitrogen flow through the bearing is measured using a series of rotameters (common tapered glass tube flow meters).

5. Significance and Use

5.1 In service, there is a space between a shaft and a self-lubricating PM bearing that contains an oil film when the bearing is operating properly. In the event the oil film is disrupted or fails to form the bearing will exhibit increased wear and possibly fail. Therefore the ability for oil to flow through the porosity of a PM bearing is critical to the performance of the bearing.

5.2 The porosity of the bearing must be open to the surface and interconnected within the bearing. This allows the oil in a self-lubricating PM bearing to flow during operation to the space between the bearing and the shaft to form an oil film and protect the shaft from wear.

5.3 The ability of a gas to flow through the bearing reflects the openness and interconnected properties of the porosity in the bearing.

5.4 Data from this test can be used as an internal quality tool and can be reported to buyers of bearings.

5.5 A number of other factors also affect the performance of the bearing and the movement of oil; factors such as the oil viscosity, operating temperature, load, shaft speed, surface area, surface finishes and others. This test provides information on only one property and cannot be the sole consideration in the design and testing of a bearing application.

6. Apparatus

6.1 Source of pressurized air (700 ± 140 kPa).

6.2 Source of pressurized nitrogen (200 ± 34.5 kPa).

6.3 *Rotameters*—(calibrated at 34.5 ± 0.34 kPa)

Rotameter 1 0-50 cm^3/min
Rotameter 2 0-500 cm^3/min
Rotameter 3 0-2500 cm^3/min
Rotameter 4 0-50000 cm^3/min

[1] This test method is under the jurisdiction of ASTM Committee B09 on Metal Powders and Metal Powder Products and is the direct responsibility of Subcommittee B09.04 on Bearings.

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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.

6.3.1 Readability at maximum flow:
Rotameter 1 2 cm^3/min
Rotameter 2 5 cm^3/min
Rotameter 3 25 cm^3/min
Rotameter 4 200 cm^3/min

NOTE 1—Rotameters are manufactured using specific conditions and gases resulting in flows and readability that differ slightly from those found when performing an actual test. A calibration done at the conditions used in the actual testing will yield either a calculation or a conversion chart to correct the readings to the actual flows.

6.4 Pressure gauges/regulators and suggested capacities.
6.4.1 Incoming air regulator (minimum capacity 830 kPa).
6.4.2 Nitrogen regulator (minimum capacity 100 kPa).
6.4.3 Air to clamping device (700 ± 140 kPa).
6.4.4 Nitrogen to test piece (34.5 ± 0.34 kPa).

6.5 Device for clamping bearings between two plates.

6.6 Tubing and valves as needed.

6.7 The following figures are of a typical permeability test apparatus. These do not represent the only design capable of performing this test.

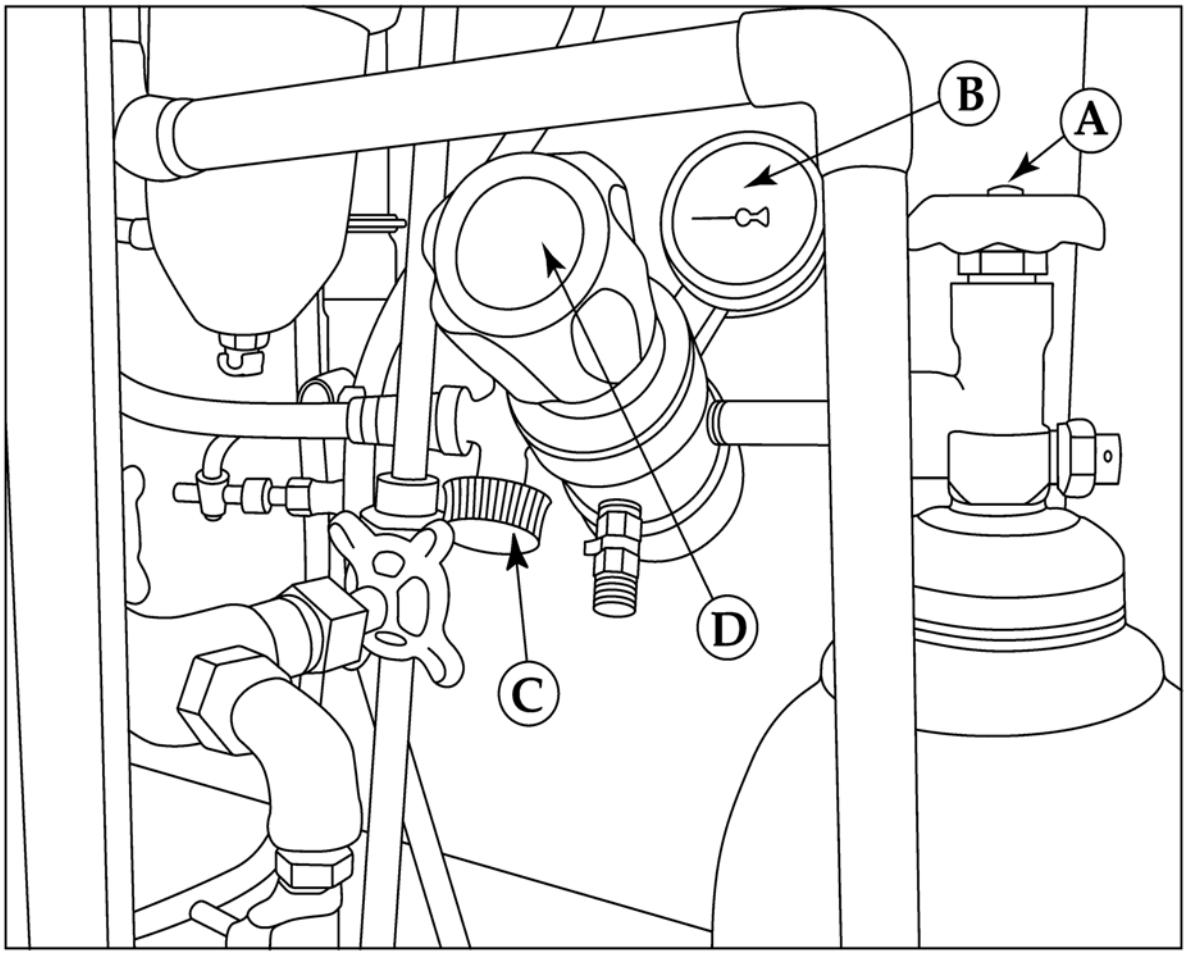
7. Sample Preparation

7.1 Thirty sample bearings shall be obtained randomly from the lot of bearings being tested. Each lot of bearings shall be tested separately.

7.2 Test pieces shall be dry; remove any impregnated fluids. Take care not to change the structure or quantity of the porosity when removing the fluids. Remove volatile fluids by heating to 150°C in air for ten minutes. Remove oils using a Soxhlet apparatus followed by heating to remove the solvent 150°C in air for ten minutes.

8. Procedure

8.1 Check the apparatus for leaks by placing an impermeable, hollow cylinder between two plates. Apply nitrogen under pressure to the ID of the hollow cylinder through a hole in one of the plates connected to the nitrogen line. Rubber sheets can be used between the plates and the bearing to help seal the test piece in the clamping apparatus. A pneumatic cylinder normally provides clamping force on the plates. After the bearing has been pressurized, shut off the nitrogen supply from the



A—Nitrogen Cylinder Valve
B—Pressure Regulator Dial
C—Valve to Permeability Tester
D—Pressure Regulator Control

FIG. 1 Nitrogen tank and Regulator