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An American National Standard

Standard Guideline for Reporting Friction and Wear Test Results of Manufactured Carbon and Graphite Bearing and Seal Materials[1]

This standard is issued under the fixed designation C 808; 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 guideline covers the following areas for reporting friction and wear test results of manufactured carbon and graphite bearing and seal materials:

1.1.1 Description of test device and techniques (Table 1 and Table 2.)

1.1.2 Description of carbon and graphite material test specimen (Table 3).

1.1.3 Description of mating member test specimen (Table 4).

1.1.4 Report of friction and wear test results (Table 5).

1.2 Many types of equipment and techniques will yield consistent data characterizing the friction and wear of carbon and graphite materials. However, the ranking of the materials by the various test methods used is not necessarily the same. This guideline is an initial effort to promote more complete description of the test methods, whatever they may be. It is the eventual intent to identify one or more specific standard test methods when sufficient information becomes available.

2. Significance and Use

2.1 The purpose of this guideline is two-fold. First, it is a research tool that will aid in the analysis and correlation of test results obtained on various test devices by different investigators. Second, it serves to identify important considerations that must be made in testing to make the results easily understood and comparable with the results of other investigators.

3. Keywords

3.1 carbon; friction; graphite; reporting; wear

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TABLE 1 Description of Test Device and Techniques

DATE _____

1. DESCRIPTION OF TEST DEVICE

1.1 *Preferred Designation, Manufacturer, and Modifications* _____

1.2 *Orientation of Carbon Specimen Test Surface:*
1.2.1 Horizontal ☐
1.2.2 Vertical ☐
1.2.3 Other (describe) _____

1.3 *Description of Sliding:*
1.3.1 Linear ☐
1.3.2 Rotational ☐
1.3.3 Discontinuous motion ☐ Describe _____
1.3.4 Continuous motion ☐ Describe _____
1.3.5 Discontinuous contact ☐ Describe _____
1.3.6 Continuous contact ☐ Describe _____
1.3.7 Approximate duration of test _____ minutes, _____ hours, _____ days

1.4 *Description of Loading System:*
1.4.1 Maximum capacity _____ N (_____ lbf)
1.4.2 Type of measuring element _____
1.4.3 Type of recording device _____
1.4.4 Estimate of error _____
1.4.5 Calibration procedure and frequency _____

1.5 *Description of Speed-Measuring System:*
1.5.1 Maximum capacity _____ m/s (_____ ft/s), _____ rev/min, other _____
1.5.2 Type of measuring element _____
1.5.3 Type of recording device _____
1.5.4 Estimate of error _____
1.5.5 Calibration procedure and frequency _____

1.6 *Description of Temperature-Measuring System:*
1.6.1 Location (describe):
1.6.1.1 Carbon test specimen _____
1.6.1.2 Mating member test specimen _____
1.6.1.3 Fluid (for example, upstream and downstream of test specimens and test cavity) _____

1.6.2 Maximum value:
1.6.2.1 Carbon test specimen _____ K (_____°F)
1.6.2.2 Mating member test specimen _____ K (_____°F)
1.6.2.3 Fluid _____K (_____°F)
1.6.3 Type of measuring element:
1.6.3.1 Carbon test specimen _____
1.6.3.2 Mating member test specimen _____
1.6.3.3 Fluid _____
1.6.4 Type of recording device:
1.6.4.1 Carbon test specimen _____
1.6.4.2 Mating member test specimen _____
1.6.4.3 Fluid _____
1.6.5 Estimate of error:
1.6.5.1 Carbon test specimen _____
1.6.5.2 Mating member test specimen _____
1.6.5.3 Fluid _____
1.6.6 Calibration procedure and frequency:
1.6.6.1 Carbon test specimen _____
1.6.6.2 Mating member test specimen _____
1.6.6.3 Fluid _____

1.7 *Description of Pressure-Measuring System Across Test Specimens:*
1.7.1 Maximum value:
1.7.1.1 Upstream _____ Pa absolute (_____ psia)
1.7.1.2 Downstream _____ Pa absolute (_____ psia)
1.7.1.3 Differential _____ Pa differential (_____ psid)
1.7.2 Type of measuring element:
1.7.2.1 Upstream _____
1.7.2.2 Downstream _____
1.7.2.3 Differential _____
1.7.3 Type of recording device:
1.7.3.1 Upstream _____
1.7.3.2 Downstream _____
1.7.3.3 Differential _____
1.7.4 Estimate of error:
1.7.4.1 Upstream _____
1.7.4.2 Downstream _____
1.7.4.3 Differential _____
1.7.5 Calibration procedure and frequency: _____
1.7.5.1 Upstream _____

TABLE 2 Description of Test Device and Techniques *Continued*

1.7.5.2 Downstream _____
1.7.5.3 Differential _____
1.8 *Description of Fluid Flow Rate Measuring Systems:*
1.8.1 Maximum value:
1.8.1.1 Across test specimens _____
1.8.1.2 Through test cavity _____
1.8.2 Type of measuring element:
1.8.2.1 Across test specimens _____
1.8.2.2 Through test cavity _____
1.8.3 Type of recording device:
1.8.3.1 Across test specimens _____
1.8.3.2 Through test cavity _____
1.8.4 Estimate of error:
1.8.4.1 Across test specimens _____
1.8.4.2 Through test cavity _____
1.8.5 Calibration procedure and frequency:
1.8.5.1 Across test specimens _____
1.8.5.2 Through test cavity _____

1.9 *Description of Friction-Measuring System:*
1.9.1 Maximum capacity _____ N (_____ lbf), _____ N·m (_____ lbf·ft), other _____
1.9.2 Type of measuring element _____
1.9.3 Type of recording device _____
1.9.4 Estimate of error _____
1.9.5 Calibration procedure and frequency _____

2. METHOD OF FIXTURING CARBON TEST SPECIMEN

2.1 *Rigid* ☐
2.2 *Pivot* (1-D rotational freedom) ☐
2.3 *Swivel, Universal* (2-D rotational freedom) ☐
2.4 *Hydraulic* ☐
2.5 *Pneumatic* ☐
2.6 *Misalignment* _____ radians, other _____
2.7 *Installed Eccentricity* (TIR) _____ m (_____ in.)
2.8 *Axial Runout* (TIR) _____ m (_____ in.)
2.9 *Radial Runout* (TIR) _____ m (_____ in.)

3. METHOD OF FIXTURING MATING MEMBER

3.1 *Rigid* ☐
3.2 *Pivot* (1-D rotational freedom) ☐
3.3 *Swivel, Universal* (2-D rotational freedom) ☐
3.4 *Hydraulic* ☐
3.5 *Pneumatic* ☐
3.6 *Misalignment* _____ radians, other _____
3.7 *Installed Eccentricity* (TIR) _____ m (_____ in.)
3.8 *Axial Runout* (TIR) _____ m (_____ in.)
3.9 *Radial Runout* (TIR) _____ m (_____ in.)

4. ENVIRONMENTAL CONDITIONS

4.1 *Carbon Test Specimen Conditioning Environment:*
4.1.1 Fluid medium: air ☐ (specify moisture content _____), distilled water ☐, deionized water ☐, other (specify composition quantitatively) _____
4.1.2 Temperature _____ K (_____ °F)
4.1.3 Pressure: ambient ☐, other _____
4.1.4 Time at these conditions _____ minutes, _____ hours, _____ days
4.2 *Mating Member Test Specimen Conditioning Environment:*
4.2.1 Fluid medium: air ☐ (specify moisture content _____), distilled water ☐, deionized water ☐, other (specify composition quantitatively) _____
4.2.2 Temperature _____ K (_____ °F)
4.2.3 Pressure: ambient ☐, other _____
4.2.4 Time at these conditions _____ minutes, _____ hours, _____ days

4.3 *Test Environment:*
4.3.1 Fluid medium:
4.3.1.1 Before test condition: air ☐ (specify moisture content _____), distilled water ☐, deionized water ☐, other (specify composition quantitatively) _____
4.3.1.2 During test condition (specify how monitored and controlled, including limits) _____
4.3.1.3 After test condition (describe quantitatively, if possible, the change in composition or quality) _____
4.3.2 Substance other than fluid medium initially applied at test specimens interface (for example, lubricating oil) _____
4.3.3 Fluid temperature:
4.3.3.1 Upstream _____ K (_____ °F)
4.3.3.2 Downstream _____ K (_____ °F)
4.3.4 Fluid pressure:
4.3.4.1 Upstream _____ Pa absolute (_____ psia)
4.3.4.2 Downstream _____ Pa absolute (_____ psia)
4.3.4.3 Differential _____ Pa differential (_____ psid)
4.3.5 Fluid flow through test cavity _____
4.3.6 Time to reach test conditions _____ minutes, _____ hours
4.3.7 Time at test conditions prior to test _____ minutes, _____ hours

TABLE 3 Description of Carbon Test Specimen

1. DESCRIPTION OF CARBON MATERIAL

1.1 *Manufacturer* _____
1.2 *Grade Number* _____
1.3 *Lot Number* _____
1.4 *Raw Ingredients, if not Proprietary:*
1.4.1 Filler _____
1.4.2 Binder _____
1.4.3 Additives _____
1.4.4 Impregnants _____
1.4.5 Other _____
1.5 *Original Billet Forming Process* _____
1.6 *Original Billet Size* _____
1.7 *Heat Treatment, if not Proprietary:*
1.7.1 Graphitizing temperature _____ K (_____ °F)
1.7.2 Rate of heating _____ K/min (_____ °F/min)
1.7.3 Soak time _____minutes, _____hours

2. DESCRIPTION OF TEST SPECIMEN

2.1 *Location and Orientation in Original Billet* _____
2.2 *Grain Size and Orientation in Test Specimen* _____

	Before Test		*After Test*	
2.3 *Microstructure* (provide sketch or photo)				
2.4 *Surface Coating*				
2.5 *Dimensions and Tolerances* (provide print)				
2.6 *Test Surface Condition:*				
2.6.1 Roughness (specify method used)		μm aa		μm aa
2.6.2 Waviness (specify method used)				
2.6.3 Flatness (specify method used)		μm		μm
2.7 *Hardness and Location Where Measured*				
2.8 *Density and Method Used*				

TABLE 4 Description of Mating Member Test Specimen

1. DESCRIPTION OF MATING MEMBER MATERIAL

1.1 *Manufacturer* _____
1.2 *Commercial Name* _____
1.3 *Chemical Composition Limits* _____
1.4.1 Processing _____
1.4.2 Heat treatment _____

2. DESCRIPTION OF TEST SPECIMEN

2.1 *Location and Orientation in As-Received Piece* _____
2.2 *Grain Size and Orientation in Test Specimen* _____
2.3 *Microstructure:* cystalline ☐, polycrystalline ☐, amorphous ☐, other _____ (provide sketch or photo)

	Before Test		*After Test*	
2.4 *Dimension and Tolerances* (provide print)				
2.5 *Test Surface Condition:*				
2.5.1 Roughness (specify method used)		μm aa		μm aa
2.5.2 Waviness (specify method used)				
2.5.3 Flatness (specify method used)		μm		μm
2.6 *Hardness and Location Where Measured*				

TABLE 5 Report of Friction and Wear Test Results

1. DATE OF TEST _____ **TEST NO.** _____ **MACHINE NO.** _____ **OPERATOR**_____

2. CARBON TEST SPECIMEN IDENTIFICATION: GRADE NO. _____ **LOT NO.** _____ **SPECIMEN NO.**_____

3. MATING MEMBER TEST SPECIMEN IDENTIFICATION: SPECIMEN NO. _____

4. NUMBER OF TESTS IN THIS SERIES: FRICTION _____ **WEAR**_____

5. TEST CONDITIONS

5.1 *Unit Load* _____Pa (_____ psi). Specify whether net or applied load, and describe method of calculation _____

5.2 *Speed* _____ *m/s* _____ (_____ *ft/s),* _____ *rev/min, other* _____

5.3 *Fluid Temperature:*
5.3.1 Upstream _____ K (_____ °F)
5.3.2 Downstream _____ K (_____ °F)
5.4 *Fluid Pressure:*
5.4.1 Upstream _____ Pa absolute (_____ psia)
5.4.2 Downstream _____ Pa absolute (_____ psia)
5.4.3 Differential _____ Pa differential (_____ psid)
5.5 *Flow Across Test Specimens* (if controlled) _____
5.6 *Flow Through Test Cavity* _____

6. CARBON TEST SPECIMEN TEMPERATURE

6.1 *Start-Up Temperature* _____ K (_____ °F); how and when obtained _____
6.2 *Equilibrium or Average Temperature* _____ K (_____ °F); how and when obtained _____
6.3 *Maximum Temperature* _____ K (_____ °F); how and when obtained _____
6.4 *Final Temperature* _____ K (_____ °F); how and when obtained _____

7. FRICTION

7.1 *Break-Away or Static Friction* _____ N (_____ lbf), _____ N·m (_____ lbf·ft), other _____ ; how obtained _____

7.2 *Start-Up Friction* (if different from break-away friction) _____ N (_____ lbf), _____ N·m (_____ lbf·ft), other _____ ; how and when obtained _____

7.3 *Equilibrium or Average Friction* _____ N (_____ lbf), N·m (_____ lbf·ft), other _____ ; how and when obtained _____

7.4 *Maximum Friction* _____ N (_____ lbf), _____ N·m (_____ lbf·ft), other _____ ; how and when obtained _____

7.5 *Final Friction* _____ N (_____ lbf), _____ N·m (_____ lbf·ft), other _____ ; how and when obtained _____

8. WEAR

8.1 *Carbon Test Specimen:*
8.1.1 Wear measurement _____ length, _____ weight, _____ volume; accuracy and how obtained _____

8.1.2 If length used, linear dimensional change of some reference dimension other than that used to measure wear _____m/m (_____ in./in.); how and where measured _____

8.1.3 Time duration of wear _____ minutes, _____ hours
8.1.4 Wear: per unit time _____ , per unit of distance traveled _____
8.1.5 Description of worn surface (provide sketch or photo) _____
8.1.6 Surface roughness (μm aa): before test _____ after test _____
8.1.7 Hardness: before test _____ after test _____
8.2 *Mating Member Test Specimen:*
8.2.1 Wear measurement _____ length _____ weight _____ volume; accuracy and how obtained _____

8.2.2 If length used, linear dimensional change of some reference dimension other than that used to measure wear _____m/m (_____ in./in.); how and where measured _____

8.2.3 Time duration of wearing _____ minutes, _____ hours
8.2.4 Wear: per unit time _____ per unit of distance traveled _____
8.2.5 Description of worn surface (provide sketch or photo) _____
8.2.6 Surface roughness (μm aa): before test _____ after test _____
8.2.7 Hardness: before test _____ after test _____

9. FLOW ACROSS TEST SPECIMENS

9.1 *Start-Up Flow* _____ ; how and when obtained _____
9.2 *Equilibrium or Average Flow* _____ ; how and when obtained _____
9.3 *Maximum Flow* _____ ; how and when obtained _____
9.4 *Final Flow* _____ ; how and when obtained _____

10. SUSPENDED TEST

10.1 *Reason for Test Suspension* _____
10.2 *Time Duration Before Suspension* _____ minutes, _____ hours