

Standard Guideline for Reporting Friction and Wear Test Results of Manufactured Carbon and Graphite Bearing and Seal Materials¹

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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 Medifi	pations	
1.1 Preferred Designation, Manufacturer, and Mound		
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		
1.3.4 Continuous motion Describe		
1.3.5 Discontinuous contact		
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		
1.5 Description of Speed-Measuring System:	(t/c) rov/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	m of toot sporimons and toot cavitul	
1.0.1.3 Fluid (for example, opstream and downstrea	in of test specifiens 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	К (°F)	
1.6.2.3 FluidK (°F)		
1.6.3.1 Carbon test speciment:		
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		
1.6.4.3 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		
1.6.6.1 Carbon test specimen		
1.6.6.2 Mating member test specimen		
1.6.6.3 Fluid		
1.7 Description of Pressure-Measuring System Acro	ss 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 (psia)	
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		
1733 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 Opstream		

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. 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 Inrough test cavity
1.5.5 Type of recording device. 1.8.3.1 Across test specimens
18.3.2 Through test cavity
1.8.4 Estimate of error:
1.8.4.1 Across test specimens
1.8.4.2 Through test cavity
1.5.5 Calibration procedure and nequency. 18.5.1 Across test specimens
1.8.5.2 Through test cavity
1.9. Description of Friction-Measuring System
1.9.1 Maximum capacity N (lbf), Nrm (lbf·ft), other
1.9.2 Type of measuring element
1.9.3 Type of recording device
1.9.4 Estimate of error
1.9.9 Calibration procedure and requercy
2. METHOD OF FIXTURING CARBON TEST SPECIMEN
2.1 Rigid
2.2 Pivot (1-D rotational freedom)
2.3 Swiver, Universal (2-D rotational freedom)
2.4 Hydraulic L 25 Deputy
2.6 Misalianment 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
32 Piyot (1-D rotational freedom)
3.3 Swivel, Universal (2-D rotational freedom)
3.4 Hydraulic
3.5 Pneumatic
3.0 Misalginitient radians, other
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: all [specify moistine officint], distined water D, detonized water D, other (specify composition quantitatively)
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 now 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 N (
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)
4.3.6 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)				
1.7.5 Soak timenours				
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)	<u> </u>	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				
2. DESCRIPTION OF TEST SPECIMEN				
 2.1 Location and Orientation in As-Received Piece	er			
	Before Test		After Test	
2.4 Dimension and Tolerances (provide print)				
2.5 Test Surface Condition: 2.5.1 Boughness (specify method used)		um aa		um aa
2.5.2 Waviness (specify method used)		µ/// du		µiii uu
2.5.3 Flatness (specify method used)		μm		μm
2.6 Hardness and Location Where Measured		<u> </u>		

TABLE 5 Report of Friction and Wear Test Results

1 DATE OF TEST TEST I			OPERATOR	, 	
2. CARBON TEST SPECIMEN IDENTIFIC	CATION: GRADE NO.		SPECIMEN NO.	_	
3. MATING MEMBER TEST SPECIMEN		EN NO.	•• •• •• •• •• •• •• •• •• •• •• •		
4 NUMBER OF TESTS IN THIS SERIES		WEAR			
5 TEST CONDITIONS			_		
5. Lat conditions	nci) Chooify whathar n	at an applied lead	and describe method of cal	aulation	
5.1 Onit LoadFa (psi). Specity whether h	let or applied load,	and describe method of car		
5.2 Speed m/s	(ft/s),	rev/mir	, other		
5.3 Fluid Temperature: 5.3.1 Upstream K (5.3.2 Downstream K (5.4 Fluid Pressure:	°F) °F)				
5.4.1 Upstream Pa absolute	e (psia)				
5.4.2 Downstream Pa abs	olute (psia)				
5.5 Flow Across Test Specimens (if control	olled)			 .	
6. CARBON TEST SPECIMEN TEMPERA	ATURE				
6 1 Start-I In Temperature	(°E); bow an	nd when obtained			
6.2 Equilibrium or Average Temperature _	K (°F); how and w	hen obtained		
6.3 Maximum Temperature	K (°F); how a	and when obtained			
6.4 Final Temperature K (°F); now and w	vnen obtaineu			
7. FRICTION				1	
7.1 Break-Away or Static Friction	N (IDT	ī), N	I·m (ΙDΤ·π), Ο	ther; now obtained	
7.2 Start-Up Friction (if different from broand when obtained	eak-away friction)	N (lbf), N	·m (lbf·ft), other	; how
7.3 Equilibrium or Average Friction		bf), 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	artan a san arta
0 WEAD				<i></i>	
0. WEAR					
8.1.1 Wear measurement	length, weigh	ht, v	volume; accuracy and how o	btained	
8.1.2 If length used, linear dimensional cl	hange of some reference di	imension other tha	n that used to measure we	arm/m (_ in./in.); how and
where measured					
8.1.3 Time duration of wear	_ minutes, n per unit of distance traveler	nours d			
8.1.5 Description of worn surface (provide	e sketch or photo)				
8.1.6 Surface roughness (µm aa): before	test		after test		
8.1./ Mardness: before test	· · · · · · · · · · · · · · · · · · ·				
8.2.1 Wear measurement	length weigh	nt vo	olume; accuracy and how ob	otained	
8.2.2 If length used, linear dimensional cl where measured	hange of some reference di	imension other tha	n that used to measure we	arm/m (_ in./in.); how and
8.2.3 Time duration of wearing	minutes,	_ hours			
8.2.4 Wear: per unit time 8.2.5 Description of worn surface (provid	per unit of distance traveled le sketch or photo)	J			
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 an	id when obtained	ined		·····	
9.3 Maximum Flow: how a	and when obtained				
9.4 Final Flow; how and w	when obtained			······	
10. SUSPENDED TEST					
10.1 Reason for Test Suspension	minutoe	houre	·····		
TOLE TIME DUI AUON DEI DIE SUSPENSION _		10013			

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