Physical Properties Test Report

Link Test Report:	108091-2-1
Test Description:	SAE J661 Rev Feb 1997 Brake Lining Quality Test
Purpose of Test:	To Evaluate the Characteristics of Brake Materials
Material Identification:	XBP Severe Duty FF
Test Date:	01/17/2023 - 01/24/2023

Requested By:

International Motor Products, Inc.
Rodolfo Lopez
3515 NW 114th Ave.
Doral, FL 33178
United States Minor Outlying Islands

Report Approved by:

Radoslaw Mazurek

Date: 01/26/2023

Laboratory Manager

ANAB ACCREDITED ISO/IEC 17025 TESTING LABORATORY

LINK Engineering Company
Dearborn Technical Center
401 Southfield Road
Dearborn, MI 48120
www.linkeng.com
Phone: (313) 625-4000

SAE J661 Rev Feb 1997 Brake Lining Quality Test

Test Information

Customer Name	International Motor Products, Inc.
Requestor	Rodolfo Lopez
Program Number	J661noinsp
Test Coordinator	Eric DeJules
Test Equipment	Chase Machine 5531
Test Dates	01/17/2023 - 01/24/2023
Datalogger	3.51
Template Version	1.78

Setup Details

Sample Material	XBP Severe Duty FF
Sample Size	1 inch x 1 inch
Sample Manufacturer	International Motor Products, Inc.
Test Pressure	150 psi

Sample Test Summary

Normal Friction Coefficient	0.545	Pass
Normal Friction Class	G	
Hot Friction Coefficient	0.482	Pass
Hot Friction Class	G	
Minimum Bold Coefficient	0.484	Pass
Max Variation Below Average for Bold Readings	0.044	Pass
Max % Variation for Bold Readings	8.10%	Pass

Pass / Fail

Pass

Comments:

Processed by:	Eric DeJules (313) 625-4000	Title:	Test Engineer	Date: 01/26/2023
Reviewed by:	Radoslaw Markiewicz (313) 625-4000	Title:	Laboratory Manager	Date: 01/26/2023

Data applicable to the materials tested and parameters agreed by customer. Valid if signed by the test engineer. Report can be copied in full. Bilateral uncertainty of measurements 0.63% of FS. Coverage factor of 2.Confidence of 95%. Details available upon request.

Test Number

	Sample 1	Sample 2	Sample 3	Sample 4	Sample 5
	108091-2-1	108091-2-4	108091-2-5	108091-2-6	108091-2-7

Manufacturer:
International Motor Products, Inc.
Material:
XBP Severe Duty FF

Initial Baseline

Application	Sample 1	Sample 2	Sample 3	Sample 4	Sample 5
1	0.589	0.457	0.454	0.508	0.429
20	0.617	0.444	0.480	0.492	0.449

Normal **0.545** **G**

First Fade

Temp (°F)	Sample 1	Sample 2	Sample 3	Sample 4	Sample 5
200.0	0.614	0.457	0.479	0.501	0.463
550.0	0.453	0.392	0.356	0.416	0.374

(or Temp @ 10min)

Hot **0.482** **G**

First Recovery

Temp (°F)	Sample 1	Sample 2	Sample 3	Sample 4	Sample 5	Average	Norm/Hot
500.0	0.514	0.466	0.413	0.444	0.436	0.454	
400.0	0.541	0.485	0.435	0.472	0.458	0.478	Hot
300.0	0.568	0.500	0.466	0.492	0.480	0.501	Hot
200.0	0.586	0.502	0.485	0.516	0.484	0.515	

Wear

Application	Sample 1	Sample 2	Sample 3	Sample 4	Sample 5
1	0.575	0.504	0.490	0.501	0.492
100	0.507	0.504	0.518	0.507	0.483

Second Fade

Temp (°F)	Sample 1	Sample 2	Sample 3	Sample 4	Sample 5	Average	Max Var. < Average	Norm/Hot	% Var
200.0	**0.524**	**0.545**	**0.544**	**0.569**	**0.540**	**0.544**	**0.020**	**Normal**	**4%**
250.0	**0.544**	**0.538**	**0.567**	**0.566**	**0.515**	**0.546**	**0.031**	**Normal**	**6%**
300.0	**0.550**	**0.557**	**0.551**	**0.567**	**0.501**	**0.545**	**0.044**	**Normal**	**8%**
350.0	**0.555**	**0.555**	**0.569**	**0.568**	**0.526**	**0.554**	**0.029**	**-**	**5%**
400.0	**0.545**	**0.545**	**0.556**	**0.555**	**0.521**	**0.544**	**0.023**	**Normal**	**4%**
450.0	**0.528**	**0.518**	**0.539**	**0.539**	**0.511**	**0.527**	**0.016**	**Hot**	**3%**
500.0	**0.514**	**0.503**	**0.520**	**0.512**	**0.502**	**0.510**	**0.008**	**Hot**	**2%**
550.0	**0.503**	**0.491**	**0.493**	**0.485**	**0.484**	**0.491**	**0.007**	**Hot**	**2%**
600.0	0.483	0.455	0.457	0.453	0.444	0.458	0.014	Hot	3%
650.0	0.434	0.382	0.383	0.378	0.382	0.392	0.013	Hot	3%

(or Temp @ 10min)

Second Recovery

Temp (°F)	Sample 1	Sample 2	Sample 3	Sample 4	Sample 5	Average	Max Var. < Average	Norm/Hot	% Var
600.0	0.470	0.438	0.442	0.429	0.440	0.444	0.015	-	3%
500.0	0.491	0.450	0.464	0.456	0.457	0.463	0.014	Hot	3%
400.0	0.513	0.472	0.486	0.486	0.488	0.489	0.017	Hot	3%
300.0	**0.516**	**0.489**	**0.520**	**0.509**	**0.514**	**0.509**	**0.021**	**Hot**	**4%**
200.0	**0.489**	**0.513**	**0.517**	**0.536**	**0.524**	**0.516**	**0.027**	**-**	**5%**

Final Baseline

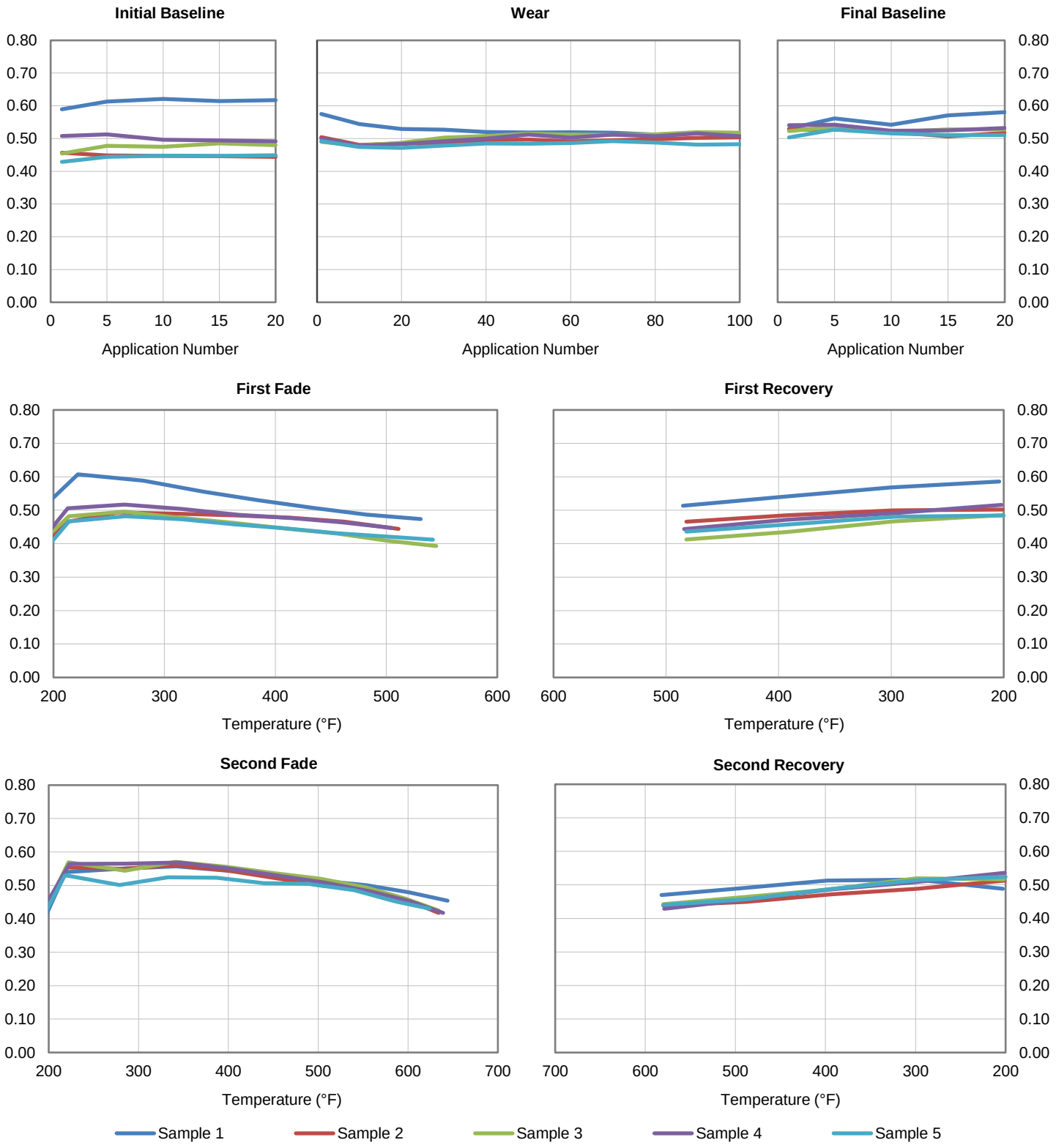
Application	Sample 1	Sample 2	Sample 3	Sample 4	Sample 5
1	0.530	0.527	0.523	0.541	0.503
20	0.581	0.517	0.528	0.532	0.511

Manufacturer: International Motor Products, Inc.
Material: XBP Severe Duty FF
Test Pressure: 150 psi

Test Dates: 01/17/2023 - 01/24/2023

Summary of 5 Samples

Coefficient of Friction



Manufacturer: International Motor Products, Inc.
Material: XBF SEVER DUTY FF
Test Pressure: 150 psi

Normal **0.541** **G**
Hot **0.509** **G**

1/17/2023
108091-2-1
Sample 1 of 5

Wear

	Initial	Final	Loss	Loss / %	Specific Wear	
Weight (gr)	10.135	9.166	0.969	9.56	6.06E-01	gr/hp-hr
Thickness (inch)	0.252	0.228	0.024	9.52	1.50E-02	in³/hp-hr

Baseline

	Initial		Final	
Event	Force (lb)	μ	Force (lb)	μ
1	87.7	0.589	79.1	0.530
5	92.0	0.613	83.8	0.562
10	92.6	0.621	81.1	0.542
15	92.4	0.614	85.3	0.571
20	92.0	0.617	87.0	0.581

Wear

Event	Force (lb)	μ
1	85.7	0.575
10	82.0	0.544
20	79.3	0.529
30	79.7	0.527
40	78.6	0.520
50	78.3	0.518
60	78.0	0.519
70	76.8	0.518
80	75.9	0.512
90	76.7	0.516
100	76.6	0.507

First Fade

Time (sec)	Force (lb)	μ	Temp (°F)
0.0	80.7	0.472	179
30.0	91.8	0.607	222
60.0	88.8	0.588	281
90.0	83.1	0.556	335
120.0	79.3	0.529	385
150.0	76.2	0.507	435
180.0	73.8	0.487	482
210.0	70.9	0.474	531

Second Fade

Time (sec)	Force (lb)	μ	Temp (°F)
0.0	54.5	0.304	179
30.0	81.0	0.540	219
60.0	81.8	0.550	283
90.0	82.7	0.557	342
120.0	82.6	0.545	396
150.0	80.2	0.532	449
180.0	77.4	0.515	500
210.0	75.0	0.500	554
240.0	71.7	0.478	602
270.0	68.1	0.454	644

First Recovery

Event	Force (lb)	μ	Temp (°F)
1	76.3	0.514	485
2	81.9	0.541	394
3	85.8	0.568	300
4	88.3	0.586	204

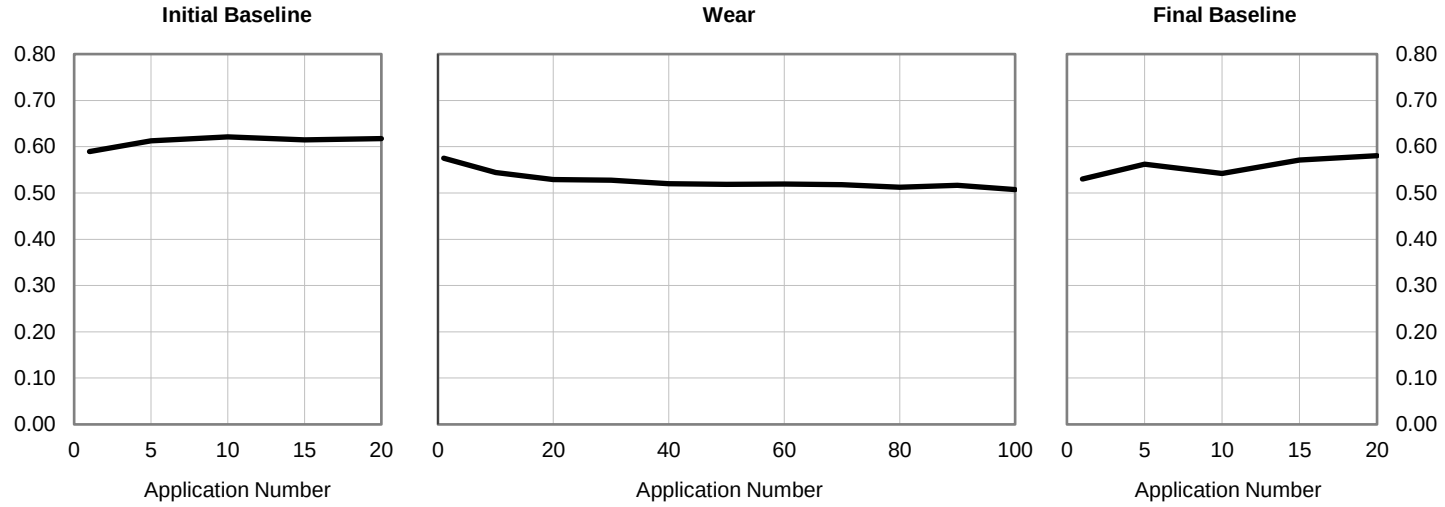
Second Recovery

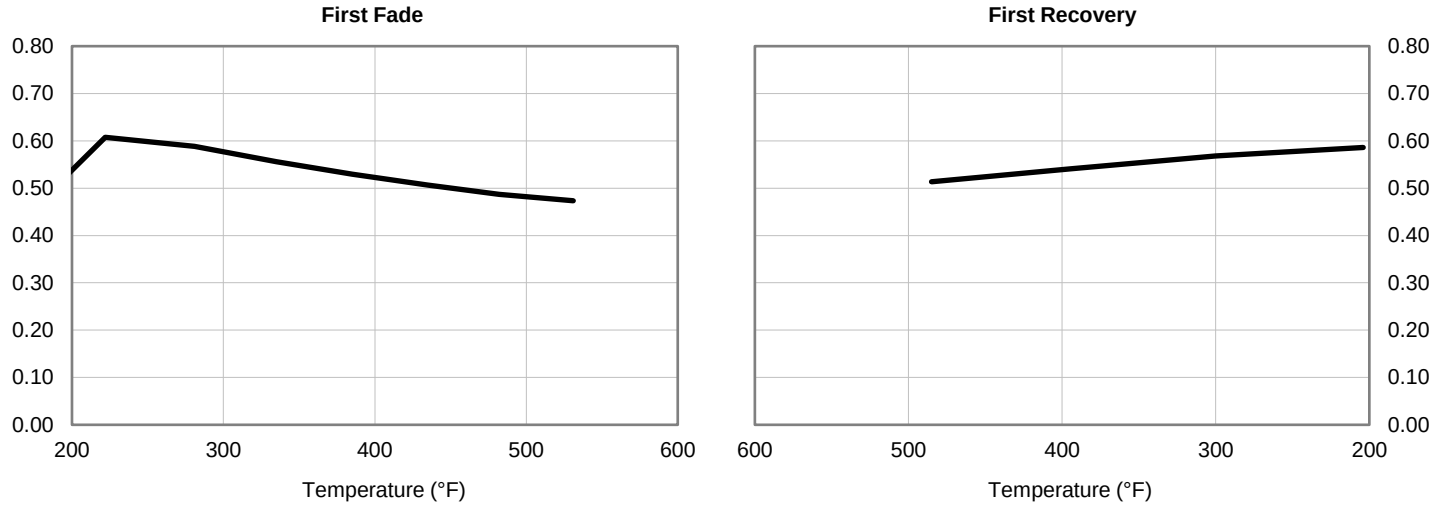
Event	Force (lb)	μ	Temp (°F)
1	70.9	0.470	582
2	74.2	0.491	491
3	77.4	0.513	398
4	77.2	0.516	300
5	73.1	0.489	203

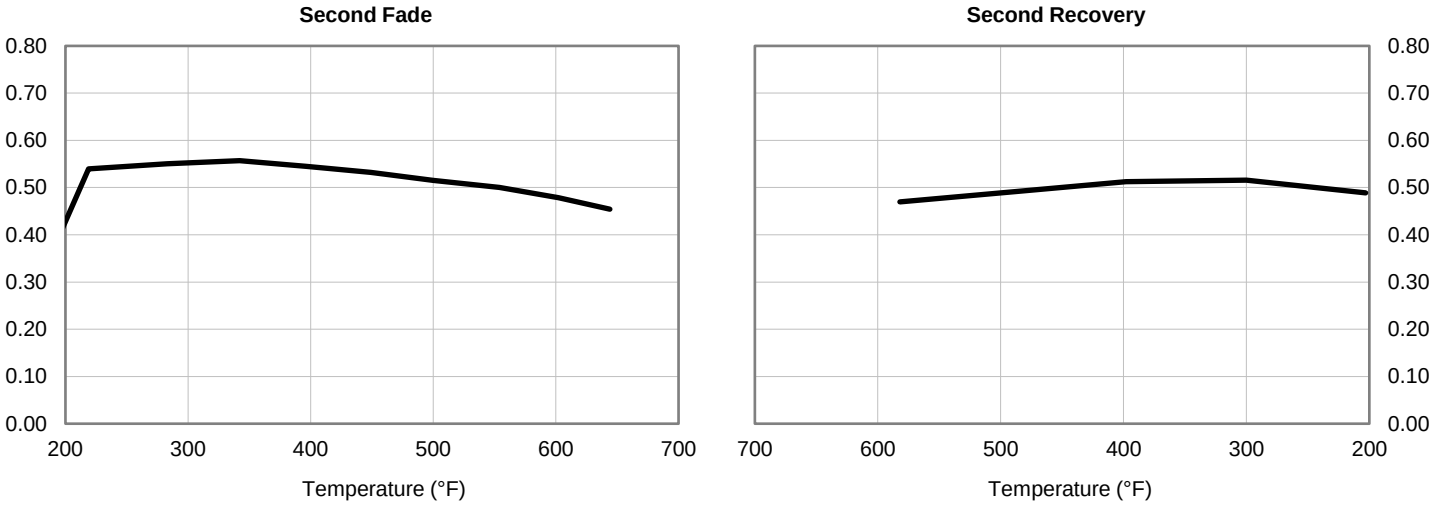
Manufacturer: International Motor Products, Inc.
Material: XBF SEVER DUTY FF
Test Pressure: 150 psi

1/17/2023
108091-2-1
Sample 1 of 5

Coefficient of Friction







Manufacturer: International Motor Products, Inc.
Material: XBF SEVER DUTY FF
Test Pressure: 150 psi

Normal **0.546** **G**

Hot **0.474** **G**

1/18/2023
108091-2-4
Sample 2 of 5

Wear

	Initial	Final	Loss	Loss / %	Specific Wear	
Weight (gr)	10.123	9.316	0.807	7.97	5.61E-01	gr/hp-hr
Thickness (inch)	0.259	0.240	0.019	7.34	1.32E-02	in^3/hp-hr

Baseline

	Initial		Final	
Event	Force (lb)	μ	Force (lb)	μ
1	68.0	0.457	78.6	0.527
5	67.9	0.448	79.0	0.527
10	66.5	0.447	78.3	0.520
15	66.8	0.446	76.1	0.507
20	67.4	0.444	77.6	0.517

Wear

Event	Force (lb)	μ
1	75.1	0.504
10	71.3	0.481
20	73.3	0.485
30	73.0	0.487
40	73.9	0.495
50	74.6	0.497
60	73.9	0.492
70	74.7	0.495
80	75.4	0.498
90	75.3	0.502
100	74.9	0.504

First Fade

Time (sec)	Force (lb)	μ	Temp (°F)
0.0	60.1	0.341	179
30.0	69.7	0.464	210
60.0	74.8	0.493	258
90.0	73.4	0.490	310
120.0	73.1	0.485	362
150.0	71.8	0.478	413
180.0	70.1	0.466	462
210.0	66.6	0.444	511

Second Fade

Time (sec)	Force (lb)	μ	Temp (°F)
0.0	60.4	0.336	179
30.0	83.9	0.553	220
60.0	82.7	0.549	282
90.0	82.9	0.560	341
120.0	81.7	0.546	397
150.0	78.7	0.521	453
180.0	75.0	0.499	505
210.0	72.9	0.489	553
240.0	68.6	0.458	597
270.0	62.8	0.418	634

First Recovery

Event	Force (lb)	μ	Temp (°F)
1	70.3	0.466	482
2	73.5	0.485	393
3	75.8	0.500	298
4	76.1	0.502	201

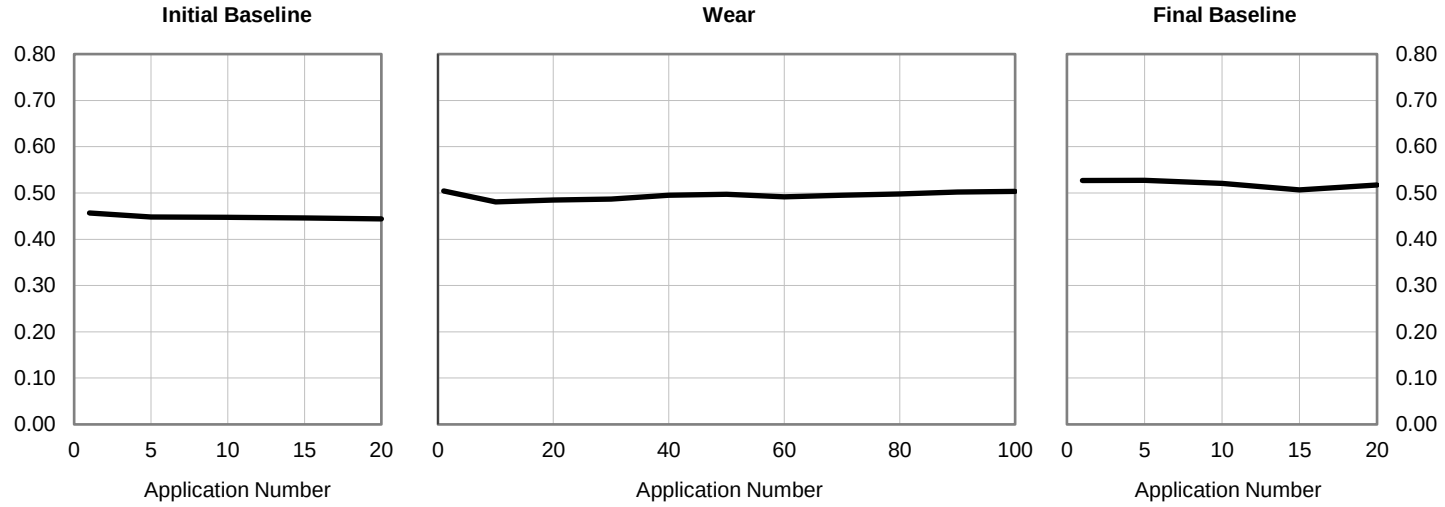
Second Recovery

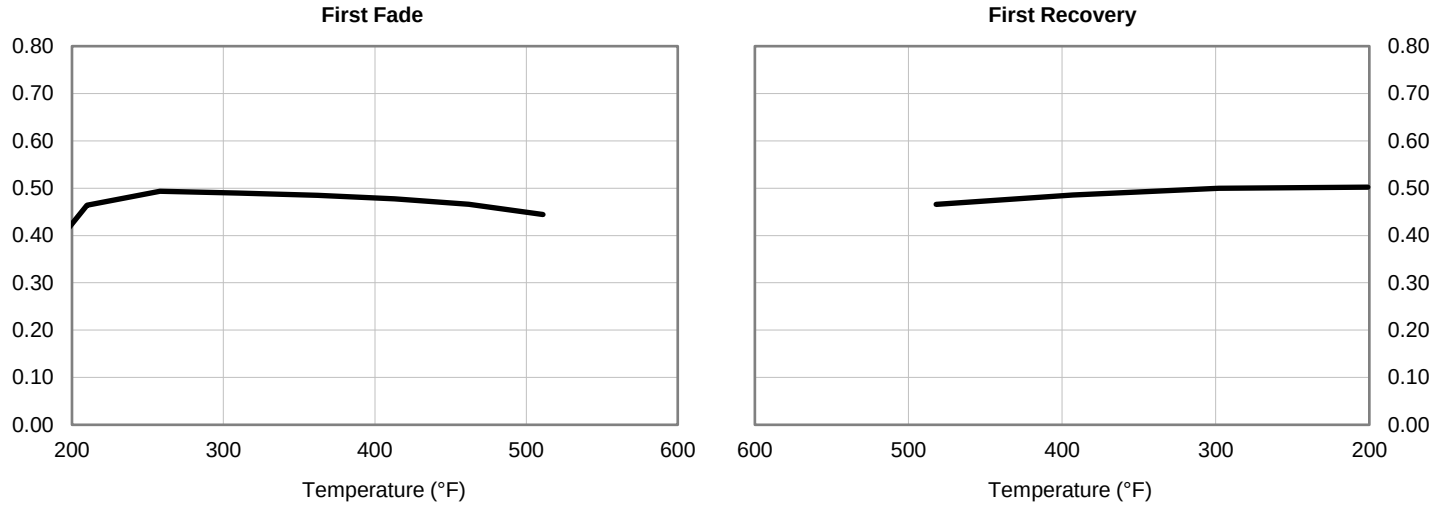
Event	Force (lb)	μ	Temp (°F)
1	65.8	0.438	580
2	67.8	0.450	488
3	70.3	0.472	394
4	73.0	0.489	298
5	77.3	0.513	201

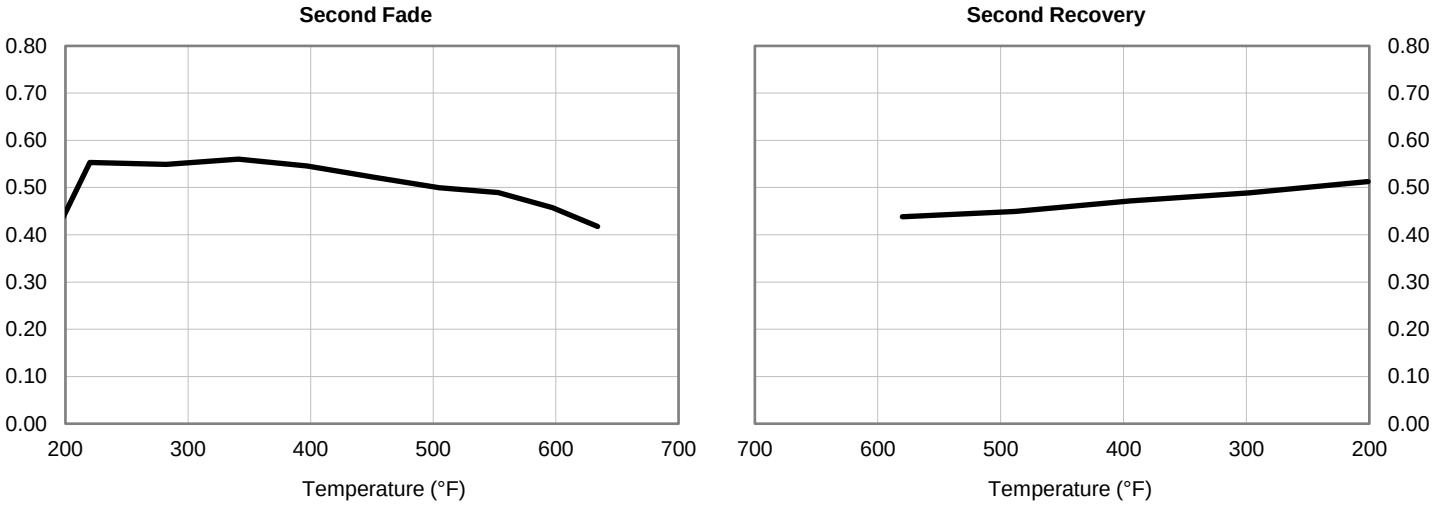
Manufacturer: International Motor Products, Inc.
Material: XBF SEVER DUTY FF
Test Pressure: 150 psi

1/18/2023
108091-2-4
Sample 2 of 5

Coefficient of Friction







Manufacturer: International Motor Products, Inc.
Material: XBF SEVER DUTY FF
Test Pressure: 150 psi

Normal **0.555** **H**
Hot **0.476** **G**

1/18/2023
108091-2-5
Sample 3 of 5

Wear

	Initial	Final	Loss	Loss / %	Specific Wear	
Weight (gr)	10.295	9.574	0.721	7.00	4.90E-01	gr/hp-hr
Thickness (inch)	0.259	0.241	0.018	6.95	1.22E-02	in³/hp-hr

Baseline

	Initial		Final	
Event	Force (lb)	μ	Force (lb)	μ
1	68.5	0.454	78.1	0.523
5	71.9	0.478	80.8	0.536
10	70.9	0.475	78.3	0.520
15	73.1	0.485	79.0	0.528
20	72.0	0.480	78.5	0.528

Wear

Event	Force (lb)	μ
1	74.0	0.490
10	72.2	0.479
20	73.7	0.487
30	75.0	0.503
40	76.9	0.508
50	77.9	0.515
60	77.5	0.512
70	77.1	0.512
80	77.4	0.513
90	77.7	0.520
100	78.5	0.518

First Fade

Time (sec)	Force (lb)	μ	Temp (°F)
0.0	65.1	0.373	179
30.0	71.5	0.482	214
60.0	73.4	0.496	264
90.0	72.0	0.478	313
120.0	68.9	0.462	362
150.0	66.7	0.445	410
180.0	64.6	0.430	456
210.0	61.6	0.409	500
240.0	59.2	0.393	545

Second Fade

Time (sec)	Force (lb)	μ	Temp (°F)
0.0	59.3	0.329	179
30.0	84.8	0.569	222
60.0	82.0	0.544	285
90.0	85.0	0.570	341
120.0	83.0	0.556	397
150.0	81.0	0.537	450
180.0	77.9	0.520	502
210.0	74.2	0.494	553
240.0	68.0	0.460	598
270.0	64.3	0.425	634

First Recovery

Event	Force (lb)	μ	Temp (°F)
1	61.9	0.413	482
2	65.7	0.435	392
3	69.1	0.466	298
4	72.8	0.485	201

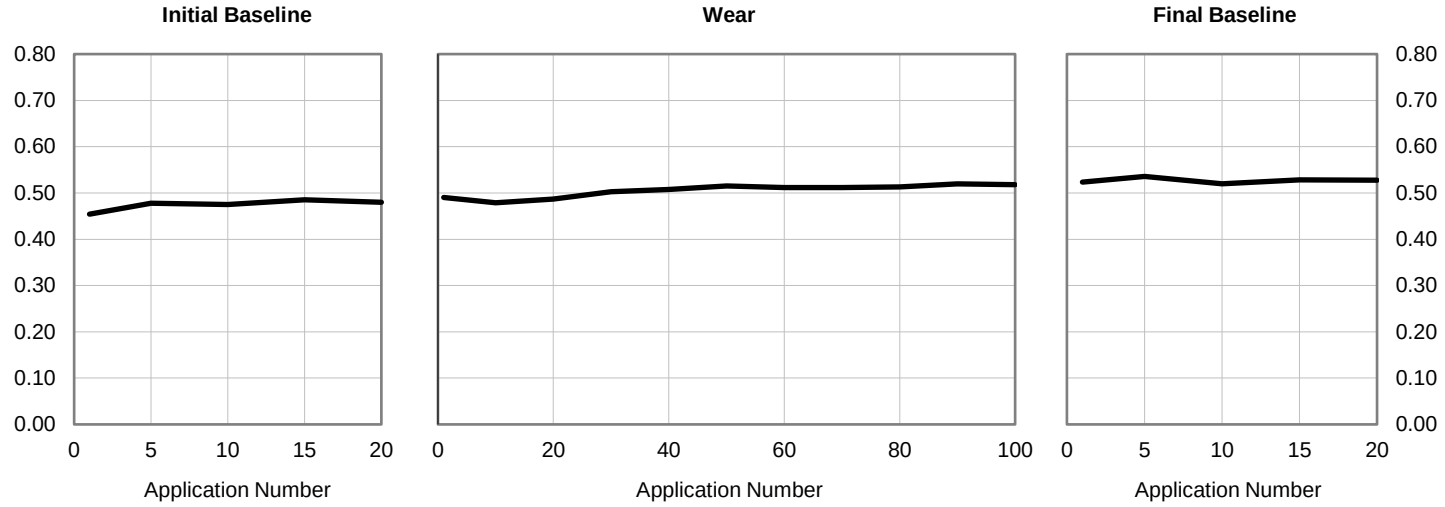
Second Recovery

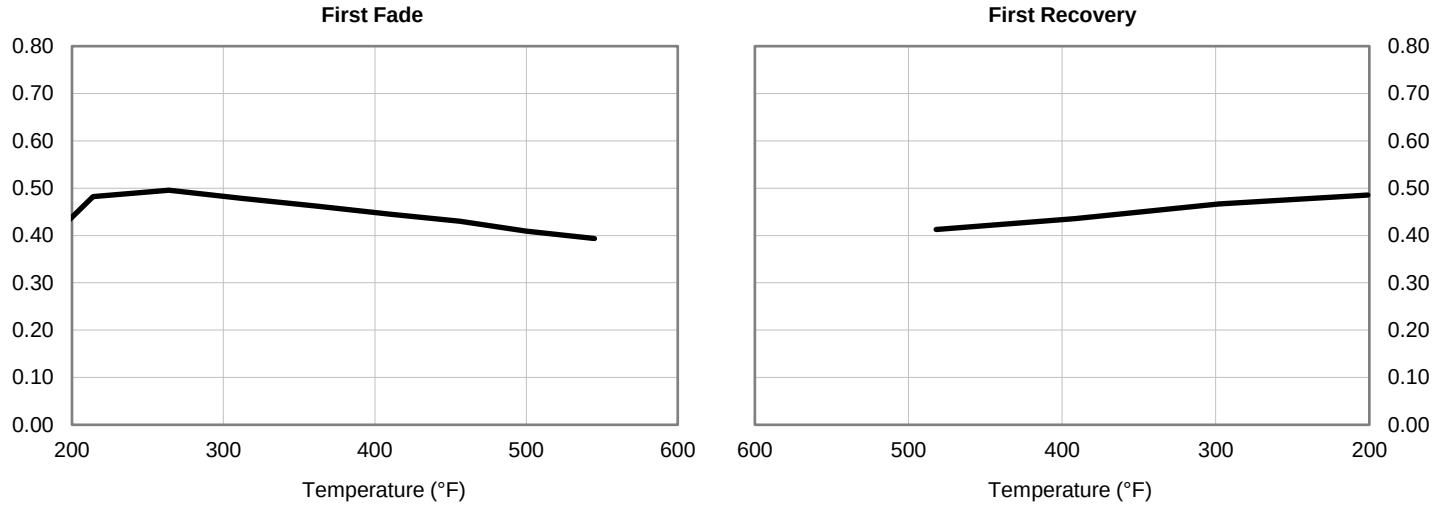
Event	Force (lb)	μ	Temp (°F)
1	65.7	0.442	580
2	69.9	0.464	489
3	73.8	0.486	395
4	78.0	0.520	299
5	77.1	0.517	202

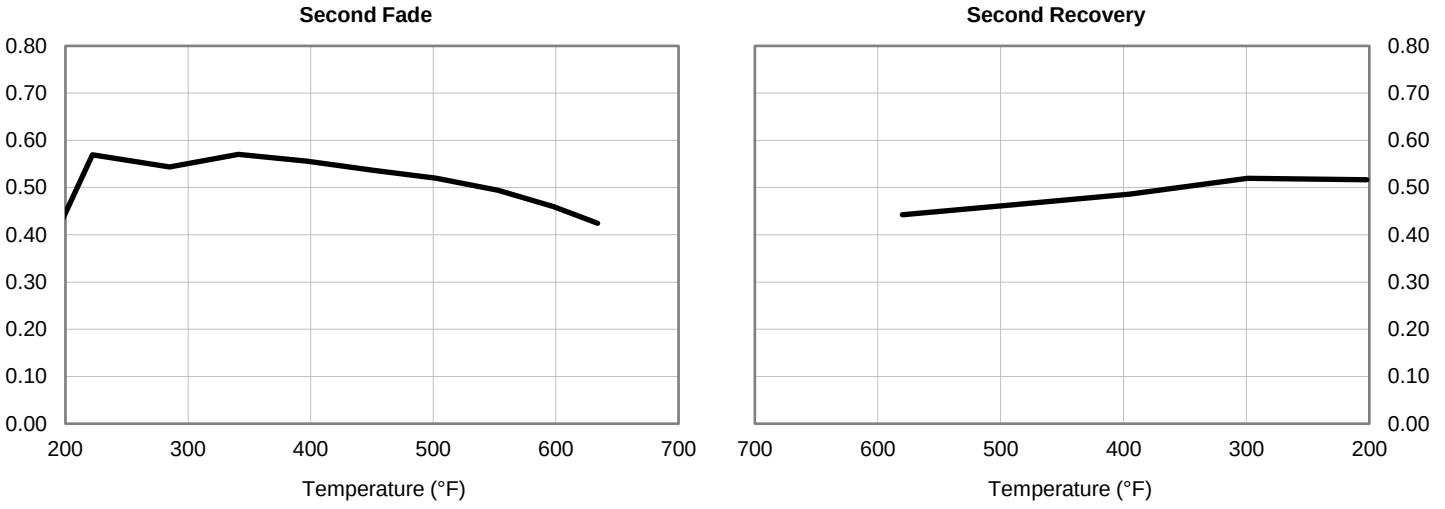
Manufacturer: International Motor Products, Inc.
Material: XBF SEVER DUTY FF
Test Pressure: 150 psi

1/18/2023
108091-2-5
Sample 3 of 5

Coefficient of Friction







Manufacturer: International Motor Products, Inc.
Material: XBP SEVERE DUTY FF
Test Pressure: 150 psi

Normal **0.564** **H**

Hot **0.478** **G**

1/24/2023
108091-2-6
Sample 4 of 5

Wear

	Initial	Final	Loss	Loss / %	Specific Wear	
Weight (gr)	10.189	9.488	0.701	6.88	4.70E-01	gr/hp-hr
Thickness (inch)	0.254	0.238	0.016	6.30	1.07E-02	in³/hp-hr

Baseline

	Initial		Final	
Event	Force (lb)	μ	Force (lb)	μ
1	75.8	0.508	81.7	0.541
5	76.4	0.513	82.4	0.542
10	74.5	0.496	79.7	0.524
15	74.9	0.495	78.9	0.525
20	74.5	0.492	79.7	0.532

Wear

Event	Force (lb)	μ
1	75.3	0.501
10	72.0	0.478
20	72.5	0.484
30	74.0	0.492
40	75.4	0.500
50	76.0	0.512
60	75.8	0.503
70	77.4	0.512
80	76.4	0.507
90	77.9	0.516
100	76.2	0.507

First Fade

Time (sec)	Force (lb)	μ	Temp (°F)
0.0	67.0	0.367	179
30.0	75.4	0.506	213
60.0	76.8	0.517	264
90.0	76.1	0.504	316
120.0	73.4	0.486	367
150.0	71.5	0.477	415
180.0	69.4	0.464	460
210.0	66.1	0.447	505

Second Fade

Time (sec)	Force (lb)	μ	Temp (°F)
0.0	62.7	0.358	179
30.0	85.3	0.564	223
60.0	85.5	0.565	286
90.0	85.2	0.569	346
120.0	82.7	0.550	402
150.0	79.6	0.529	457
180.0	76.5	0.508	508
210.0	72.1	0.482	558
240.0	67.6	0.453	602
270.0	62.0	0.417	639

First Recovery

Event	Force (lb)	μ	Temp (°F)
1	67.0	0.444	484
2	71.1	0.472	393
3	74.0	0.492	298
4	77.6	0.516	202

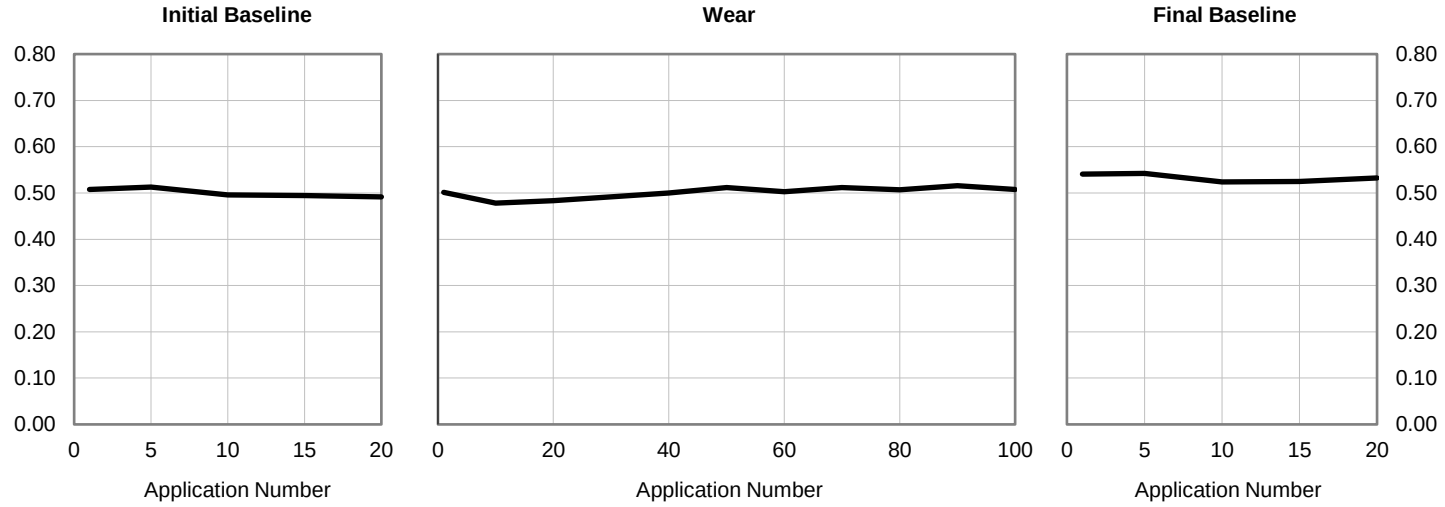
Second Recovery

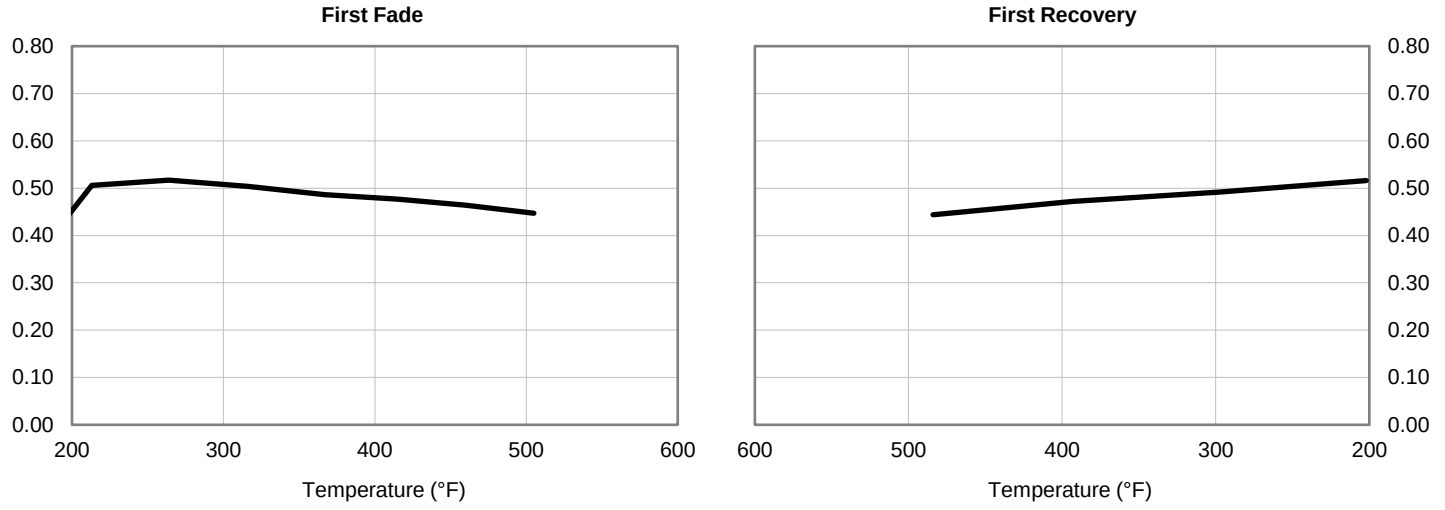
Event	Force (lb)	μ	Temp (°F)
1	65.1	0.429	579
2	68.8	0.456	488
3	72.8	0.486	394
4	76.5	0.509	298
5	80.5	0.536	201

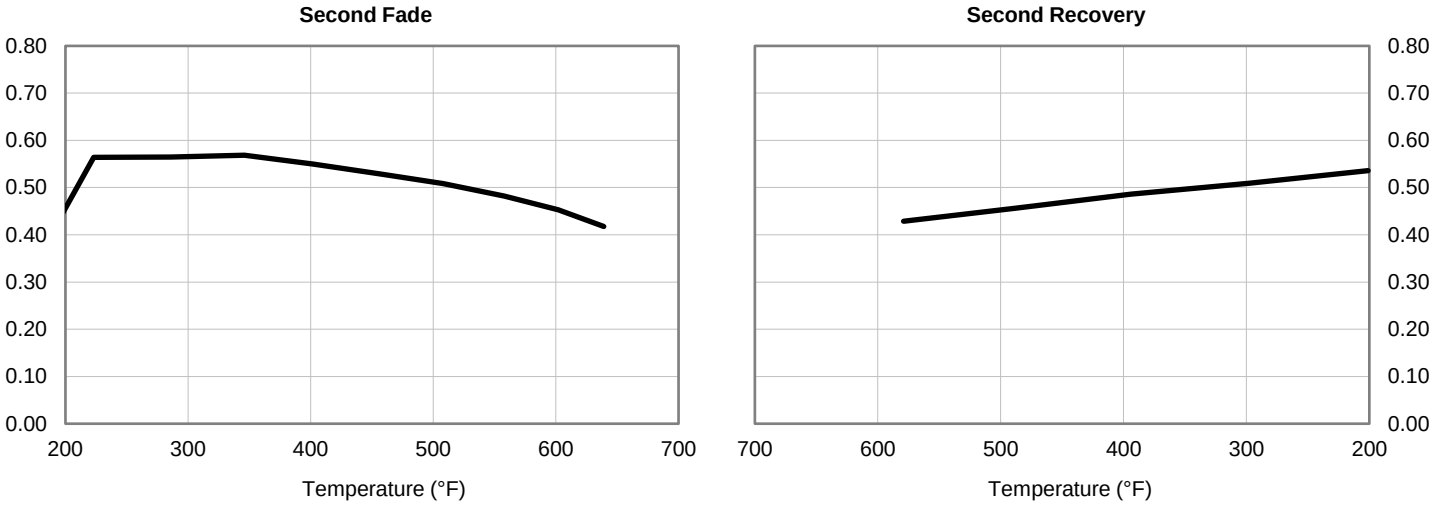
Manufacturer: International Motor Products, Inc.
Material: XBP SEVERE DUTY FF
Test Pressure: 150 psi

1/24/2023
108091-2-6
Sample 4 of 5

Coefficient of Friction







Manufacturer: International Motor Products, Inc.
Material: XBP SEVERE DUTY FF
Test Pressure: 150 psi

Normal **0.519** **G**

Hot **0.472** **G**

1/24/2023
108091-2-7
Sample 5 of 5

Wear

	Initial	Final	Loss	Loss / %	Specific Wear	
Weight (gr)	10.221	9.407	0.814	7.96	5.75E-01	gr/hp-hr
Thickness (inch)	0.255	0.237	0.018	7.06	1.27E-02	in³/hp-hr

Baseline

	Initial		Final	
Event	Force (lb)	μ	Force (lb)	μ
1	64.6	0.429	76.3	0.503
5	66.8	0.444	79.0	0.528
10	66.9	0.448	77.3	0.516
15	67.0	0.447	77.1	0.511
20	67.2	0.449	77.0	0.511

Wear

Event	Force (lb)	μ
1	74.2	0.492
10	71.0	0.475
20	71.2	0.472
30	71.2	0.478
40	72.1	0.485
50	73.1	0.484
60	72.2	0.487
70	73.9	0.492
80	73.6	0.488
90	72.7	0.481
100	73.1	0.483

First Fade

Time (sec)	Force (lb)	μ	Temp (°F)
0.0	59.5	0.329	179
30.0	70.3	0.467	214
60.0	71.7	0.482	265
90.0	71.2	0.473	316
120.0	68.7	0.458	364
150.0	66.8	0.446	410
180.0	64.9	0.432	454
210.0	63.1	0.422	498
240.0	62.1	0.412	542

Second Fade

Time (sec)	Force (lb)	μ	Temp (°F)
0.0	57.3	0.332	179
30.0	79.8	0.530	218
60.0	75.9	0.501	279
90.0	78.6	0.524	333
120.0	78.2	0.523	387
150.0	76.1	0.507	439
180.0	75.2	0.504	489
210.0	73.5	0.486	540
240.0	68.0	0.452	586
270.0	64.5	0.430	624

First Recovery

Event	Force (lb)	μ	Temp (°F)
1	65.8	0.436	482
2	68.6	0.458	391
3	72.5	0.480	297
4	73.3	0.484	200

Second Recovery

Event	Force (lb)	μ	Temp (°F)
1	66.4	0.440	580
2	68.7	0.457	488
3	73.3	0.488	394
4	76.3	0.514	297
5	79.5	0.524	200

Manufacturer: International Motor Products, Inc.
Material: XBP SEVERE DUTY FF
Test Pressure: 150 psi

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108091-2-7
Sample 5 of 5

Coefficient of Friction