



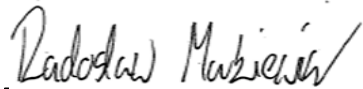
Physical Properties Test Report

Link Test Report: 109511-1-1
Test Description: SAE J661 Rev Oct 2021 Brake Lining Quality Test
Purpose of Test: To Evaluate the Characteristics of Brake Materials
Material Identification: BPD1685 D1685-8870
Test Date: 11/27/2023 - 11/28/2023

Requested By:

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

Report Approved by:


Laboratory Manager

Issue Date: 11/30/2023



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



SAE J661 Rev Oct 2021 Brake Lining Quality Test

Test Information

Customer Name	International Motor Products, Inc.
Requestor	Rodolfo Lopez
Program Number	109511-1-1
Test Coordinator	Eric DeJules
Test Equipment	Chase Machine 13
Test Dates	11/27/2023 - 11/28/2023
Datalogger	v1.0.21
Template Version	1.83

Setup Details

Sample Material	BPD1685 D1685-8870
Sample Size	1 inch x 1 inch
Sample Manufacturer	International Motor Products, Inc.
Test Pressure	150 psi

Sample Test Summary

Normal Friction Coefficient	0.522	Pass
Normal Friction Class	G	
Hot Friction Coefficient	0.468	Pass
Hot Friction Class	G	
Minimum Bold Coefficient	0.442	Pass
Max Variation Below Average for Bold Readings	0.029	Pass
Max % Variation for Bold Readings	6.08%	Pass

Pass / Fail

Pass

Comments:

Authorized by: Eric DeJules
(313) 625-4000

Title: Test Engineer

Issue Date: 11/30/2023

Data applicable to the materials tested and parameters agreed to by customer. Valid if signed by the test engineer. Report can be copied in full. Uncertainty of Measurement details are available upon request.



Test Number

<u>Sample 1</u>	<u>Sample 2</u>	<u>Sample 3</u>	<u>Sample 4</u>	<u>Sample 5</u>
109511-1-1	109511-1-2	109511-1-3	109511-1-4	109511-1-5

Manufacturer:
**International Motor
Products, Inc.**
Material:
BPD1685 D1685-8870

Initial Baseline

Application	<u>Sample 1</u>	<u>Sample 2</u>	<u>Sample 3</u>	<u>Sample 4</u>	<u>Sample 5</u>
1	0.360	0.373	0.352	0.343	0.352
20	0.323	0.324	0.354	0.326	0.356

Normal **0.522** **G**

First Fade

Temp (°F)	<u>Sample 1</u>	<u>Sample 2</u>	<u>Sample 3</u>	<u>Sample 4</u>	<u>Sample 5</u>
200.0	0.345	0.342	0.369	0.324	0.361
550.0	0.419	0.422	0.415	0.370	0.417

(or Temp @ 10min)

Hot **0.468** **G**

First Recovery

Temp (°F)	<u>Sample 1</u>	<u>Sample 2</u>	<u>Sample 3</u>	<u>Sample 4</u>	<u>Sample 5</u>	<u>Average</u>
500.0	0.439	0.430	0.456	0.400	0.427	0.430
400.0	0.474	0.448	0.468	0.435	0.447	0.454
300.0	0.461	0.439	0.478	0.448	0.458	0.457
200.0	0.414	0.383	0.408	0.406	0.427	0.408

Norm/Hot

Hot

Hot

Wear

Application	<u>Sample 1</u>	<u>Sample 2</u>	<u>Sample 3</u>	<u>Sample 4</u>	<u>Sample 5</u>
1	0.432	0.431	0.479	0.433	0.433
100	0.523	0.521	0.507	0.495	0.500

Second Fade

Temp (°F)	<u>Sample 1</u>	<u>Sample 2</u>	<u>Sample 3</u>	<u>Sample 4</u>	<u>Sample 5</u>	<u>Average</u>	Max Var. <u>< Average</u>	<u>Norm/Hot</u>	<u>% Var</u>
200.0	0.482	0.472	0.511	0.496	0.505	0.493	0.021	Normal	4%
250.0	0.519	0.516	0.540	0.505	0.531	0.522	0.017	Normal	3%
300.0	0.516	0.534	0.558	0.520	0.557	0.537	0.021	Normal	4%
350.0	0.527	0.527	0.535	0.545	0.533	0.533	0.006	-	1%
400.0	0.540	0.531	0.532	0.538	0.534	0.535	0.004	Normal	1%
450.0	0.541	0.535	0.524	0.517	0.520	0.527	0.010	Hot	2%
500.0	0.507	0.511	0.504	0.498	0.492	0.502	0.010	Hot	2%
550.0	0.504	0.500	0.465	0.459	0.498	0.485	0.026	Hot	5%
600.0	0.445	0.443	0.457	0.445	0.435	0.445	0.010	Hot	2%
650.0	0.396	0.401	0.431	0.407	0.410	0.409	0.013	Hot	3%

(or Temp @ 10min)

Second Recovery

Temp (°F)	<u>Sample 1</u>	<u>Sample 2</u>	<u>Sample 3</u>	<u>Sample 4</u>	<u>Sample 5</u>	<u>Average</u>	Max Var. <u>< Average</u>	<u>Norm/Hot</u>	<u>% Var</u>
600.0	0.417	0.422	0.434	0.418	0.411	0.420	0.009	-	2%
500.0	0.457	0.421	0.453	0.432	0.429	0.438	0.017	Hot	4%
400.0	0.503	0.463	0.491	0.456	0.442	0.471	0.029	Hot	6%
300.0	0.493	0.486	0.490	0.497	0.482	0.490	0.008	Hot	2%
200.0	0.442	0.472	0.470	0.490	0.479	0.471	0.029	-	6%

Final Baseline

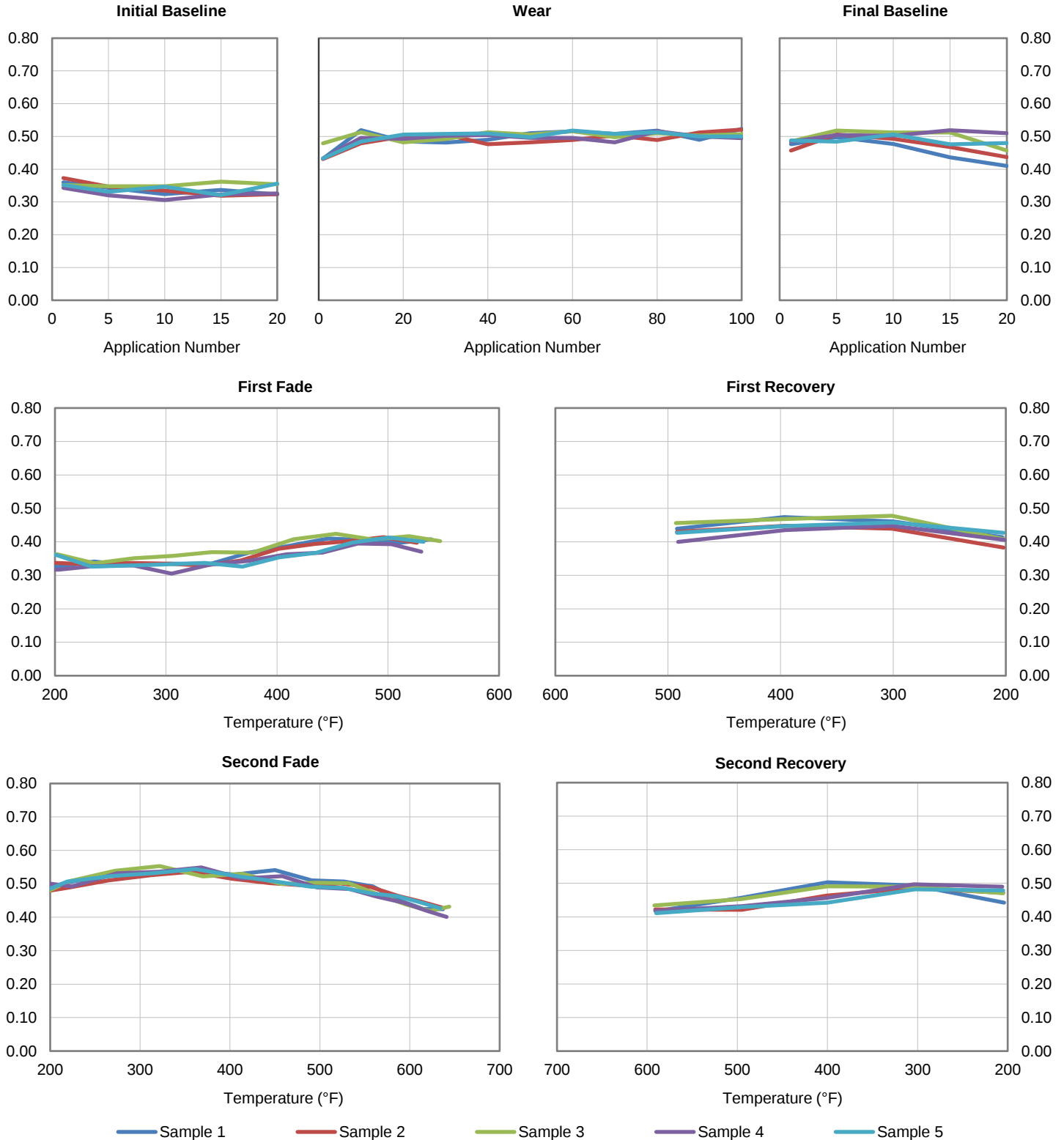
Application	<u>Sample 1</u>	<u>Sample 2</u>	<u>Sample 3</u>	<u>Sample 4</u>	<u>Sample 5</u>
1	0.476	0.457	0.485	0.484	0.488
20	0.410	0.437	0.457	0.510	0.480

Manufacturer: International Motor Products, Inc.
Material: BPD1685 D1685-8870
Test Pressure: 150 psi

Test Dates: 11/27/2023 - 11/28/2023

Summary of 5 Samples

Coefficient of Friction





Manufacturer: International Motor Products, Inc.
Material: BPD1685 D1685-8870
Test Pressure: 150 psi

Normal

0.514

G

Hot

0.478

G

11/27/2023

109511-1-1

Sample 1 of 5

Wear

	Initial	Final	Loss	Loss / %
Weight (gr)	10.394	9.725	0.669	6.44
Thickness (inch)	0.253	0.238	0.015	5.93

Baseline

Event	Initial		Final	
	Force (lb)	μ	Force (lb)	μ
1	53.9	0.360	71.2	0.476
5	51.8	0.343	75.3	0.498
10	48.9	0.324	71.7	0.477
15	50.5	0.337	66.8	0.436
20	49.3	0.323	61.6	0.410

Wear

Event	Force (lb)	μ
1	64.5	0.432
10	78.5	0.519
20	73.7	0.485
30	72.5	0.481
40	73.8	0.490
50	76.1	0.510
60	77.4	0.516
70	77.2	0.508
80	77.6	0.518
90	74.1	0.490
100	78.6	0.523

First Fade

Time (sec)	Force (lb)	μ	Temp (°F)
0.0	50.7	0.332	179
30.0	49.1	0.325	203
60.0	51.4	0.341	235
90.0	49.4	0.330	269
120.0	51.1	0.335	304
150.0	50.6	0.334	340
180.0	55.1	0.368	375
210.0	57.9	0.389	412
240.0	61.1	0.410	446
270.0	60.5	0.406	479
300.0	59.1	0.397	511
330.0	61.1	0.408	539

Second Fade

Time (sec)	Force (lb)	μ	Temp (°F)
0.0	73.0	0.479	185
30.0	75.7	0.504	219
60.0	78.1	0.526	266
90.0	79.6	0.532	313
120.0	80.0	0.538	359
150.0	79.7	0.528	405
180.0	80.7	0.541	450
210.0	76.8	0.510	491
240.0	76.5	0.507	527
270.0	73.4	0.492	559
300.0	67.8	0.450	589
330.0	64.3	0.425	615
360.0	63.0	0.424	637

First Recovery

Event	Force (lb)	μ	Temp (°F)
1	66.5	0.439	492
2	71.9	0.474	397
3	70.1	0.461	300
4	62.8	0.414	203

Second Recovery

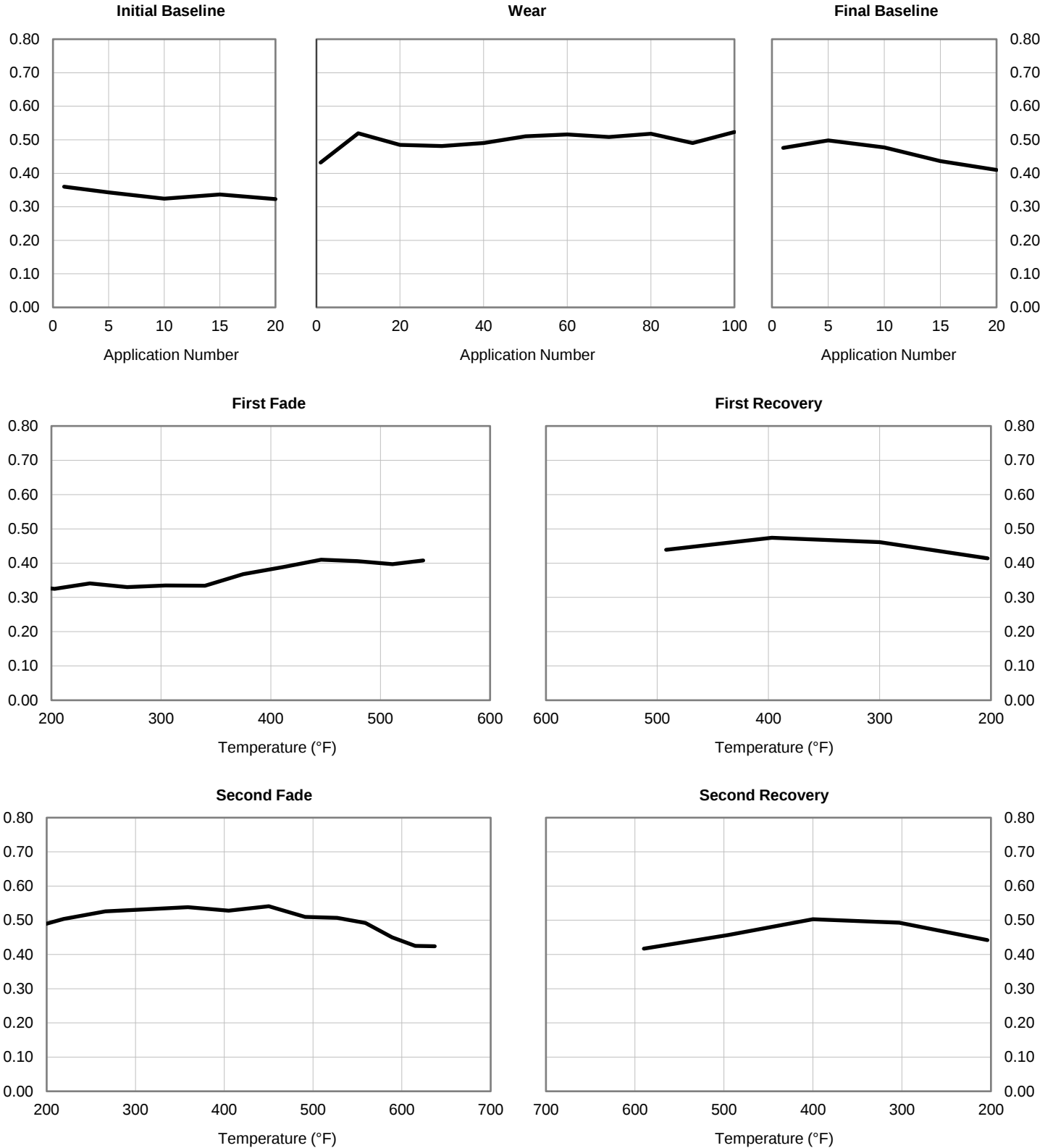
Event	Force (lb)	μ	Temp (°F)
1	63.0	0.417	590
2	69.3	0.457	495
3	75.4	0.503	400
4	74.0	0.493	303
5	67.2	0.442	204



Manufacturer: International Motor Products, Inc.
Material: BPD1685 D1685-8870
Test Pressure: 150 psi

11/27/2023
109511-1-1
Sample 1 of 5

Coefficient of Friction





Manufacturer: International Motor Products, Inc.
Material: BPD1685 D1685-8870
Test Pressure: 150 psi

Normal

0.513

G

Hot

0.465

G

11/28/2023

109511-1-2

Sample 2 of 5

Wear

	Initial	Final	Loss	Loss / %
Weight (gr)	10.305	9.641	0.664	6.44
Thickness (inch)	0.253	0.239	0.014	5.53

Baseline

Event	Initial		Final	
	Force (lb)	μ	Force (lb)	μ
1	55.4	0.373	68.9	0.457
5	52.1	0.347	75.9	0.506
10	50.3	0.335	74.1	0.493
15	48.7	0.319	70.2	0.468
20	48.7	0.324	65.9	0.437

Wear

Event	Force (lb)	μ
1	64.5	0.431
10	71.8	0.479
20	74.9	0.500
30	75.5	0.506
40	72.7	0.476
50	72.9	0.482
60	73.6	0.489
70	75.1	0.503
80	72.8	0.489
90	76.2	0.512
100	78.3	0.521

First Fade

Time (sec)	Force (lb)	μ	Temp (°F)
0.0	52.1	0.342	178
30.0	50.9	0.337	201
60.0	49.9	0.333	233
90.0	49.8	0.337	267
120.0	49.9	0.335	301
150.0	49.2	0.329	334
180.0	52.0	0.344	367
210.0	55.9	0.379	401
240.0	59.3	0.394	434
270.0	59.9	0.402	465
300.0	61.2	0.414	496
330.0	60.3	0.397	526

Second Fade

Time (sec)	Force (lb)	μ	Temp (°F)
0.0	71.4	0.473	185
30.0	73.7	0.488	219
60.0	75.9	0.510	265
90.0	78.5	0.526	312
120.0	80.6	0.536	357
150.0	78.0	0.515	402
180.0	76.1	0.502	445
210.0	73.9	0.495	485
240.0	73.9	0.501	523
270.0	73.7	0.490	557
300.0	68.8	0.464	587
330.0	66.9	0.447	612
360.0	64.2	0.429	636

First Recovery

Event	Force (lb)	μ	Temp (°F)
1	64.3	0.430	492
2	67.9	0.448	396
3	66.1	0.439	301
4	57.7	0.383	202

Second Recovery

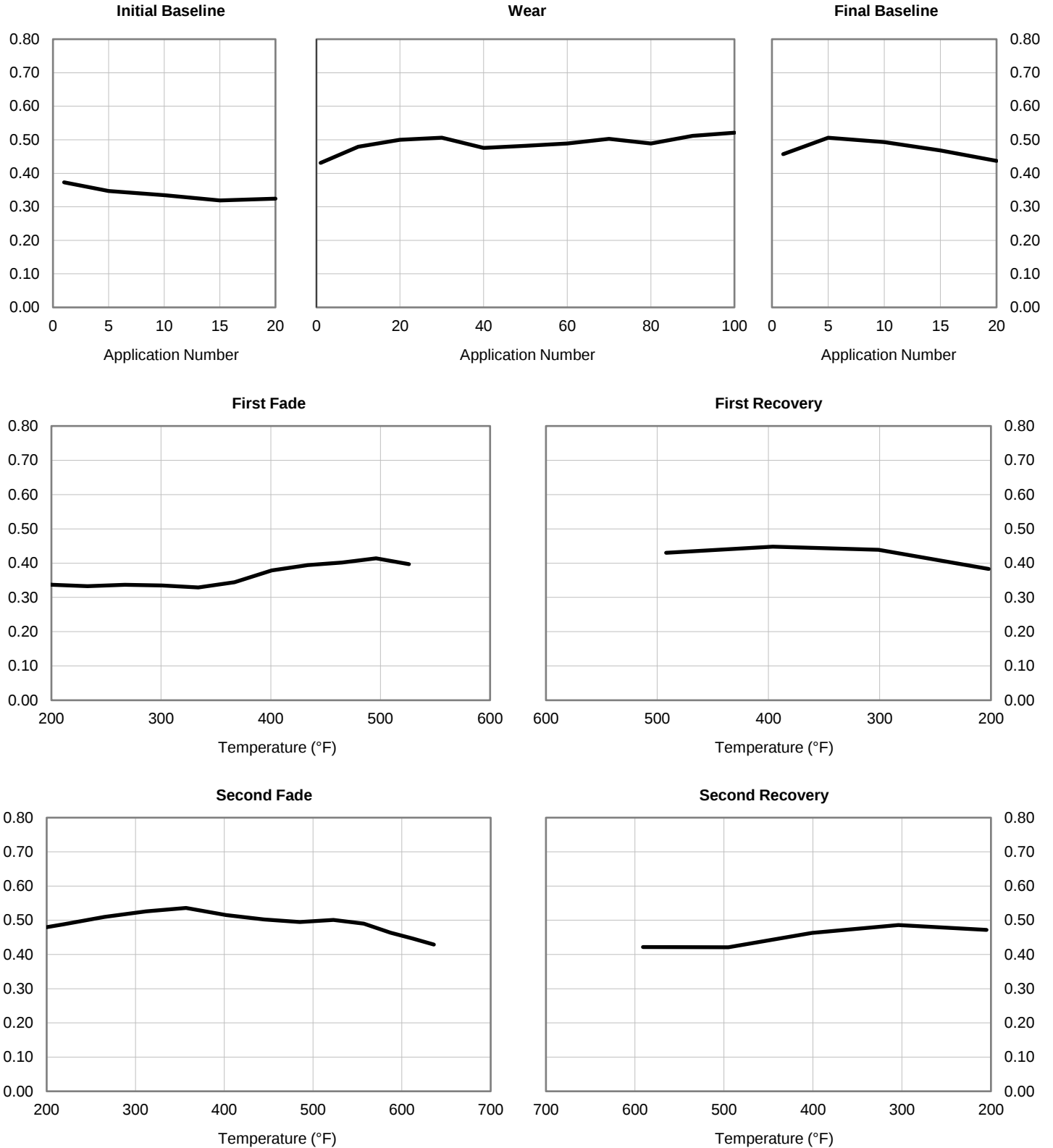
Event	Force (lb)	μ	Temp (°F)
1	63.6	0.422	591
2	64.3	0.421	495
3	70.4	0.463	401
4	72.9	0.486	304
5	71.6	0.472	205



Manufacturer: International Motor Products, Inc.
Material: BPD1685 D1685-8870
Test Pressure: 150 psi

11/28/2023
109511-1-2
Sample 2 of 5

Coefficient of Friction





Manufacturer: International Motor Products, Inc.
Material: BPD1685 D1685-8870
Test Pressure: 150 psi

Normal
Hot

0.535
0.476

G
G

11/28/2023
109511-1-3
Sample 3 of 5

Wear

	Initial	Final	Loss	Loss / %
Weight (gr)	9.904	9.268	0.636	6.42
Thickness (inch)	0.253	0.237	0.016	6.32

Baseline

Event	Initial		Final	
	Force (lb)	μ	Force (lb)	μ
1	53.7	0.352	72.4	0.485
5	52.8	0.348	77.5	0.518
10	52.7	0.348	77.2	0.512
15	54.3	0.362	76.6	0.512
20	53.6	0.354	68.7	0.457

Wear

Event	Force (lb)	μ
1	72.1	0.479
10	77.7	0.513
20	73.1	0.482
30	74.6	0.492
40	77.1	0.513
50	76.3	0.506
60	78.0	0.516
70	74.6	0.498
80	75.9	0.510
90	75.9	0.503
100	75.3	0.507

First Fade

Time (sec)	Force (lb)	μ	Temp (°F)
0.0	54.1	0.353	179
30.0	54.1	0.363	202
60.0	50.8	0.336	236
90.0	52.7	0.351	271
120.0	53.3	0.358	306
150.0	54.9	0.369	341
180.0	55.8	0.368	378
210.0	61.4	0.408	415
240.0	63.1	0.424	453
270.0	61.9	0.407	486
300.0	61.9	0.417	519
330.0	60.3	0.402	547

Second Fade

Time (sec)	Force (lb)	μ	Temp (°F)
0.0	70.9	0.464	186
30.0	76.4	0.508	222
60.0	81.3	0.539	272
90.0	82.4	0.553	322
120.0	79.5	0.522	370
150.0	79.2	0.530	414
180.0	75.0	0.500	457
210.0	74.9	0.503	497
240.0	74.0	0.502	532
270.0	70.0	0.466	567
300.0	66.0	0.439	595
330.0	62.8	0.419	622
360.0	63.9	0.432	644

First Recovery

Event	Force (lb)	μ	Temp (°F)
1	68.6	0.456	493
2	71.1	0.468	397
3	72.4	0.478	301
4	61.7	0.408	202

Second Recovery

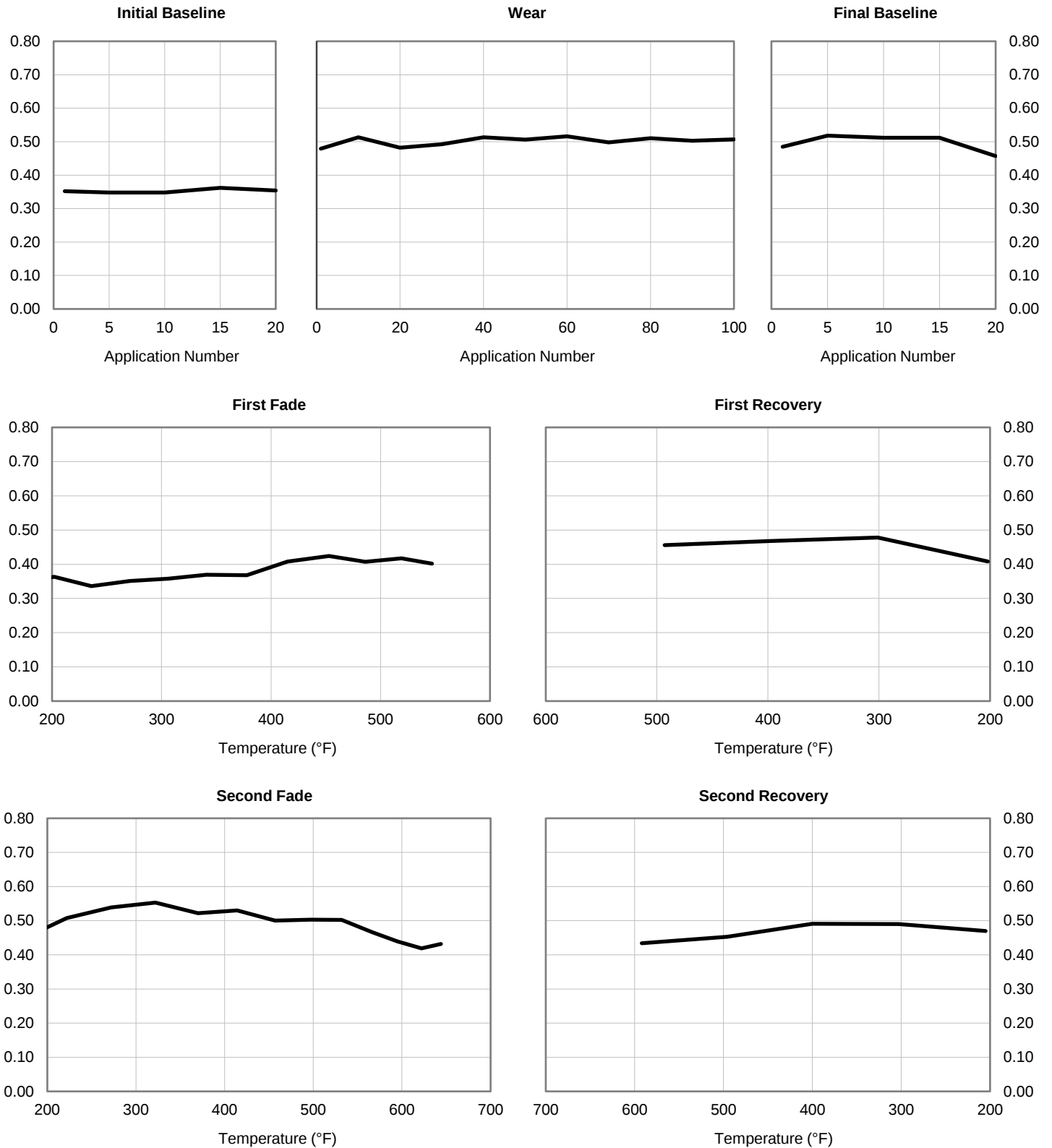
Event	Force (lb)	μ	Temp (°F)
1	66.4	0.434	592
2	68.6	0.453	496
3	73.8	0.491	400
4	73.6	0.490	303
5	71.0	0.470	205



Manufacturer: International Motor Products, Inc.
Material: BPD1685 D1685-8870
Test Pressure: 150 psi

11/28/2023
109511-1-3
Sample 3 of 5

Coefficient of Friction





Manufacturer: International Motor Products, Inc.
Material: BPD1685 D1685-8870
Test Pressure: 150 psi

Normal
Hot

0.515
0.459

G
G

11/28/2023
109511-1-4
Sample 4 of 5

Wear

	Initial	Final	Loss	Loss / %
Weight (gr)	10.577	9.934	0.643	6.08
Thickness (inch)	0.253	0.238	0.015	5.93

Baseline

Event	Initial		Final	
	Force (lb)	μ	Force (lb)	μ
1	52.2	0.343	72.7	0.484
5	48.4	0.320	76.0	0.504
10	47.1	0.306	75.4	0.502
15	48.9	0.323	78.2	0.519
20	49.3	0.326	76.4	0.510

Wear

Event	Force (lb)	μ
1	64.9	0.433
10	75.2	0.496
20	73.2	0.493
30	74.2	0.502
40	76.7	0.504
50	73.6	0.496
60	74.9	0.496
70	73.7	0.482
80	77.7	0.516
90	76.2	0.500
100	75.7	0.495

First Fade

Time (sec)	Force (lb)	μ	Temp (°F)
0.0	49.3	0.321	180
30.0	47.7	0.317	203
60.0	49.1	0.327	234
90.0	49.1	0.330	270
120.0	46.2	0.305	305
150.0	49.9	0.332	340
180.0	52.4	0.343	375
210.0	55.0	0.363	409
240.0	55.3	0.368	441
270.0	58.9	0.395	473
300.0	59.6	0.393	503
330.0	55.8	0.371	530

Second Fade

Time (sec)	Force (lb)	μ	Temp (°F)
0.0	75.8	0.505	186
30.0	74.4	0.492	224
60.0	79.2	0.531	274
90.0	80.6	0.536	321
120.0	81.3	0.549	368
150.0	77.1	0.516	413
180.0	78.3	0.523	458
210.0	73.1	0.489	497
240.0	72.1	0.484	533
270.0	69.4	0.461	564
300.0	67.0	0.444	593
330.0	62.7	0.419	619
360.0	60.1	0.401	641

First Recovery

Event	Force (lb)	μ	Temp (°F)
1	60.0	0.400	491
2	65.7	0.435	396
3	66.8	0.448	301
4	61.2	0.406	201

Second Recovery

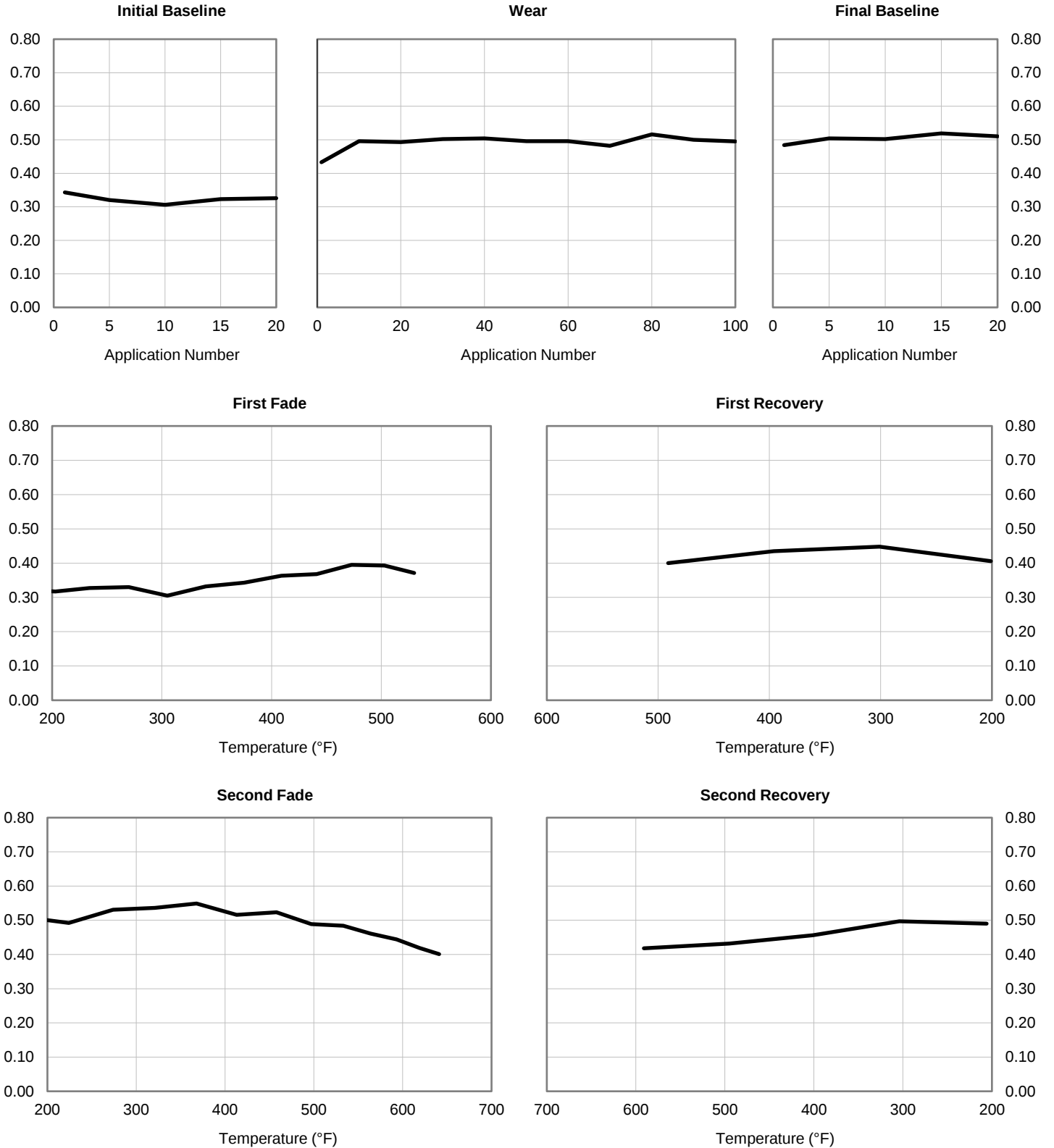
Event	Force (lb)	μ	Temp (°F)
1	63.3	0.418	591
2	65.4	0.432	495
3	68.8	0.456	401
4	74.2	0.497	304
5	74.3	0.490	206



Manufacturer: International Motor Products, Inc.
Material: BPD1685 D1685-8870
Test Pressure: 150 psi

11/28/2023
109511-1-4
Sample 4 of 5

Coefficient of Friction





Manufacturer: International Motor Products, Inc.
Material: BPD1685 D1685-8870
Test Pressure: 150 psi

Normal

0.532

G

Hot

0.461

G

11/28/2023

109511-1-5

Sample 5 of 5

Wear

	Initial	Final	Loss	Loss / %
Weight (gr)	10.329	9.657	0.672	6.51
Thickness (inch)	0.253	0.238	0.015	5.93

Baseline

Event	Initial		Final	
	Force (lb)	μ	Force (lb)	μ
1	52.2	0.352	73.2	0.488
5	49.9	0.331	73.1	0.484
10	52.3	0.347	76.1	0.506
15	48.3	0.321	71.7	0.476
20	53.8	0.356	72.1	0.480

Wear

Event	Force (lb)	μ
1	65.4	0.433
10	72.8	0.484
20	76.6	0.506
30	76.4	0.508
40	77.4	0.509
50	74.9	0.498
60	76.9	0.518
70	76.2	0.508
80	77.0	0.513
90	74.8	0.500
100	76.7	0.500

First Fade

Time (sec)	Force (lb)	μ	Temp (°F)
0.0	54.1	0.360	179
30.0	53.7	0.361	201
60.0	49.7	0.326	233
90.0	49.9	0.329	267
120.0	49.3	0.333	301
150.0	50.3	0.337	335
180.0	49.3	0.326	369
210.0	53.3	0.354	402
240.0	55.5	0.367	435
270.0	59.7	0.398	468
300.0	62.3	0.413	501
330.0	60.0	0.400	532

Second Fade

Time (sec)	Force (lb)	μ	Temp (°F)
0.0	71.3	0.468	185
30.0	75.2	0.507	219
60.0	78.9	0.523	267
90.0	80.7	0.532	316
120.0	80.4	0.544	361
150.0	78.5	0.523	408
180.0	76.3	0.507	451
210.0	73.8	0.491	490
240.0	73.8	0.488	526
270.0	71.5	0.471	558
300.0	69.9	0.463	586
330.0	66.4	0.445	611
360.0	63.6	0.427	634

First Recovery

Event	Force (lb)	μ	Temp (°F)
1	64.3	0.427	492
2	67.7	0.447	397
3	69.2	0.458	300
4	63.8	0.427	202

Second Recovery

Event	Force (lb)	μ	Temp (°F)
1	62.8	0.411	590
2	65.0	0.429	495
3	67.6	0.442	400
4	72.0	0.482	303
5	72.5	0.479	205



Manufacturer: International Motor Products, Inc.
Material: BPD1685 D1685-8870
Test Pressure: 150 psi

11/28/2023
109511-1-5
Sample 5 of 5

Coefficient of Friction

