



Sample Lab Test Report

Link Test Report: 143947-1
Test Description: SAE J661 Rev Feb 1997 Brake Lining Quality
Purpose of Test: To Evaluate the Characteristics of Brake
Materials
Program: J661noinsp.chp
Lining Material: ECX888X0934
Test Date(s): 9/10/2014 to 9/11/2014

Requested By

HARDEX BRAKES LTD
DELLA DIBADJ
200-1311 HOWE STREET
VANCOUVER, BC V6Z 2P3
CANADA

Tested By:

Testing Coordination and Facility
Dearborn Technical Center
401 Southfield Road
Dearborn, MI 48120
www.linkeng.com
Phone: (313) 625-4000



Test Number
143947-1

Customer Reference
ECX888X0934

SAE J661 Rev Feb 1997 Brake Lining Quality Test

Test Information

Customer Name	Hardex Brakes Ltd
Requestor	Della Dibadj
Test Procedure	SAE J661
Program Number	J661noinsp.chp
Test Coordinator	Timothy Coleman
Test Equipment	Chase Machine 12
Test Dates	9/10/2014 to 9/11/2014
Datalogger	v1.0.10
Template Version	2.06

Setup Details

Sample Material	ECX888X0934
Sample Size	25.4mm x 25.4mm
Sample Manufacturer	Hardex Brakes Ltd
Test Pressure	1034.21 kPa

Sample Test Summary

Normal Friction Coefficient	0.434	Pass
Normal Friction Class	F	
Hot Friction Coefficient	0.408	Pass
Hot Friction Class	F	
Minimum Bold Coefficient	0.385	Pass
Max Variation Below Avg for Bold readings	0.036	Pass
Max % Variation for Bold Readings	9%	Pass

Pass / Fail

Pass

Comments:

Created by:	Timothy Coleman (313) 625-4000	Title	Lead Technician	Date	9/17/2014
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Reviewed by:	Timothy Coleman (313) 625-4000	Title	Lead Technician	Date	9/17/2014
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Data applicable to the materials tested. **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
143947-1

Customer Reference
ECX888X0934

Test Number				
Sample 1	Sample 2	Sample 3	Sample 4	Sample 5
143947-A3	143947-A4	143947-A5	143947-A6	143947-A7

Manufacturer
HARDEX BRAKES

Initial Baseline					
Application	Sample 1	Sample 2	Sample 3	Sample 4	Sample 5
1	0.335	0.358	0.314	0.313	0.334
20	0.369	0.329	0.364	0.374	0.390

Material
ECX888X0934

Normal **0.434** **F**

First Fade					
Temp (°C)	Sample 1	Sample 2	Sample 3	Sample 4	Sample 5
93.3	0.352	0.307	0.347	0.363	0.374
260.0	0.394	0.434	0.422	0.422	0.443

(or Temp @ 10min)

Hot **0.408** **F**

First Recovery							Norm/Hot
Temp (°C)	Sample 1	Sample 2	Sample 3	Sample 4	Sample 5	Average	
260.0	0.395	0.418	0.358	0.443	0.442	0.411	
204.4	0.431	0.440	0.412	0.478	0.445	0.441	Hot
148.9	0.418	0.431	0.445	0.451	0.435	0.436	Hot
93.3	0.412	0.419	0.407	0.443	0.426	0.421	

Wear					
Application	Sample 1	Sample 2	Sample 3	Sample 4	Sample 5
1	0.440	0.444	0.435	0.430	0.441
100	0.431	0.409	0.448	0.433	0.443

Second Fade							Max Var.		
Temp (°C)	Sample 1	Sample 2	Sample 3	Sample 4	Sample 5	Average	< Average	Norm/Hot	% Var
93.3	0.401	0.395	0.392	0.425	0.429	0.408	0.016	Normal	4%
121.1	0.445	0.423	0.419	0.434	0.449	0.434	0.015	Normal	3%
148.9	0.451	0.445	0.437	0.450	0.456	0.448	0.011	Normal	2%
176.7	0.436	0.428	0.456	0.441	0.451	0.442	0.014	-	3%
204.4	0.464	0.442	0.452	0.434	0.441	0.447	0.013	Normal	3%
232.2	0.448	0.413	0.441	0.453	0.447	0.440	0.027	Hot	6%
260.0	0.445	0.433	0.456	0.449	0.457	0.448	0.015	Hot	3%
287.8	0.438	0.385	0.404	0.431	0.447	0.421	0.036	Hot	9%
315.6	0.379	0.351	0.362	0.375	0.395	0.372	0.021	Hot	6%
343.3	0.343	0.345	0.334	0.339	0.346	0.341	0.007	Hot	2%

(or Temp @ 10min)

Second Recovery							Max Var.		
Temp (°C)	Sample 1	Sample 2	Sample 3	Sample 4	Sample 5	Average	< Average	Norm/Hot	% Var
315.6	0.356	0.364	0.347	0.347	0.374	0.358	0.011	-	
260.0	0.388	0.362	0.370	0.373	0.377	0.374	0.012	Hot	
204.4	0.413	0.392	0.370	0.394	0.405	0.395	0.025	Hot	
148.9	0.451	0.406	0.412	0.404	0.399	0.414	0.015	Hot	
93.3	0.431	0.395	0.405	0.458	0.407	0.419	0.024	-	

Final Baseline					
Application	Sample 1	Sample 2	Sample 3	Sample 4	Sample 5
1	0.403	0.394	0.380	0.448	0.395
20	0.410	0.394	0.400	0.485	0.403



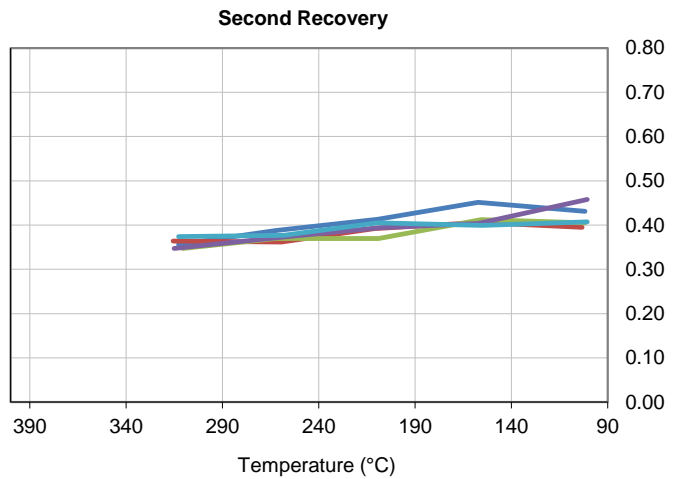
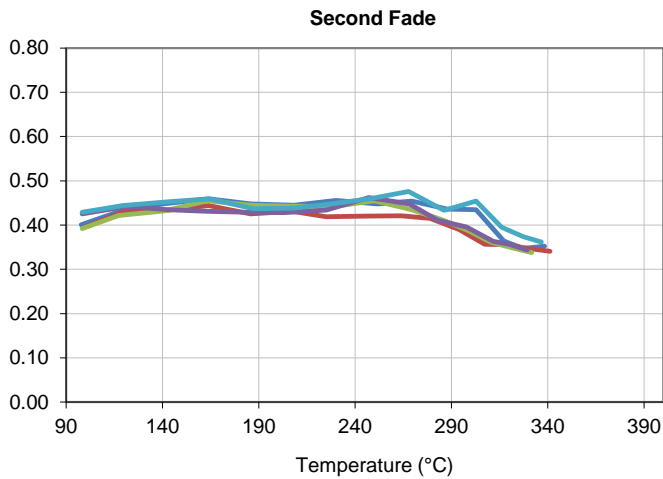
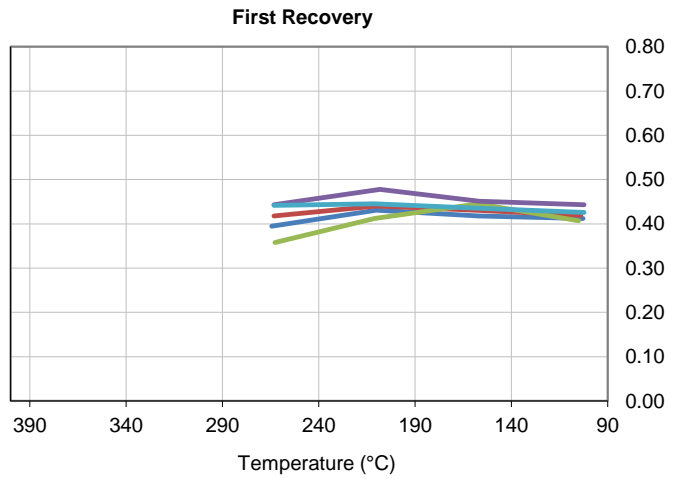
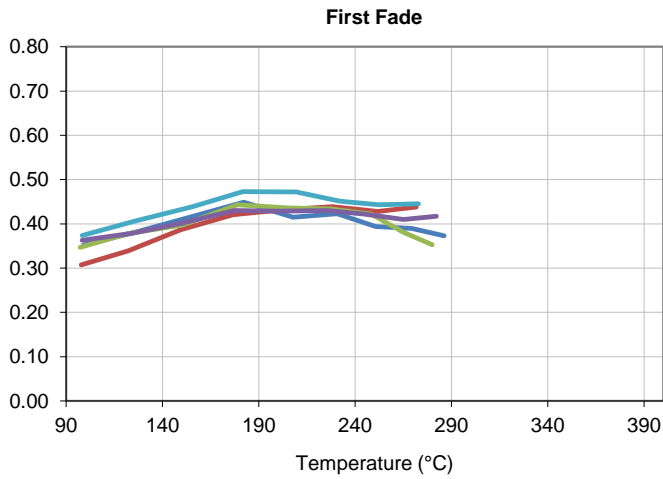
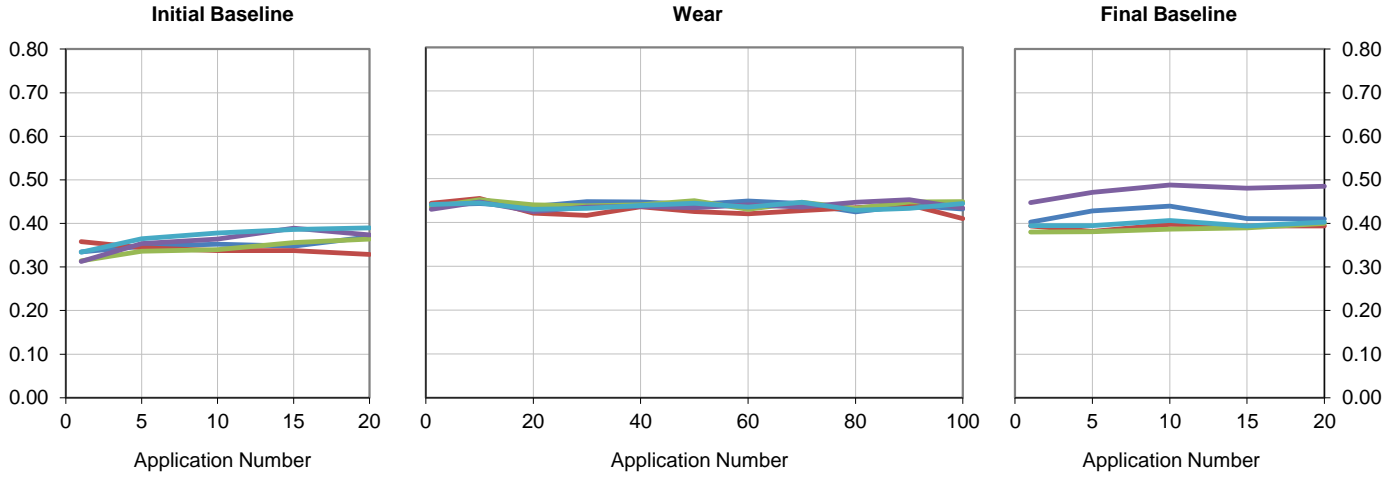
Test Number
143947-1

Customer Reference
ECX888X0934

Manufacturer: HARDEX BRAKES LTD
Material: ECX888X0934
Test Pressure: 1034.21 kPa

9/10/2014 to 9/11/2014
Summary of 5 Samples

Coefficient of Friction





Test Number
143947-1

Customer Reference
ECX888X0934

Manufacturer: HARDEX BRAKES
Material: ECX888X0934
Test Pressure: 1034.21 kPa

Normal **0.440**
Hot **0.415**

F
F

9/10/2014
143947-A3
Sample 1 of 5

Wear

	Initial	Final	Loss		Specific Wear	
Weight (gr)	9.096	8.671	0.425	5%	2.36E-01	gr/kWh
Thickness (cm)	0.645	0.615	0.03	5%	1.08E-01	cm ³ /kWh

Baseline

Event	Initial		Final	
	Force (N)	μ	Force (N)	μ
1	222	0.335	268	0.403
5	233	0.347	287	0.429
10	234	0.352	294	0.440
15	232	0.348	274	0.411
20	246	0.369	273	0.410

Wear

Event	Force (N)	μ
1	292	0.440
10	299	0.443
20	292	0.437
30	301	0.448
40	299	0.447
50	292	0.441
60	299	0.449
70	295	0.443
80	283	0.424
90	293	0.439
100	289	0.431

First Fade

Time (sec)	Force (N)	μ	Temp (°C)
0	234	0.352	99
30	253	0.379	124
60	275	0.413	152
90	300	0.449	182
120	278	0.415	208
150	282	0.423	231
180	263	0.394	251
210	262	0.390	269
240	249	0.373	286
270			
300			
330			
360			
390			
420			
450			
480			
510			
540			
570			
600			

Second Fade

Time (sec)	Force (N)	μ	Temp (°C)
0	267	0.401	98
30	288	0.431	118
60	298	0.448	140
90	307	0.459	164
120	299	0.448	186
150	298	0.445	208
180	303	0.456	230
210	301	0.448	252
240	303	0.454	269
270	293	0.436	288
300	289	0.435	303
330	244	0.364	317
360	234	0.347	327
390	236	0.352	338
420			
450			
480			
510			
540			
570			
600			

First Recovery

Event	Force (N)	μ	Temp (°C)
1	264	0.395	264
2	287	0.431	210
3	280	0.418	157
4	275	0.412	103

Second Recovery

Event	Force (N)	μ	Temp (°C)
1	240	0.356	313
2	260	0.388	262
3	277	0.413	209
4	300	0.451	157
5	290	0.431	102



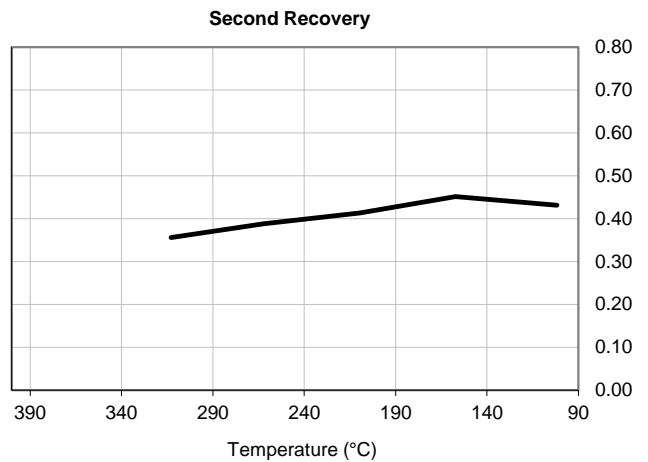
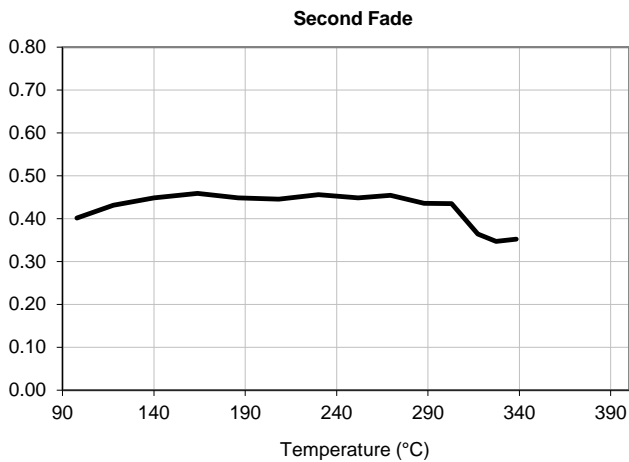
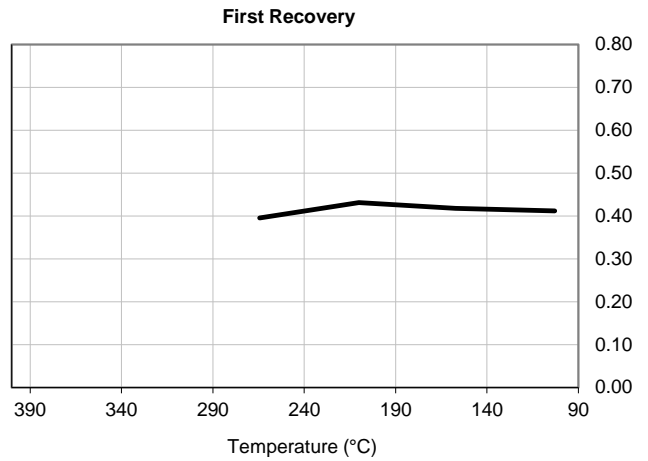
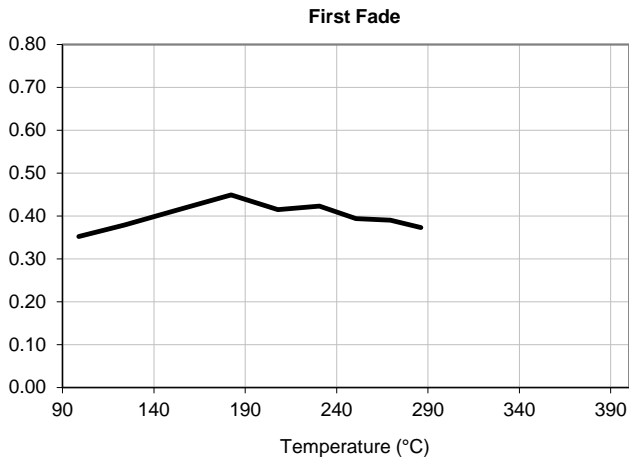
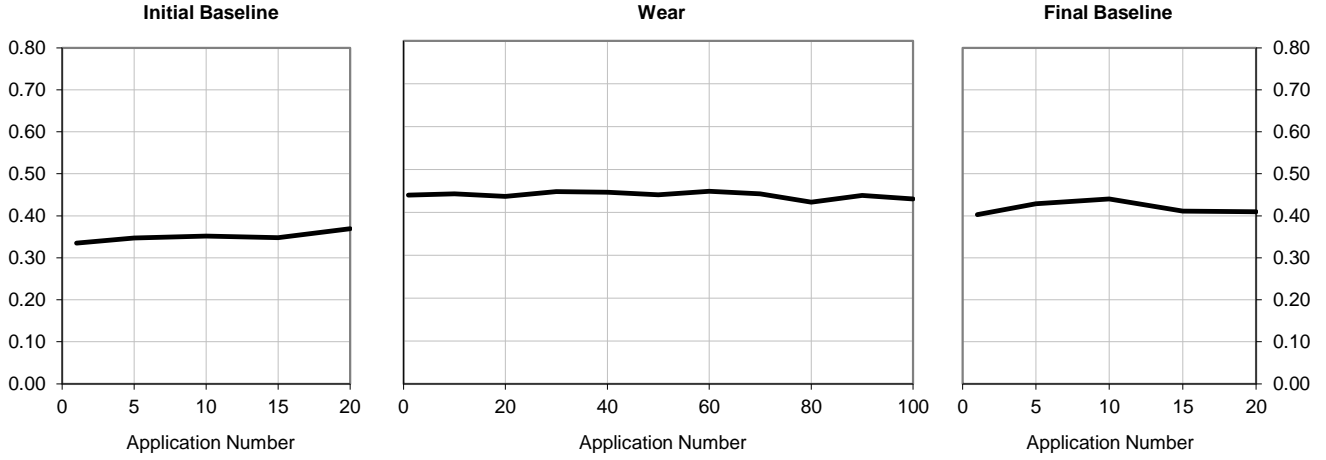
Test Number
143947-1

Customer Reference
ECX888X0934

Manufacturer: HARDEX BRAKES
Material: ECX888X0934
Test Pressure: 1034.21 kPa

9/10/2014
143947-A3
Sample 1 of 5

Coefficient of Friction





Test Number
143947-1

Customer Reference
ECX888X0934

Manufacturer: HARDEX BRAKES
Material: ECX888X0934
Test Pressure: 1034.21 kPa

Normal **0.426**
Hot **0.396**

F
F

9/10/2014
143947-A4
Sample 2 of 5

Wear

	Initial	Final	Loss		Specific Wear	
Weight (gr)	9.219	8.822	0.397	4%	2.27E-01	gr/kWh
Thickness (cm)	0.648	0.62	0.028	4%	1.03E-01	cm ³ /kWh

Baseline

Event	Initial		Final	
	Force (N)	μ	Force (N)	μ
1	240	0.358	264	0.394
5	230	0.344	256	0.382
10	225	0.338	266	0.398
15	225	0.338	263	0.394
20	218	0.329	263	0.394

Wear

Event	Force (N)	μ
1	298	0.444
10	303	0.455
20	281	0.421
30	278	0.416
40	290	0.436
50	285	0.425
60	281	0.420
70	285	0.427
80	290	0.434
90	292	0.440
100	275	0.409

First Fade

Time (sec)	Force (N)	μ	Temp (°C)
0	205	0.307	98
30	226	0.339	122
60	260	0.387	149
90	280	0.421	177
120	289	0.432	204
150	291	0.439	228
180	287	0.428	252
210	292	0.438	272
240			
270			
300			
330			
360			
390			
420			
450			
480			
510			
540			
570			
600			

Second Fade

Time (sec)	Force (N)	μ	Temp (°C)
0	263	0.395	99
30	287	0.430	119
60	290	0.433	142
90	293	0.444	164
120	285	0.425	186
150	289	0.431	207
180	282	0.419	225
210	281	0.420	245
240	282	0.421	264
270	279	0.415	279
300	260	0.390	294
330	238	0.357	307
360	238	0.356	318
390	232	0.347	330
420	227	0.341	341
450			
480			
510			
540			
570			
600			

First Recovery

Event	Force (N)	μ	Temp (°C)
1	278	0.418	263
2	293	0.440	210
3	289	0.431	159
4	279	0.419	104

Second Recovery

Event	Force (N)	μ	Temp (°C)
1	242	0.364	316
2	242	0.362	259
3	262	0.392	211
4	270	0.406	157
5	263	0.395	103



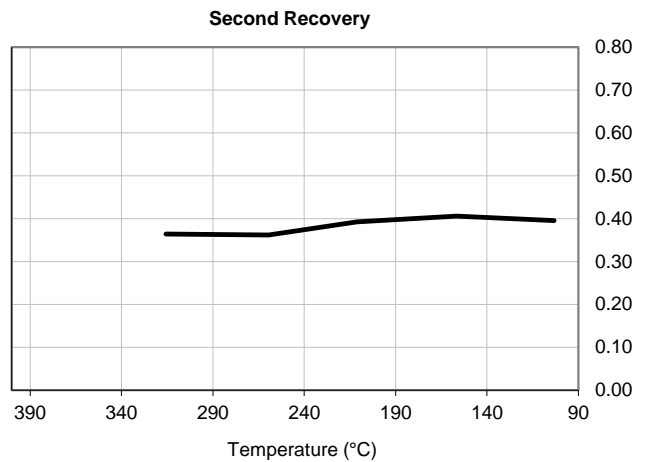
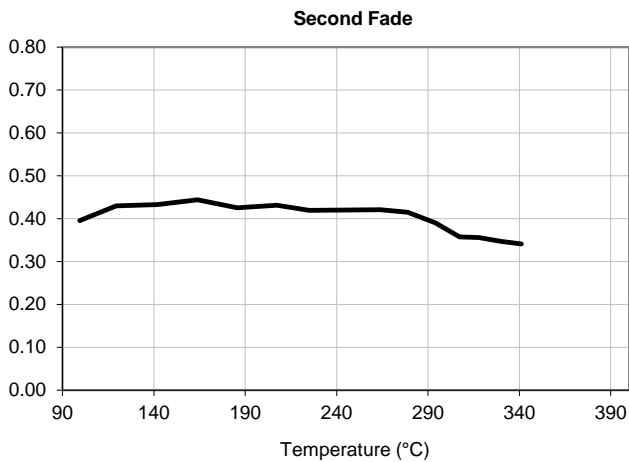
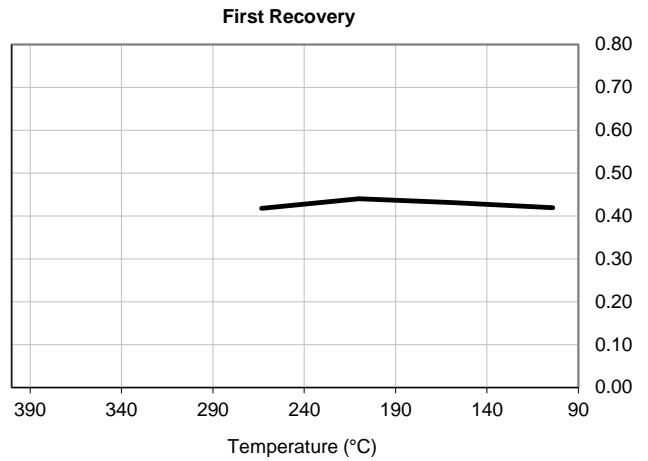
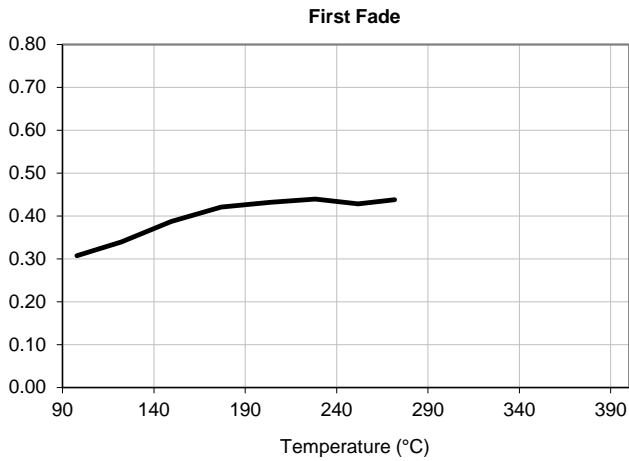
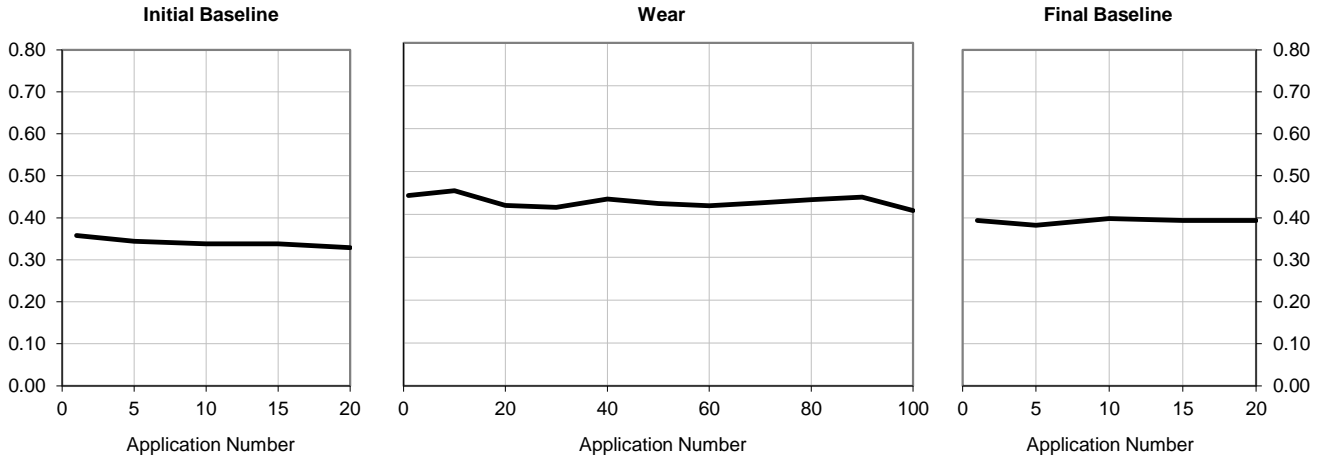
Test Number
143947-1

Customer Reference
ECX888X0934

Manufacturer: HARDEX BRAKES
Material: ECX888X0934
Test Pressure: 1034.21 kPa

9/10/2014
143947-A4
Sample 2 of 5

Coefficient of Friction





Test Number
143947-1

Customer Reference
ECX888X0934

Manufacturer: HARDEX BRAKES
Material: ECX888X0934
Test Pressure: 1034.21 kPa

Normal **0.425** **F**
Hot **0.401** **F**

9/10/2014
143947-A5
Sample 3 of 5

Wear

	Initial	Final	Loss		Specific Wear	
Weight (gr)	9.159	8.731	0.428	5%	2.39E-01	gr/kWh
Thickness (cm)	0.645	0.617	0.028	4%	1.01E-01	cm ³ /kWh

Baseline

Event	Initial		Final	
	Force (N)	μ	Force (N)	μ
1	208	0.314	254	0.380
5	225	0.336	254	0.381
10	228	0.340	258	0.387
15	239	0.356	259	0.390
20	242	0.364	267	0.400

Wear

Event	Force (N)	μ
1	290	0.435
10	299	0.452
20	292	0.440
30	292	0.438
40	296	0.440
50	298	0.450
60	287	0.430
70	299	0.446
80	290	0.432
90	299	0.447
100	299	0.448

First Fade

Time (sec)	Force (N)	μ	Temp (°C)
0	232	0.347	97
30	251	0.378	122
60	265	0.398	151
90	295	0.443	179
120	291	0.436	206
150	290	0.434	227
180	281	0.422	248
210	255	0.381	265
240	236	0.353	280
270			
300			
330			
360			
390			
420			
450			
480			
510			
540			
570			
600			

Second Fade

Time (sec)	Force (N)	μ	Temp (°C)
0	264	0.392	98
30	281	0.422	117
60	291	0.432	141
90	306	0.455	163
120	301	0.445	186
150	295	0.443	208
180	292	0.442	229
210	304	0.455	250
240	291	0.435	269
270	275	0.412	285
300	258	0.387	299
330	242	0.361	311
360	231	0.348	322
390	226	0.338	332
420			
450			
480			
510			
540			
570			
600			

First Recovery

Event	Force (N)	μ	Temp (°C)
1	239	0.358	263
2	274	0.412	211
3	296	0.445	157
4	270	0.407	105

Second Recovery

Event	Force (N)	μ	Temp (°C)
1	233	0.347	311
2	247	0.370	262
3	246	0.370	209
4	277	0.412	156
5	271	0.405	102



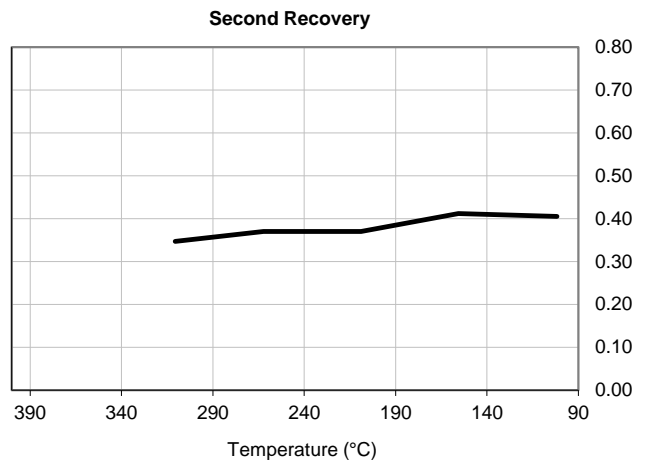
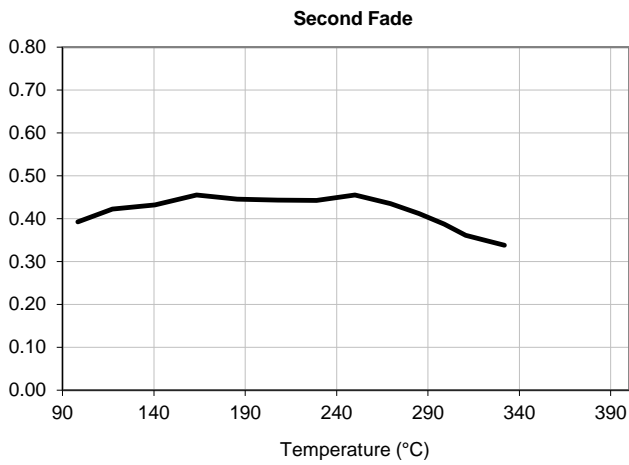
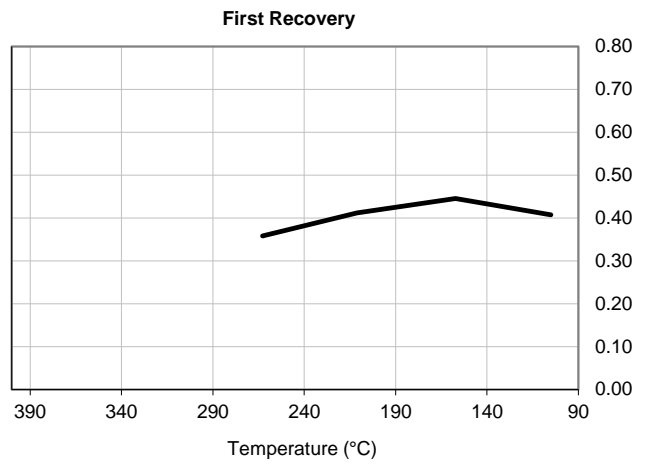
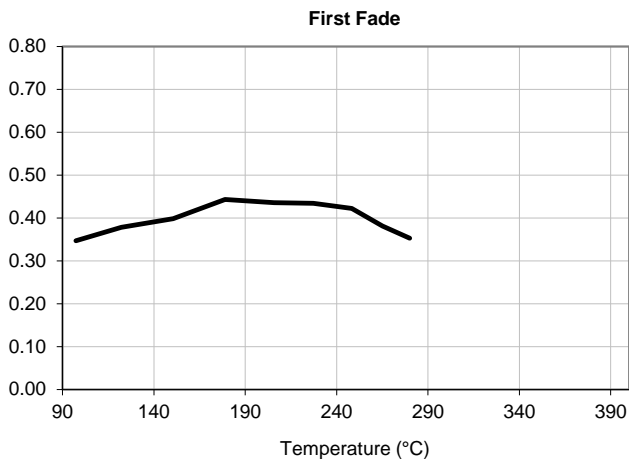
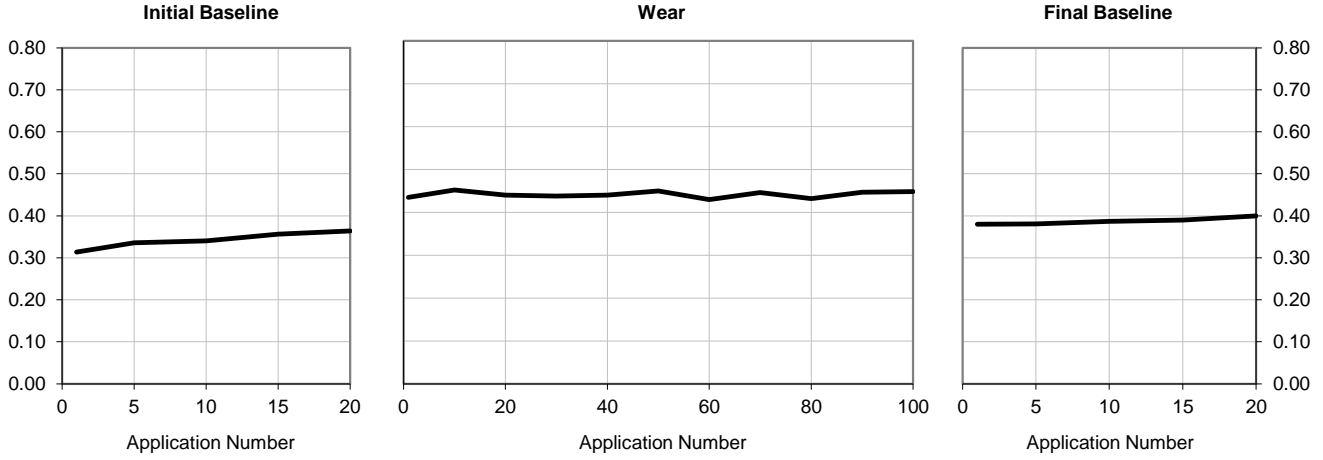
Test Number
143947-1

Customer Reference
ECX888X0934

Manufacturer: HARDEX BRAKES
Material: ECX888X0934
Test Pressure: 1034.21 kPa

9/10/2014
143947-A5
Sample 3 of 5

Coefficient of Friction





Test Number
143947-1

Customer Reference
ECX888X0934

Manufacturer: HARDEX BRAKES
Material: ECX888X0934
Test Pressure: 1034.21 kPa

Normal **0.436** **F**
Hot **0.415** **F**

9/11/2014
143947-A6
Sample 4 of 5

Wear

	Initial	Final	Loss		Specific Wear	
Weight (gr)	8.757	8.284	0.473	5%	2.59E-01	gr/kWh
Thickness (cm)	0.635	0.605	0.03	5%	1.06E-01	cm ³ /kWh

Baseline

Event	Initial		Final	
	Force (N)	μ	Force (N)	μ
1	210	0.313	298	0.448
5	236	0.354	314	0.471
10	241	0.364	327	0.488
15	259	0.389	320	0.481
20	251	0.374	324	0.485

Wear

Event	Force (N)	μ
1	287	0.430
10	297	0.447
20	285	0.425
30	292	0.435
40	292	0.437
50	291	0.434
60	291	0.440
70	289	0.435
80	299	0.446
90	303	0.452
100	288	0.433

First Fade

Time (sec)	Force (N)	μ	Temp (°C)
0	242	0.363	98
30	250	0.379	124
60	269	0.402	151
90	287	0.430	177
120	286	0.429	201
150	287	0.430	226
180	282	0.422	244
210	274	0.410	265
240	279	0.417	282
270			
300			
330			
360			
390			
420			
450			
480			
510			
540			
570			
600			

Second Fade

Time (sec)	Force (N)	μ	Temp (°C)
0	284	0.425	98
30	295	0.442	121
60	291	0.435	143
90	287	0.431	163
120	288	0.429	184
150	285	0.428	203
180	291	0.434	225
210	305	0.462	247
240	296	0.448	268
270	275	0.411	283
300	265	0.396	298
330	242	0.363	312
360	238	0.357	320
390	231	0.344	329
420			
450			
480			
510			
540			
570			
600			

First Recovery

Event	Force (N)	μ	Temp (°C)
1	296	0.443	263
2	318	0.478	208
3	302	0.451	157
4	295	0.443	102

Second Recovery

Event	Force (N)	μ	Temp (°C)
1	232	0.347	315
2	248	0.373	258
3	262	0.394	208
4	269	0.404	157
5	305	0.458	101



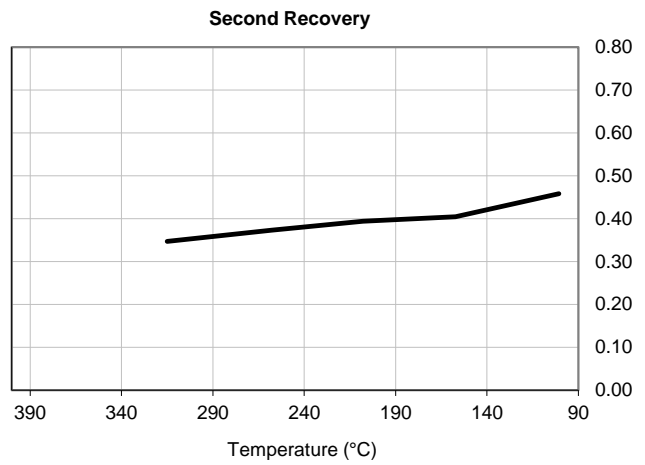
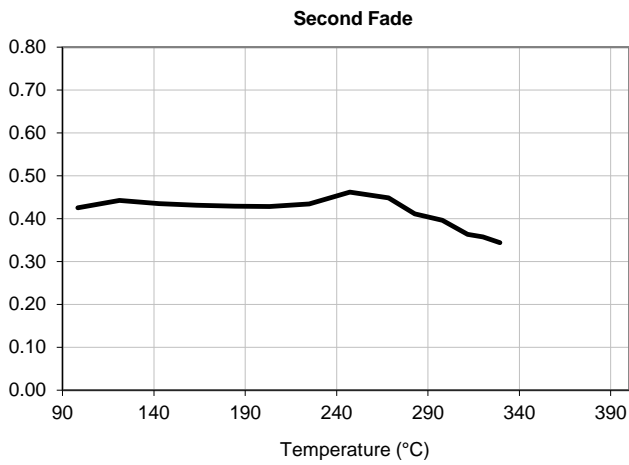
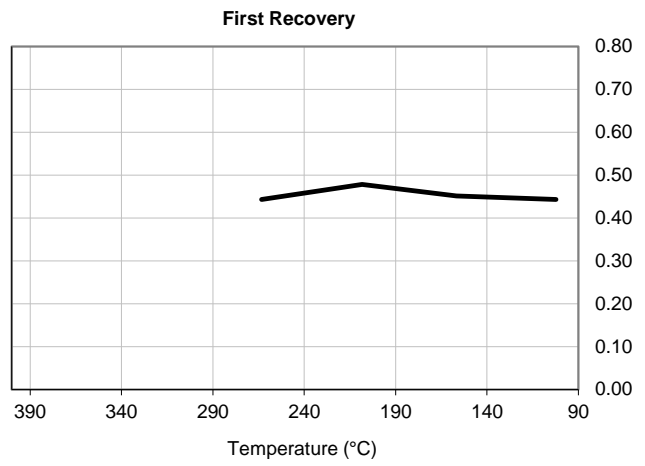
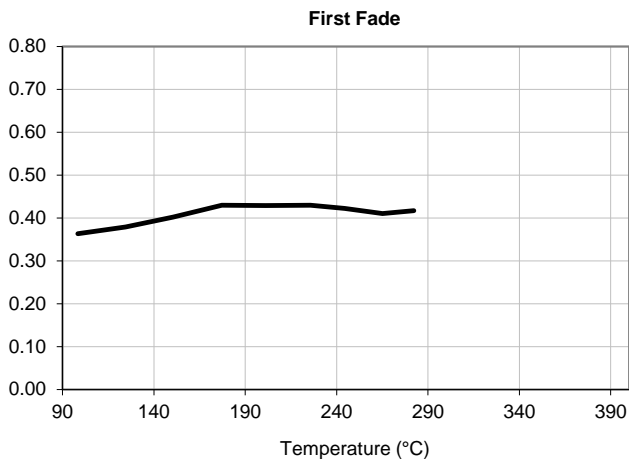
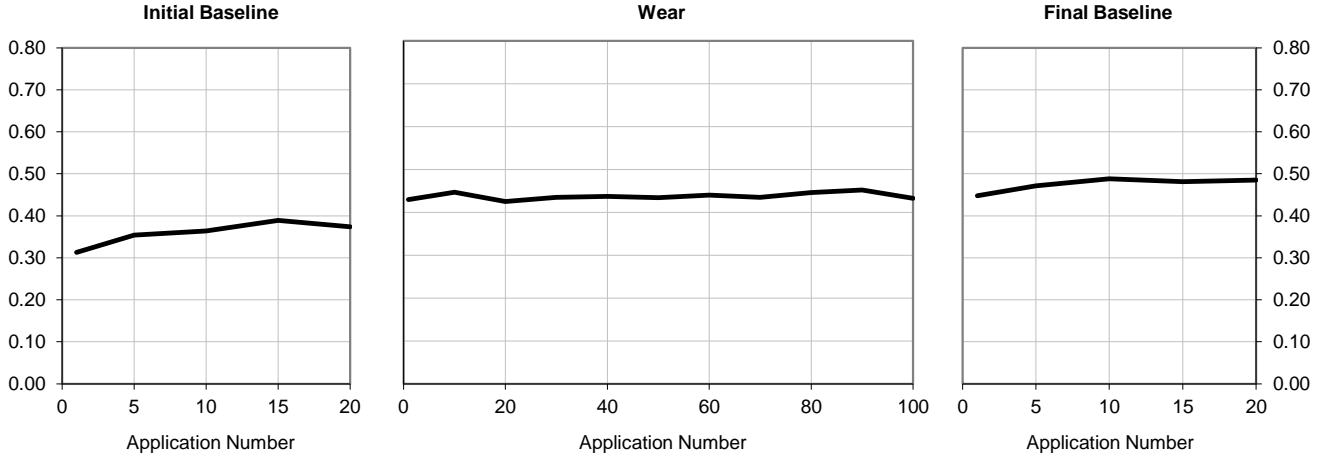
Test Number
143947-1

Customer Reference
ECX888X0934

Manufacturer: HARDEX BRAKES
Material: ECX888X0934
Test Pressure: 1034.21 kPa

9/11/2014
143947-A6
Sample 4 of 5

Coefficient of Friction





Test Number
143947-1

Customer Reference
ECX888X0934

Manufacturer: HARDEX BRAKES
Material: ECX888X0934
Test Pressure: 1034.21 kPa

Normal **0.444** **F**
Hot **0.415** **F**

9/11/2014
143947-A7
Sample 5 of 5

Wear

	Initial	Final	Loss		Specific Wear	
Weight (gr)	8.32	7.871	0.449	5%	2.48E-01	gr/kWh
Thickness (cm)	0.638	0.605	0.033	5%	1.17E-01	cm ³ /kWh

Baseline

Event	Initial		Final	
	Force (N)	μ	Force (N)	μ
1	222	0.334	262	0.395
5	243	0.365	261	0.395
10	253	0.378	271	0.407
15	258	0.386	264	0.394
20	261	0.390	267	0.403

Wear

Event	Force (N)	μ
1	298	0.441
10	299	0.445
20	285	0.430
30	289	0.432
40	293	0.439
50	295	0.444
60	291	0.435
70	298	0.446
80	286	0.428
90	289	0.432
100	294	0.443

First Fade

Time (sec)	Force (N)	μ	Temp (°C)
0	250	0.374	98
30	270	0.406	126
60	292	0.439	156
90	319	0.473	182
120	315	0.472	209
150	301	0.451	232
180	298	0.443	252
210	297	0.445	273
240			
270			
300			
330			
360			
390			
420			
450			
480			
510			
540			
570			
600			

Second Fade

Time (sec)	Force (N)	μ	Temp (°C)
0	287	0.429	98
30	297	0.444	119
60	303	0.453	143
90	305	0.459	164
120	294	0.437	187
150	292	0.438	208
180	299	0.448	227
210	307	0.460	248
240	317	0.476	268
270	288	0.433	286
300	301	0.454	303
330	262	0.395	316
360	250	0.374	327
390	243	0.362	337
420			
450			
480			
510			
540			
570			
600			

First Recovery

Event	Force (N)	μ	Temp (°C)
1	296	0.442	263
2	297	0.445	211
3	290	0.435	157
4	284	0.426	102

Second Recovery

Event	Force (N)	μ	Temp (°C)
1	251	0.374	313
2	251	0.377	258
3	270	0.405	209
4	266	0.399	155
5	271	0.407	101



Test Number
143947-1

Customer Reference
ECX888X0934

Manufacturer: HARDEX BRAKES
Material: ECX888X0934
Test Pressure: 1034.21 kPa

9/11/2014
143947-A7
Sample 5 of 5

Coefficient of Friction

