



Test Request #:
111381-1

Link Testing Laboratories, Inc.
Brake Dynamometer Testing

Customer Ref.:
4515 - HARDEX

Test Description:

TP121D PERFORMANCE TEST

Customer:

HARDEX BRAKES LTD.
1035 CROOKS ROAD

TROY, MI 48084
USA

Testing Facility, and Report Prepared By:

LINK TESTING LABORATORIES
13840 ELMIRA AVE.

DETROIT, MI 48227
USA

Requested By:

HARRY D

Test Coordinator:

ST. AUBIN, TERRY

Test Information

Test Procedure:

RP-628 FMVSS-121

Link Control Program:

W05002A0

Date Test Parts Rec'd / Started / Completed:

N/A / 04/23/11 / 04/24/11

Brake Name:

MERITOR TRAILER

Datalog/Report Version:

2.81

Brake A Test Conditions

Gross Axle Weight:

N/A

Gross Vehicle Weight:

N/A

Required / Actual Wheel Load:

11,500.0 / 11,514.4 lb

Required / Actual Inertia:

953.50 / 955.20 slug-ft²

Rolling Radius:

19.6 in

Brake Orientation:

LEFT

Dynamometer:

65

Brake Type:

AIR

Axle Position:

TRAILER

Brake/Fixture Information

Brake Part ID:

N/A

Brake Condition/Description:

N/A

Air Chamber:

TYPE 30/30

Brake Hose Part Number:

N/A

Fixture ID / Fixture Design:

97T019 / CV TRAILER

Brake Size:

16.5 x 7

Brake Type:

DRUM

Slack Adjuster:

5.5"HALDEX AUTOMATIC

Rotor/Drum/Lining Information

Rotor/Drum Type:

CAST

Rotor/Drum Number:

WEBB 66864

Rotor/Drum Finish:

NEW

Pri/Lead/Inner Lining:

4515-HARDEX

Pri/Lead/Inner FMSI:

4515

Insulator Type/Size (Pri/Lead/Inner):

N/A

Chamfer Type/Size (Pri/Lead/Inner):

N/A

Additional Comments (Pri/Lead/Inner):

N/A

Sec/Trail/Outer Lining:

4515-HARDEX

Sec/Trail/Outer Lining FMSI:

4515

Insulator Type/Size (Sec/Trail/Outer):

N/A

Chamfer Type/Size (Sec/Trail/Outer):

N/A

Additional Comments (Sec/Trail/Outer):

N/A

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.



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Stop Num	Brake Speed mph	Rel. Speed mph	Stop Time sec	Avg Decel (time) fpsps	Min Torq. lb-ft	Avg Torq. (time) lb-ft	Max Torq. lb-ft	Min Press psi	Avg Press (time) psi	Max Press psi	Min Stroke in	Avg Stroke (time) in	Max Stroke in	Init Lead F	Final Lead F	Init Drum F	Final Drum F
Burnish																	
1	40.0	0.5	5.83	9.94	5841	6283	6860	48.5	57.3	70.9	1.61	1.72	1.89	350	383	544	592
10	40.0	0.5	5.77	10.05	5519	6275	7133	31.7	43.3	57.9	1.26	1.42	1.58	351	384	464	550
20	40.0	0.5	5.74	10.11	5613	6292	7063	33.7	41.2	52.2	1.13	1.26	1.40	351	384	464	550
30	40.1	0.5	5.78	10.06	5712	6253	7281	31.9	40.8	54.5	1.14	1.28	1.43	350	387	467	551
40	40.1	0.5	5.77	10.08	5487	6255	7149	30.3	39.8	54.6	1.18	1.31	1.45	350	388	463	552
50	40.0	0.5	5.78	10.04	5598	6252	6995	31.8	38.9	52.0	1.21	1.33	1.49	348	387	463	553
60	40.0	0.5	5.77	10.04	5611	6252	7046	31.4	38.3	52.3	1.22	1.35	1.48	354	389	469	554
70	40.0	0.5	5.77	10.06	5464	6260	7012	31.7	38.6	52.5	1.26	1.38	1.50	350	390	468	556
80	40.0	0.5	5.77	10.05	5403	6253	7125	28.9	37.1	52.3	1.24	1.39	1.51	351	390	468	562
90	40.1	0.5	5.78	10.06	5319	6254	7171	28.4	37.0	53.3	1.25	1.41	1.53	350	394	468	566
100	40.0	0.5	5.76	10.07	5316	6257	7044	28.2	37.0	52.2	1.29	1.42	1.55	351	395	469	574
110	40.1	0.5	5.78	10.06	5271	6223	7136	26.4	35.6	49.3	0.95	1.11	1.26	351	397	456	556
120	40.0	0.5	5.80	10.00	5382	6216	6992	26.0	35.7	47.4	0.98	1.14	1.31	349	397	456	555
130	40.1	0.5	5.79	10.04	5323	6214	7113	23.6	35.2	50.1	0.98	1.16	1.30	350	400	461	560
140	40.1	0.5	5.79	10.04	5200	6214	7203	23.2	35.7	49.7	1.03	1.20	1.35	352	404	464	562
150	40.1	0.5	5.80	10.02	4489	6206	7432	21.1	34.6	50.2	0.99	1.22	1.37	352	407	465	565
160	40.1	0.5	5.81	10.02	4614	6197	7335	21.6	34.3	50.6	1.04	1.26	1.39	350	407	466	564
170	40.1	0.5	5.79	10.05	4346	6194	7398	20.7	33.8	50.5	1.05	1.29	1.45	351	407	466	566
180	40.1	0.5	5.79	10.04	4470	6190	7492	20.3	34.9	51.1	1.08	1.32	1.46	349	408	469	575
190	40.0	0.5	5.79	10.02	4878	6207	7099	23.1	35.1	47.8	1.15	1.34	1.54	350	407	469	574
200	40.1	0.5	5.81	10.02	4491	6194	7454	20.4	34.7	51.0	1.13	1.36	1.50	350	408	473	574
210	40.2	0.5	5.84	9.98	5613	6190	7081	36.0	57.7	77.7	1.55	1.80	2.07	500	542	674	756
220	40.0	0.5	5.83	9.94	5523	6200	6743	34.1	45.9	68.8	1.50	1.67	1.95	501	543	658	745
230	40.1	0.5	5.83	9.97	4993	6188	7390	26.7	44.5	64.7	1.50	1.70	1.93	498	552	668	746
240	40.0	0.5	5.81	9.99	5667	6206	7204	32.2	43.0	60.2	1.06	1.21	1.43	501	551	650	746
250	40.0	0.5	5.81	9.98	5660	6209	6758	34.2	43.0	61.5	1.11	1.24	1.49	500	551	640	734
260	40.0	0.5	5.82	9.97	5475	6201	6995	27.5	42.2	60.3	1.12	1.29	1.50	500	551	649	736
270	40.1	0.5	5.81	10.02	4916	6189	7492	24.2	41.0	58.0	1.12	1.33	1.54	499	552	649	745
280	40.0	0.5	5.81	9.98	5228	6192	7147	26.0	41.4	62.8	1.18	1.37	1.63	500	553	659	749
290	39.9	0.5	5.80	9.96	5594	6206	6909	30.4	41.3	59.5	1.10	1.24	1.47	501	554	649	739
300	40.1	0.5	5.83	9.97	5007	6192	7442	24.9	40.2	58.5	1.11	1.30	1.51	500	554	652	747
310	40.1	0.5	5.80	10.03	4984	6187	7381	24.3	40.1	59.7	1.16	1.37	1.60	501	555	658	755
320	40.0	0.5	5.80	9.99	5129	6191	7395	24.2	40.3	60.2	1.22	1.42	1.66	499	556	658	751
330	40.2	0.5	5.82	10.02	4841	6185	7431	23.8	40.1	60.6	1.26	1.48	1.71	499	561	660	753
340	40.1	0.5	5.82	9.99	4929	6188	7402	25.2	41.9	61.9	1.34	1.54	1.77	499	566	659	754
350	40.0	0.5	5.82	9.97	5638	6203	6896	31.4	42.8	63.2	1.46	1.59	1.82	499	567	669	754
360	39.9	0.5	5.77	10.02	5350	6188	7169	26.4	43.4	67.1	1.46	1.64	1.87	499	572	672	765
370	40.0	0.5	5.82	9.96	5567	6201	6820	32.5	45.0	66.2	1.55	1.69	1.94	500	572	672	773
380	40.0	0.5	5.83	9.95	5402	6200	6929	35.0	44.7	68.3	1.60	1.73	2.00	502	573	670	753
390	39.9	0.5	5.85	9.89	5458	6189	7062	28.9	46.2	72.5	1.62	1.77	2.00	500	580	685	757
400	40.0	0.5	5.85	9.91	5490	6201	6873	38.4	47.5	72.4	1.67	1.82	2.07	500	581	687	773



Stop Num	Brake Speed mph	Rel. Speed mph	Stop Time sec	Avg Decel (time) fpsps	Min Torq. lb-ft	Avg Torq. (time) lb-ft	Max Torq. lb-ft	Avg Press (time) psi	Min Stroke in	Avg Stroke (time) in	Max Stroke in	Min Req'd Retard Ratio	Ret Ratio Act	Pass/Fail	Init Lead F	Final Lead F	Init Drum F	Final Drum F
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PERFORMANCE REQUIREMENT:

Retardation ratio above minimum per table below

Brake Retardation

1	50.0	0.5	20.6	3.54	1729	2083	2690	20.0	0.551	0.657	0.771	0.050	0.111	Pass	169	461	205	482
2	50.1	0.5	12.2	5.99	3185	3598	3995	30.0	0.712	0.832	0.946	0.120	0.191	Pass	170	240	212	418
3	50.1	0.5	8.8	8.30	4526	5047	5559	40.0	0.833	0.961	1.079	0.180	0.268	Pass	171	324	209	439
4	50.1	0.5	6.7	10.82	6247	6672	7120	50.0	0.958	1.082	1.204	0.250	0.355	Pass	172	366	212	385
5	49.9	0.5	5.7	12.62	7476	7897	8331	60.1	1.071	1.193	1.308	0.310	0.420	Pass	175	291	212	429
6	50.1	0.5	5.1	14.31	8582	8961	9244	70.0	1.172	1.292	1.410	0.370	0.476	Pass	170	355	212	450
7	50.1	0.5	4.5	16.20	9799	10343	10654	80.1	1.288	1.398	1.504	0.410	0.550	Pass	167	313	208	482



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Stop Num	Brake Speed mph	Rel. Speed mph	Stop Time sec	Cycle Time sec	Avg Decel (time) fpsps	Min Torq. lb-ft	Avg Torq. (time) lb-ft	Max Torq. lb-ft	Min Press psi	Avg Press (time) psi	Max Press psi	Pass/Fail	Avg Stroke (time) in	Max Stroke in	Init Lead F	Final Lead F	Init Drum F	Final Drum F
PERFORMANCE REQUIREMENT: Maximum pressure during snubs/stop of 100 psi / 690 kPa																		
Brake Power																		
1	50.0	15.0	5.63	650.7	9.12	5241	5877	6771	33.4	45.4	55.1	Pass	1.034	1.148	147	386	179	396
2	49.9	15.0	5.70	72.0	8.97	4948	5817	6725	31.3	43.5	57.5	Pass	1.111	1.224	224	375	294	534
3	50.0	15.0	5.77	72.0	8.90	4991	5822	6697	31.3	43.4	59.0	Pass	1.187	1.288	259	337	373	482
4	50.1	15.0	5.67	71.9	9.09	5363	5874	6578	32.6	43.8	56.9	Pass	1.248	1.367	283	366	416	472
5	49.9	15.0	5.66	72.0	9.03	4929	5864	6793	28.1	44.9	58.3	Pass	1.305	1.440	301	384	460	506
6	50.1	15.0	5.67	71.9	9.07	5274	5867	6587	30.0	47.1	55.2	Pass	1.365	1.502	329	419	500	549
7	49.9	15.0	5.63	72.0	9.08	5054	5856	6848	27.6	47.2	55.7	Pass	1.404	1.548	349	465	539	591
8	50.0	15.0	5.80	72.0	8.84	5340	5863	6780	30.8	50.7	57.4	Pass	1.463	1.616	375	523	572	646
9	50.1	15.0	5.75	72.0	8.95	5259	5887	6898	29.8	50.9	62.3	Pass	1.496	1.685	413	551	600	685
10	50.0	15.0	5.75	72.0	8.93	5414	5913	6877	33.8	55.9	68.0	Pass	1.572	1.769	435	565	623	705

Hot Stop																		
1	20.1	0.5	2.09	66.5	13.78	8215	9658	10676	52.2	69.2	101.1	N/A	1.758	1.969	459	501	651	675

PERFORMANCE REQUIREMENT:

Pressure within limits

	Min.	Max.
w/o Antilock	20/138	85/586
	psi/kPa	psi/kPa
w/ Antilock	12/83	85/586
	psi/kPa	psi/kPa

Recovery																		
1	30.0	0.5	3.61	122.8	11.98	6460	7645	8490	38.4	52.4	67.5	Pass	1.465	1.578	413	473	558	634
2	30.1	0.5	3.60	60.0	12.05	6805	7637	8590	33.4	50.5	68.6	Pass	1.450	1.615	413	480	556	629
3	30.1	0.5	3.62	60.0	11.99	6956	7640	8683	32.2	49.6	67.0	Pass	1.441	1.612	411	479	545	624
4	30.0	0.5	3.60	60.0	12.02	6293	7657	8350	37.2	50.9	63.7	Pass	1.439	1.541	417	469	541	615
5	30.0	0.5	3.64	60.0	11.89	6454	7653	8514	35.6	50.8	65.0	Pass	1.437	1.536	401	465	537	613
6	30.0	0.5	3.65	60.0	11.87	6655	7656	8436	35.3	49.7	64.3	Pass	1.431	1.534	402	463	529	605
7	30.0	0.5	3.60	60.0	12.04	6712	7673	8392	36.6	50.4	64.6	Pass	1.432	1.533	402	460	521	595
8	30.0	0.5	3.62	60.0	11.95	6982	7665	8604	33.4	50.3	66.4	Pass	1.434	1.546	396	461	517	588
9	30.0	0.5	3.58	60.0	12.09	6764	7700	8362	37.4	49.9	64.2	Pass	1.432	1.538	393	459	513	585
10	30.0	0.5	3.60	60.0	12.02	6664	7700	8366	37.5	49.8	63.8	Pass	1.435	1.527	387	451	503	584
11	30.1	0.5	3.64	60.0	11.92	6649	7699	8578	33.5	46.9	67.1	Pass	1.427	1.559	379	450	501	578
12	30.1	0.5	3.62	60.0	12.00	6902	7684	8668	33.0	49.7	67.0	Pass	1.440	1.567	379	449	499	574
13	30.1	0.5	3.63	59.9	11.96	6786	7722	8507	34.4	49.0	66.9	Pass	1.440	1.552	373	442	498	571
14	30.1	0.5	3.60	60.0	12.06	6783	7719	8556	34.0	48.6	67.1	Pass	1.443	1.552	372	440	498	567
15	30.1	0.5	3.57	59.9	12.16	6926	7689	8634	32.7	48.9	67.3	Pass	1.448	1.567	368	439	495	563
16	30.1	0.5	3.64	59.9	11.93	6836	7685	8673	32.3	48.7	67.6	Pass	1.450	1.575	372	439	491	563
17	30.0	0.5	3.58	60.0	12.08	6982	7690	8587	34.2	47.2	66.7	Pass	1.450	1.582	374	432	484	563
18	30.0	0.5	3.60	59.9	12.02	7057	7693	8562	34.6	47.7	66.7	Pass	1.455	1.570	365	433	487	561
19	30.1	0.5	3.62	60.0	12.01	6784	7711	8432	36.2	49.4	65.0	Pass	1.465	1.586	361	426	487	554
20	30.1	0.5	3.58	60.0	12.15	7040	7692	8595	33.3	48.7	67.7	Pass	1.465	1.601	360	426	484	549



<u>Lead/Inner</u>	<u>in</u>												Avg
	1	2	3	4	5	6	7	8	9	10	11	12	
Initial	0.792	0.875	0.900	0.853	0.785	0.638	0.633	0.780	0.857	0.899	0.875	0.795	0.807
Final	0.788	0.854	0.866	0.825	0.752	0.633	0.616	0.739	0.824	0.867	0.867	0.799	0.786
Loss	0.004	0.021	0.034	0.028	0.033	0.005	0.017	0.041	0.033	0.032	0.008	-0.004	0.021

<u>Trail/Outer</u>	<u>in</u>												Avg
	1	2	3	4	5	6	7	8	9	10	11	12	
Initial	0.788	0.873	0.901	0.858	0.788	0.638	0.632	0.780	0.858	0.900	0.873	0.789	0.806
Final	0.791	0.860	0.875	0.846	0.775	0.640	0.637	0.787	0.860	0.877	0.857	0.777	0.798
Loss	-0.003	0.013	0.026	0.012	0.013	-0.002	-0.005	-0.007	-0.002	0.023	0.016	0.012	0.008

<u>Weight</u>	<u>Lead Shoe</u>	<u>Trail Shoe</u>	<u>Drum</u>		
	gr	gr	lb		
Initial	7581	7480	111.56		
Final	7478	7412	111.36		
Loss	103	68	0.19	Drum Runout	0.009 in

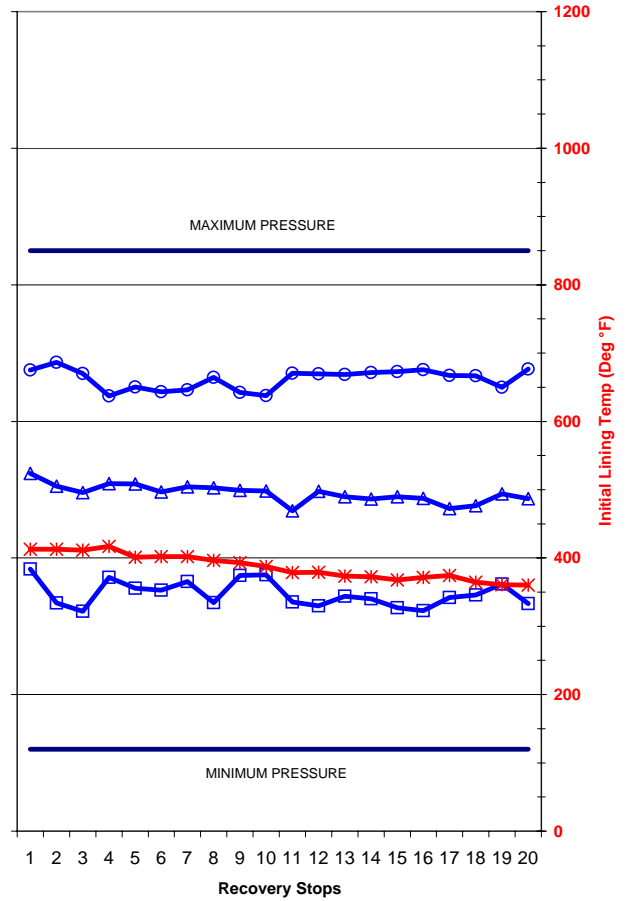
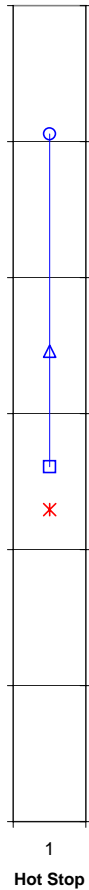
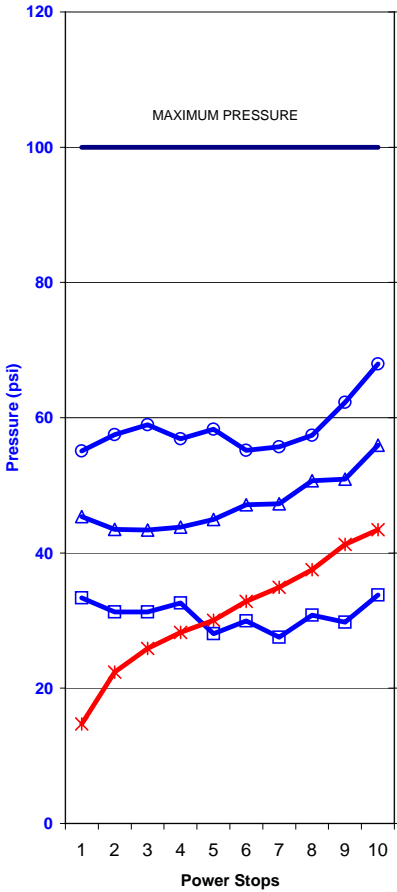
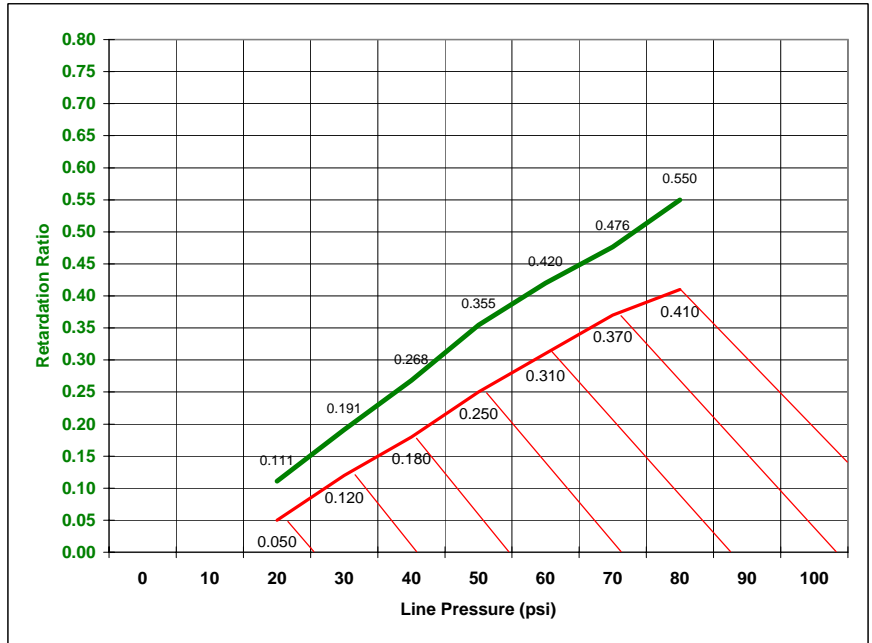
<u>Drum/Rotor Diameter</u>	<u>in</u>					
	3 equally spaced positions					
	In	Out	In	Out	In	Out
	1	2	3	4	5	6
Initial	16.509	16.510	16.507	16.506	16.508	16.509
Final	16.507	16.511	16.507	16.509	16.507	16.510
Loss	0.002	-0.001	0.000	-0.003	0.001	-0.001

<u>Surfometer</u>	<u>uinch</u>		
	3 equally spaced positions		
	1	3	5
Initial	116	129	119
Final	85	68	73



Test Request #:
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BRAKE SIZE: 16.5 x 7
 BRAKE TYPE: MERITOR TRAILER
 GAWR (lb): 0
 ROLLING RADIUS (inch): 19.6
 INNER LINING: 4515-HARDEX
 OUTER LINING: 4515-HARDEX
 AIR CHAMBER: TYPE 30/30
 SLACK ADJUSTER: 5.5"HALDEX AUTOMATIC

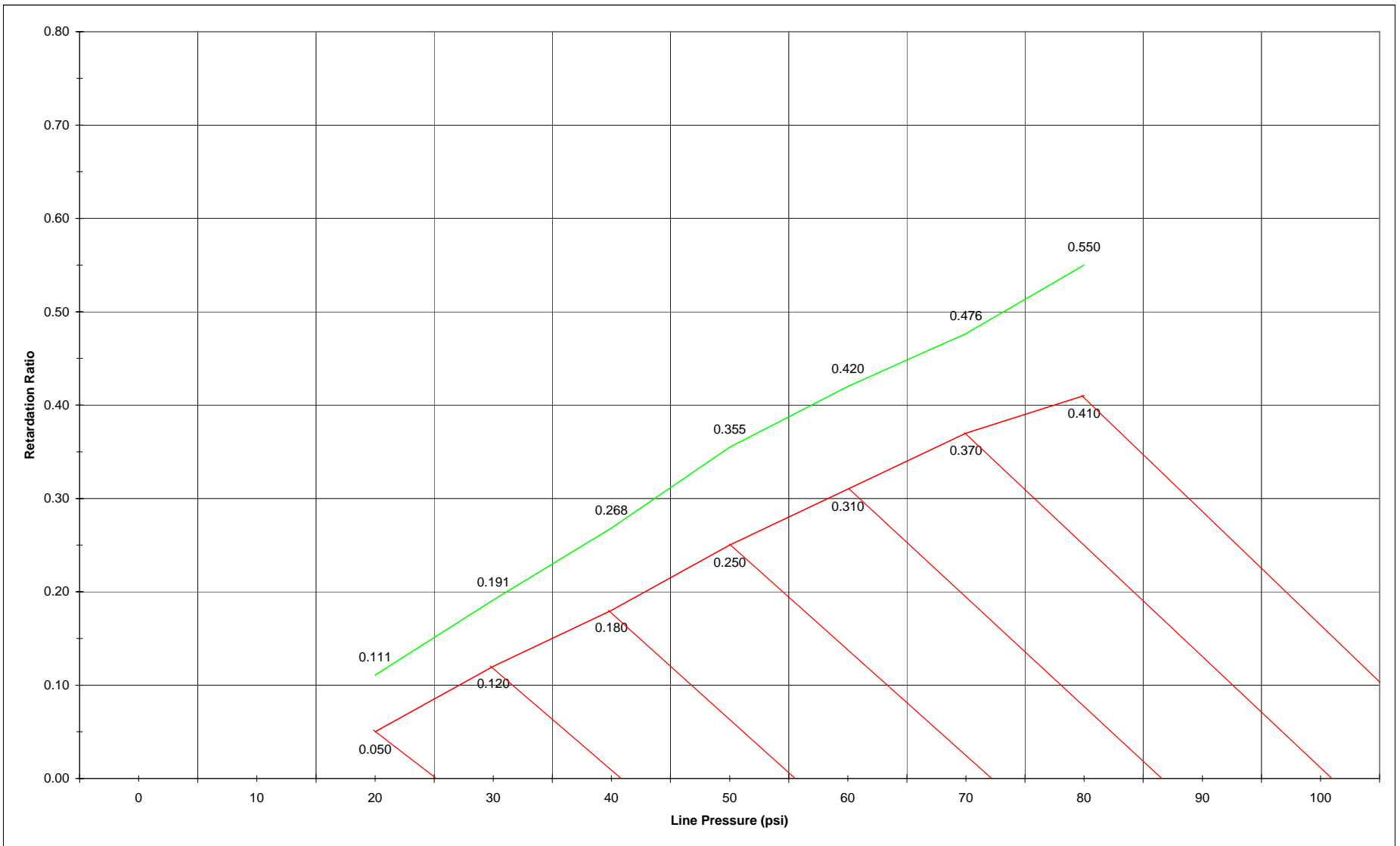


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Brake Dynamometer Testing

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Link Control Program:	W05002A0	Rolling Radius (in):	19.6	RETARDATION RATIO
Actual Wheel Load (lb):	11514.4	Slack Adjuster:	5.5"HALDEX AUTOMATIC	
Actual Inertia (slug-ft ²):	955.2	Inner Lining:	4515-HARDEX	
Brake Type:	MERITOR TRAILER	Outer Lining:	4515-HARDEX	

Test Request #: 111381-1

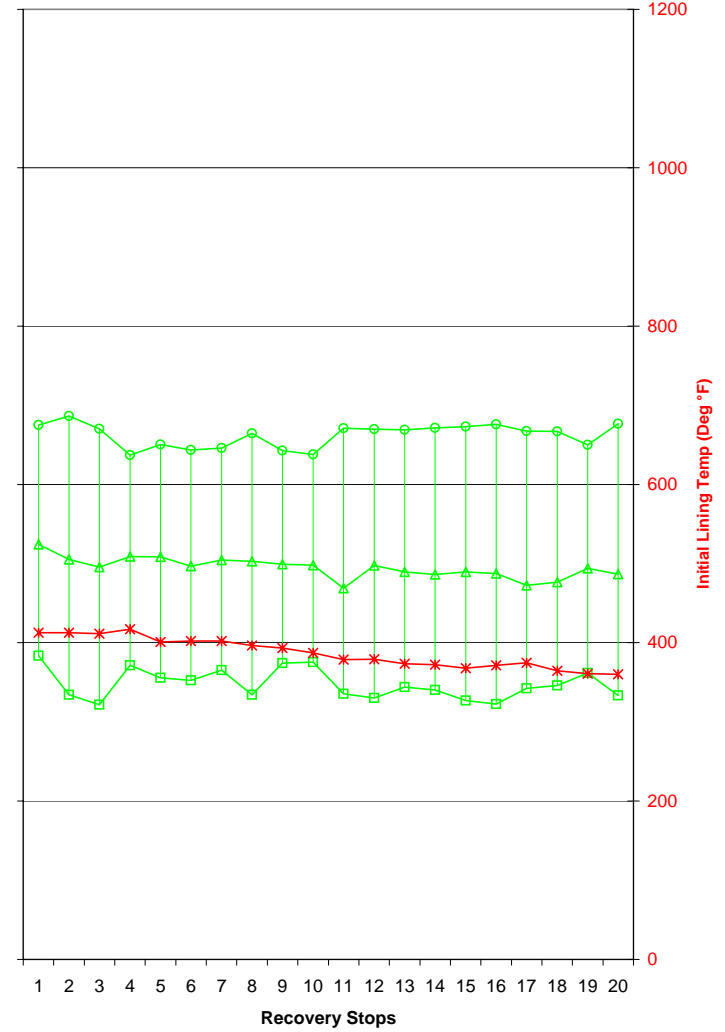
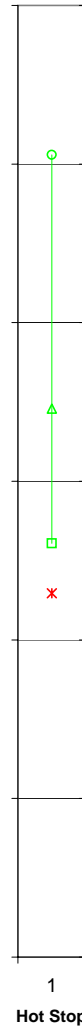
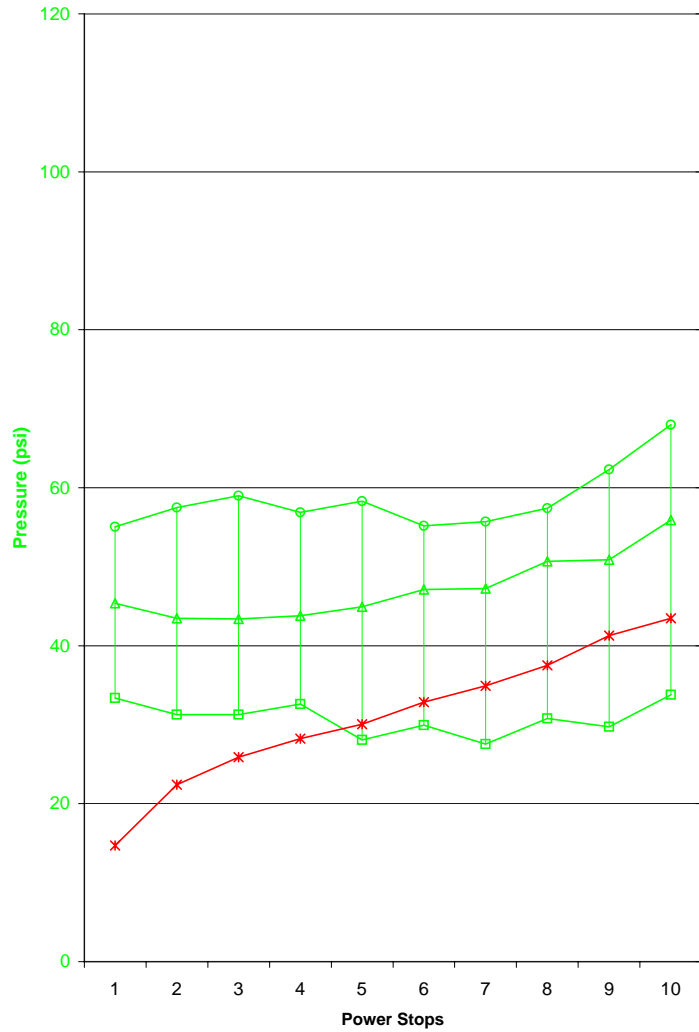


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Brake Dynamometer Testing

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LINK TESTING LABORATORIES, INC.

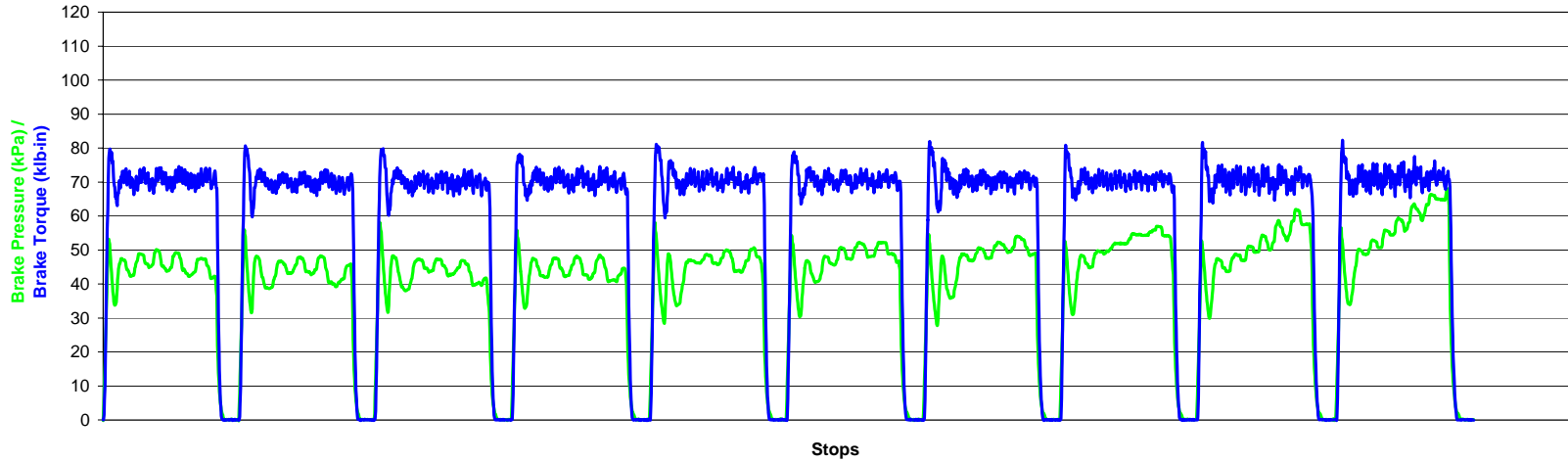
BRAKE POWER, HOT STOP & RECOVERY



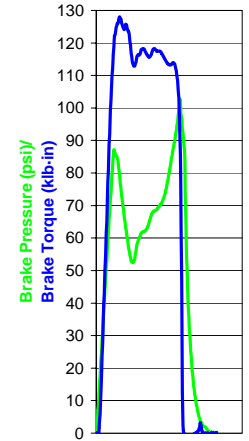
Link Control Program:	W05002A0	Rolling Radius (in):	19.6	TEMP.	— X —
Actual Wheel Load (lb):	11514.4	Slack Adjuster:	5.5"HALDEX AUTOMATIC		
Actual Inertia (slug-ft²):	955.2	Inner Lining:	4515-HARDEX		
Brake Type:	MERITOR TRAILER	Outer Lining:	4515-HARDEX		
				MIN	MAX
				AVG	



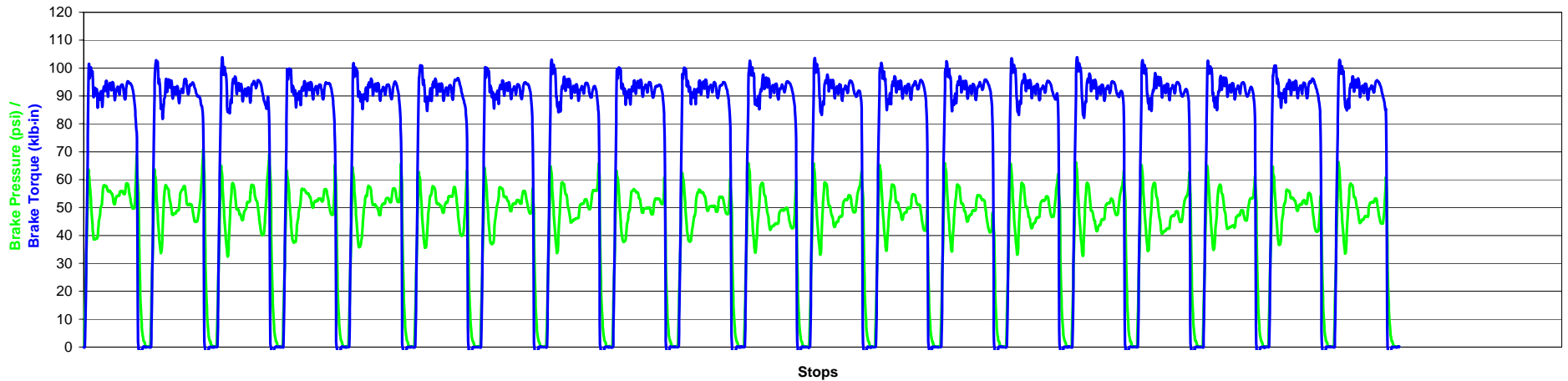
Brake Power



Hot Stop



Brake Recovery



Link Control Program:	W05002A0	Rolling Radius (inch):	19.6
Actual Wheel Load (lb):	11514	Slack Adjuster:	5.5" HALDEX AUTOMATIC
Actual Inertia (slug-ft ²):	955.2	Inner Lining:	4515-HARDEX
Brake Type:	MERITOR TRAILER	Outer Lining:	4515-HARDEX



Test Request #:
111381-1

Link Testing Laboratories, Inc.
Brake Dynamometer Testing

Customer Ref.:
4515 - HARDEX

This report has been reviewed and verified by Link Testing Laboratories, Inc.

Comments:

Unless otherwise specified, all Brakes will be assumed to have ABS

Link
Signature:

Title:
Project Engineer

Date:
April 28, 2011

Contact Information:

Name: ST. AUBIN, TERRY
Phone #: (313) 933-4900
Email:

- END OF TEST REPORT -