

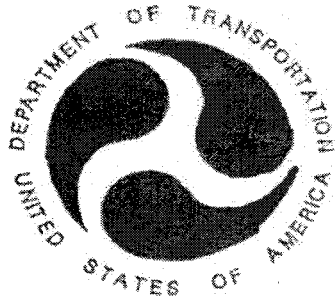
638820

REPORT NO. 121D-LTL- 06-005

SAFETY COMPLIANCE TESTING FOR FMVSS 121D
Air Brakes Systems - Dynamometer

INTERNATIONAL
2007 8600 Tractor Front
Spicer 3628522C91
NHTSA No.: C70700

LINK TESTING LABORATORIES, INC.
13840 Elmira Avenue
Detroit, MI 48227-3017



May 2, 2007

FINAL REPORT

U.S. DEPARTMENT OF TRANSPORTATION
National Highway Traffic Safety Administration
Enforcement
Office of Vehicle Safety Compliance
400 Seventh Street, SW
Room 6115 (NVS-220)
Washington, DC 20590

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Prepared By: Allen P. Nicholas

Approved By: [Signature]

Approval Date: March 29, 2007

FINAL REPORT ACCEPTANCE BY OVSC:

Accepted By: [Signature]

Acceptance Date: 5/8/07

1. REPORT NUMBER 121D-LTL- 06-005		2. GOVERNMENT ACCESSION NUMBER		3. RECIPIENT'S CATALOG NUMBER	
4. TITLE AND SUBTITLE Final Report of FMVSS 121D Compliance 2007 International 8600 Tractor Front Front Axle: Spicer 3628522C91 NHTSA No.C70700		5. REPORT DATE: 05/02/2007		6. PERFORMING ORGANIZATION CODE LTL	
7. AUTHOR(S) Carlos Agudelo, Engineering Manager Alex J. Nicholson, Associate Test Engineer		8. PERFORMING ORGANIZATION REPORT NUMBER: LTL-DOT-067452-001			
9. PERFORMING ORGANIZATION NAME AND ADDRESS Link Testing Laboratories, Inc. 13840 Elmira Avenue Detroit, Michigan 48227-3017		10. WORK UNIT NUMBER		11. CONTRACT OR GRANT NUMBER DTNH22-06-P-00017	
12. SPONSORING AGENCY NAME AND ADDRESS US Department of Transportation National Highway Traffic Safety Administration Safety Assurance Office of Vehicle Safety Compliance 400 Seventh Street, SW Mail Code: NVS-220, Room 6115 Washington, DC 20590		13. TYPE OF REPORT AND PERIOD COVER Final Test Report			
14. SPONSORING AGENCY CODE NVS-220		15. SUPPLEMENTARY NOTES			
16. ABSTRACT A compliance test was conducted on the 2007 International 8600 Tractor Front Front Axle in accordance with the specifications of the Office of Vehicle Safety Compliance Test Procedure No TP-121D-01 for the determination of FMVSS 121D compliance. Test Failures identified were as follows: None					
17. KEY WORDS Compliance Testing FMVSS 121D 2007 International 8600 4x2			18. DISTRIBUTION STATEMENT Copies of this report are available from- NHTSA Technical Reference Division Mail Code: NAD-52, Room 5108 400 Seventh Street, SW Washington, DC 20590 Telephone No.: 202-366-4946		
19. SECURITY CLASSIFICATION OF REPORT Unclassified		20. SECURITY CLASSIFICATION OF PAGE Unclassified	21. NUMBER OF PAGES 30	22. PRICE	

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SECTION I

PURPOSE OF COMPLIANCE TEST

A test was conducted on the braking performance of a 2007 INTERNATIONAL 8600 TRACTOR FRONT FRONT VIN# 1HSHWAHNX7J377874, to determine compliance with the dynamometer portion of FMVSS 121, "Air Brake Systems."

The compliance test was conducted in accordance with the National Highway Traffic Safety Administration (NHTSA), Office of Vehicle Safety Compliance (OVSC) Laboratory Test Procedure TP-121D-01 Dated May 9, 1990 and the corresponding Link Testing Laboratories, Inc. test procedure Link \ D98071A0 dated October 2, 1998.

There were no test failures.

SECTION II
TEST DATA SUMMARY

DYNAMOMETER TEST SUMMARY

S5.4.1.1 - BRAKE RETARDATION FORCE RATIO

REQUIRED		ACTUAL		PASS / FAIL
AIR PRESSURE	RETARDATION FORCE RATIO (Min)	AVERAGE AIR PRESSURE (psi)	RETARDATION FORCE RATIO	
20 psi	0.05	20	0.10	PASS
30 psi	0.12	30	0.18	PASS
40 psi	0.18	40	0.27	PASS
50 psi	0.25	50	0.35	PASS
60 psi	0.31	60	0.43	PASS
70 psi	0.37	70	0.50	PASS
80 psi	0.41	80	0.57	PASS

S5.4.2.1 - BRAKE POWER PHASE - Requirement: Max Pressure During Stops: 100 psi

SNUB	MAXIMUM AIR PRESSURE (psi)	PASS/FAIL	REMARKS
1	57	PASS	-
2	54	PASS	-
3	53	PASS	-
4	58	PASS	-
5	61	PASS	-
6	69	PASS	-
7	77	PASS	-
8	81	PASS	-
9	83	PASS	-
10	85	PASS	-

S5.4.2.1 - 20 MPH STOP

STOP	MAXIMUM AIR PRESSURE (psi)	PASS/FAIL	REMARKS
11	105	-	-

S5.4.3 - BRAKE RECOVERY - Requirement: Air Pressure (psi)

*Not applicable to steer axles per S5.4.3

	MIN	MAX
w/o antilock	20	85
w/ antilock	12	85

STOP	AIR PRESSURE (psi)		PASS / FAIL	REMARKS
	MINIMUM	MAXIMUM		
1	71	89	N/A	-
2	74	99	N/A	-
3	71	97	N/A	-
4	67	99	N/A	-
5	68	100	N/A	-
6	68	96	N/A	-
7	61	92	N/A	-
8	62	94	N/A	-
9	61	90	N/A	-
10	57	88	N/A	-
11	56	86	N/A	-
12	57	83	N/A	-
13	54	81	N/A	-
14	51	78	N/A	-
15	53	77	N/A	-
16	50	76	N/A	-
17	51	73	N/A	-
18	48	73	N/A	-
19	51	72	N/A	-
20	47	71	N/A	-

SECTION III

TEST DATA

SPECIFICATIONS

TEST NO.: 121D-LTL-06-005 DATE: 5/2/2007

VEHICLE:

MODEL YEAR/MAKE/MODEL: 2007 International 8600 Tractor Front
NHTSA NO.: C70700 VIN: 1HSHWAHNX7J377874
AXLE: Spicer 3628522C91

BRAKE ASSEMBLY:

BRAKE TYPE: Spicer
MANUFACTURER: Spicer Assy P/N: ETN0975541
DRUM SIZE: 15" X 4"
MANUFACTURER: Gunite P/N: Gunite 3721 AX
FRICTION MATERIAL: ETN 0327842
MANUFACTURER: Spicer Assy P/N: 975506 ES 450S FF SS
SLACK ADJUSTER: Auto 5.5"
MANUFACTURER: Spicer Assy P/N: ETN 0975715
AIR CHAMBER: MGM Type 20 inch Long Stroke
MANUFACTURER: MGM P/N: ZAJ1621901

TEST PARAMETERS:

TEST START: 03/16/07 DYNAMOMETER: 66
TEST COMPLETE: 03/16/07 FIXTURE: 066651-1
REQUIRED WHEEL LOAD (lb): 6,000 ROLLING RADIUS (in): 19.8
ACTUAL WHEEL LOAD (lb): 5961 ROTATION: Right
REQUIRED INERTIA (slug ft²): 507.953 COOLING AIR TEMP: 84°F
ACTUAL INERTIA (slug ft²): 504.64 COOLING AIR VELOCITY (ft/min): 2,200

REMARKS:

Cooling air velocity was manually adjusted to ensure the flow over the brake was 2,200 feet/min.

BRAKE ADJUSTMENT S6.2.6

VEHICLE MY/MAKE/MODEL: 2007 International 8600 Tractor Front

VEHICLE NHTSA NO.: C70700 DATE OF TEST: 03/16/07

SCHEDULE:

PERFORMANCE REQUIREMENT:

Brakes may be adjusted up to 3 times during the burnish procedure at intervals specified by vehicle manufactures, and may be adjusted at the conclusion of the burnishing in accordance with the vehicle manufacturer's recommendation

1st Brake Adjustment = Initial Before Burnish

2nd-4th Brake Adjustment = During Burnish

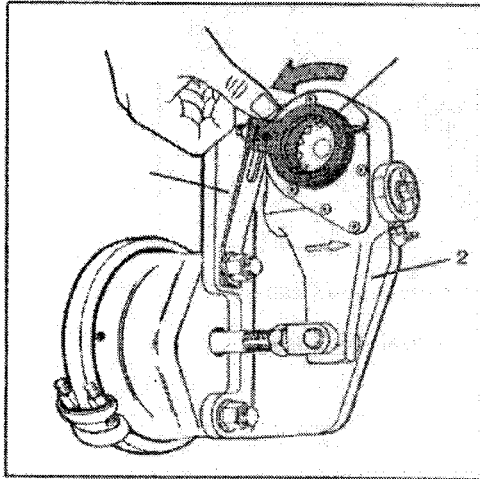
5th Brake Adjustment = Before Performance

*Refer to manual for brake adjustment on following pages.

BRAKE MANUAL FOR INSTRUCTIONS

HALDEX AUTOMATIC SLACK ADJUSTER

Refer to Figure 24 for the following procedure, steps 1 through 4.



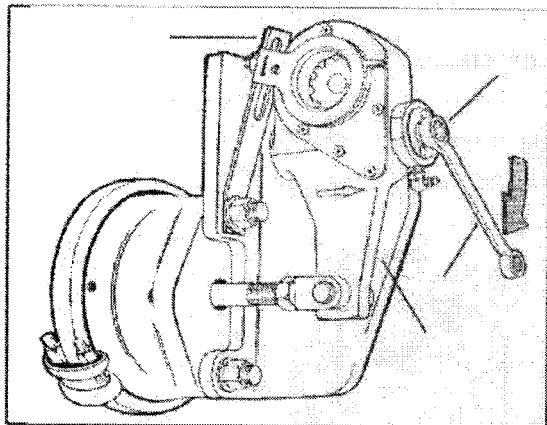
(Right click on graphics to bring up an option list)

Figure 24. Installation Of Control Arm

1. CONTROL ARM
2. AUTOMATIC SLACK ADJUSTER ASSEMBLY
3. ANCHOR BRACKET

1. Rotate the control arm away from the adjusting hex towards the air chamber, until it comes to a definite internal stop as illustrated.
2. Most adjusters will be equipped with an installation indicator. Indicator must fall within the slot for proper installation.
3. If the control position is wrong, tight brakes will occur.
4. Tighten all anchor bracket fasteners if loosened or removed. Make sure the control arm does not move while tightening the anchor bracket fasteners.

Refer to Figure 25 for steps 5 through 9.



(Right click on graphic to bring up an option list)

Figure 25. Manual Adjusting

1. HEX ADJUSTING NUT
2. WRENCH
3. AUTOMATIC SLACK ADJUSTER
4. ANCHOR BRACKET

5. The adjuster must be manually adjusted at this time.
6. Rotate the adjusting hex clockwise until the lining contacts the drum.
7. Back off the adjuster hex, turning the hex counterclockwise 1/2 turn.
8. A minimum of 13 ft-lbs. is necessary to overcome the internal clutch. A ratcheting sound will be heard.
9. **Final inspection.** With full air pressure, release spring and service brake and check that the installation indicator is within the slotted area. Remove clevis pin and check that the clevis hole and adjuster hole remain in alignment. If the air chamber push rod was pulled into the air chamber, repeat steps 1, 2 and 3. After final inspection, install cotter pin into clevis pin. Refer to *Brake Adjustment Stroke Table* for push rod stroke adjustment.
10. If spring parking brake was serviced, uncage parking brake. Refer to GROUP 04 - AIR BRAKES in the CTS-5000 Master Service Manual.
11. Remove floor stands. Road test vehicle for correct brake operation before putting vehicle back into service.



BURNISH TEST DATA S6.2.6

VEHICLE NHTSA NO.: C70700 DATE OF TEST: 03/16/07

SCHEDULE:

200 stops from 40 MPH (340 rpm) @ 10 ft/s/s, IBT
 315-385°F each stop
 200 stops from 40 mph (340 rpm) @ 10 ft/s/s, IBT
 450-550°F each stop
 Stop time: 5.78-5.96 seconds

PERFORMANCE REQUIREMENT:

None

STOP	RPM	F/M TEMP. (315-385°F)	TORQUE (lb-ft)	STOP TIME (5.78 - 5.96 sec)	AVERAGE AIR PRESSURE	REMARKS
1	339	350	3078	5.76	56	-
20	339	350	3066	5.76	64	-
40	340	350	2991	5.91	75	-
60	340	350	2931	6.04	109	-
80	339	351	3033	5.84	105	-
100	339	351	3050	5.78	68	-
101	339	351	3057	5.78	66	-
120	339	350	3070	5.76	56	-
140	339	350	3046	5.80	53	-
160	339	350	3074	5.76	56	-
180	339	350	3040	5.79	65	-
200	340	350	3087	5.76	63	-
		(450-550°F)				
201	340	391	3071	5.77	60	-
220	339	500	2702	6.50	113	-
240	339	500	3041	5.74	98	-
260	339	500	3048	5.76	86	-
280	339	499	3036	5.78	74	-
300	339	500	3058	5.76	79	-
301	339	500	3039	5.78	79	-
320	339	499	3034	5.78	78	-
340	340	500	3065	5.79	76	-
360	339	498	3057	5.78	77	-
380	339	500	3043	5.81	79	-
400	339	499	3061	5.79	82	-

Percent Shoe Contact	LEADING SHOE	97%
	TRAILING SHOE	97%

BRAKE RECOVERY S5.4.3

*Not applicable to steer axles per S5.4.3

VEHICLE NHTSA NO.: C70700 DATE OF TEST: 03/16/07

SCHEDULE:

Speed 30 mph (270 RPM)
 Deceleration at 12 ft/s/s
 @ 1 minute intervals
 Stop time = 3.52 - 3.83 seconds

PERFORMANCE REQUIREMENT:

	Min.	Max.
w/o Antilock	20 psi	85 psi
w/ Antilock	12 psi	85 psi

STOP No.	RPM	F/M TEMP. (°F)	TORQUE (lb-ft)	AIR PRESSURE (psi)		STOP TIME (sec)	PASS/ FAIL
				MINIMUM	MAXIMUM		
1	254	391	3665	71.1	89.5	3.60	
2	254	391	3671	74.1	99.2	3.59	
3	254	387	3662	71.0	96.9	3.60	
4	254	384	3707	67.4	98.8	3.57	
5	254	378	3693	67.5	100.2	3.58	
6	254	374	3670	67.8	96.1	3.60	
7	254	371	3681	60.9	92.2	3.58	
8	254	369	3698	61.6	94.0	3.58	
9	254	365	3673	61.3	90.3	3.59	
10	254	363	3706	57.1	87.6	3.57	
11	254	361	3682	56.2	86.3	3.58	
12	254	360	3673	57.2	83.2	3.59	
13	254	358	3691	54.0	80.9	3.58	
14	254	355	3679	50.9	77.5	3.59	
15	254	354	3688	52.6	77.3	3.59	
16	254	351	3682	50.3	76.2	3.59	
17	254	350	3679	51.0	73.1	3.59	
18	255	349	3713	47.5	73.3	3.58	
19	254	349	3682	51.1	72.5	3.60	
20	254	346	3671	47.3	70.6	3.60	

DATA INDICATES: N/A PASS N/A FAIL

TEST DATA PLOTS: S5.4.1, S5.4.2 AND S5.4.3

REPORT NUMBER:

LTL-DOT-067452-001

MODEL YEAR/MAKE/MODEL:

2007 International 8600 Tractor Front

AXLE:

Spicer 3628522C91

BRAKE TYPE:

Spicer

DRUM SIZE AND TYPE:

15" X 4" Gunite Gunite 3721 AX

FRICTION MATERIAL:

ETN 0327842

AIR CHAMBER:

MGM Type 20 inch Long Stroke

SLACK ADJUSTER:

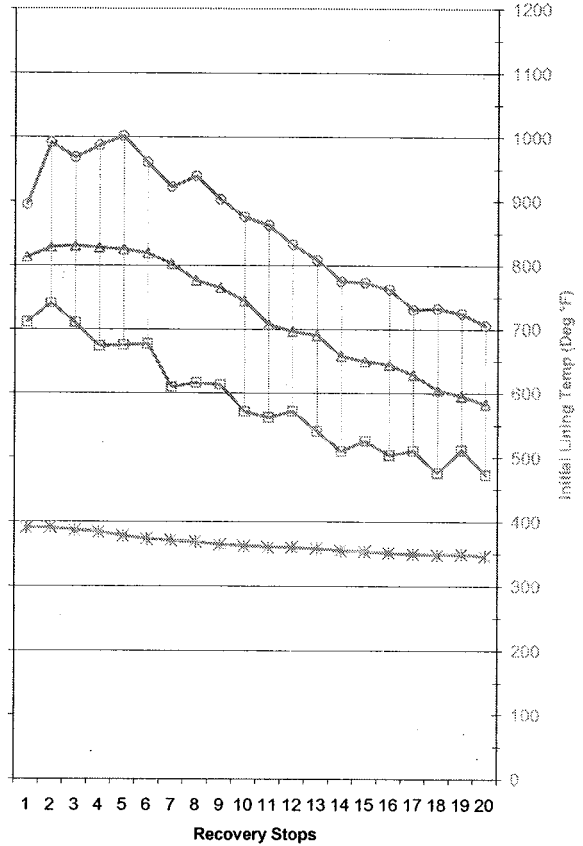
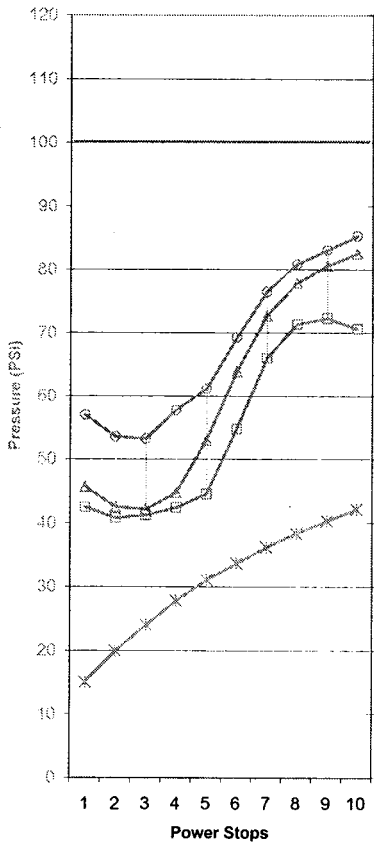
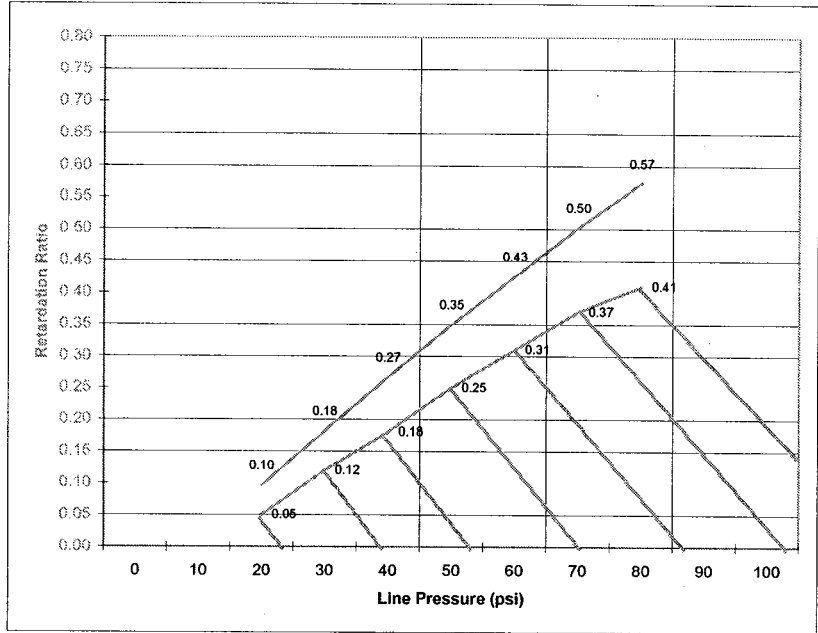
Spicer 5.5" Automatic

GAWR (lbs):

12000

ROLLING RADIUS (in):

19.8



SECTION IV
TEST EQUIPMENT AND
CALIBRATION RECORDS

Section IV - INSTRUMENTATION

Testing Equipment

Link Dynamometer No. 66

Description	Serial Number	*Calibration Date	Next Calibration Date
Torque	6827-F	1/24/2007	1/24/2008
Brake Temperature	200748-2-1	1/24/2007	1/24/2008
Air Pressure	790198	1/24/2007	1/24/2008
Stroke	30030340	1/24/2007	1/24/2008
Shaft Speed	RE9181	1/24/2007	1/24/2008
Air Velocity	0066CS	1/24/2007	1/24/2008

*Calibration By Matthew J. Curtis



Certificate of Calibration

Calibration Performed By:
 Link Testing Laboratories
 13840 Elmira Ave.
 Detroit, Mi 48227
 (313) 933-4900

Calibration Performed For:
 Link Testing Laboratories
 13840 Elmira Ave
 Detroit, Michigan 48227

Project Description: 3499-0A
 Link Work Order Number: 06D066
 Report Number: 200748-1-2007
 Certificate Number: 6827-R2007
 Calibration File Name: 06D066 - 6827-R.cal
 Calibration Date: 1/24/2007
 Next Calibration Date: 1/24/2009
 Procedure Used: 1 Torque Calibration
 Technician: M Curtis H Flynn
 Technician's Initials: M.C.

Item Description: Torque Rev
 Manufacturer: Lebow
 Condition: Good
 Serial Number: 6827-R
 Model Number: 3124-10K
 Instrument Range: 200 Kib-in
 Rated Full-Scale: 200 Kib-in
 Temperature: 72 °F
 Relative Humidity: 18 %RH
 Calibration Site: Link Facility

Calibration Standard Value (lb-ft)	Initial "As Found" Value (lb-ft)	Calibration Standard Value (lb-ft)	Final Calibrated Value (lb-ft)	Initial Percent (%) of Full Scale Range (FSR) Error	Final Percent (%) of Full Scale Range (FSR) Error
0.0	0.0	0.0	0.0	.000%	.000%
2500.0	2490.0	2500.0	2497.0	-.060%	-.030%
5000.0	5008.0	5000.0	4995.0	-.048%	-.030%
10000.0	10027.0	10000.0	10002.0	.162%	.022%
15000.0	15042.0	15000.0	15000.0	.252%	.000%

	PRE-CAL	POST-CAL
Maximum % of full-scale error observed:	0.252%	-0.030%
Maximum % of FSR error allowable (+/-):	1.000%	1.000%
Pre-Calibration Status:	Instrument met required accuracy	
Post-Calibration Status:	Instrument meets required accuracy	

Technical Comments:

The reported expanded uncertainty of measurement is stated as the standard uncertainty multiplied by the coverage factor ($k=2$), which for a normal distribution corresponds to a coverage probability of 95%. The data contained in this document is applicable only to the above listed equipment and is not valid unless signed by the technician. Measurement standards used for this test are traceable to the National Institute of Standards and Technology. This document shall not be reproduced without the written approval of Link Testing Laboratories.

Calibration Equipment Utilized:

Ref #	Description	Serial Number	Range	Accuracy	Uncertainty	Last Cal	Cal Due
REF 3	DISPLAY MODULE	11160-3	9999 COUNTS	±0.03%	INCLUDED COUNTS	11/28/06	12/20/06
REF 10	LOAD CELL 5000 LB	97781	5000 LB	±0.025%	±0.05 %FSR	11/16/06	12/20/06

Total Measurement Uncertainty: (±) ERROR: Missing Length and/or Force

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 Detroit, Mi 48227
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Calibration Performed For:
 Link Testing Laboratories
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 Detroit, Michigan 48227

Project Description: 3499-DA
 Link Work Order Number: 06D066
 Report Number: 200748-1-2007
 Certificate Number: RE91812007
 Calibration File Name: 06D066 - RE9181.cal
 Calibration Date: 1/24/2008
 Next Calibration Date: 1/24/2009
 Procedure Used: 3 Rotational Speed Calibration
 Technician: M Curtis H Flynn
 Technician's Initials: M.C.

Item Description: Shaft Speed
 Manufacturer: Lake Shore
 Condition: Good
 Serial Number: RE9181
 Model Number: RMTACH8500
 Instrument Range: 1200 RPM
 Rated Full Scale: 1200 RPM
 Temperature: 72 °F
 Relative Humidity: 18 %RH
 Calibration Site: Link Facility

Calibration Standard Value (RPM)	Initial "As Found" Value (RPM)	Calibration Standard Value (RPM)	Final Calibrated Value (RPM)	Initial Percent (%) of Full Scale Range (FSR) Error	Final Percent (%) of Full Scale Range (FSR) Error
0.0	0.0	0.0	0.0	.000%	.000%
50.0	50.0	50.0	50.0	.000%	.000%
350.0	350.0	350.0	350.0	.000%	.000%
700.0	700.0	700.0	700.0	.000%	.000%
950.0	950.0	950.0	950.0	.000%	.000%

	PRE-CAL	POST-CAL
Maximum % of full-scale error observed	0.000%	0.000%
Maximum % of FSR error allowable (+/-)	1.000%	1.000%

Pre-Calibration Status: Instrument met required accuracy
 Post-Calibration Status: Instrument meets required accuracy

Technical Comments:

The reported expanded uncertainty of measurement is stated as the standard uncertainty multiplied by the coverage factor (k=2), which for a normal distribution corresponds to a coverage probability of 95%. The data contained in this document is applicable only to the above listed equipment and is not valid unless signed by the technician. Measurement standards used for this test are traceable to the National Institute of Standards and Technology. This document shall not be reproduced without the written approval of Link Testing Laboratories.

Calibration Equipment Utilized:

Ref #	Description	Serial Number	Range	Accuracy	Uncertainty	Last Cal	Cal Due
REF-24	NON CONTACT DIGITAL TACHOMETER	447	12000 RPM	± 0.1%	± 0.1%	02/22/08	02/02/09

Total Measurement Uncertainty: (+/-) 0.0 RPM

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 (734) 453-0800 - service@linkeng.com

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 Link Testing Laboratories
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 Detroit, MI 48227
 (313) 933-4900

Calibration Performed For:
 Link Testing Laboratories
 13840 Elmira Ave.
 Detroit, Michigan 48227

Project Description: 3499-DA
 Link Work Order Number: 06D066
 Report Number: 200748-1-2007
 Certificate Number: 300303402007
 Calibration File Name: 06D066 - 30030340.cal
 Calibration Date: 1/24/2008
 Next Calibration Date: 1/24/2008
 Procedure Used: G Distance Calibration
 Technician: M Curtis-H.Flynn
 Technician's Initials: M.C.

Item Description: 2ND Stroke
 Manufacturer: Unimeasure
 Condition: Good
 Serial Number: 30030340
 Model Number: PSA-004-NJC
 Instrument Range: 10 in
 Rated Full-Scale: 10 in
 Temperature: 72 °F
 Relative Humidity: 18 %RH
 Calibration Site: Link Facility

Calibration Standard Value (in)	Initial "As Found" Value (in)	Calibration Standard Value (in)	Final Calibrated Value (in)	Initial Percent (%) of Full Scale Range (FSR) Error	Final Percent (%) of Full Scale Range (FSR) Error
0.000	0.000	0.000	0.000	.000%	.000%
1.000	1.076	1.000	1.000	.760%	.000%
2.000	2.073	2.000	2.011	.730%	.110%
3.000	2.980	3.000	2.999	-.200%	-.060%
4.000	3.928	4.000	3.986	-.720%	-.140%

	PRE-CAL	POST-CAL
Maximum % of full-scale error observed	0.760%	-0.140%
Maximum % of FSR error allowable (+/-)	1.000%	1.000%
Pre-Calibration Status:	Instrument met required accuracy	
Post-Calibration Status:	Instrument meets required accuracy	

Technical Comments:

The reported expanded uncertainty of measurement is stated as the standard uncertainty multiplied by the coverage factor (k=2), which for a normal distribution corresponds to a coverage probability of 95%. The data contained in this document is applicable only to the above listed equipment and is not valid unless signed by the technician. Measurement standards used for this test are traceable to the National Institute of Standards and Technology. This document shall not be reproduced without the written approval of Link Testing Laboratories.

Calibration Equipment Utilized:

Ref #	Description	Serial Number	Range	Accuracy	Uncertainty	Last Cal	Cal Due
REF 5	C IN CALPER	0033393	0-6 IN	±.001 IN	±.001 IN	7/12/05	12 MO

Total Measurement Uncertainty: (+/-) ERROR: Invalid units of 'in.' for 'range', the conversion returns zero.

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 (734) 453-0800 service@lnkeng.com

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Certificate of Calibration

Calibration Performed By:
 Link Testing Laboratories
 13840 Elmira Ave.
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Calibration Performed For:
 Link Testing Laboratories
 13840 Elmira Ave
 Detroit, Michigan 48227

Project Description: 3499-DA
 Link Work Order Number: 08D066
 Report Number: 200745-1-2007
 Certificate Number: 6827-F2007
 Calibration File Name: 08D066 - 6827-F.cal
 Calibration Date: 1/24/2007
 Next Calibration Date: 1/24/2008
 Procedure Used: 1 Torque Calibration
 Technician: M Curtis H Flynn
 Technician's Initials: M.C.F.

Item Description: Torque Fwd
 Manufacturer: Labov
 Condition: Good
 Serial Number: 6827-F
 Model Number: 3124-10K
 Instrument Range: 200 Klb-in
 Rated Full Scale: 200 Klb-in
 Temperature: 72 °F
 Relative Humidity: 18 %RH
 Calibration Site: Link Facility

Calibration Standard Value (lb-ft)	Initial "As Found" Value (lb-ft)	Calibration Standard Value (lb-ft)	Final Calibrated Value (lb-ft)	Initial Percent (%) of Full Scale Range (FSR) Error	Final Percent (%) of Full Scale Range (FSR) Error
0.0	0.0	0.0	0.0	0.00%	0.00%
2500.0	2475.0	2500.0	2491.0	-1.50%	-0.54%
5000.0	4952.0	5000.0	4996.0	-2.88%	-0.24%
10000.0	9932.0	10000.0	10002.0	-4.08%	-0.12%
15000.0	14912.0	15000.0	15005.0	-5.28%	-0.30%

	PRE-CAL	POST-CAL
Maximum % of full-scale error observed:	-0.528%	-0.54%
Maximum % of FSR error allowable (+/-):	1.000%	1.000%
Pre-Calibration Status:	Instrument met required accuracy	
Post-Calibration Status:	Instrument meets required accuracy	

Technical Comments:

The reported expanded uncertainty of measurement is stated as the standard uncertainty multiplied by the coverage factor (k=2), which for a normal distribution corresponds to a coverage probability of 95%. The data contained in this document is applicable only to the above listed equipment and is not valid unless signed by the technician. Measurement standards used for this test are traceable to the National Institute of Standards and Technology. This document shall not be reproduced without the written approval of Link Testing Laboratories.

Calibration Equipment Utilized:

Ref #	Description	Serial Number	Range	Accuracy	Uncertainty	Last Cal	Cal Due
REF 2	DISPLAY MODULE	11196-3	9999 COUNTS	±0.25%	INCLUDED COUNTS	11/15/06	12/30/06
REF 30	IONIC CELL 3600 LB	97781	3000 LB	±0.0015%	±0.0015%	11/10/06	12/30/06

Total Measurement Uncertainty: {+/} ERROR: Missing Length and/or Force

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Certificate of Calibration

Calibration Performed By:

Link Testing Laboratories
13840 Elmira Ave.
Detroit, MI 48227
(313) 933-4900

Calibration Performed For:

Link Testing Laboratories
13840 Elmira Ave
Detroit, Michigan 48227

Project Description: 3499-DA
Link Work Order Number: 060066
Report Number: 200748-1-2007
Certificate Number: 200748-2-12007
Calibration File Name: 060066 - 200748-2-1.cal
Calibration Date: 1/24/2007
Next Calibration Date: 1/24/2008
Procedure Used: 4 Temperature Calibration (thermocouple cond.)
Technician: M Curtis-H Flynn
Technician's Initials: M.C.

Item Description: Temperature
Manufacturer: Link Engineering
Condition: Good
Serial Number: 200748-2-1
Model Number: 2031-CAE
Instrument Range: 2400 °F
Rated Full-Scale: 2400 °F
Temperature: 72 °F
Relative Humidity: 18 %RH
Calibration Site: Link Facility

Calibration Standard Value (°F)	Initial "As Found" Value (°F)	Calibration Standard Value (°F)	Final Calibrated Value (°F)	Initial Percent (%) of Full Scale Range (FSR) Error	Final Percent (%) of Full Scale Range (FSR) Error
0.0	5.8	0.0	0.2	242%	0.008%
500.0	506.7	500.0	499.2	279%	0.008%
1000.0	1006.2	1000.0	1001.6	253%	0.067%
1500.0	1505.2	1500.0	1500.4	217%	0.17%
2000.0	2004.5	2000.0	2000.3	187%	0.13%
2390.0	2394.9	2390.0	2389.8	204%	0.008%

Maximum % of full-scale error observed:	PRE-CAL 0.279%	POST-CAL 0.067%
Maximum % of FSR error allowable (+/-):	1.000%	1.000%

Pre-Calibration Status:	Instrument met required accuracy
Post-Calibration Status:	Instrument meets required accuracy

Technical Comments:

The reported expanded uncertainty of measurement is stated as the standard uncertainty multiplied by the coverage factor (k=2), which for a normal distribution corresponds to a coverage probability of 95%. The data contained in this document is applicable only to the above listed equipment and is not valid unless signed by the technician. Measurement standards used for this test are traceable to the National Institute of Standards and Technology. This document shall not be reproduced without the written approval of Link Testing Laboratories.

Calibration Equipment Utilized:

Ref #	Description	Serial Number	Range	Accuracy	Uncertainty	Last Cal	Cal Due
REF 4	TEMP	1-135365	270-730 °C	±0.1 °C	±0.1 °C	12/16/06	12/16/07

Total Measurement Uncertainty: (+/-) ERROR: Invalid units of 'C' for Range; the conversion returns zero. 1

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Date: 5/2/2007
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Certificate of Calibration

Calibration Performed By:
 Link Testing Laboratories
 13840 Elmira Ave.
 Detroit, MI 48227
 (313) 933-4900

Calibration Performed For:
 Link Testing Laboratories
 13840 Elmira Ave
 Detroit, Michigan 48227

Project Description: 3489-DA
 Link Work Order Number: 06D066
 Report Number: 203748-1-2007
 Certificate Number: 7931982007
 Calibration File Name: 06D066 - 790198 cal
 Calibration Date: 1/24/2007
 Next Calibration Date: 1/24/2008
 Procedure Used: 2 Pressure Calibration
 Technician: M. Curtis-H. Flynn
 Technician's Initials: M.C.

Item Description: Air Pressure
 Manufacturer: Sensotec
 Condition: Good
 Serial Number: 790198
 Model Number: TJE10708-12JG
 Instrument Range: 200 PSI
 Rated Full-Scale: 200 PSI
 Temperature: 72 °F
 Relative Humidity: 15 %RH
 Calibration Site: Link Facility

Calibration Standard Value (PSI)	Initial "As Found" Value (PSI)	Calibration Standard Value (PSI)	Final Calibrated Value (PSI)	Initial Percent (%) of Full Scale Range (FSR) Error	Final Percent (%) of Full Scale Range (FSR) Error
0.0	0.0	0.0	0.0	.000%	.000%
25.0	25.0	25.0	25.0	.000%	.000%
50.0	49.9	50.0	49.8	-.050%	-.050%
75.0	74.9	75.0	74.9	-.050%	-.050%
100.0	100.0	100.0	100.0	.000%	.000%

	PRE-CAL	POST-CAL
Maximum % of full-scale error observed:	-0.050%	-0.050%
Maximum % of FSR error allowable (+/-):	1.000%	1.000%
Pre-Calibration Status:	Instrument met required accuracy	
Post-Calibration Status:	Instrument meets required accuracy	

Technical Comments:

The reported expanded uncertainty of measurement is stated as the standard uncertainty multiplied by the coverage factor (k=2), which for a normal distribution corresponds to a coverage probability of 95%. The data contained in this document is applicable only to the above listed equipment and is not valid unless signed by the technician. Measurement standards used for this test are traceable to the National Institute of Standards and Technology. This document shall not be reproduced without the written approval of Link Testing Laboratories.

Calibration Equipment Utilized:

Ref #	Description	Serial Number	Range	Accuracy	Uncertainty	Last Cal	Cal Due
REF 3	DISP. AY MODULE	11169-C	9999 COUNTS	±0.05%	INCLUDED COUNTS	11/19/06	12 MO.
REF 6	PRESSURE DELI 200 PSI	832283	200 PSI	±0.25%FSR	±0.25%FS	11/19/06	12 MO.

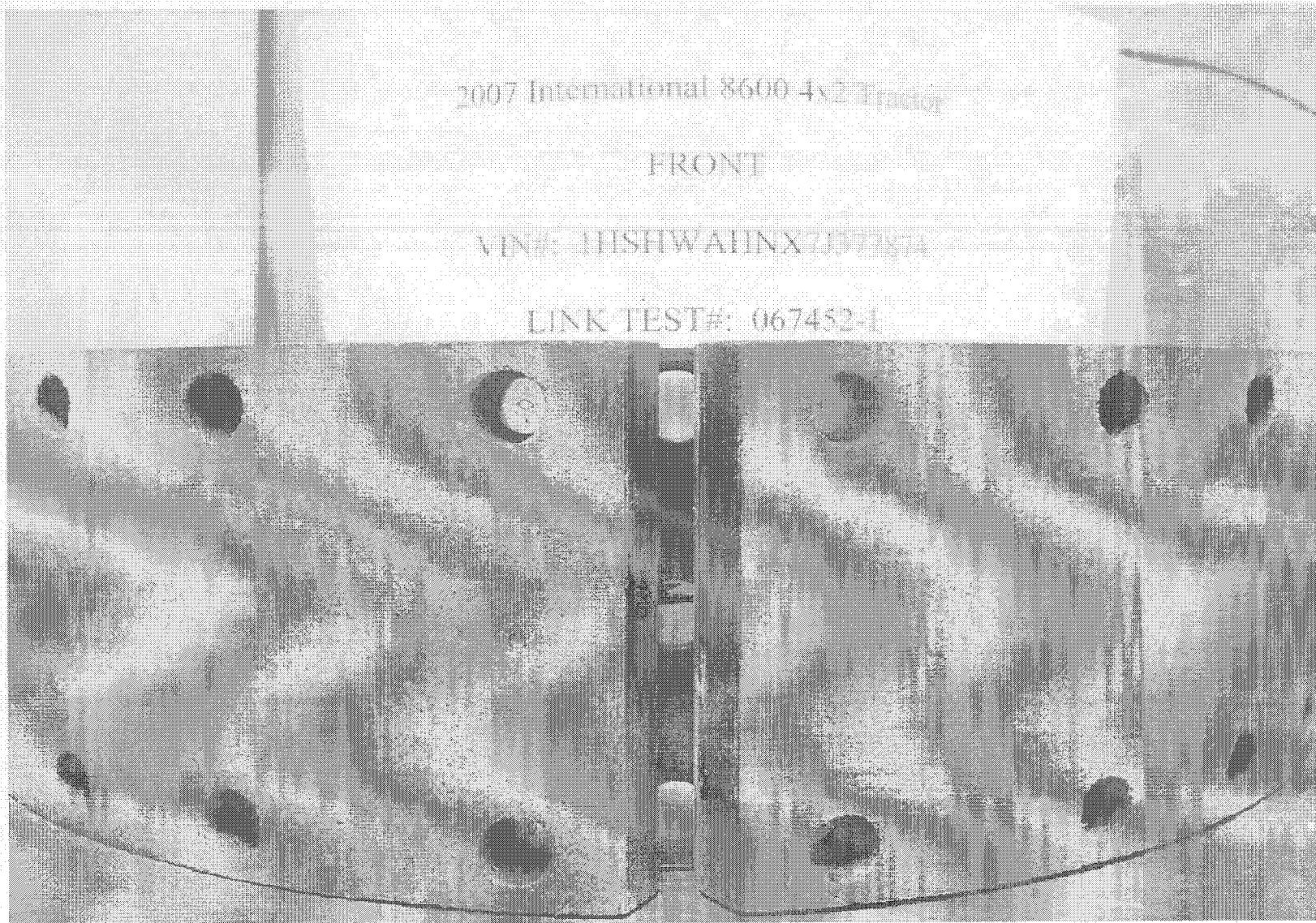
Total Measurement Uncertainty: (+/-) 0.0 PSI

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SECTION V
DYNAMOMETER
BRAKE ASSEMBLY
SET UP
PHOTOGRAPHS

Thermocouple Installation



Dynamometer Setup

