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DATE: MAY 18, 1999

REPORT #MRL2312

EVALUATION OF FOUR CONCRETE POWER BUGGIES
IN ACCORDANCE WITH ASME B56.8-1993/B56.8a-1994
SAFETY STANDARD FOR PERSONNEL AND BURDEN CARRIERS

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ABSTRACT

Four concrete power buggies (Miller Spreader Model MB-16, Wacker Model WB-16, Amida Model WBH16 and Morrison Model PB-16) were tested in accordance with ASME B56.8-1993 and B56.8a-1994 to verify their performance with respect to lateral stability, longitudinal stability, parking brake effectiveness and service brake effectiveness. The Miller Spreader Model MB-16 passed all of the testing protocols required in the ASME standard and was the only power buggy model to pass the service brake test. All of the tested power buggies passed the longitudinal stability testing protocol. The Wacker Model WB-16 passed one of the lateral stability test protocols but failed the remaining three and passed the parking brake testing protocol. The Morrison Model PB-16 passed two of the lateral stability testing protocols but failed the remaining two and failed both the parking and service brake testing protocols. The Amida Model WBH16 failed all of the lateral stability testing protocols and failed both the parking and service brake testing protocols. Test results are illustrated graphically in Data section B of this report. Testing of the four power buggies was conducted on May 14 and May 17, 1999 at the Miller Spreader Company under the direction of and in the presence of Andrew M. Hirt of Materials Research Laboratories, Inc.

Results of ASME B56.8-1993 / B56.8a-1994
Reported in % Grade

Test	Requirement	Miller	P/F	Wacker	P/F	Morrison	P/F	Amida	P/F
Lateral Stability	27								
Left (Payload+Operator)		27.00	***P***	27.00	***P***	25.60	F	22.79	F
Right (Payload+Operator)		27.00	***P***	25.82	F	27.00	***P***	25.38	F
Left (Operator)		27.00	***P***	20.88	F	24.51	F	23.01	F
Right (Operator)		27.00	***P***	19.40	F	27.00	***P***	23.44	F
Longitudinal Stability	25								
Downgrade (Payload+Operator)		25.00	***P***	25.00	***P***	25.00	***P***	25.00	***P***
Upgrade (Payload+Operator)		25.00	***P***	25.00	***P***	25.00	***P***	25.00	***P***
Downgrade (Operator)		25.00	***P***	25.00	***P***	25.00	***P***	25.00	***P***
Upgrade (Operator)		25.00	***P***	25.00	***P***	25.00	***P***	25.00	***P***
Parking Brake	15								
Downgrade		15.00	***P***	15.00	***P***	13.29	F	11.91	F
Upgrade		15.00	***P***	15.00	***P***	13.70	F	12.19	F
Service Brake	21								
Downgrade		21.00	***P***	17.46	F	16.97	F	15.65	F
Upgrade		21.00	***P***	9.72	F	11.50	F	9.86	F

Note: ***P*** = Passed Test F = Failed Test

I. INTRODUCTION

Four concrete power buggies (Miller Spreader Model MB-16, Wacker Model WB-16, Amida Model WBH16 and Morrison Model PB-16) were tested in accordance with ASME B56.8-1993 and B56.8a-1994 to verify their performance with respect to lateral stability, longitudinal stability, parking brake effectiveness and service brake effectiveness. ASME B56.8-1993 and B56.8a-1994 defines safety requirements relating to the elements of design, operation, and maintenance of powered personnel and burden carriers having three or more wheels, a maximum speed not exceeding 35 mph (56 km/h), and a load capacity not exceeding 10,000 lb (4536 kg). All of the power buggies tested in this study fall within the stated parameters. Each power buggy tested is listed in Data Section A in this report with its manufacturer, model number, serial number and characteristics.

II. PROCEDURE

All of the procedures used in this study were in accordance with ASME B56.8-1993 and B56.8a-1994 (the Standard). Specific testing specifications for each test are listed below. For the overall experiment, the simulated payload weight used was constructed of steel slabs and based on the manufacturer's specified maximum material load as mandated in section 7.3.9 (a) (4) of the Standard. The height of the center of gravity of the test load was determined in accordance with section 7.3.9(a)(4)(a) using the *average* area of the bed carrier since calculations using the lowest areas of the beds or of the framework under the carriers resulted in values below the midpoints of the load heights and using the areas of the top of the carriers resulted in load heights substantially above the midpoints. The calculations used resulted in the closest approximations of the actual load centers of gravity using Figure 1 of ASME B56.8-1993 and B56.8a-1994. The simulated operator weight used was constructed of a welded steel frame with a top weight of 80 lbs (concrete) and was in accordance with ASME B56.8a-1994 section 7.2.9(a)(5)(b) and had a total weight of 200 lbs (including attachment hardware) with a center of gravity 40 in. above the operator platform. The tilting test platform used was constructed of welded steel I-beams and steel plate with an expanded metal friction surface welded to the steel plate floor. The platform dimensions were 63 in. by 93 in. (within 0.1%) and was in accordance with ASME B56.8-1993 and B56.8a-1994 section 7.3.9(a)(1). The platform flatness and squareness were both within about 1%.

The longitudinal stability test was performed to a grade of 25% based on section 7.3.9(c)(2)(a). The lateral stability testing was performed in accordance with 7.3.9(b)(2) with a platform grade of 27% from ASME B56.8-1993 and B56.8a-1994 Figure 2. The parking brake testing was performed in accordance with section 7.3.10(f) at a platform grade of 15% and the service brake testing was performed in accordance with section 7.3.10(d) using a tilting platform grade of 21% with a 125 lb weight (7.3.10(c)(1)) applied to the center of the brake pedal or to a bar attached to the pedal when the pedal location prevented positioning of the weight over the center. This would result in a higher applied force at the position of the pedal but was maintained since this would give the greatest chance for the power buggies tested to meet the testing requirements.

All of the values obtained were measured in inches of displacement of the platform edge being lifted and converted to grade using trigonometric calculations. The data were then plotted for each power buggy in the form of bar charts with the requirements listed and the actual performance of each buggy for each testing protocol.

III. RESULTS AND DISCUSSION

All tables and plots are included in the Data Section of this report. Each of the four power buggy samples was serviced in accordance with their maintenance manuals to meet the requirements of the testing protocols in ASME B56.8-1993 and B56.8a-1994. Where deviations occurred these are noted along with the reason for the deviation. Results of the testing protocols are listed below for each power buggy:

Miller Spreader Model MB-16

The Miller MB-16 power buggy was the only sample of the four tested to meet all of the requirements of ASME B56.8-1993 and B56.8a-1994 for lateral stability, longitudinal stability, parking brake effectiveness and service brake effectiveness. Specifications of the power buggy during the test are listed in Table 3. In order to achieve compliance with the longitudinal stability testing protocol in the upgrade direction with simulated operator load only, the steering wheels of the Miller MB-16 were immobilized against the buggy frame to prevent wheel roll and accompanying wheel slide of the drive wheels. The left and right stability tests, the upgrade and downgrade stability tests with both payload and operator simulated loads and the service brake tests were continued past the grade requirements of ASME B56.8-1993 and B56.8a-1994. For the left side lateral stability test, the Miller MB-16 power buggy achieved a grade of 31.6% before toppling. For the right side lateral stability test, the Miller MB-16 achieved a grade of 29% before toppling. The downgrade longitudinal stability test was continued to 25.2% at which point wheel roll ended the testing protocol. The upgrade longitudinal stability test was continued to a grade of 40% before wheel roll ended the test. The results of these tests are actually an indication of the effectiveness of the parking brake (which was engaged during the test) as well as the longitudinal stability. From these data, the Miller MB-16 exceeds the lateral stability testing requirements by 7.5% in the right side direction and 17% in the left side direction. The parking brake exceeds the ASME B56.8-1993 and B56.8a-1994 requirements by 68% in the upgrade direction and by 167% in the downgrade direction. Since the longitudinal stability tests ended due to wheel roll, the amount by which the Miller MB-16 exceeds the testing requirements could not be calculated. The service brake tests for the Miller MB-16 exceeded the testing requirements by 17.5% in the downgrade direction and by 33% in the upgrade direction.

Wacker Model WB-16

The Wacker WB-16 passed all of the longitudinal stability tests, passed one of the lateral stability test protocols but failed the remaining three, passed the parking brake testing protocol and failed the service brake testing protocol. In order to achieve compliance with the longitudinal stability testing protocol in the upgrade direction with simulated operator load only, the steering wheels of the Wacker WB-16 were immobilized against the buggy frame to prevent wheel roll and accompanying wheel slide of the drive wheels. For the lateral stability tests, only the left side lateral stability test with payload and operator simulated loads resulted in compliance with the required grade of 27%. The Wacker WB-16 had the lowest attainable grade of all the tested power buggies with the right side lateral stability test with simulated operator only achieved a grade of only 19.4% (about 30% less than the requirement). The Wacker WB-16 passed the parking brake test but it was noted that the brake could not be adjusted according to the operator and maintenance manual. The manual calls for adjustment of the brake shoe to a distance of ¼"- ½"from the tire with the parking brake off and the pedal in its rest position. When this adjustment was made the parking brake could not be engaged. The brake shoe was thus adjusted to a distance of 1 3/8"from the tire which was the absolute minimum distance achievable while still being capable of operating the parking brake. Failure to achieve the adjustment indicated in the manual was due either to incorrect linkage design or to a typographical error in the manual. It was noted that at this adjusted distance, the metal brake shoe depressed the tire by about ½ when engaged. The Wacker WB-16 passed the parking brake testing protocol at this adjustment. The Wacker WB-16 failed the service brake testing protocol achieving only 80% of the grade requirement in the downgrade direction. Even this level of grade was achieved only because the small surface area of the contact zone of the brake was wedged into a tire groove. Once the tire rubber in the groove area flexed to release the metal brake shoe, the Wacker WB-16 rolled immediately. The Wacker WB-16 achieved only 47% of the grade requirement in the upgrade direction. The brake adjustment was left at that position dictated by the parking brake test. This was selected since the brake system cannot be set to one adjustment for the parking brake and another for the service brake during normal operation so that required for the parking brake was maintained. Two additional observations were noted concerning the Wacker WB-16 during testing. One is that the arrows designating the direction of buggy movement associated with operation of the twist grip accelerator appear to be reversed. Movement of the grip in the counterclockwise direction (when viewing the grip edge-on) results in forward motion while the arrows above the twist grip suggest that this would result in reverse motion. The converse is true of the arrows that are associated with reverse motion. This might result in confusion for the operator of this buggy and is not in compliance with ASME B56.8-1993 and B56.8a-1994 section 7.3.8 (f). The second observation is that during startup of the buggy using the pullcord on the engine the pull handle slipped from the operator's hand and resulted in damage to the fuel filter and a rapid fuel spill onto the engine, the operator platform and the ground. Since this type of accident might be considered common for pull-start engines, the lack of a guard to prevent damage to the fuel delivery system might be considered an operational hazard.

Morrison Model PB-16

The Morrison PB-16 passed all of the longitudinal stability tests and passed two of the lateral stability testing protocols but failed the remaining two and failed both the parking and service brake testing protocols. In order to perform the longitudinal stability tests, the drive wheels of the Morrison PB-16 were immobilized against the buggy frame to prevent wheel roll since the braking system was incapable of preventing wheel roll at the grade requirements of the test. The Morrison PB-16 passed the lateral stability tests for the right side with the simulated operator load and both with and without the simulated payload. The PB-16, however, failed both of the left side stability tests achieving only about 90-95% of the required grade. The Morrison PB-16 failed all of the braking tests (parking and service brakes, upgrade and downgrade) achieving at best only 84% of the grade requirement (parking-upgrade) and at worst only 50% of the grade requirement (service-upgrade).

Amida Model WBH16

The Amida WBH16 passed all of the longitudinal stability tests but failed all of the lateral stability testing protocols and failed both the parking and service brake testing protocols. In order to perform the longitudinal stability tests, the drive wheels of the Amida WBH16 were immobilized against the buggy frame (as for the Morrison PB-16) to prevent wheel roll since the braking system was incapable of preventing wheel roll at the grade requirements of the test. Also, in order to achieve compliance with the longitudinal stability testing protocol in the upgrade direction with simulated operator load only, the steering wheels of the Amida WBH16 were immobilized against the buggy frame to prevent wheel roll and accompanying wheel slide of the drive wheels. The Amida WBH16 failed all of the lateral stability tests (despite having the lowest payload center-of-gravity above its load bed) with the lowest grade achieved being for the left side tests at about 85% of the requirement and the best being for the right side at about 95% of the requirement. The Amida WBH16 failed all of the braking tests (parking and service brakes, upgrade and downgrade) achieving at best only 75% of the grade requirement (parking-upgrade) and at worst only 48% of the grade requirement (service-upgrade).

IV. CONCLUSIONS

The Miller Spreader Model MB-16 passed all of the testing protocols required in the ASME standard and was the only power buggy model to pass the service brake test. All of the tested power buggies passed the longitudinal stability testing protocol. The Wacker Model WB-16 passed one of the lateral stability test protocols but failed the remaining three and passed the parking brake testing protocol (although the brake could not be adjusted in accordance with their maintenance manual due either to incorrect linkage design or a typographical error in the manual). The Morrison Model PB-16 passed two of the lateral stability testing protocols but failed the remaining two and failed both the parking and service brake testing protocols. The Amida Model WBH16 failed all of the lateral stability testing protocols and failed both the parking and service brake testing protocols. Test results are illustrated graphically in Data section B of this report.

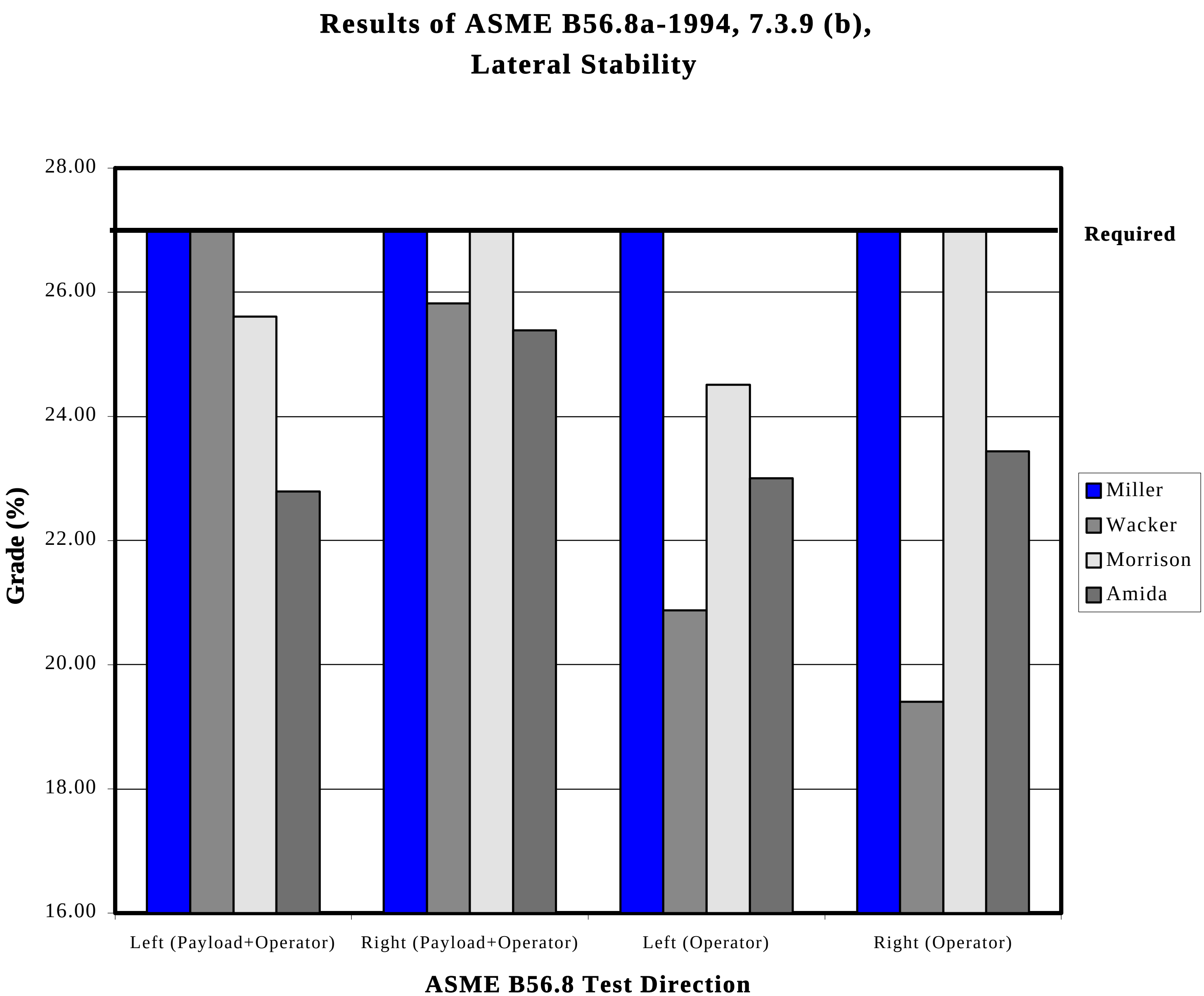
V. DATA

A. POWER BUGGY CHARACTERISTICS

Characteristic/Protocol	Miller	Wacker	Morrison	Amida
Power Buggy Model	MB-16	WB-16	PB-16	WBH16
Serial Number	G13567	5059109	9903-53887	980246419
Average Bed Area	8.66 sq.ft.	8.63 sq.ft.	8.66 sq.ft.	8.31 sq.ft.
Published Payload (Cubic Feet)	16 cu.ft.	16 cu.ft.	16 cu.ft.	16 cu.ft.
Published Payload (Weight)	2432 lb	2432 lb	2432 lb	2432 lb
Bucket Weight	71 lb	67 lb	60 lb	58 lb
Payload Center of Gravity	14.75 in.	14.75 in.	14.75 in.	14.25 in.
Measured Bucket Capacity	16.93 cu.ft.	15.78 cu.ft.	15.97 cu.ft.	15.32 cu.ft.
Weight Empty	1230 lb	1197 lb	1180 lb	965 lb
Engine RPM	3700	3800	3900	3900
Tire Pressure	Checked	Checked	Checked*	Checked
Published Maximum Speed	7 mph	7 mph	7 mph	7 mph

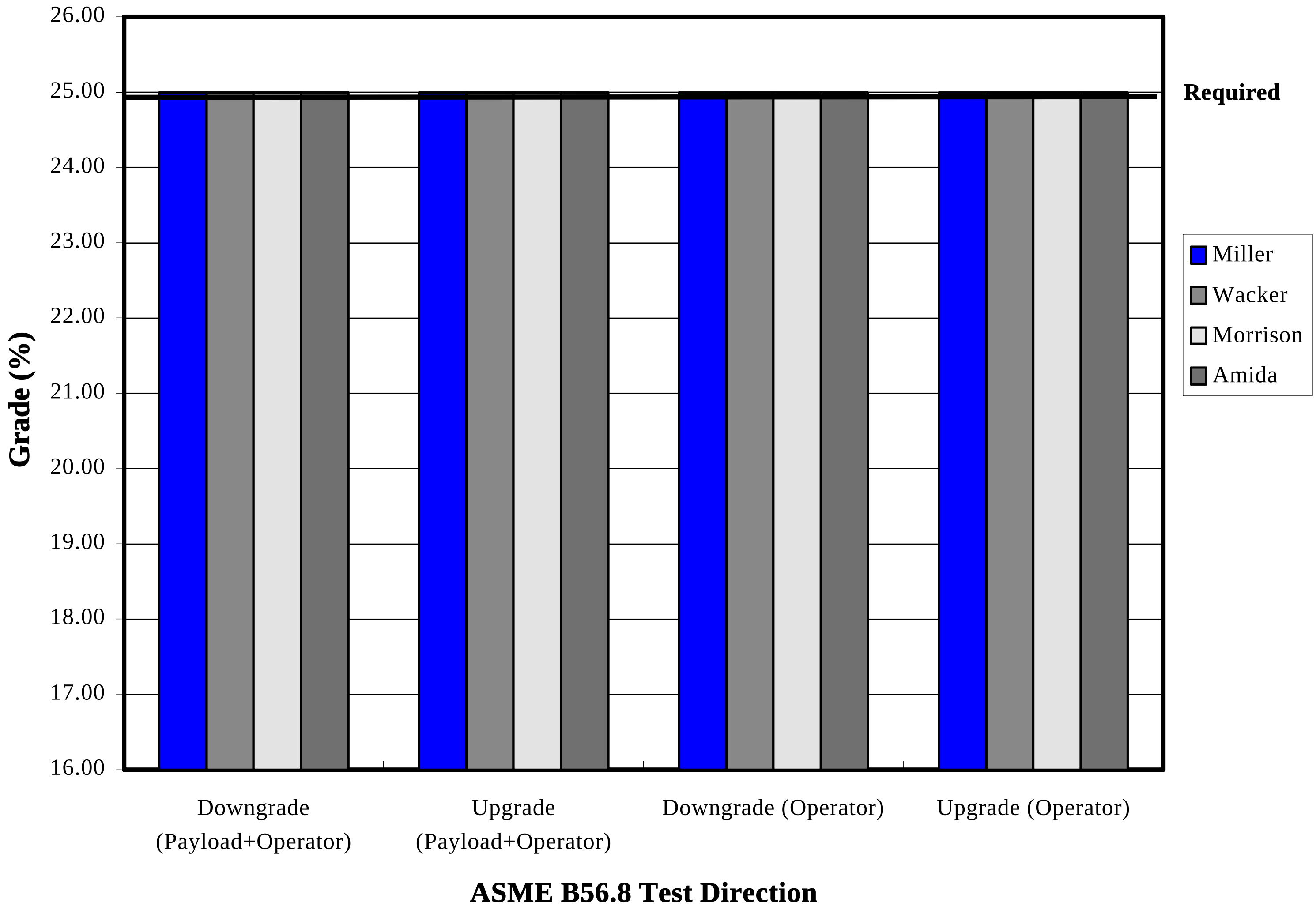
* Foam Filled Tires Replaced with Standard Pneumatic Tires for Comparison Purposes of this Study.

B. PLOTS

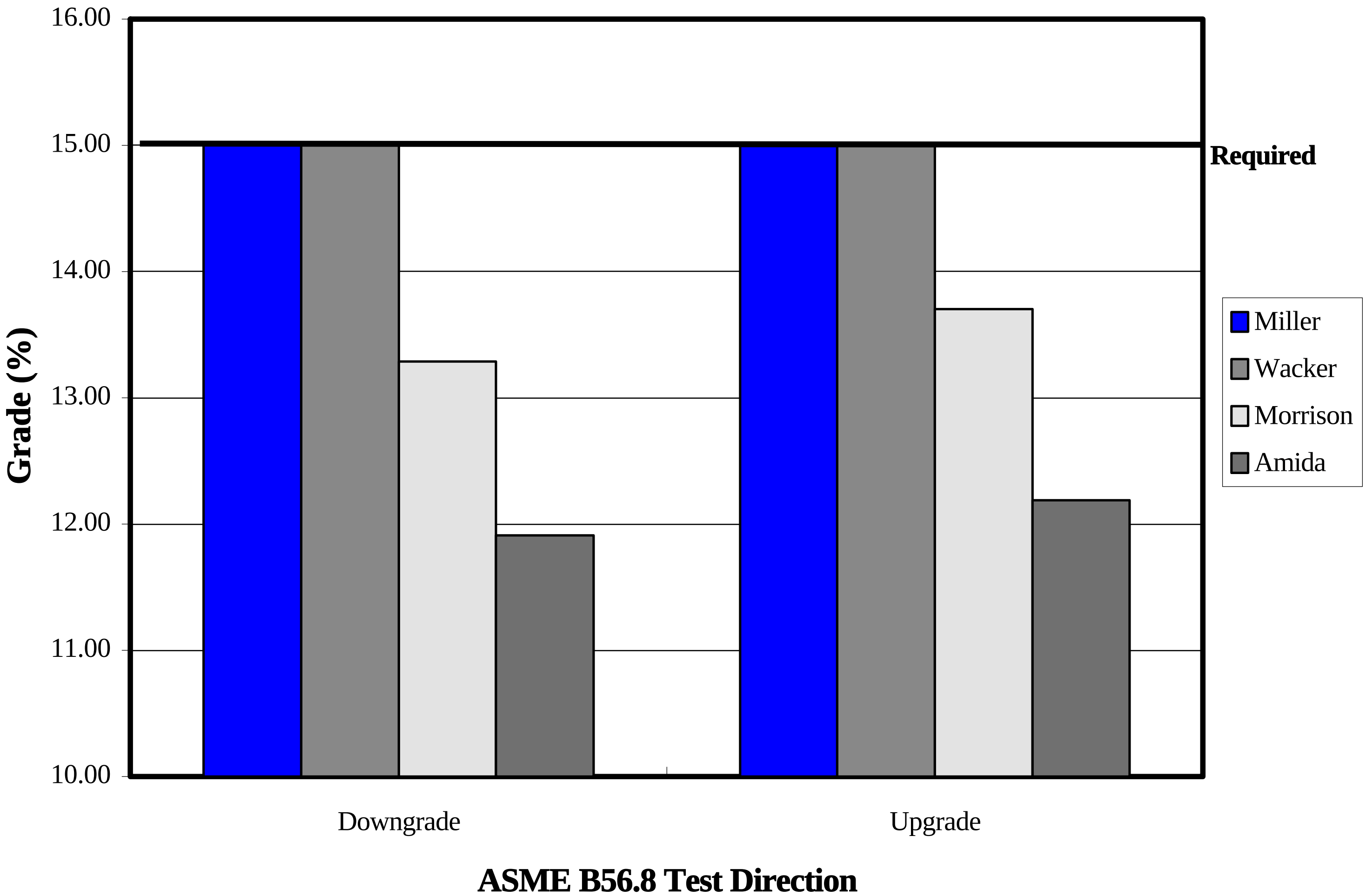


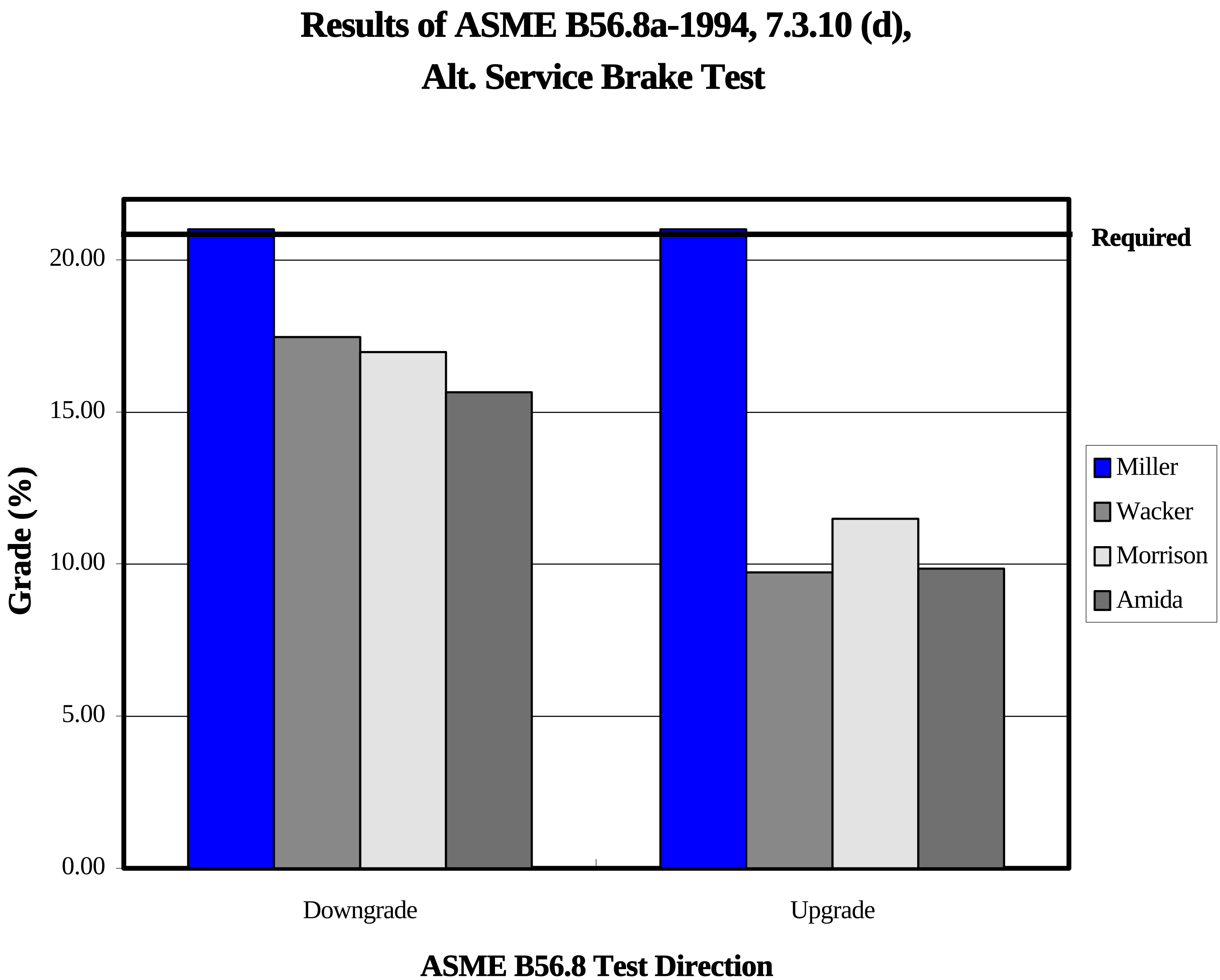
Results of ASME B56.8a-1994, 7.3.9 (b),
Lateral Stability
28.00
26.00
24.00
22.00
20.00
18.00
16.00
Grade (%)
Required
Miller
Wacker
Morrison
Amida
Left (Payload+Operator)
Right (Payload+Operator)
Left (Operator)
Right (Operator)
ASME B56.8 Test Direction

Results of ASME B56.8a-1994, 7.3.9 (c),
Longitudinal Stability



Results of ASME B56.8a-1994, 7.3.10 (f), Parking Brake Test




Results of ASME B56.8a-1994, 7.3.10 (d),
Alt. Service Brake Test
Required
20.00
15.00
10.00
5.00
0.00
Grade (%)
Miller
Wacker
Morrison
Amida
Downgrade
Upgrade
ASME B56.8 Test Direction

VI. APPENDIX

A. MATERIALS RESEARCH LABORATORIES, INC.

Materials Research Laboratories, Inc. (MRL) was organized to provide a wide range of materials analysis services to high technology dependent industries both nationally and internationally. The intent of the company is to make use of state-of-the-art instrumentation for materials analysis to provide clients in industry, government and academia the best possible analytical data for the study of materials related problems. Currently, our in-house capabilities include x-ray photoelectron spectroscopy (XPS/ESCA), ion scattering spectroscopy (ISS), high-resolution scanning Auger microscopy (SAM), scanning electron microscopy (SEM), transmission electron microscopy (TEM), energy dispersive x-ray spectroscopy (EDS), wavelength dispersive x-ray spectroscopy (WDS), infrared spectroscopy/microscopy (IR/MIR/FTIR), ultraviolet/visible/near infrared spectroscopy (UV/VIS/NIR), residual gas analysis (RGA), metallography, light microscopy (LM), microtomy, gas chromatography (GC), thermal analysis (DSC/DTA/TGA), physical testing (tensile/shear/etc.) and x-ray diffraction (XRD). Other available techniques include scanning transmission electron microscopy (STEM), atomic force microscopy (AFM), scanning tunneling microscopy (STM), laser Raman spectroscopy (LRS), emission spectroscopy (DCP/ICP), x-ray fluorescence (XRF), atomic absorption spectroscopy (AA), ion chromatography (IC), gas chromatography/mass spectroscopy (GC/MS), nuclear magnetic resonance (NMR), secondary ion and laser ionization mass spectroscopies (SIMS/LIMS) and time-of-flight secondary ion mass spectroscopy (ToFSIMS). All out-of-house analytical services are conducted by or under the direction of MRL staff at local facilities with whom arrangements have been made to share and exchange analytical capabilities.

The intent of MRL is not simply to supply analytical data for its clients but to provide all necessary experimental design and data interpretation and to produce a clear and concise report of all studies in answer to specific materials related research & development, quality control and/or failure analysis projects/problems. Current staff represents forty years of experience in the contract analytical services/problem solving field. The staff is familiar with the study of numerous materials systems and with nearly all of the currently available analytical techniques along with the strengths and weaknesses of each method. MRL can identify the experimental procedure most likely to produce the needed results and has the flexibility to quickly provide the services required.

The staff of MRL is affiliated with numerous scientific and professional societies and makes every effort to keep abreast of advances in the materials analysis field. With our emphasis on addressing specific experimental considerations, the right technique is applied to the right project and experiments remain flexible as results are obtained and interpreted.

B. POLICY STATEMENT

This study has been performed and report prepared based upon the specific samples provided to Materials Research Laboratories, Inc. (MRL) by the Miller Spreader Company. MRL assumes no responsibility for variations in sample or data quality (composition, appearance, performance, etc.) or any other feature of similar subject matter produced (measured, manufactured, fabricated, etc.) by persons or under conditions over which we have no control.

The analytical services have been performed, results obtained, data interpreted and report prepared in accordance with generally accepted laboratory principles and practices. This warranty is in lieu of all other warranties, either expressed or implied. This report is provided for informational purposes only and is not intended as a certification of the materials analyzed.

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C. AMSE/ANSI B56.8-1993

Contact Miller Spreader Company at 800-377-4565 for a copy of the specification.

AN AMERICAN NATIONAL STANDARD

POWERED AND NONPOWERED INDUSTRIAL TRUCKS

Safety Standard for Personnel and Burden Carriers

ASME/ANSI B56.8-1993

(REVISION OF ASME/ANSI B56.8-1988)

The American Society of Mechanical Engineers

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