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ARPRO®
Expanded Polypropylene (EPP)

ARPRO® Expanded Polypropylene (EPP) Foam Manhole Grade Adjustment Ring

Proof-Load Testing
January 26, 2017

Kipp Boegner

Digitally signed by Kipp Boegner
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Date: 2017.02.20 09:09:58 -05'00'

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The information contained herein is based upon the results of limited laboratory tests on test samples of material molded from expanded polyolefin resin manufactured by JSP. There can be no assurance that similar results will be achieved in simulated tests or actual use of commercial product molded by customers of JSP. Product performance may vary substantially depending upon the particular application or processing involved. The listed properties are illustrative only and applications of JSP foam products can influence molded part performance in many ways. Consequently, processors and/or users are advised that there may be a need to conduct independent tests and experiments in order for them to determine the extent to which they may choose to rely upon such information in their business operations. JSP disclaims any liability in connection with the use of the information and does not warrant against infringement by reasons of the use of its products in combination with other material or in any process.

Introduction

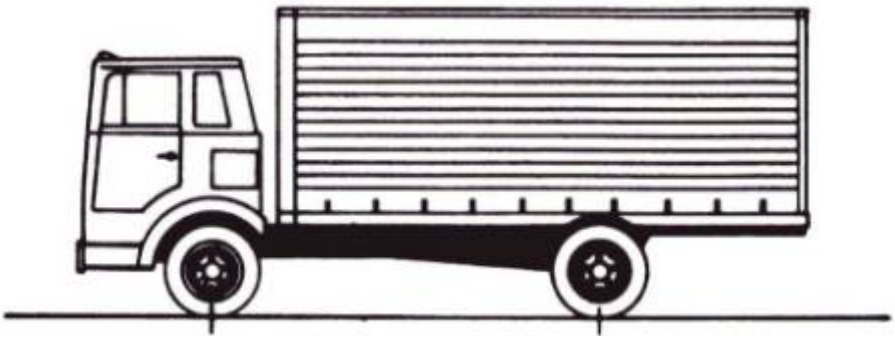
The following is a summary report of the evaluation of the ARPRO® EPP Manhole Grade Adjustment Ring application for HS-25 Static Loading.

Sanitary sewer systems necessitate that a manhole grade adjustment ring bear the load requirements of the installation.

Load Requirements and Standard Testing Methods

The American Association of State Highway and Transportation Officials (AASHTO) Standard Specification M306 identifies the proof-load testing required for drainage, sewer, and related castings intended for use in traffic service. AASHTO M306 was originally developed as a specification for cast iron, but the proof-load testing method can also be applied to ARPRO® Expanded Polypropylene (EPP) manhole grade rings. A specifying agency or municipality may have established its own procedure that might differ from this AASHTO specification; however it is likely that any method will require the application of a specific load on a defined area. Any crack or detrimental permanent deformation will cause the cover, grating, frame, or grade ring to be rejected.

The AASHTO Standard Specifications for Highway Bridges, 17th Edition, Section 3, identifies two types of design vehicle loads. They represent categories of individual vehicles and are routinely referred to as the H or HS truck. The H truck configuration includes only two theoretical axles as in figure 1.



H-15	**6,000 lbs.**	**24,000 lbs.**
H-20	**8,000 lbs.**	**32,000 lbs.**
H-25	**10,000 lbs.**	**40,000 lbs.**

Figure 1 – Standard H Trucks

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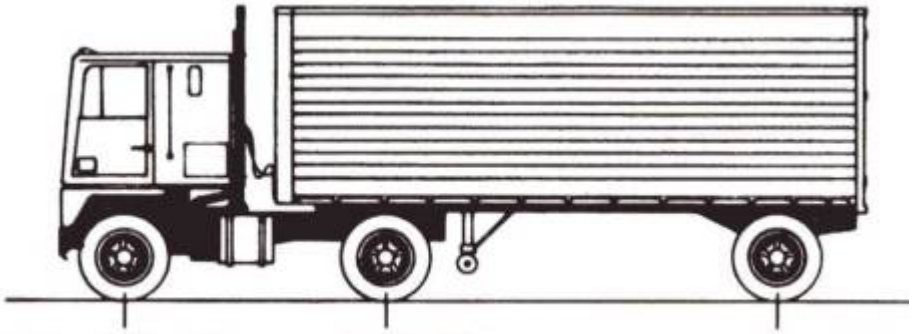
The HS truck configuration represents the conventional semi- or tractor-trailer. It is identical to the H truck, but with an extra axle representing the rear axle of the trailer, as in figure 2.



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H-20	**8,000 lbs.**	**32,000 lbs.**	**32,000 lbs.**
H-25	**10,000 lbs.**	**40,000 lbs.**	**40,000 lbs.**

Figure 2 – Standard HS Trucks

Results

Vehicular load testing was performed for JSP by the MGA Research Corporation, Report #C17H7-032.1 (Appendix A), in accordance with the proof-load testing standards outlined by AASHTO M306, Section 6. Per AASHTO M306, Section 6, a proof-load shall be applied to the drainage, sewer, utility, and all related castings. This proof load represents a safety factor of 2.5 for H-20 or HS- 20 loading. A 50,000 lb. proof load will be used to represent a safety factor of 2.5 for H-25 or HS-25 loading.

The proof-load test was conducted on one (1) standard ARPRO® Expanded Polypropylene (EPP) 36-24GF-600 grade-finish ring. A standard 36-24GF-600 grade-finish ring has an outer diameter of 36 inches, an inner diameter of 24 inches, and a starting height of 6.0 inches. The ring was placed onto a flat metal surface with an East Jordan cast iron manhole frame and cover placed on top as it would be during intended usage (figure 1). A servo hydraulic actuator was mounted to a crosshead attached to two stanchions. The specified force was applied and held for a minimum of 1 minute at which time a maximum deflection was recorded at three locations on the ring. Upon removal of the load, the sample was inspected for cracks and the height was measured, in three locations, for deformation. The tested sample was then allowed

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to recover for 60 minutes and then the height was again measured, in three locations, for deformation. . The results are recorded in tables 1 and 2.

Figure 1 – Proof-Load Test Set-up

Table 1 – W17087 Proof-Load Test Results @ 40,000 Lbf

Measurement Location	Pre-Test Measurement (in.)	Post Test Measurement (in.)	Post Test + 1 Hr. Measurement (in.)	Post Test Deformation (in.)	Post Test + 1 Hr. Deformation (in.)	Remarks
1	5.966	5.941	5.958	0.025	0.008	No visible deterioration
2	6.030	5.975	5.978	0.055	0.052	No visible deterioration
3	5.992	5.961	5.973	0.031	0.019	No visible deterioration

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Table 2 – W17088 Proof-Load Test Results @ 50,000 Lbf

Measurement Location	Pre-Test Measurement (in.)	Post Test Measurement (in.)	Post Test + 1 Hr. Measurement (in.)	Post Test Deformation (in.)	Post Test + 1 Hr. Deformation (in.)	Remarks
1	5.969	5.927	5.940	0.042	0.029	No visible deterioration
2	5.996	5.912	5.944	0.084	0.052	No visible deterioration
3	5.996	5.972	5.984	0.024	0.012	No visible deterioration

Conclusions

Per ASSHTO M306, Section 6, upon removal of the proof load, the test specimen shall be examined for cracks or detrimental permanent deformation. Permanent deformation shall not exceed 3.2 mm (0.125 inch). Any cracks shall be cause for rejection.

Based upon the above proof load test results, it is apparent that the ARPRO® Expanded Polypropylene (EPP) Manhole Grade Adjustment Rings, when installed properly, can be utilized in traffic environments where H-20, HS-20, H-25, and HS-25 vehicle loading is expected.

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Appendix A

The information contained herein is based upon the results of limited laboratory tests on test samples of material molded from expanded polyolefin resin manufactured by JSP. There can be no assurance that similar results will be achieved in simulated tests or actual use of commercial product molded by customers of JSP. Product performance may vary substantially depending upon the particular application or processing involved. The listed properties are illustrative only and applications of JSP foam products can influence molded part performance in many ways. Consequently, processors and/or users are advised that there may be a need to conduct independent tests and experiments in order for them to determine the extent to which they may choose to rely upon such information in their business operations. JSP disclaims any liability in connection with the use of the information and does not warrant against infringement by reasons of the use of its products in combination with other material or in any process.

mga research corporation

JSP INTERNATIONAL
36-24GF-600 MANHOLE
STATIC LOADING TEST
(PO # P76275)

TEST REPORT

MGA REPORT NO.:	C17H7-032.1
TEST(S) PERFORMED ON:	January 26, 2017
TEST REFERENCE NUMBER(S):	W17087-W17088
PROCEDURE NUMBER:	MGATP_CQSL_GTDS Last Revision Date: 7/14/2016
TEST LABORATORY:	MGA Research Corporation 446 Executive Drive Troy, Michigan 48083
SUBMITTED TO:	Eric Naber JSP International 1443 East 12 Mile Road Madison Heights, MI 48071
REPORT DATE:	January 31, 2017
MGA PERSONNEL:	Ross Crumbaugh Project Leader

* The results presented in this report relate only to the specified test items.
** This report shall not be reproduced except in full, without the written approval of the laboratory.

Procedure/Method
This test series was performed as follows:

1. Each test sample was mounted beneath a cast manhole cover and compressed using a vertically oriented hydraulic actuator.
2. Sample 1 was loaded to 40,000lbf at 400lbf/sec and held for 1 minute.
3. Sample 2 was loaded to 50,000lbf at 400 lbf/sec and held for 1 minute.
4. Load and displacement data were recorded.
5. Pre-test, instant post-test, and one-hour post-test thickness measurements were taken at equidistant locations around the perimeter of each sample.

Equipment
The following instrumentation was used to perform this test. All equipment and data has been calibrated by a source traceable to the National Institute of Standards and Technology (NIST). Calibration certificates can be furnished upon request.

Sensor ID Number	Data Type	Calibration Date	Calibration Due Date
335994	Load Cell	1/4/2017	7/4/2017
265151	6” Digital Calipers	4/11/2016	4/22/2017
MGA00918	Digital Protractor	2/8/2016	2/8/2017
328782	Force Gauge	7/27/2016	7/27/2017
TPM002-83	Tape Measure	3/22/2017	3/22/2018

Test Results
Photographs as well as all data processing and graphs can be found in Appendix B.

W17087 – Sample 1 – 40k lbf			
Location	**Pre-Test Measurement (in)**	**Post-Test Measurement (in)**	**1 Hour Post-Test Measurement (in)**
1	5.966	5.941	5.958
2	6.030	5.975	5.978
3	5.992	5.961	5.973

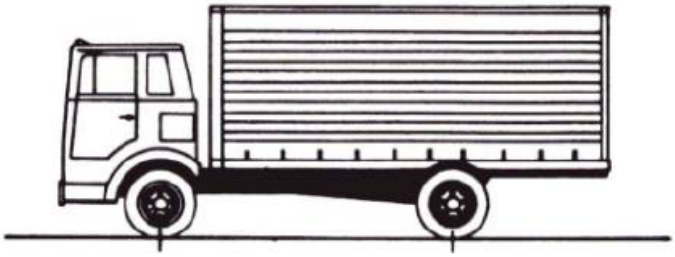
W17088 – Sample 2 – 50k lbf			
Location	**Pre-Test Measurement (in)**	**Post-Test Measurement (in)**	**1 Hour Post-Test Measurement (in)**
1	5.969	5.927	5.940
2	5.996	5.912	5.944
3	5.996	5.972	5.984

Additional test documentation can be found in the following appendices.

Appendix A
Customer Test Request and Related Documents

ASHTO Loading Conditions

The AASHTO Standard Specifications for Highway Bridges, 17th Edition, Section 3, identifies two types of design vehicle loads. They represent categories of individual vehicles and are routinely referred to as the H or HS truck. The H truck configuration includes only two theoretical axles as in figure 1.



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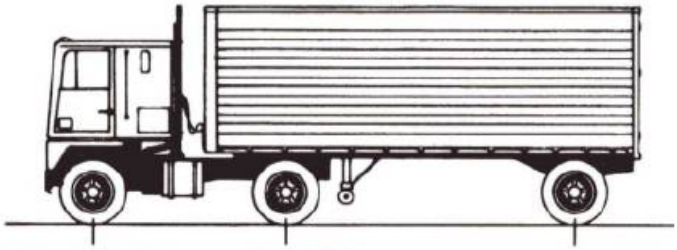

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H-20	**8,000 lbs.**	**32,000 lbs.**	**32,000 lbs.**
H-25	**10,000 lbs.**	**40,000 lbs.**	**40,000 lbs.**

Figure 2 – Standard HS Trucks

Load Calculations

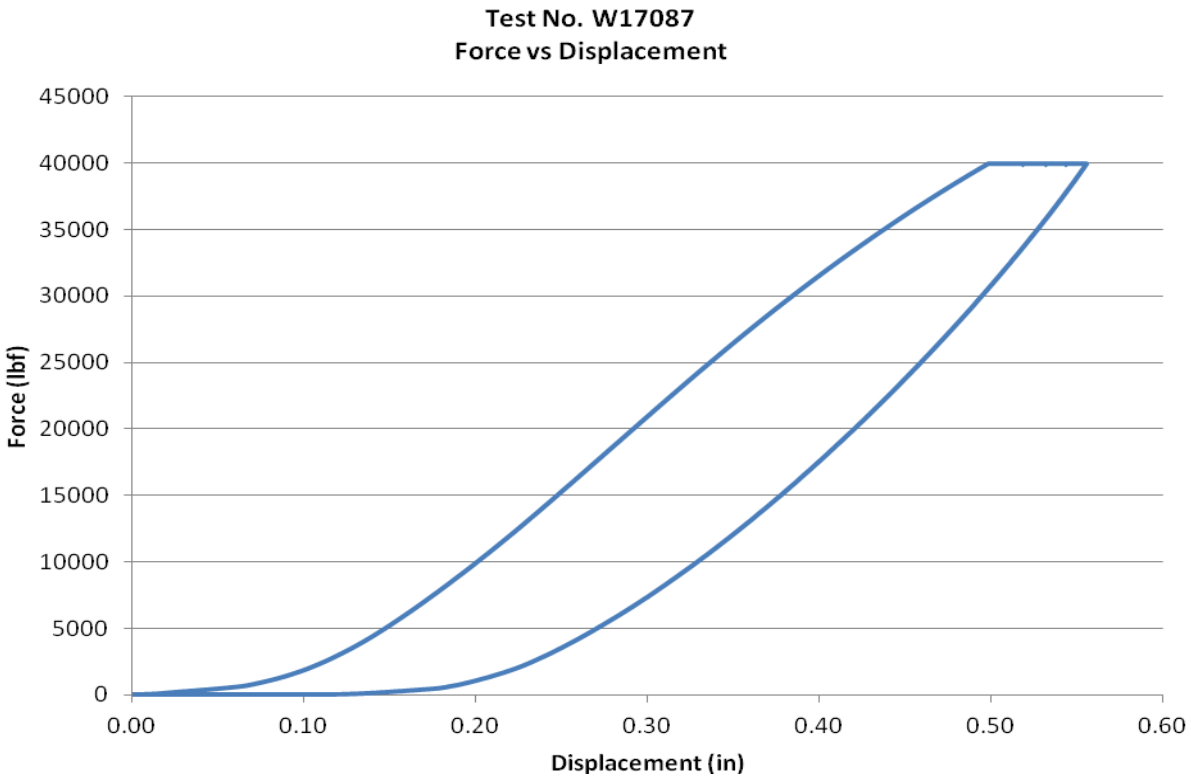
The 40,000 lbf proof loads represent a safety factor of 2.5 for H-20 or HS- 20 loading on one tire patch.

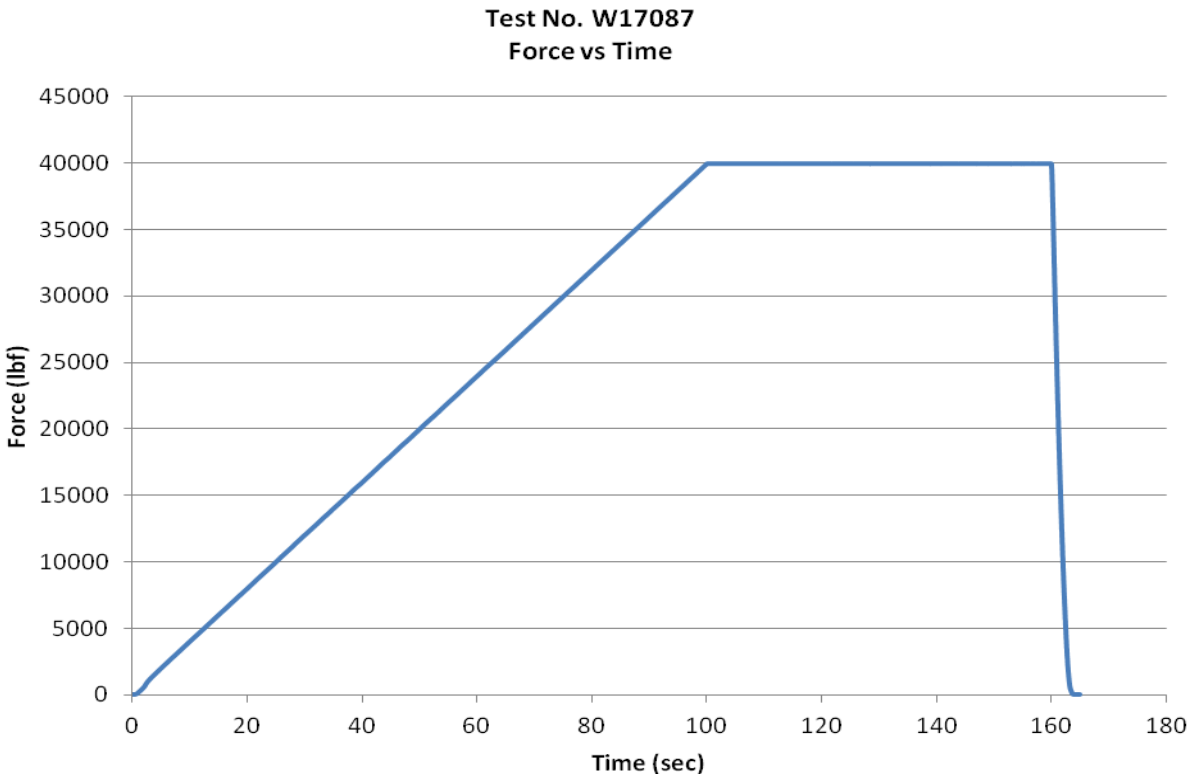
36,600 lb rear axel / 2 tire patches * 2.5 safety factor = 40,000 lbf proof load

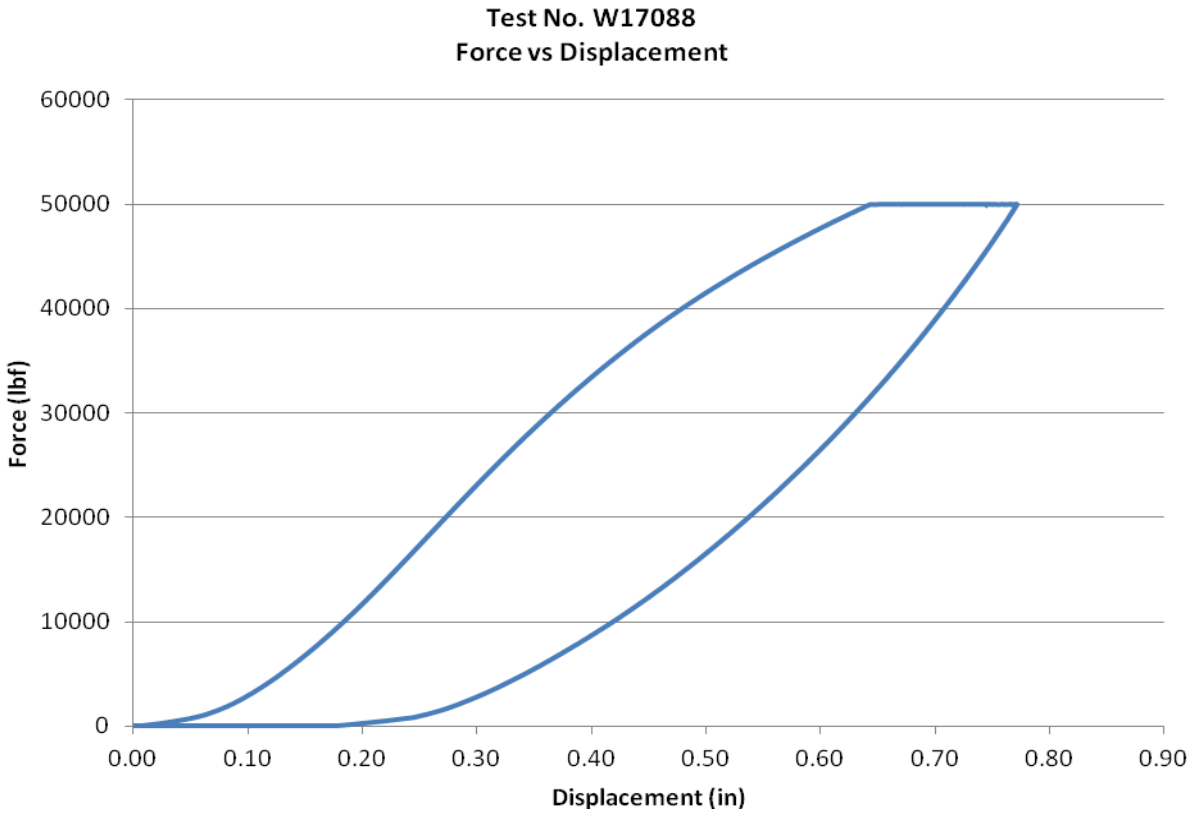
A 50,000 lb. proof load will be used to represent a safety factor of 2.5 for H-25 or HS-25 loading on one tire patch.

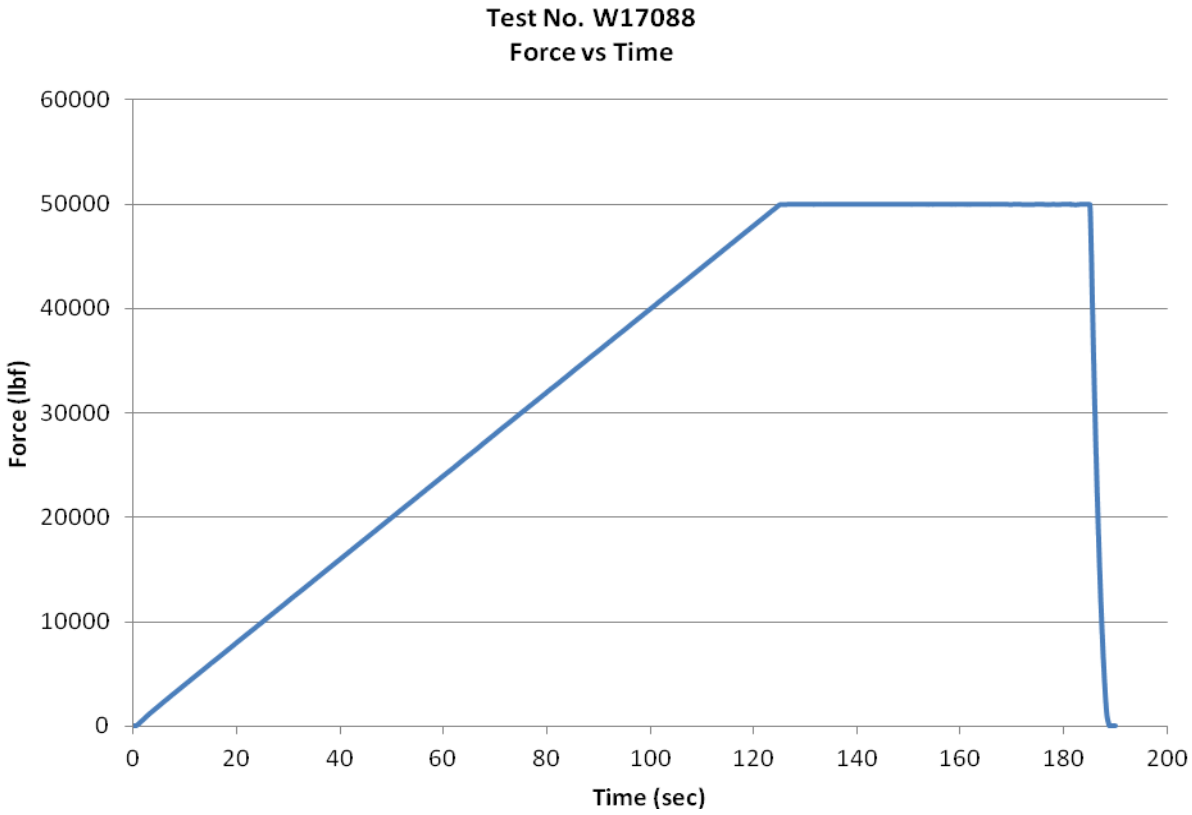
40,000 lb rear axel / 2 tire patches * 2.5 safety factor = 50,000 lbf proof load

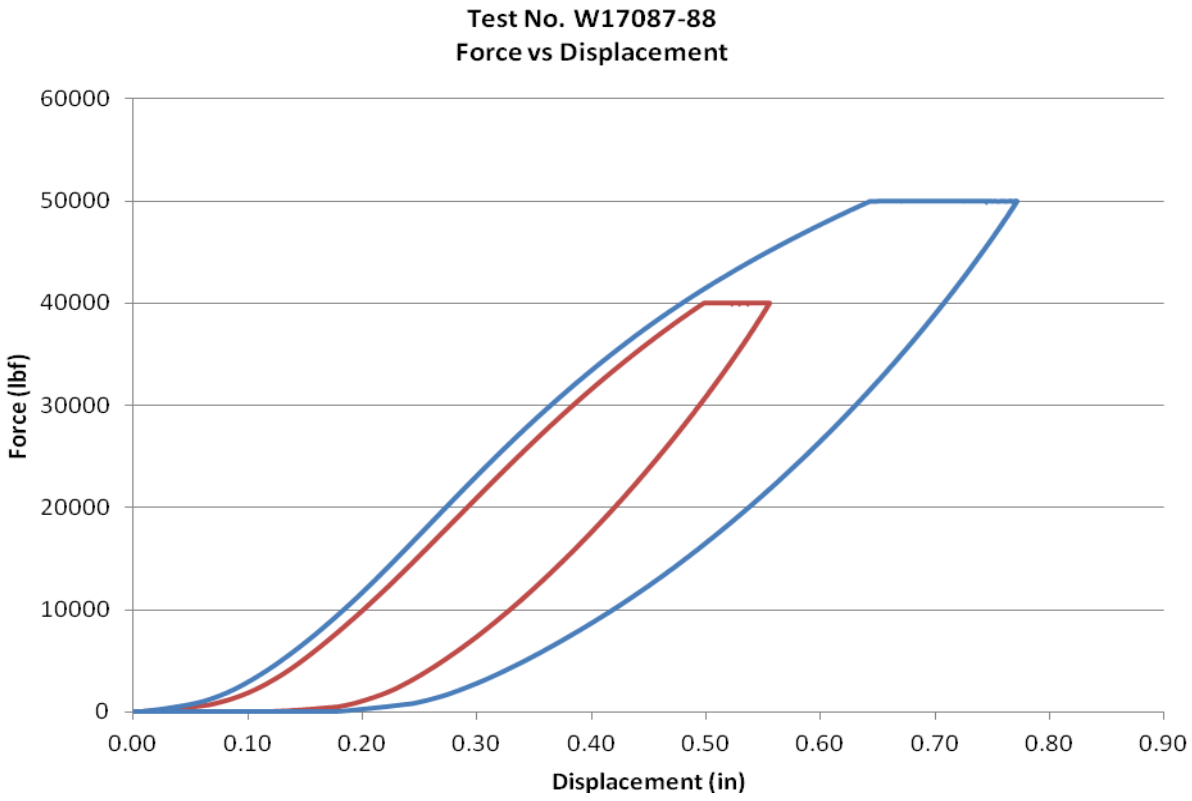
Appendix B
Test Data and Photographs



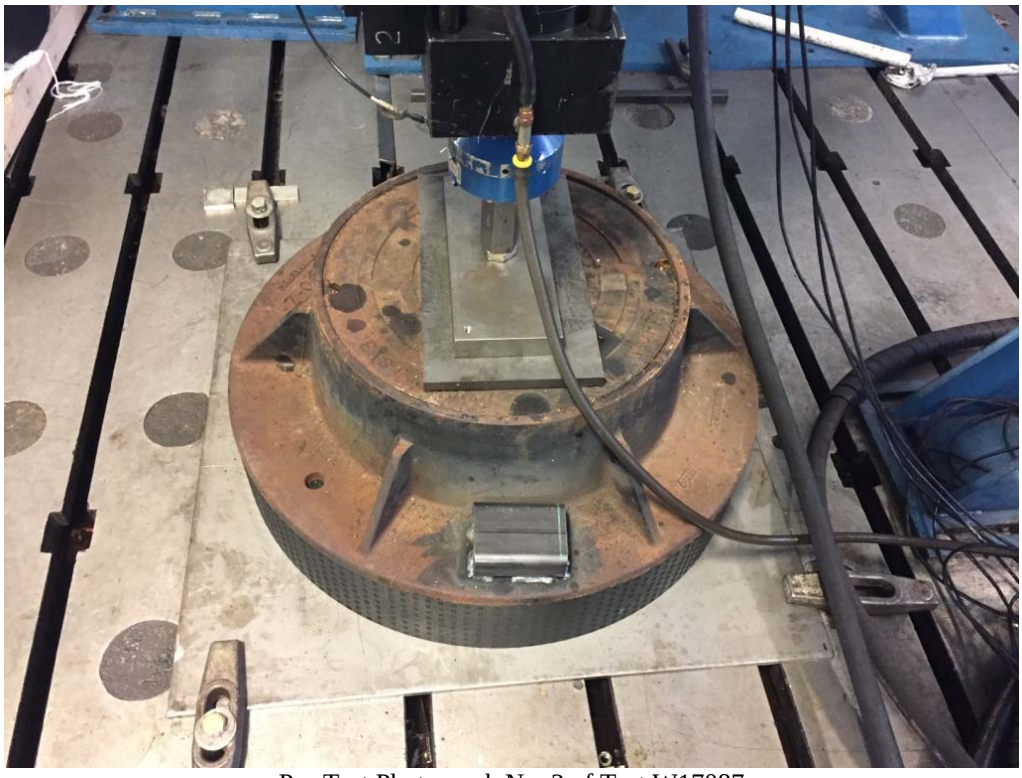



Test No. W17088
Force vs Displacement
60000
50000
40000
30000
20000
10000
0
Force (lbf)
0.00
0.10
0.20
0.30
0.40
0.50
0.60
0.70
0.80
0.90
Displacement (in)


Test No. W17088
Force vs Time
60000
50000
40000
30000
20000
10000
0
Force (lbf)
0
20
40
60
80
100
120
140
160
180
200
Time (sec)


Test No. W17087-88
Force vs Displacement
60000
50000
40000
30000
20000
10000
0
Force (lbf)
0.00
0.10
0.20
0.30
0.40
0.50
0.60
0.70
0.80
0.90
Displacement (in)

Pre-Test Photograph No. 1 of Test W17087



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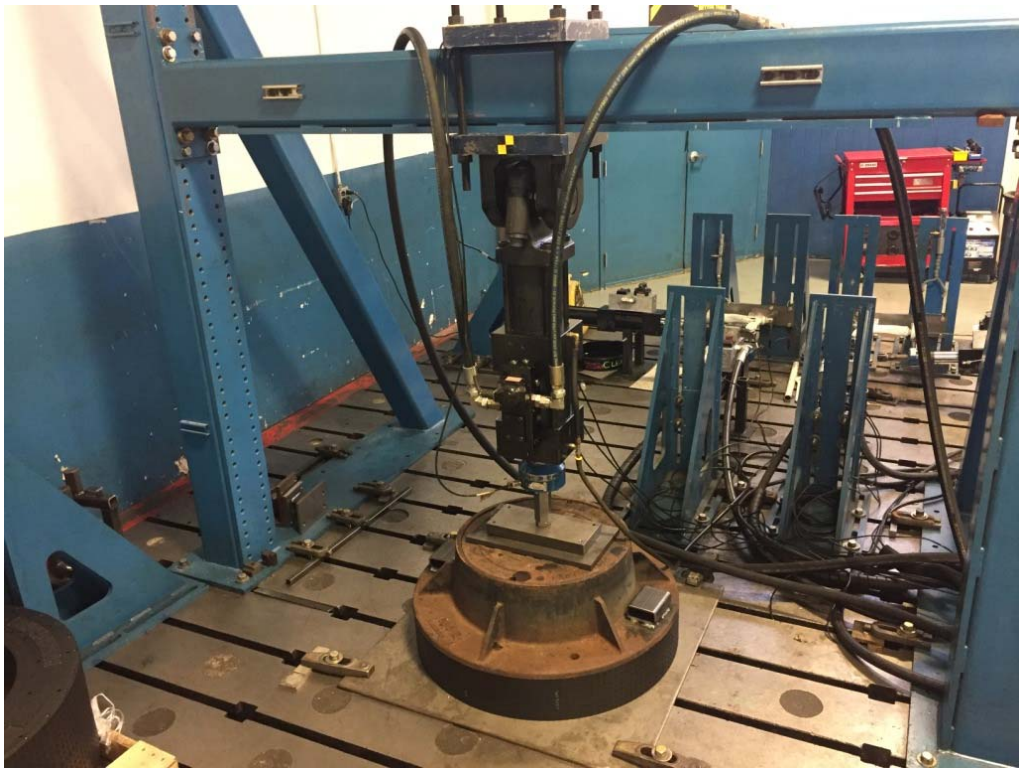

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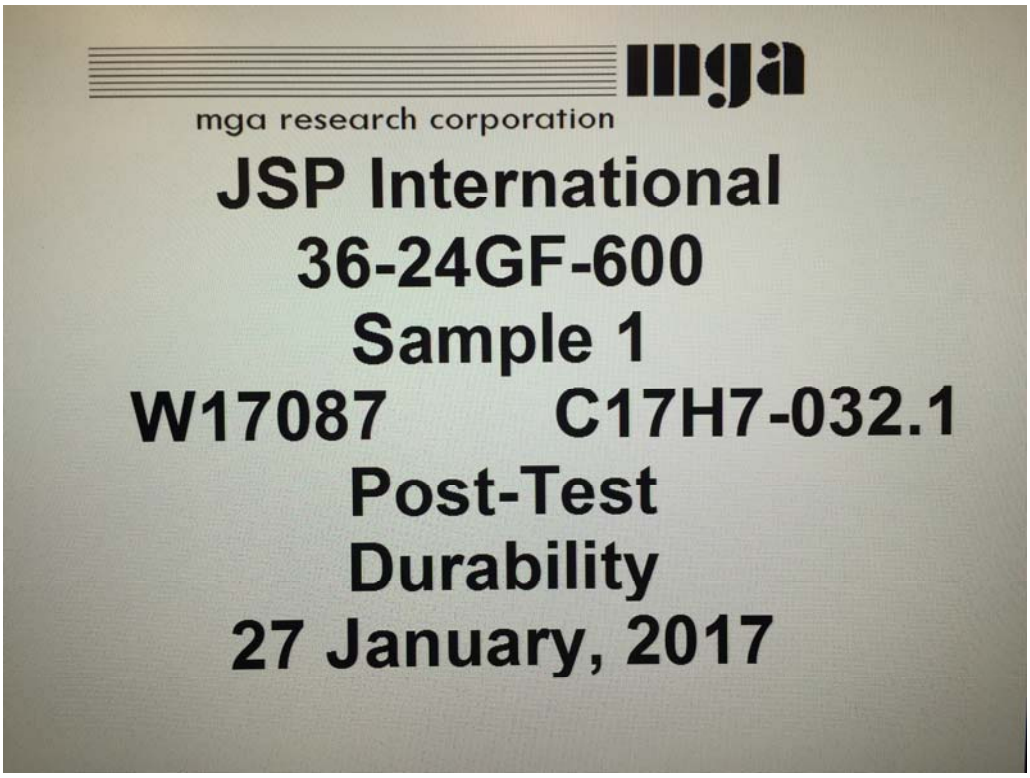


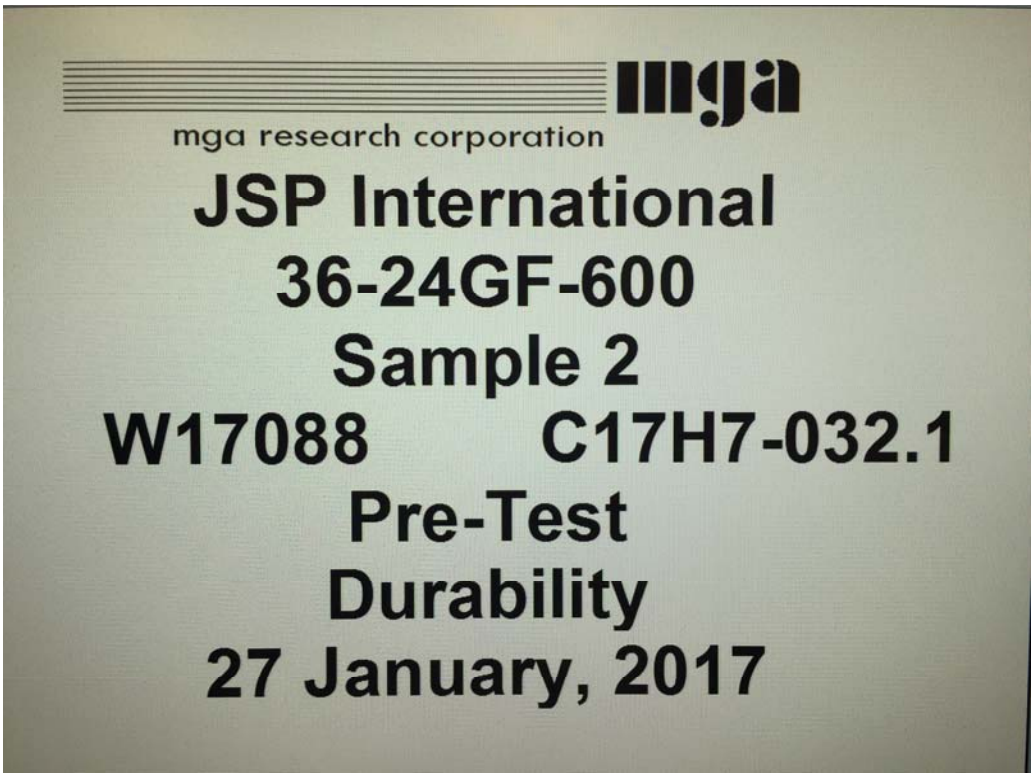
Post-Test Photograph No. 1 of Test W17087

Post-Test Photograph No. 2 of Test W17087

Post-Test Photograph No. 3 of Test W17087

Post-Test Photograph No. 4 of Test W17087

Post-Test Photograph No. 5 of Test W17087



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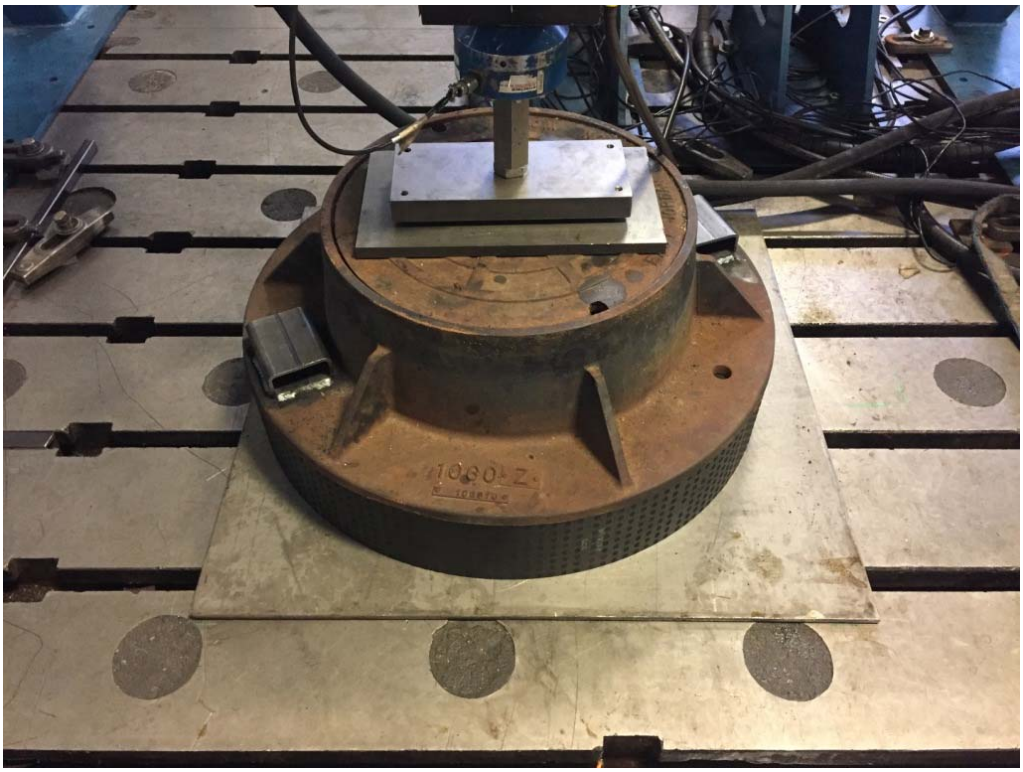
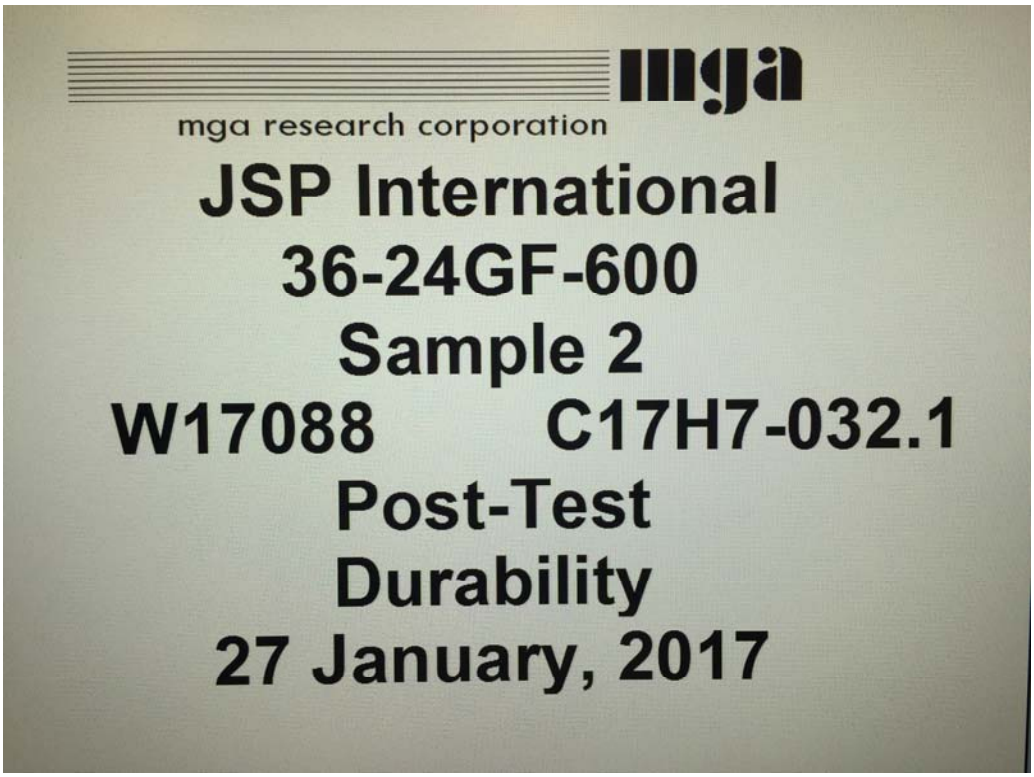
Pre-Test Photograph No. 2 of Test W17088



Pre-Test Photograph No. 3 of Test W17088



Post-Test Photograph No. 1 of Test W17088

Post-Test Photograph No. 2 of Test W17088

Post-Test Photograph No. 3 of Test W17088

Post-Test Photograph No. 4 of Test W17088

Post-Test Photograph No. 5 of Test W17088