



Birkom Shock Comparison Durability Test

SGS Report No. 16Y-0075-352_REV.2

Test Start Date: 6/13/16

Test End Date: 9/13/16

Attention: Bob Carlstedt
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Issued by:

Dennis Shaffer
Test Engineer
September 14, 2016

*Note: This report is not to be reproduced unless authorized by SGS Advanced Testing & Engineering, Inc.
The condition as received of all samples is good unless otherwise noted. This report only applies to the samples included.
Measurement Uncertainty Budget available upon request.*

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INSPECTION, VERIFICATION, TESTING AND CERTIFICATION COMPANY.



Test Method Identification

Test Specification: Testing was completed per SGS Quotation 16Y-0075-352 dated 5-30-2016. Additional test plan revision direction via email correspondence and as outlined below. *Reference Set-up Photographs #1 & 2.*

- Displacement: ±50mm @ 1.0Hz with ±10mm @ 10Hz superimposed
- Mid-Stroke: 94mm from rod shoulder to top of tube
- Waveform: Sine on Sine
- Total Cycles: 1M cycles at 1.0Hz.
- Temperature Range: 90°C – 110°C located near top of tube
- Coolant Water Jackets and shop air used to reduce thermal-cycling
- Weight: Recorded at 0, 1M, and EOT cycles only
- Failure Criteria: >20% D/F loss

Note: 2 Rigs were ultimately used due to Rig 1 malfunction (actuator manifold cracked on 8/9/2016). Test samples were not compromised due to the malfunction in any way.

Test Item Identification

| | |
|----------------|--|
| <u>Sample#</u> | <u>Part Description</u> |
| S.1916 | Comparison Shock |
| Birkom #1 | Birkom Shock |
| Birkom #2 | Birkom Shock |
| Birkom#3 | Replacement shock for Birkom #2 continuation |

Durability Test Results

| Sample | Rig | Start Date | End Date | Total Cycles | SOT Weight (g) | 1M Weight (g) | EOT Weight (g) | Comments |
|-----------|-----|------------|----------|--------------|----------------|---------------|----------------|--|
| S.1916 | 1,2 | 6/17/16 | 9/5/16 | 1,310,825 | 3,354 | 3,159 | 3,147 | Suspend test. Sample 36% loss of load & Rod discoloration noted. No oil leakage noted. Replace with Slave Shock #3 (Replacement) |
| Birkom# 1 | 1 | 6/17/16 | 6/19/16 | 82,655 | 3,654 | NA | 3,645 | Suspend test. Sample 70% loss of load & Rod discoloration noted. No oil leakage noted. Replace with Birkom #2. |
| Birkom# 2 | 1,2 | 8/12/16 | 9/13/16 | 1,568,926 | 3,656 | 3,584 | 3,571 | Test Suspended per customer request. <i>Shock still operating normally.</i> Discoloration noted. No oil leakage noted. |

Cyclic Load Data

| Cycles | S1916 | Birkom S.#1 Shock | Birkom S.#2 Shock | Slave Shock (Replacement) |
|-----------|--------------|--------------------|-------------------|---------------------------|
| SOT | 13,661/-1149 | 12,043/-1185 | 13,385/-2010 | NA |
| 82,655 | 12,404/-1037 | <i>*3941/-1024</i> | 11,329/-1851 | NA |
| 336,536 | 12,652/-1668 | NA | 11,319/-1854 | NA |
| 500,000 | 12,825/-1479 | NA | 11,401/-1958 | NA |
| 917,345 | *10,861/-919 | NA | 11,388/-1564 | NA |
| 1M | *10,427/-890 | NA | 11,336/-1202 | NA |
| 1,310,825 | *8,621/-505 | NA | 11,120/-1333 | NA |
| 1,568,926 | NA | NA | 11,231/-1313 | NA |

**Indicates a load loss of greater than 20%*

Test Photographs



Photograph #1: Rig1 Setup



Photograph #2: Rig2 Setup

Test Photographs (Continued)



Photograph #3: Comparison Shock
Rod discoloration at 82,655 cyc.



Photograph #4: Comparison Shock Post Test



Photograph #5: Birkom#1, rod discoloration at 50,610 cyc.



Photograph #6: Birkom#2, rod discoloration at 34,692 cyc.



Photograph #7: Birkom#2, rod discoloration at 219,866 cyc.



Photograph #8: Birkom#2 Post-test

A2LA Certification

American Association for Laboratory Accreditation



SCOPE OF ACCREDITATION TO ISO/IEC 17025:2005

SGS ADVANCED TESTING & ENGINEERING, INC.¹
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MECHANICAL

Valid To: January 31, 2018

Certificate Number: 1901.01

In recognition of the successful completion of the A2LA evaluation process, accreditation is granted to this laboratory at the location listed above as well as the one satellite laboratory location listed below to perform the following tests on the following automotive components: Seating Systems and Components, Exhaust Systems and Components, Shock Absorbers, Interior and Exterior Trim, Structural Components and Stampings:

| Test | Parameter | Test Method |
|---|---|--|
| Airleak Testing ² | (Up to 100 slpm) | ES8C34-5K214-AD:2008 |
| Durability / Axial and Bending Fatigue & Ultimate Strength ² | 50,000 lbs max. | ES-F8UA-5K214-AA:1997, Section III D & F; Ford CETP 09.03-E300 Rev 200412; GES-97040A; GMW14390:2005 |
| High / Low Temperature ² | (-55 to 120) °C, 62 ft ³ | TES TSD6522G:2004 |
| High Temperature Air Flow ² | 2,500 scfm, 1200 °C max. | CTS, Section 4.4.2.1; Ford CETP 09.02-E-300, Ford CETP 09.02-E-301; GMPT Catalytic Converter Assembly |
| Thermal Shock (Waterspray) | | CTS, Section 4.4.2.1; DCX PF-9019, Section 2.4; Ford CETP 09.02-E-301; GMPT Catalytic Converter Assembly |
| Vibration ² with High Temperature Air Flow 2,500 scfm, 1200 °C max. | (5 to 3,000) Hz Up to 3" peak to peak displacement | CTS, Section 4.4.2.1; DCX PF-9019; Ford CETP 09.02-E-302, Ford CETP 09.02-E-304, Ford CETP 09.02-E-308, Ford CETP 09.02-E-309; GMPT Catalytic Converter Assembly |
| Sine | 22,000 lbf | |
| Random | 22,000 lbf | |
| Shock | 54,000 lbf | |

(A2LA Cert. No. 1901.01) 05/10/2016

Page 1 of 2

5202 Presidents Court, Suite 220 | Frederick, MD 21703-8398 | Phone: 301 644 3248 | Fax: 240 454 9449 | www.A2LA.org

A2LA Certification (Continued)

¹This accreditation covers testing performed at the main laboratory location listed above, and the following laboratory listed below:

804 Mapleawn
Troy, MI 48084

| Test | Parameter | Test Method |
|---|-------------------------------------|---|
| Durability / Axial and Bending Fatigue & Ultimate Strength ² | 50,000 lbs max. | ES-F8UA-5K214-AA:1997, Section III D & F; Ford CETP 09.03-E300 Rev 200412; GES-97040A; GMW14390:2005 |
| High / Low Temperature ² | (-40 to 120) °C, 62 ft ³ | TES TSD6522G-2004 |
| Acoustic Measurements | (45-138) dbA in anechoic chamber | TES TSD6542G |

²This laboratory also uses customer supplied specifications and/or methods (or methods developed by the lab and approved by the client) directly related to the types of tests and within the parameters listed above.



Accredited Laboratory

A2LA has accredited

SGS ADVANCED TESTING & ENGINEERING, INC.

Taylor, MI

for technical competence in the field of

Mechanical Testing

This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2005 General requirements for the competence of testing and calibration laboratories. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (refer to joint ISO-ILAC-IAF Communiqué dated 8 January 2009).

Presented this 10th day of May 2016.




Senior Director of Quality and Communications
For the Accreditation Council
Certificate Number 1901.01
Valid to January 31, 2018

For the types of tests to which this accreditation applies, please refer to the laboratory's Mechanical Scope of Accreditation.