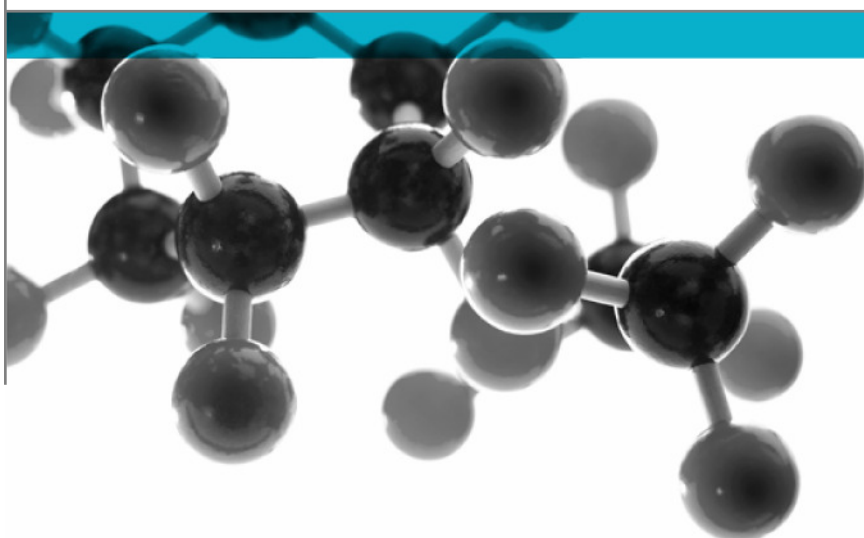


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Analysis of Heat Shrinkable Identification Sleeves



Testing Identification sleeves to Boeing Material Specification 13-69A

Date: 05 December 2011

Issue No.: 1

Page 1

Document Reference: 313856

A Report To: **Barrie Hamilton**
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**Testing
Advising
Assuring**

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Executive Summary

Objective To determine the performance of the following material when tested in accordance with **Boeing Material Specification 13 – 69**

Test Items **Heat Shrink Tubing**

Material Type **Polyolefin**

Part Number REF 1: Sumitomo Heat Shrink Tubing B2-3x
 Ribbon: Kroy 92-BLK-PR243STUC
 Printer: Kroy K44XX / K47XX series printers

REF 2: Sumitomo Heat Shrink Tubing NHP (TW)
 Ribbon: Kroy 92-BLK-PR243STUC
 Printer: Kroy K44XX / K47XX series printers

REF 3: Sumitomo Heat Shrink Tubing NH (TW)
 Ribbon: Kroy 92-BLK-PR243STUC
 Printer: Kroy K44XX / K47XX series printers

Test Date 17/11/2011

Test Details / Results



| Test | Specification | Pass / Fail |
|---------------------|-------------------------|-------------|
| Fluid Resistance | BSM 13 – 69, clause 8.8 | Pass |
| Marking Performance | BMS 13 – 69, clause 8.9 | Pass |

Accreditation statuses of all tests within this report are as per relevant quotation. The test data and result sheets containing more detailed information in accordance with the technical works procedures or standards used are held at Exova as part of the accredited quality assurance system. Opinions and interpretations expressed herein are outside the scope of the UKAS accreditation of this laboratory.

Specimen Information

| | |
|--------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Conditioning of samples | <p>The samples were received on the 4th November 2011</p> <p>Samples were received as being suitable for testing purposes and were tested in accordance with or apart of Quote Number Q13064A and Your Purchase Order number PO10521</p> <p>Test samples were prepared and conditioned in a controlled atmosphere maintained at a nominal 23°C and 50% Room Humidity for 24 hours before commencement of testing and exposure.</p> |
| Unique Reference No. | <p style="text-align: right;">W21272</p> <p>Specimens are allocated unique reference numbers in accordance with our quality systems</p> |
| Sample disposal | <p>Representative test samples will be stored at Exova for 1 month prior to disposal.</p> <p>Should you require these samples, e.g. for QS 9000 materials PPAP submission, please arrange for their return within this period.</p> |

Report Signatories and Approval

| | |
|-----------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>Author</p> |  <p>Chris Smith – Automotive Test Engineer (For and on behalf of Exova (UK) Ltd)</p> |
| <p>Approver</p> |  <p>Natalie Stokes – Automotive Test Engineer (For and on behalf of Exova (UK) Ltd)</p> |

Revision History

| | |
|-----------------------------|--------------------------|
| <p>Issue No :</p> | <p>Re - Issue Date :</p> |
| <p>Revised By:</p> | <p>Approved By:</p> |
| <p>Reason for Revision:</p> | |

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| <p>Issue No :</p> | <p>Re - Issue Date :</p> |
| <p>Revised By:</p> | <p>Approved By:</p> |
| <p>Reason for Revision:</p> | |

Test Results

Clause:

Fluid Resistance

Test Conditions:

Test pieces were placed in Petri dishes that were filled with the fluids listed below. These were then conditioned for 24 hours as defined in the table below. Pieces were then removed and allowed to drip dry for 24 hours, before a visual evaluation was carried out on the printing.

| Fluid ref | Test Fluid | Conditioning Temperature (°C) |
|-----------|---------------------------------------------|-------------------------------|
| 1 | BMS 3-11 HY Jet IVA | 70 |
| 2 | Isopropyl Alcohol TT - I - 735 | 23 |
| 3 | ASTM - E - 1119 - 92 Ethylene Glycol | 23 |
| 4 | MIL - H - 5606 Hydraulic Fluid | 70 |
| 5 | MIL - T - 5624 Jet Fuel, Jet A | 23 |
| 6 | MIL - L - 7808 Lubricating Oil, Castrol 399 | 70 |
| 7 | MIL - L - 23699 Turbine Oil, Turbo 2380 | 70 |
| 8 | MIL - P - 83800 Propylene Glycol | 23 |
| 9 | Salt Water 5% | 23 |

Requirements:

The sleeve will meet the legibility requirements of BMS 13-69, 5.7. Which states: the printed information shall be legible without magnification at a minimum distance of fifteen inches under average work light.

Findings:

Printing was still clearly legible on all samples after exposure to the fluids. There was however some evidence of text whitening on the NHP (TW) and NH (TW) samples when exposed to Isopropyl alcohol.

Some physical changes had occurred after exposure to some fluids with swelling or softening affecting some samples.

| Fluid Ref | Appearance Effect | | |
|-----------|-------------------|---------------------------|---------------------------|
| | B2 - 3x | NHP (TW) | NH (TW) |
| 1 | None | Swelling / Softening | Swelling / Softening |
| 2 | None | Text Whitening | Text Whitening |
| 3 | None | None | None |
| 4 | Slight Swelling | Slight Swelling | Slight Swelling |
| 5 | None | Swelling / Softening | Swelling / Softening |
| 6 | Slight Swelling | Softening / Swollen to 2X | Softening / Swollen to 2X |
| 7 | Slight Swelling | Softening / Swollen to 2X | Softening / Swollen to 2X |
| 8 | None | None | None |
| 9 | None | None | None |

Clause:

Marking Performance

Test Conditions:

Test samples were mounted onto a linear abrader and the following conditions were applied:

| | |
|---------------|-------------------------------------------|
| Rub Material: | Abrasive Felt |
| Load: | 2lbs (approximately 9N) |
| Cycles: | 15 (1 cycle is 1 back and forth movement) |
| Speed: | 60 rubs per minute |

After completion, the test piece was removed and assessed for any defects as a result of the abrasion.

Requirements:

The sleeve will meet the legibility requirements of BMS 13-69, 5.7. Which states: the printed information shall be legible without magnification at a minimum distance of fifteen inches under average work light.

Findings:

The printing was still clearly legible on all 3 parts; there was evidence of some transfer of yellow dye from the parts to the abrasive felt in all 3 tests.

End of Report