



AEROSPACE INFORMATION REPORT

AIR7930™

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Dimensional Life of Heat-Shrinkable Sleeve

RATIONALE

This SAE Aerospace Information Report is intended to provide additional information in regard to the dimensional life specified in AS23053 and its detail specifications to address questions regarding this term as requested by users of the specification and by the AE-8D committee.

1. SCOPE

This SAE Aerospace Information Report provides additional information and background in regard to the dimensional life of a heat-shrinkable sleeve. The term dimensional life is newly introduced in AS23053 to relate to the dimensional stability instead of the material stability often associated or referred to as the "shelf life." When the material exceeds such shelf life, it becomes harmful or non-functional.

1.1 Purpose

This AIR explains intent of the dimensional life requirements as specified in AS23053.

2. APPLICABLE DOCUMENTS

The following publications form a part of this document to the extent specified herein. The latest issue of SAE publications shall apply. The applicable issue of other publications shall be the issue in effect on the date of the purchase order. In the event of conflict between the text of this document and references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

2.1 SAE International

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AS23053 Insulation Sleeving, Electrical, Heat Shrinkable, General Specification for

3. GENERAL

3.1 Heat-Shrinkable Sleeve Basics

A heat-shrinkable sleeve (HSS) is made of a variety of materials. Specific materials and their properties are defined in detail specifications. Some materials contain elastomeric materials and some do not. The material ingredients determine specific properties required to perform in the intended use and in environment.

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Documents

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Typically, an HSS is extruded (though some may be molded), cross-linked, expanded, and packaged. The extrusion (or molding) forms the initial configuration. Cross-linking, done in variety of ways such as radiation cross-linking, chemical cross-linking, etc., locks in the extruded shape. Expansion may be done by heating the cross-linked material and enlarging the diameter of the sleeve. Then, sleeves are cooled to maintain the enlarged diameter. The expanded sleeve is converted into the required finished product format—cut or spooled to required length prior to packaging for shipment.

When the finished product is heated, the expanded tubing recovers to the original or near-original dimensions. Some materials will recover to their specified dimensions essentially forever. Some materials will recover to their specified dimensions initially, but over time, they may not recover fully to the specified value. This phenomenon is described as the sleeve having an amnesia, i.e., “forgetting” to recover fully to its original “as-supplied” dimension(s).

3.2 Unresolved Recovery (URR)

When a HSS is fully recovered, it is said to have 0% unresolved recovery (URR). Conversely, HSS that is not recovered is said to have 100% unresolved recovery. When a HSS is recovered onto a substrate with equal to or less than the diameter of a sleeve, i.e., allows full recovery without any restriction, this HSS has 0% URR. If an HSS is recovered onto a substrate that is 80% of the as supplied diameter, the HSS has 80% URR. HSS with higher URR maybe more prone to split, and the wall thickness will be thinner than HSS with lower URR. Because of the wide range of substrate diameters one HSS can accommodate, a range of URR may exist in an application with multiple diameters. A typical recommended URR range is 20 to 80%. This range provides sufficient hoop stress on the substrate while minimizing the risk of HSS splitting, keeping in mind the causes of higher risk of splitting is not the only side effect of high URR, i.e., material formulation, processing, user practices, etc. also may affect material splitting. Recovered wall thickness in the range from fully expanded to fully recovered is indirectly portional to URR.

3.3 Shelf-Life

A shelf-life can be defined as a predetermined date or period beyond which the product is chemically or otherwise transformed such that the product is either harmful to the user or the no longer is capable of providing the intended function of the product. For example, a milk past its use-by date may be spoiled. When consumed, it may result in an illness. As another example, when an adhesive beyond the expiration date may have undergone a chemical transformation that it no longer bonds as intended.

3.4 Dimensional Life

The term “Dimensional Life” was put to use to define a useable period of HSS when AS23053 conversion from AMS-DTL-23053 started to define the useable time of some HSS that may exhibit amnesia. HSS with amnesia over time will not fully recover to the specified unrestricted recovered dimensions (typically recovered diameter). Unlike products with shelf-life, the material properties of the HSS with amnesia would not have diminished over time. For example, specified unrestricted recovery diameter of an HSS is 0.500 inch, maximum. A fresh HSS exhibits as-tested URR diameter of 0.490 inch. A same type of product that is beyond its use-by date results in the URR diameter of 0.510. They are recovered onto a substrate of 0.625 inch diameter, both fresh and aged HSS will have the equal longevity in their application(s). For this reason, AS23053 allows end users the option to use an HSS beyond its use-by date based on the application. AS23053 also allows the extension of the initial use-by date provided that the HSS meets the extension criteria set forth in AS23053 and/or its detail specification. To further define and explain, Required Dimensional Life and Declared Dimensional Life will be used.

3.4.1 Required Dimensional Life

Required Dimensional Life (RDL) is specified in detailed specification as “Dimensional Life.” RDL is stated as required minimum time a sleeve must be dimensionally stable after manufacturing without any extension(s).