American Gear Manufacturers Association

AGMA Information Sheet

Splines – Design and Application (Inch Edition)

AGMA 945-2-B20

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ABSTRACT

This information sheet covers inch based parallel straight sided and involute splines. It provides information relating to geometry, fit types, materials, manufacturing, rating, inspection, lubrication, and failure of splined elements. For metric based splines see AGMA 945-1-B20.

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Foreword

[The foreword, footnotes and annexes, if any, in this document are provided for informational purposes only and are not to be construed as a part of AGMA Information Sheet AGMA 945-2-B20, *Splines – Design and Application (Inch Edition).*

Several documents exist relating to various aspects of spline design and manufacture. For example, spline geometry is well covered in other standards and rather than repeating those standards, this document makes reference to each one. Even the term *spline* can refer to a multitude of part shapes. This document is an attempt to augment other spline standards and consolidate information on spline types, geometry, assembly, inspection, materials, manufacturing processes, lubrication, rating, and failure modes.

Although involute splines of 30° pressure angle are very popular, this information sheet also covers involute splines of 37.5° and 45° pressure angle, parallel straight sided splines and modifications to spline geometry such as lead modification, missing tooth, and end geometry from the manufacturing process.

This information sheet is an extension of AGMA 945-1-B20 to cover inch based splines. Heat treatment requirements were updated, the rating and troubleshooting clause was separated, and new references were added. The committee began work on this information sheet in August 2019.

The first draft of AGMA 945-2-B20 was created in May 2020. It was approved by the membership in August 2020 and approved for publication by the Technical Division Executive Committee (TDEC) on August 20, 2020.

Suggestions for improvement of this standard will be welcome. They may be submitted to tech@agma.org.

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1 Scope

The scope of this information sheet includes involute splines (some of which are governed by ANSI B92.1), plus variants such as modifications to helix, lead crown, form diameters, root geometry, tooth thickness, and fits and straight sided splines with parallel teeth in the external spline (some of which are governed by SAE J499 or SAE J501). It also includes longitudinal effects such as the washout of the minor diameter in splines that are formed or cut into a shaft and hoop strength effects of hollow splined sections. A limited range of materials is included: hard steel, soft steel, powdered metal steel (PM), and cast iron. Manufacturing processes discussed include: rolling, hobbing, shaping, milling, broaching, grinding, net formed PM, and cold forming. Rating for compressive, shear, bending, and hoop stresses are covered, as are tolerances, lubrication, and failure modes. Both elemental and attribute inspection of splines are included. It also describes drawing requirements, and a troubleshooting guide. Table 1 provides a summary of the scope.

Table 1 – Document scope

Category	In Scope	Not in scope
Geometry:		
Shape:	a. Cylindrical b. Involute 30°, 37.5°, 45° pressure angle c. Straight sided with parallel teeth in external spline	a. Non-parallel straight sided b. Castle c. Other involute pressure angle d. Serration e. Face including Curvic
Modifications:	a. Crowned b. Tapered c. Reduced form clearance d. Modified tooth thickness e. Tip chamfer or internal corner clearance f. Splines with some teeth intentionally missing	a. Modified tooth height
Tooth Size:	a. Involute: 2.5 to 48 diametral pitch	a. Finer than 48 diametral pitch b. Coarser than 2.5 diametral pitch
Tooth count:	a. Involute: Equal to or more than 6 teeth b. Parallel straight sided: 4, 6, 8, 10, 16 teeth	a. Involute: Less than 6 teeth b. Parallel straight sided: other tooth counts
Location:	a. Internal b. External	a. Face
Spline standard:	a. English involute stub pitch: ANSI B92.1-1996 b. Metric involute: ISO 4156, DIN 5480 c. English parallel straight sided: SAE J499 or SAE J501 d. Metric parallel straight sided: ISO 14	
Lead:	a. Straight, or spur b. Slight helix on shaft for interference fit	a. Spur or helical; continuation of gear tooth b. Helix splines for locking > 1 degree
Root geometry:	a. Flat root b. Full fillet c. Undercuts in internal spline major diameter d. Net formed root shape	