



American
Gear Manufacturers
Association

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AGMA Information Sheet

Splines – Design and Application

**American Gear
Manufacturers
Association** ***Splines – Design and Application***
AGMA 945-1-B20

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ABSTRACT

This information sheet covers parallel straight sided and involute splines. It provides information relating to geometry, fit types, materials, manufacturing, rating, inspection, lubrication, and failure of splined elements.

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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 945-1-B20, *Splines – Design and Application*.

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 committee first met in November 2011 to develop this information sheet. The committee consisting of automotive, industrial, aerospace component and system manufacturers and consultants were responsible for first developing this document.

The first draft of AGMA 945-A18 was created in December 2012. It was approved by the membership in February 2018.

AGMA 945-1-B20 replaces AGMA 945-A18. This edition clarified some terminology, corrected equations 9 and 10, and modified equation 11 to include alternate materials beyond steel on steel splines. Equation 31 was corrected.

The first draft of AGMA 945-1-B20 was made in December 2019. It was approved by the AGMA membership in February 2020 and approved for publication by the Technical Division Executive Committee (TDEC) on April 7, 2020.

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

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American Gear Manufacturers Association – Splines – Design and Application

1 Scope

The scope of this information sheet includes involute splines (some of which are governed by ISO 4156 and DIN 5480), 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 ISO 14). 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:	<ul style="list-style-type: none"> a. Cylindrical b. Involute 30°, 37.5°, 45° pressure angle c. Straight sided with parallel teeth in external spline 	<ul style="list-style-type: none"> a. Non-parallel straight sided b. Castle c. Other involute pressure angle d. Serration e. Face including Curvic
Modifications:	<ul style="list-style-type: none"> 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 	<ul style="list-style-type: none"> a. Modified tooth height
Tooth Size:	<ul style="list-style-type: none"> a. Involute: 0.5 to 10 mm metric module 	<ul style="list-style-type: none"> a. Finer than 0.5 module b. Coarser than 10 module
Tooth count:	<ul style="list-style-type: none"> a. Involute: Equal to or more than 6 teeth b. Parallel straight sided: 4, 6, 8, 10, 16 teeth 	<ul style="list-style-type: none"> a. Involute: Less than 6 teeth b. Parallel straight sided: other tooth counts
Location:	<ul style="list-style-type: none"> a. Internal b. External 	<ul style="list-style-type: none"> a. Face
Spline standard:	<ul style="list-style-type: none"> a. English involute stub pitch: ANSI B92.1-1996 b. Metric involute: ISO 4156, DIN 5480 d. Parallel straight sided: ISO 14 	
Lead:	<ul style="list-style-type: none"> a. Straight, or spur b. Slight helix on shaft for interference fit 	<ul style="list-style-type: none"> a. Spur or helical; continuation of gear tooth b. Helix splines for locking > 1 degree
Root geometry:	<ul style="list-style-type: none"> a. Flat root b. Full fillet c. Undercuts in internal spline major diameter d. Net formed root shape 	