When the straight-tooth bevel gears are an identical pair and operate at right angles, they are called miter gears. Both shafts will then rotate at the same speed. When the angle is other than a right angle, they are designated as angular bevels. There are limitations on the pitch angle of the pinion due to constrictions on some gear generators, which usually require an angle of above 5º. Subject to certain ratio limitations, shaft angles between 30º and 150º are usually permissible.

As with spur gears, the sound levels of straight-toothed bevel gears are likely to increase in proportion to increases in speed. The sound emanates from the action of the full-tooth length instantaneously entering the zone of engagement.

**Pressure Angles**

The bevel gear is standardized with a 20º pressure angle, also made with 14½º, 16º, 17½º, 22½º, 25º, and 35º pressure angles. For straight bevels, the AGMA standard recommends pressure angles of 20º and, for 12 or 13 teeth, 25º. The angle is measured normal to the surface of the tooth. The smaller angles are sometimes necessary when very large gears stretch the capacity of the gear generator. These smaller angles result in a lower rating, and there is a tendency to undercut the profile. The theory is to use the lowest pressure angle possible without reducing the strength or introducing undercutting. It is widely known that a lower pressure angle produces a lower decibel level and an increased arc of action. The effect of any eccentricity is reduced, and the tooth’s radial load component minimized. In theory, the pressure angle may be any one of a number, but the same practical result is obtained in most generating systems by using the approved standard angles. The rarely used 17½º was introduced to provide the quietest form of tooth consistent with the necessary strength and wear qualities.

In future columns, we’ll discuss gear blanks, basics of bevel gears, and bevel gears of more than 90º.

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The teeth of bevel gears are formed on the same principle as spur or helical gears, but their contact surfaces are not developed upon the actual pitch circle. A tooth section would show the actual shape and would not be in a plane parallel to the base of the pitch cone, but instead in a plane perpendicular to the conical pitch surface. The teeth placement is perpendicular to this pitch surface. In order to prevent an excessive difference in proportions between the inner and outer ends of the teeth, it is good practice to limit the face-width to approximately one third of the cone distance.

The tooth dimensions are taken from the large end of the tooth. When load calculations are made, the forces and dimensions at the central section location are used. The diametral pitches are of the same series as those of spur gears listed in chapter four. The circular pitch and pitch diameters are calculated in the same manner as spur gears.

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**ABOUT THE AUTHOR:**

William P. Crosher is former director of the National Conference on Power Transmission, as well as former chairman of the AGMA's Marketing Council and Enclosed Drive Committee. He was resident engineer-North America for Thyssen Gear Works, and later at Flender Graffenstaden. He is author of the book *Design and Application of the Worm Gear*.