

AUTOMOTIVE SYNCHRONOUS BELT DRIVES

Foreword—This Reaffirmed Document has been changed only to reflect the new SAE Technical Standards Board Format.

1. **Scope**—The following information applies to automotive camshaft drives, distributor drives, or other underhood drives that may require synchronization. For other power transmission drives requiring synchronization, refer to Specifications for Drives using Synchronous Belts (MXL, XL, L, H, XH, and XXH belt sections) (IP 24/1978), published jointly by the Rubber Manufacturers Association (RMA), the Mechanical Power Transmission Association (MPTA), and the Rubber Association of Canada (RAC).

2. **References**

2.1 **Applicable Publications**—The following publications form a part of this specification to the extent specified herein. The latest issue of SAE publications shall apply.

2.1.1 SAE PUBLICATION—Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

SAE J1278—SI (Metric) Synchronous Belts and Pulleys

2.1.2 OTHER PUBLICATION

IP 24/1978—Published jointly by the Rubber Manufacturers Association (RMA), the Mechanical Power Transmission Association (MPTA), and the Rubber Association of Canada (RAC)

3. **Pulleys**

3.1 **Minimum Pulley Diameters**—Minimum recommended pulley diameters are shown in Table 1.

TABLE 1—MINIMUM RECOMMENDED PULLEY DIAMETERS (MM)

Pulley Section	Pitch	Minimum Grooves	Minimum Pitch Diameter	Minimum Outside Diameter
ST	9.525	10	30.32	29.56
SU	12.700	14	56.60	55.23
STA	9.525	19	57.61	56.23

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3.2 Minimum Pulley Width—The minimum pulley width between flanges (Figure 1) is determined by Equation 1:

$$1.5 (\text{belt plus side tolerance}) + \text{nominal width} \quad (\text{Eq. 1})$$

NOTE—Stack up tolerances should be handled between pulley manufacturer and the user.

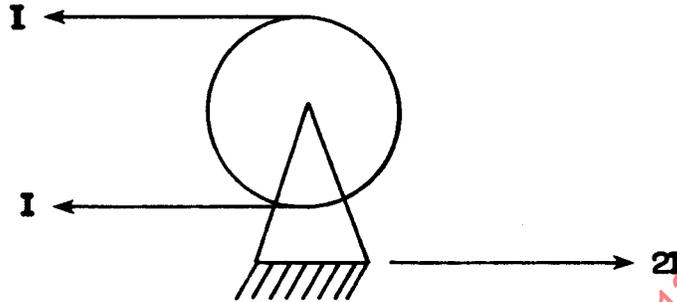


FIGURE 1—MINIMUM PULLEY WIDTH

3.3 Pulley Finish—A maximum surface finish of 2 μm Ra is normally satisfactory for standard drives. However, a maximum of 1 μm Ra finish is strongly recommended for crankshaft and other critical drive pulleys.

3.4 Flanging—Since a synchronous belt will have a tendency to ride to one side similar to a flat belt, it is necessary to contain it. Due to an inextensible tensile member, it is impossible to utilize a crown as is typical with flat belts. Therefore, flanges are used to guide the belt on the pulleys. The direction of track is controlled by the direction of rotation. (Any given belt will track opposite to its original track when the direction of rotation is reversed.) Since the direction of rotation is not usually furnished, and because of reversal applications, smaller driving pulleys are generally furnished with flanges on both sides.

3.5 Flanged Pulleys—Recommended flange dimensions are shown in Table 2 and Figure 2.

TABLE 2—FLANGE DIMENSIONS (mm)

Pulley Section	Minimum Flange Thickness	Minimum Flange Height
ST	1.3	1.6
SU	1.3	2.0
STA	1.3	2.4

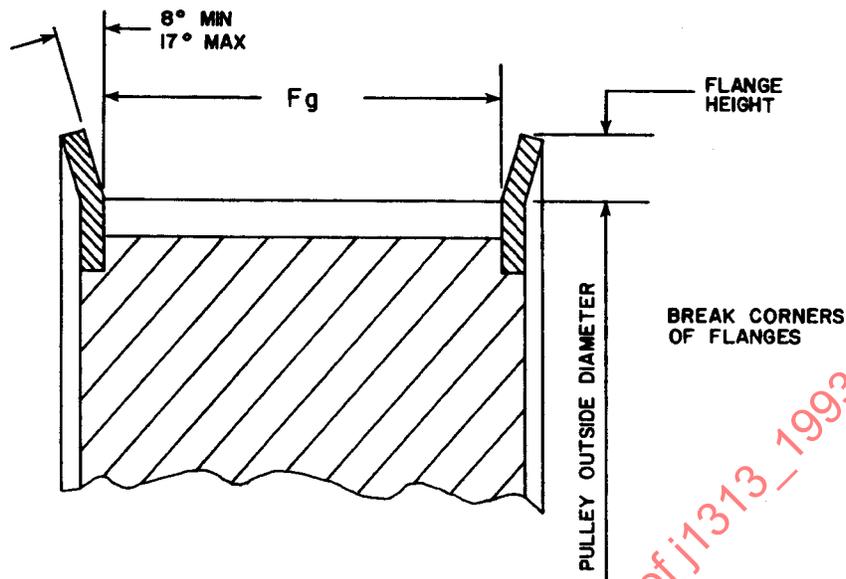


FIGURE 2—PULLEY FLANGES

- 3.6 Selection of Flanged Pulleys**—On all two-pulley drives, the minimum flanging requirements are: two flanges on one pulley, or one flange on each pulley on opposite sides.

On drives where the center distance is more than eight times the diameter of the small pulley, both pulleys should be flanged on both sides. On vertical shaft drives, it is usually advisable to flange the bottom side of the larger pulley as well as both sides of the smaller pulley. This is a function of center distance, speed ratio, and belt width, and will vary with respective applications.

On multipoint drives, the minimum flanging requirements are two flanges on every other pulley, or one flange on every pulley alternating sides around the system.

- 4. Recommended Use of Idlers**—The use of idlers should be restricted to those cases in which they are functionally necessary. The usual cases are:
- As a means of applying tension when pulley centers are not adjustable.
 - To increase the number of teeth in mesh on the small pulley of relatively high ratio drives.

Idlers should be located on the slack side of the belt. For inside idlers, grooved pulleys are recommended up to 40 grooves. On larger diameters, flat uncrowned pulleys may be used. Outside idlers should be flat, uncrowned pulleys. Idler diameters should not be smaller than the smallest pulley diameter in the system.

Fixed idlers are recommended.

5. Belts

- 5.1 Maximum Belt Width**—Belt width should not exceed the small pulley diameter in order to avoid excessive belt side thrust.

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6. **Installation Tension**—Installation tension varies considerably with respective users. This is a result of other factors involved in the drive, such as guards, clearance areas, etc., as well as individual belt manufacturers' recommendations. The formulae in Table 3 are offered for general guidance covering belt widths from 5 to 50 mm:

TABLE 3—INSTALLATION TENSION FORMULAE

Section	Installation Tension (N)		Installation Tension (N)
	Min	Max	
ST	$5.5 b_s - 17$	$\leq 1 \leq$	$7.6 b_s - 24$
SU STA	$12 b_s - 38$	$\leq 1 \leq$	$20 b_s - 62$

where nominal belt width = b_s in millimeters

7. **Master Profile**—The master profile is generated by the nominal pulley generating tool rack form Table 1 of SAE J1278 at a specific number of grooves and nominal pulley OD. Master profiles can be obtained from belt manufacturers.
8. **Tolerances**—Pulley groove tolerances are applied separately to the four general areas of the profile: top curvature, flank, bottom curvature, and depth.
- 8.1 **Top Curvature**—The top curvature is the area from the outside diameter to the upper reference depth, start of the flank. The top curvature of an acceptable pulley must:
- Fall within the tolerance band.
 - Have pulley top radius equal to or greater than the master profile, but not exceeding the maximum radius tolerance.
 - Have a top radius which blends smoothly into the flank no lower than the upper reference depth.
 - Have a top radius which blends smoothly into the outside diameter.
- 8.2 **Flank**—The flank is the distance between the upper and the lower reference depths. The flank of an acceptable pulley must fall within the tolerance band and must be parallel to the master profile within 0.5 degrees.
- 8.3 **Bottom Curvature**—The bottom curvature is the area from the lower reference depth to the bottom of the groove profile. The bottom curvature of an acceptable pulley must fall within the tolerance band.
- 8.4 **Depth**—The depth of an acceptable pulley groove must fall within the tolerance band.
- 8.5 **Lower Reference Depth**—The lower reference depth is the point of tangency of the belt tooth bottom radius and the straight-sided belt tooth flank. This point has been selected because below it there is no contact between the belt tooth and pulley groove. It is measured radially from the pulley outside diameter.
- 8.6 **Upper Reference Depth**—The upper reference depth divides the profile into an area generated by the rack top radius and an area generated by the cutter flank. Hence, it determines the start of the involute portion of the groove profile. It is measured radially from the pulley outside diameter.