

- the capacity to maintain the necessary accuracy.
4. Pulleys for fixed center systems should be manufactured with a process that is capable of producing the required O.D. tolerances accurately enough.
  5. The performance capabilities of the drive system should be verified by testing belts produced over their full length tolerance range on drive systems representing the full potential center-distance variation.

## SECTION 13 IDLER USAGE

Idlers in synchronous belt drives are commonly used to take up belt slack, apply installation tension or to clear obstructions within a system. While idlers cause additional belt bending, resulting in fatigue, this effect is generally not significant as long as proper design procedures are followed. Synchronous belts elongate very little over time, making them relatively maintenance free. All idlers should be capable of being locked down after being adjusted and should require little additional attention. Specific guidelines and recommendations are given below.

### 13.1 Inside/Outside

Inside idlers are generally preferred over backside idlers from a belt fatigue standpoint. Both are commonly used with good success. Inside idlers should be pulleys, but can be flat, if the O.D. is equivalent to the pitch diameter of a 40-groove pulley. Backside idlers should be flat and uncrowned.

### 13.2 Tight Side/Slack Side

Idlers should be placed on the slack (or nonload-carrying) side, if possible. Their effect on belt fatigue is less on the slack side than on the tight (or load-carrying) side. If spring-loaded idlers are used, they should never be placed on the tight side (see Spring-Loaded Idlers). Also, note that drive direction reversals cause the tight and slack spans to reverse, potentially placing the idler on the tight side.

### 13.3 Idler Placement

In synchronous belt drives, idlers can be placed nearly anywhere they are needed. Synchronous drives are much less sensitive to idler placement and belt wrap angles than V-belt drives. The designer should make sure that at least 6 belt teeth are in mesh on load-carrying pulleys. For every tooth in mesh less than this (with a minimum of 2), 20% of the belt torque rating must be subtracted. In order to minimize the potential for belt ratcheting, each loaded pulley in the system should also have a wrap angle of at least 60°. If a loaded pulley has less than 6 teeth in mesh and 60° of wrap, idlers can often be used to improve this condition. Nonloaded idler pulleys do not have tooth meshing or wrap angle restriction.

### 13.4 Spring-Loaded Idlers

Using a spring to apply a predetermined force against a tensioning idler to obtain proper belt installation tension is acceptable as long as the idler can be locked down after belt installation.

Dynamic spring-loaded idlers are generally not recommended for synchronous belt drives. If used, spring-loaded belt idlers should never be used on the tight (or load-carrying) side. Tight side tensions vary with the magnitude and type of load carried by the system. High tight side tensions can overcome the idler spring force allowing the belt to ratchet. In order to prevent this from occurring, an excessively high spring force is required. This high spring force can result in high shaft/bearing loads and accelerated belt wear.

If dynamic spring-loaded idlers are to be used, they should be used on the slack (or nonload-carrying) side of the drive. Potential drive loading variations in the system will have the least possible impact on idler movement due to spring compression with the idler placed in this way. Be sure to note that the tight and slack spans shift as the direction of drive rotation reverses. This could place the spring-loaded idler on the tight side. In some cases, drive vibration and harmonic problems may also be encountered with the use of spring-loaded idlers.

### 13.5 Size Recommendations

Inside idler pulleys can be used in the minimum recommended size for each particular belt pitch. Inside flat idlers can be used on the tooth side of synchronous belts as long as they are of a diameter equivalent to the pitch diameter of a 40-groove pulley in the same pitch. Drives with inside flat idlers should be tested, as noise and belt wear may occur. Flat backside idlers should be used with diameters at least 30% larger than the minimum recommended inside pulley size.

Table 21 summarizes our idler size recommendations.

**Table 21 Idler Size Recommendations**

Belt Type	Minimum Inside Idler	Minimum Backside Idler O.D.		Minimum Inside Flat Idler O.D.	
		inch	mm	inch	mm
<b>MXL</b>	12 grooves	0.50	12.7	1.00	25.4
<b>XL</b>	12 grooves	1.00	25.4	2.50	63.5
<b>3 mm HTD</b>	12 grooves	0.75	19.1	1.50	38.1
<b>5 mm HTD</b>	14 grooves	1.25	31.8	2.50	63.5
<b>2 mm GT2</b>	12 grooves	0.50	12.7	1.00	25.4
<b>3 mm GT2</b>	12 grooves	0.75	19.1	1.50	38.1
<b>5 mm GT2</b>	14 grooves	1.25	31.8	2.50	63.5
<b>T2.5</b>	14* or 16 <sup>Δ</sup> grooves	.57* or .66 <sup>Δ</sup>	14.6* or 16.7 <sup>Δ</sup>	1.26	31.9
<b>T5</b>	14* or 16 <sup>Δ</sup> grooves	1.15* or 1.31 <sup>Δ</sup>	29.2* or 33.3 <sup>Δ</sup>	2.51	63.85
<b>T10</b>	16* or 18 <sup>Δ</sup> grooves	2.64* or 2.94 <sup>Δ</sup>	67* or 74.7 <sup>Δ</sup>	5.02	127.45

\*Above 1200rpm, <sup>Δ</sup>Below 1200rpm

### 13.6 Specifying Shaft Locations In Multipoint Drive Layouts

When collecting geometrical layout data for multiple pulley drive layouts, it is important to use a standard approach that is readily understood and usable for drive design calculations. This is of particular importance when the data will be provided to our Application Engineering Department for analysis.

#### 2-Point Drive

When working with a simple 2-point drive (driver/driven only) it is sufficient to specify the desired distance between shaft centers for belt length calculations.

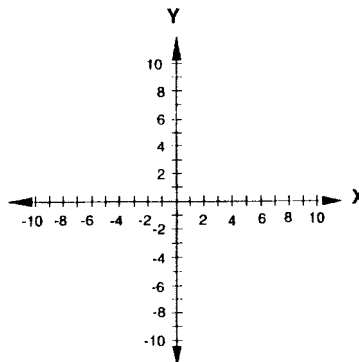
#### 3-Point Drive

When working with a 3-point drive (driver/driven/idler), X-Y coordinates are desirable. It is sufficient, however, to specify desired center distances between each of the three shaft centers to form a triangle. In either case, pulley/idler movement details for belt tensioning and take up are also necessary.

#### Multi-Point Drive

When working with a drive system having more than 3 shafts, the geometrical layout data must be collected in terms of X-Y coordinates for analysis. For those unfamiliar with X-Y coordinates, the X-Y Cartesian coordinate system is commonly used in mathematical and engineering calculations and utilizes a horizontal and vertical axis as illustrated in Figure 27.

The axes cross at the zero point, or origin. Along the horizontal, or "X" axis, all values to the right of the zero point are positive, and all values to the left of the zero point are negative. Along the vertical, or "Y" axis, all values above the zero point are positive, and all values below the zero point are negative. This is also illustrated in Figure 27.



**Fig. 27 Cartesian Coordinate System**