# Polygon Design Tradeoffs

A polygon scanner assembly has many cost drivers including:

- Polygon size
- Number of facets
- Speed, velocity stability
- Optical specifications including surface figure and surface roughness
- Special high reflectivity coating requirements
- Track specification

One tradeoff encountered in system design is the number of facets versus polygon speed. In the speed range of 500-4,000 RPM we can use either ball bearing scanners or aerostatic scanners. Ball bearing scanners are relatively low cost and are the appropriate solution for many applications but are susceptible to damage, generate many vibration frequencies, and can create some motor speed instability. The aerostatic scanners are costly and require support equipment but offer the ultimate in scanning performance.

The bearing choice in the speed range of 4,000 to 40,000 rpm is mirror size dependent. Mirrors less than 3 inch diameter and less than 0.5 inch thick offer the lowest cost package from 4,000 rpm up through 40,000 rpm. In this mirror size range there is no penalty for higher speed. Mirrors between 3 and 4.5 inch diameter and less than 0.5 inch thick may incur additional bearing costs due to shaft flexure. If the speed is high enough for a given mirror load then the bearing needs to be supported on both ends, increasing costs. Mirrors greater than 4.5 inch diameter or greater than 0.5 inch thick result in the highest cost scanners because they require large bearing support systems that could be aerodynamic, aerostatic, or ball bearing depending on speed and load.

Velocity stability standard specifications are a function of speed and mirror load. If speeds are too low or mirror loads too small then an encoder is required to achieve tight velocity stability. Our standard units work on hall position feedback to stabilize velocity. Units running greater than 4,000 RPM can easily achieve 0.02% velocity stability. On most units this can be improved upon down to 0.005% at additional cost. Below 4,000 RPM the mirror load becomes very important. The lighter the mirror and slower the speed make achieving tight velocity stability more difficult. Call our applications engineers for more details on achievable limits based on your particular application.

While we can manufacture polygons with any number of facets, fewer facets results in lower cost. The optical specifications of surface figure and surface roughness can also influence cost. We manufacture both diamond turned and conventionally polished mirrors. The diamond turned mirrors are the lowest cost and have surface roughness values less than 80Angstroms rms but we can achieve less than 50 Angstroms rms if needed but at additional cost. Conventionally polished mirrors are more costly but can bring the surface roughness down to 10 Angstroms rms. Optical surface figure callouts of lambda/4 per inch at 633nm is standard but surface figure down to lambda/8 can be achieved in both configurations at additional cost.

We offer a variety of low cost protected aluminum and protected gold coatings that meet the majority of system applications so ask our application engineers if your specific needs match up with our coating capability. If we cannot meet your coating requirement with an existing coating then we may design a new coating or send the polygon out for coating resulting in higher system cost.

A final significant cost driver is the track specification placed on the assembly. Mechanical track values of 50 arc seconds results in low cost assemblies but we can produce units down to 10 arc seconds for higher costs. This specification is a serious cost driver so we recommend reviewing your actual needs carefully to obtain the most cost effective design.

If this application note does not answer your questions, please feel free to contact an application engineer to obtain further detail.

Total integrated scatter is inversely proportional to the square of the wavelength. The table that appears below provides the scatter values for a number of common wavelengths.