CARBIDE GAGES - FOR SHORT RUN WORK

The use of carbide for quality control lags its acceptance for cutting tools by more than 20 years. Yet the benefits from gaging with carbide stem from the same characteristics which made the material so valuable for machining.

When steel is replaced with carbide for gaging, savings are substantial but not as spectacularly obvious as they are for cutting tools. Gages do not receive the same concentration of use. A tool's life may be measured in minutes, hours or days; a gage's life in weeks, months, or even years. It is only in high-volume applications that carbide's advantages for gaging become obvious. This also was the niche which first accepted the material for cutting tools; it was not until the middle '60s that carbide cutting tools gained recognition for short-lot production.

Carbide gages are seldom considered for small lots, even when production of a part is planned for years, with repetitive runs scheduled two to four times annually. The advantages of longer wear life are more difficult to assess for this type of application, and the superior long-term stability of carbide and resistance to corrosion are not as well known. The costs which are incurred to scrap or correct out-of-tolerance parts caused by accelerated wear or the development of a burr on a steel gage can be substantial, but they are difficult to track. For this reason they are seldom charged against the gage. And the costs of steel gage maintenance/replacement are routinely absorbed as a necessary cost of doing business.

But times they are a-changing. Computers with long memories are beginning to shine more light on all production problems, including those caused by gage deficiencies.

Longer Wear Life

Carbide gages are not fragile. The carbide used for them is the identical grade widely used for solid carbide rotary cutting tools (drills, mills, reamers) and cutting edges for machining cast iron. It has high wear resistance for rubbing applications, 50 to 100 times better than steel, and the ability to withstand medium shock. It is extremely hard, resists scratches in use, does not burr, is corrosion resistant and practically non-magnetic.

Dimensionally Stable

Carbide is an ideal gage material, dependably precise over long periods—in use or on the shelf. It is inherently stable; steel is not.

Steel must be stabilized after heat treat; if it is not, variations in ambient temperature or heat generated by machining operations will cause dimensional changes and warping. To stabilize gage steel, it must be subjected to a series of alternating cycles of heating and sub-zero cooling. Each heating/cooling cycle changes its state by partially transforming austenite into martensite.

After the proper number of cycles, the total transformation to martensite is completed and the steel is stabilized. The required number of cycles is established from experience; no tests exist which can measure the degree of completion.

If total stabilization is not reached, permanent size changes and deformation of the gage can occur in a user's plant as transformation is completed due to temperature variations and natural aging. The physical changes occur because of internal stresses; the transformation of austenite to martensite is accompanied by a volume expansion of up to 4%.

Carbide metals are characteristically stable and do not require comparable stabilization procedures. Carbide does not undergo phase changes with temperature and retains its stability indefinitely.

Thermal Considerations

Some who work in steel and cast iron prefer steel gages because they expand and contract with temperature at nearly the same rate as their materials. This sentiment is generally found in shops whose ambient temperatures vary seasonally from 70°F to 95°F or more. This is not a useful advantage for them. It is in this environment that the stability of steel gages is most rigorously tested. It is much more important for the gage to be dependable in size and shape. For in-process gaging where part temperature is elevated by machining, steel's thermal characteristics have no appeal; both materials must be ratioed for temperature compensation.

Avoiding Secondary Gaging Costs

The expense associated with scrap or rework stemming from defective shop gages can greatly exceed the first cost of gaging. Standards which call for spaced-interval inspection of gages and recorded results afford little protection from them. One manufacturer, however, has developed procedures which are outstanding and reasonable: Any gage must be qualified against another gage of similar size prior to use on a new shop order. Most potentially damaging gage problems are detected with these procedures, and they provide some protection if steel gages are used.

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Only a systematic analysis of all production expenditures will reveal the true cost of gaging. Reports must include definitive reasons for all scrap and rework, associated costs, and all expenditures for gage maintenance and replacement with explanations. This will show that carbide gages for low volume, repetitively produced parts are more economical than gages of steel.