PMPA | PRECISION MACHINED PRODUCTS ASSOCIATION

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Precision Ground Barstock: How It Is Manufactured, Benefits to Your Shop

Understanding the benefits provided by precision centerless ground barstock can help you avoid false economy and optimize the work you quote by maximizing benefits to your manufacturing process and customer.

How Are Bars Centerless Ground?

In centerless grinding machines, a prepared bar is supported over its length and fed into a gap between an abrasive (grinding) wheel and another rubber wheel which presses the bar into the abrasive wheel and, as it spins the bar, the bar advances forward. The amount of stock removal is determined by the force applied by the rubber wheel. Multiple passes may be needed to achieve the final size, and a final pass may take a minimum amount of removal.

Why Centerless Bar Grinding?

Grinding — in particular, centerless bar grinding — is employed when very close tolerances or a very smooth surface finish is needed for an application. There are other reasons to choose precision ground bars in our shops.

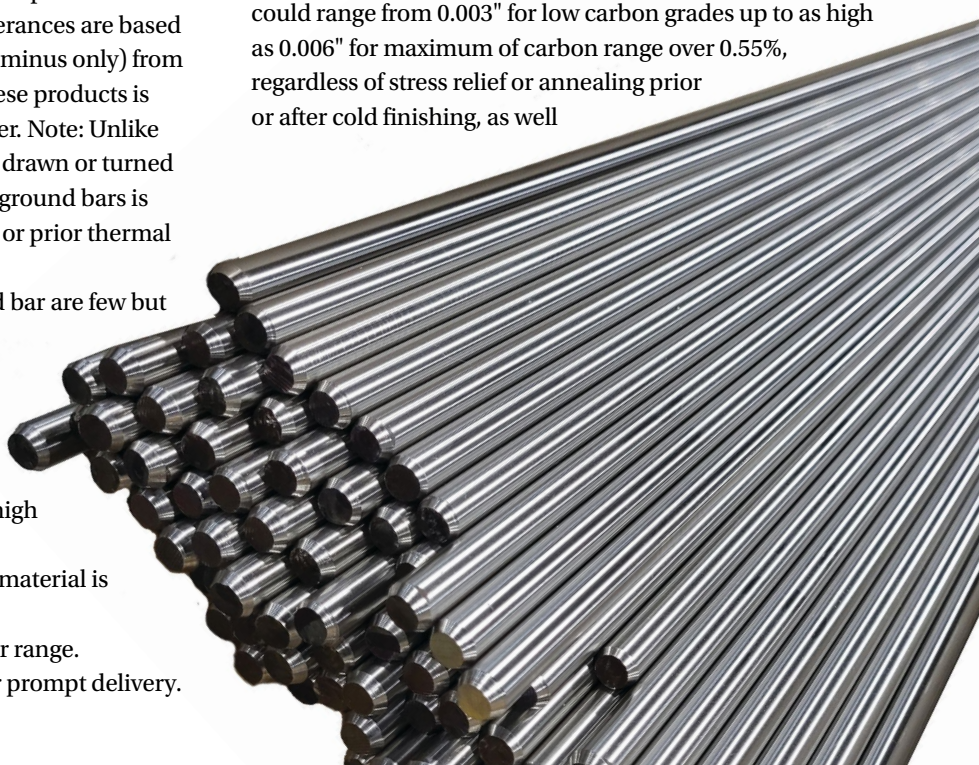
Precision ground bars are specified in ASTM A 108 Steel Bar, Carbon and Alloy, Cold-Finished. Size tolerances for Level 2 and Level 3 cold-finished round bars cold drawn, ground and polished, or turned, ground and polished can be found in Table A1.3 of ASTM A108. Tolerances are based on bar diameter and are unilateral (to the minus only) from the specified size. Out-of-roundness in these products is "as agreed" between supplier and customer. Note: Unlike Level 1 cold-finished alloy steel bars, cold drawn or turned and polished, the tolerance for centerless ground bars is not determined in part by carbon content or prior thermal treatments.

The reasons to select a precision ground bar are few but compelling:

- The customer requires a demanding surface finish (Ra).
- The customer needs the very limited size tolerance.
- The customer's equipment requires high precision feedstock.
- It adds additional assurance that the material is seam-free.
- Length tolerances are held to a tighter range.
- Material may be in stock available for prompt delivery.

The customer requires a demanding surface finish (Ra). For Level 1 ground and polished, an (Ra) of 40 microinches max may be specified. For Level 2, an (Ra) max of 30 microinches is specifiable, according to Table A 1.7; for Level 3, a 20 microinches max (Ra) is given. Note: Special surface (Ra) restrictions must be agreed upon at time of inquiry — even more restrictive finishes may be available, depending upon additional passes or processes being employed.

The customer needs the very limited size tolerance. Depending on the nominal diameter — for example 1 inch — the size tolerance of the Level 3 ground bar could be as little as 0.0008" compared to a Level 2 tolerance of just 0.001". For carbon grades, supplied as cut lengths, the Level 1 tolerance as cold drawn or turned and polished could range from 0.002 to 0.005 inches, all tolerance minus depending on diameter. For this example, we are using under 1-1/2". For alloy grades, Level 1 (cold drawn only or turned and polished) supplied as cut lengths, the tolerance could range from 0.003" for low carbon grades up to as high as 0.006" for maximum of carbon range over 0.55%, regardless of stress relief or annealing prior or after cold finishing, as well



as all carbon levels quench and tempered or normalized and tempered. (All tolerance is minus.) The maximum allowable departure from roundness (out of round or maximum ovality) is as agreed between the supplier and the customer. For very challenging parts, if the OD of the bar is going to be used in the customer's finished part, the centerless grinding process can deliver the tightest dimensional compliance of all available cold finishing processes.

The customer's equipment requires high precision feedstock. Certain types of machining processes can benefit greatly from utilizing precision ground barstock, such as CNC Swiss-type screw machining. In these instances, there are a myriad reasons for requiring ground material not detailed in this article.

It adds additional assurance the material is seam-free. Grinding and polishing takes a final additional stock removal that can help ensure that the material is seam-free (surface imperfection free.) This can be part of the normal stock removal calculation or can be additional to the removal taken prior to the grinding process to provide additional assurance. Consult with your supplier to understand the stock removal and its warranty regarding surface imperfections.

Length tolerances are held to a tighter range. (All tolerance is plus for length.) For Level 2 and Level 3, cold -finished steel bar is held to tighter range (1 inch for Level 2; half an inch for Level 3, compared to 2 inches for Level 1 product.)

Material may be in stock available for prompt delivery. Finally, a less important — but often overlooked factor — is that the bar grinder may actually have material in stock available for prompt delivery. Sometimes the quantity on hand may be sufficient for a small job in our shops. The advantage of this factor, though, is attributable more to the availability/stocking position than to any technical attributes imparted by the precision grinding. Often, the ground finish and precision may be overkill for a job, but the only material that can be found is available at the bar grinder.

The reasons arguing against the use of precision ground barstock include higher cost per pound than other cold-finished steel bar products, and perishability of finish. The higher cost of precision ground bars is not just because of the cost of the grinding operation, it is also attributable to the yield loss of material removed during the grinding process. The fine finish imparted by the centerless grinding operation can be defeated by mishandling — scratches, dings and other abrasions can render the material unfit for the most demanding applications. Handle with care! There are a number of reasons for choosing centerless ground barstock to ensure both shop productivity and that your process delivers the highest quality to your customers. P

Miles Free III is the PMPA Director of Industry Affairs with over 50 years of experience in the areas of manufacturing, quality and steelmaking. Miles' podcast is at **pmpa.org/podcast.** Email: **mfree@pmpa.org** — Website: **pmpa.org.**