ISO Standards and the EPMA

Kenneth J A Brookes, Metal Powder Report consultant editor, reviews the presentations conducted by the European Hard Materials Group during the 2013 Plansee Seminar.

First of the special presentations that made up the second part of the EHMG meeting at Reutte was a combined contribution by Bryan Roebuck of Britain’s National Physical Laboratory (NPL) and Ken Brookes (coincidentally your reporter for this event), for many years an independent consultant to the worldwide hardmetals industry (See Figure 1). Roebuck represents the UK on the important ISO (International Standards Organisation) committee TC119/SC4 dealing with powder metallurgy in general and particle characterisation in particular. Brookes is chairman of the British Standards Institution’s Technical Committee MTE18 (tools, tips and inserts for cutting applications) and represents the UK on the corresponding ISO Technical Committee TC29 (Small tools).

Hardness comparisons

Hardness is clearly an important property of hardmetals and other hard materials but, after many years, there are still two competing methods of hardness measurement, with no precise equivalence between the two.

The Vickers test employs a square-based diamond pyramid indenter with a precisely located point. Hardness is measured by the corner-to-corner measurement of an indentation made by a standard load (generally 30 kg). The Rockwell test uses a conical diamond indentor or ‘Brale’ with spherical tip, hardness being measured by depth of indentation.

Figure 1. Ken Brookes, Metal Powder Report consultant editor (left) and Bryan Roebuck of the NPL (right) provide an update on ISO work pertaining to hardmetal-related standards.

Figure 2. Hardness measurement test. Note the ‘smoothed’ results from two of the participants.
after a set load is applied and then partially unloaded. When measuring very hard materials, much of the Rockwell indentation is made by the spherical tip, adding importance to the accuracy of its shape.

The Vickers test is generally preferred by research labs because of its reliability and reproducibility, but industrial companies, especially in the United States, preferred the Rockwell for its speed and ease of use in automation and quality control. There is something of the “NIH factor” here also, because the Rockwell machine was invented by Wilson in the United States and the Vickers test originated in the UK.

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Back in my carbide-manufacturing days, I took part in a round-robin exercise organised by NPL in an attempt to produce an acceptable conversion chart for the two tests. Many years later, NPL have just initiated a new interlab exercise for the same purpose. Figure 2 illustrates the ‘smoothed’ results from two of the participants, but Figures 3 and 4 better illustrate the scope of the problem, with very significant scatter of test results, even from the same lab, same test and presumably testpieces made or chosen with very consistent microstructural properties. This project is ongoing.

Microstructure standards

Roebuck showed the excellent progress being made with ISO 4499. Part 1 dealt with photomicrographs, Part 2 with grain size and Part 3, which he illustrated, with cermets or cubic carbides. I was a little surprised to see

Figures 3 & 4. These images better illustrate the scope of the hardness measurement problem.

Figure 5. According to Bryan Roebuck, the recommended etch for optical micrography was dilute HCl. Note the shades of grey.
that the recommended etch for optical micrography was dilute HCl, giving a picture in shades of grey (See Figure 5), when I'd abandoned such monochrome reagents in the 1950s in favour of etch-ants like alkaline permanganate, which distinguish various carbides by colour. However, EBSD, which we didn’t have in those days, is considerably more colourful, and not only distinguishes cubic carbides clearly but also their orientation (See Figures 6 and 7).

Figures 6 & 7. Etchants such as alkaline permanganate can distinguish various carbides by colour. Note the detail in orientation.

Cutting tools

Whilst the TC119 committee is targeted at PM materials, TC29 is more interested in products, predominantly the hardmetal tools and inserts that make up most of the market for typical cemented carbide manufacturers.

With 5 days of committee meetings in Berlin a couple of weeks before the EHMG meeting, there was a great deal of activity to summarise.

Firstly, though TC29 subcommittee numbers SC2 and SC9 are unaltered, there has been a major change in duty allocations. Previously SC2 was for HSS tools and attachments, and SC9 was for tools with cutting edges of hard materials. Now SC9 is for tools with defined cutting edges, with SC2 for toolholders, adaptive items and interfaces.

A simplified listing of the current TC29 organisation is given below:

- Subcommittee SC2 Holding tools, adaptive items and interfaces
- Subcommittee SC5 Grinding wheels and abrasives
- Subcommittee SC8 Tools for pressing and moulding
- Subcommittee SC9 Tools with defined cutting edges, cutting items
- Subcommittee SC10 Assembly tools for screws, nuts, pliers, nippers
- Working Group WG33 Hollow tool shank interface
- Working Group WG34 Cutting tool data representation and exchange
- Maintenance Agency MA13399 for ISO Standard 13399
- Working Group WG37 Balancing of rotating tool systems.

Working Group 16 (WG16), for which I was convenor and chairman, looked at revisions to the well-known ISO 513 Standard but has now closed. Since the only thing this “Standard” standardises is its descriptive nomenclature, this is no great hardship, but the nomenclature is a little less confusing than it used to be.

On the other hand, ISO13399 (Cutting tool data representation and exchange) is vital for machine tool programming and ideal for cutting-tool research, since it aims to define unambiguously every part, dimension and angle in the cutting-tool setup. Its active Maintenance Agency has members around the world and a dedicated website (www.unm.fr/fr/core.php?page_id=135) is based at UNM in Paris.

Finally, I list some of the other International Standards of interest to hardmetal manufacturers and looked after by TC29:

- ISO 2804 1996 Wire, bar or tube drawing dies – As-sintered hardmetal pellets
- ISO 3002 Basic quantities in cutting and grinding
- Part 2: Geometry – conversion formulae
- 1984 Part 3: Geometric and kinematic quantities in cutting
- Part 4: Forces, energy, power
- 1989 Part 5: Basic terminology for grinding with grinding wheels
- ISO 5396 1977 Hardmetal heading dies – Terminology
- ISO 5407 1981 As-sintered hardmetal pellets for heading dies – Dimensions
- ISO 8688-1 1989 Tool life testing in milling – Part 1: Face milling
- ISO 8688-2 1989 Tool life testing in milling – Part 2: End milling