Lavoisier

EXHIBIT V

DIAMOND SPECIES AND INDUSTRIAL USES

All diamonds are either:

Type I — Homogeneous, octahedral, or approaching spherical form;

Type II — Laminar (like the pages of a book) with specific infra-red absorption qualities and definite fluorescent characteristics.

In a diamond, combinations of size, brilliance, and color are the principal qualities that determine whether a stone is of value as a gem or only for industrial purposes. The highest priced gemstones are blue-white and flawless. Anything smaller than a "chip" usually falls over into the industrial class, no matter what its color or how clear it may be.

Bort (sometimes Boart or Bortz) is the term applied to imperfectly crystallized or coarse diamonds. Frequently this includes the fragments left in cutting gem diamonds. It is a general term to designate diamonds for industrial purposes.

Ballas is a variety of stone having no well defined cleavage planes, therefore exceptionally tough.

Octahedral diamond is one having eight points and natural cleavage planes. Each of the eight sides is an equilaterial triangle.

Carbonado are black diamonds used for cutting tools.

Diamond dust is composed of finely pulverized diamond particles.

Industrial Diamond Uses

All diamonds have industrial value from the largest to the smallest and are reclaimed time and again until no longer economically practical. About 12 million carats of industrial diamonds are produced annually, nearly all coming from Africa, principally from the Belgian Congo and the Union of South Africa. Almost none are produced in the U.S., yet this country is by far the largest user. Total imports in 1950 amounted to almost 11 million carats, valued at more than 35 million dollars. For defense reasons the U.S. government is purchasing industrial diamonds of all classes for the national stockpile.

Diamond dressing and the truing of tools continue to represent the main uses for whole, sound industrial stones. (See Allen, R., "Dressing and Truing of Grinding Wheels," Machinist, June 24, 1950.)

Largest consumers of industrial diamonds are the manufacturers of diamond grinding wheels. Diamond grinding wheels are now available in vitrified, metal, and resin bonds. These wheels are considered indispensible for many cutting purposes and will saw through any hard material from rock to case-hardened steel.

Wire manufacturers have found diamond wire-drawing dies far better than any other material, especially for drawing the very fine wire needed for small electric motors and electronic equipment.

Dentists are using more and more diamond drills (points, wheels, and discs) in their general practice because they stand up longer, cut faster, and heat up much more slowly than do steel or carborundum (emery).

Improved diamond-bit heads for oil-well drilling have contributed to greater drilling speed plus lower costs per foot drilled and have brought about an increase in the use of diamond bits in this industry.

Diamond compounds have found an expanded market in the finishing of plastic molds, die-casting dies, production lapping, and in the manufacture of gages and precision parts.

As for diamond dust or powder, the U.S. Bureau of Standards has now set up national standards by which this material can be closely graded. Many improvements in industrial manufacturing methods in recent years call for the high and rapid finishing of many mechanical products. Closely graded diamond powder now makes this possible.

Other users: Glaziers who cut and set glass in window frames; engravers who need diamonds for their engraving tools; and miners who use industrial diamonds for drill-tips.

Diamond Tools Are So Universally Adaptable
That Their Use is Limited Only by the Ingenuity of the Operator

Diamond dressing tools can effect a saving of 80 per cent or more in production time. In other words, an operation requiring ten minutes to complete with the use of other types of tools can be performed in two minutes by the use of diamond-tipped tools. Diamond wheels are one of the principal agents used in the forming and sharpening of sintered carbide tools necessary for high-speed, precision production.

Diamond wheels are used in the manufacture of all types of automotive and diesel engines. They are used in the production of countless parts for trucks, motors, gyroscopes, and quantities of other precision parts. Diamond lens grinders are used directly in the grinding of lenses that are an essential part of precision instruments, telescopes, microscopes and binoculars as well as eyeglasses.

Diamond powder is generally produced by crushing and sifting whole bortz diamonds. Powder is also employed as the lapping agent for shaped diamond tools, gems, jewel bearings and diamond wire drawing dies.

In the making of single-point tools, when the proper diamond has been selected, it is mounted in a special metal alloy that holds the stone firmly and retains a minimum of heat. When this nib has been machined, it is press-fitted into a steel holder of required size.

One of the most widely applied uses of the diamond-tipped tool is in the truing and dressing of abrasive wheels required for precision and high finish grinding. This reshapes the face of a wheel and cuts away excess material, making the wheel accurate and free-cutting in its action. Dressing at regular intervals, whether there is any apparent need or not, is more than offset by the increase in output and uniformity of results. Saw-toothedges are eliminated and longer tool life is insured. Diamond tools are especially designed for use on special machines such as gear grinders, spline grinding machines, reamers, precision thread grinders, hard rock coring, bits and drill points. Smaller and

smaller diamonds are being used in rock drilling today. Whereas it was formerly considered best to set bits with four to eight large diamonds, 100 to 200 small ones are now used.

Diamond Wheels

The use of carbide-tipped tools has risen to unprecedented heights in recent years, and there is no more effective means of sharpening them than by use of the diamond abrasive wheel.

Common practice in making these diamond wheels is to use carefully graded diamond powder made from new bortz diamonds, employing a resin or a metal as the bonding agent. (Crushing and grading powdered diamonds to obtain maximum cutting points constitute closely held trade secrets.) Some companies are experimenting with a third type of bond which is vitrified.

Diamond wheels for truing and dressing:

Truing is the process of shaping the diamond face to run in mechanical truth with the axis of the wheel.

Dressing is the process of conditioning the diamond face of the wheel to obtain optimum cutting qualities.

There are as many kinds and shapes of diamond wheels as there are specialized uses for them. In addition, the purchaser of a diamond wheel can specify grain size, grade, concentration, bonding material, depth of diamond section, and other special requirements. The use of diamond tools is a specialization and among machinists it is common practice to train a few men in each plant to grind all the cemented carbide tools, not allowing uninstructed operators to work on these tools.

Methods of crushing diamonds to obtain the maximum number of cutting points are closely held secrets within the diamond tool-making industry. Diamond particles must be of bulky shape in order to perform the best cutting action. Slivers having a silvery sheen show up well, but lack uniformity and afford only a few scratchy cutting edges which tend to damage the work without performing the desired cutting action.

Grading of powder is equally as important, for unless the diamond dust is extremely uniform in size, larger particles scratch the work and are worn down too rapidly while the small grains are inactive because of lack of contact. (Bureau of Standards has established U. S. Commercial Standard CS123-45).

Diamond lapping powders are used extensively for charging laps of soft steel, iron, bronze, lead, boxwood, ivory, hard felt, etc. The old phrase "diamond cut diamond" applies to diamond powder in the cutting of diamond tools, dies, and gem stones which could not be cut and polished with any other material. Mirror finishes required on jeweled bearings, ceramic parts, and sintered carbide products are obtained with diamond lapping powders.

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