Turning. Uranium is turned on both conventional and numerically controlled heavy-duty equipment. In large-scale production, surface speeds up to 1.5 m/s are used for roughing, and speeds up to 3.0 m/s are used in finishing. A C-2 general-purpose grade of carbide performs satisfactorily for most turning operations; coated carbides normally used for machining steel perform well for most finishing operations.

Cutting tools having a positive rake angle are more free-cutting than negative-rake tools and put the least pressure on the workpiece. Accumulation of large quantities of chips should be avoided to diminish the potential for a pyrophoric reaction to occur.

Drilling and Tapping. Oil-hole drills, in combination with heavy flow of soluble-oil coolant, are favored for drilling uranium. Drills made of tool steels with high cobalt contents perform better than drills made of standard high speed tool steels. Drills must be kept sharp, and positive feeds must be used.

Uranium is difficult to tap. Body drills larger than those recommended for other materials are used to facilitate tapping. A tap generally can be used only once before it is reground. It is difficult to achieve thread depths greater than 50%.

Grinding. A series of tests was performed to determine optimum conditions for centerless plunge grinding of U-0.75Ti at hardness levels of 42 to 46 HRC (Ref 10). Best performance (best grinding ratio) was obtained with an A-80K-12 wheel (aluminum oxide with a vitrified binder), a 20% solution of soluble oil with chlorine and sulfur additions, an infeed rate of 0.27 mm/s, a grinding-wheel surface speed of 29.8 m/s and a regulating-wheel speed of 33.5 mm/s. Optimum operational settings will be slightly different for other uranium alloys and other types of grinding. Wheel wear, although greater than for most other metals, is considered acceptable for production grinding.

The most important consideration in grinding uranium is disposal of the fine grinding dust, which will react with the coolant and thus should not be allowed to accumulate in the machine.

Special Problems and Precautions

Depleted uranium requires special precautions during fabrication and sometimes during use. Ownership, production and use of depleted uranium are subject to state and federal regulations. These regulations are concerned mainly with three properties of the metal: radioactivity, toxicity and pyrophoricity. These problems can be handled routinely and have not constituted serious barriers to manufacture and use of depleted uranium products for commercial applications.

Health Hazards. Depleted uranium is only mildly radioactive (specific activity of 3.6×10^{-7} Ci/g vs 6.77×10^{-7} Ci/g for natural uranium) and is listed with natural uranium and thorium as a "low specific activity" (LSA) material in shipping regulations. Like lead and like metals with atomic numbers higher than lead, depleted uranium is a heavy-metal poison that can be lethal if a sufficient amount of dust or fumes is ingested.

The main hazard to health occurs in those fabrication steps where finely divided particles (dust or oxides) can become airborne. In operations such as melting and casting, machining, grinding, pickling, and heating without using a protective atmosphere or vacuum, it is essential to provide extensive ventilation and to monitor workers' breathing zones. Vents and fume hoods that protect workers are exhausted through carefully monitored filter systems. Workers must change footwear and clothing when leaving areas where finely divided uranium is present.

Users of depleted uranium objects generally do not have to be concerned with the health hazards presented by the metal. Solid pieces of depleted uranium are not sufficiently radioactive to be hazardous; neither do they present the kind of toxic hazard associated with finely divided dust or fumes.

Pyrophoricity. Large pieces of uranium will oxidize rapidly and will sustain slow combustion when heated in air to temperatures about 500 °C. The metal becomes truly pyrophoric only when finely divided. Because pyrophoric reactions take place at the surface of the metal, surface condition and the amount of exposed surface area are critical. Solid metal, particularly with a smoothly machined surface, reacts slowly; within several days the silvery as-machined surface turns to a tea color, and within a month turns black. Machine turnings, particularly fine turnings having literally hundreds of square metres of surface area per kilogram, may react sufficiently to generate enough heat to cause ignition if they are not kept cool under water. Grinding sludge, with still larger surface area, may react even under copious quantities of water.

Finely divided scrap is kept inert by storing it under water or mineral oil. Scrap prepared for shipment to disposal sites may be mixed with an inert insulating material such as sand, or may be mixed into concrete to ensure that no reaction occurs during transport.

Fires are extinguished by cooling the uranium and by restricting access of oxygen to the uranium by covering it with graphite powder or with a dry powdered chemical extinguisher. Water should never be used on uranium fires, because water reacts with the hot metal and generates hydrogen, which adds to the combustion.

Corrosion. The reactivity of uranium promotes corrosion, especially in severe environments. Figure 5 shows corrosion rates of unalloyed uranium and two uranium alloys in high-humidity, high-temperature air (Ref 11). Under such severe conditions, unalloyed depleted uranium corrodes rapidly, U-2Mo corrodes at about one-half the rate of unalloyed uranium and U-0.75Ti corrodes at a much slower rate.

Under normal storage conditions, uranium and uranium alloys have shelf lives of many years. Uranium and its alloys are shiny as machined, but in the presence of oxygen will acquire a dark oxide film in a few hours or a few days. This film serves as a protective coating.

Corrosion protection for most unalloyed uranium objects (such as radiation shields) is obtained by painting with epoxy paints or by plating. A typical plating system consists of a copper flash, followed by nickel and finally cadmium.

Because uranium alloys corrode more slowly than unalloyed uranium, they generally do not require painting or plating. For example, U-0.75Ti and U-2Mo kinetic penetrators employed by the three military services are used without protective coatings, yet have projected storage lives of more than ten years and have passed all military atmospheric exposure tests.

Considerable data are available on corrosion of uranium and its alloys in water, steam and liquid metals (Ref 12).

Scrap Disposal and Transportation. Depleted uranium scrap is buried