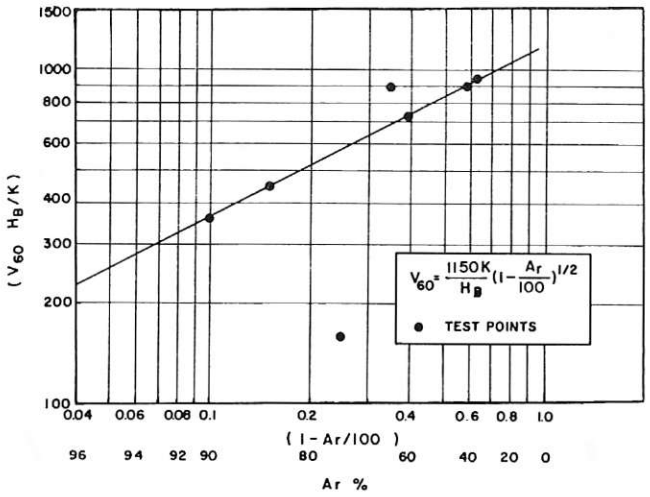

Fig. 4 The general machinability equation

material ahead of the tool, separating the metal being deformed by means of an insulating void from the bulk of the workpiece, consequently the effective thermal conductiviy is much smaller. Second, the material continues to undergo great deformation as the chip is formed.

Most of the molybdenum carbides (Mo_2C), the hardness of which is between 1400 and 1800 Vickers, are located at the grain boundaries, and consequently these hard carbides will be in contact with the tool. Their effect on the wear will be by far larger than their effect on the hardness of the work material.

To validate the general machinability equation, comparisons were made with data published by different research institutes, technical societies, and recommendations of the manufacturers. Table 5 gives the predicted values of machinability in terms of v_{60} for a variety of materials. It verifies clearly the validity of the relationship for materials as different as cast iron, steel, aluminum, zirconium, and titanium, as well as for nearly similar materials, as 1020, 1045, 4340, and 1212 steels or the stainless steels.

The final machinability relationship stated above can be used with the following qualifications:

1 The predicted machinability values are no more accurate than the properties that are used to compute them.

2 The material should not have any critical transition temperatures below 1000 deg F. If it does, it is necessary to go back to the first basic relation and select different temperatures and properties associated with them.

3 The hardness of the material should be at least 100 Brinell hardness numbers lower than that of the tool.

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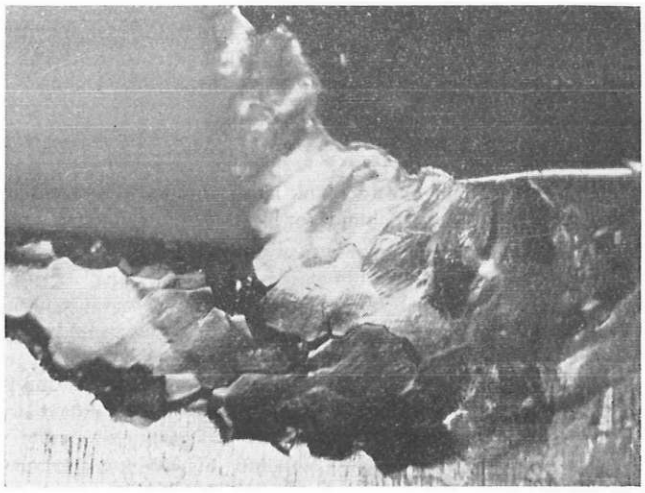

Fig. 5 Chip formation in molybdenum
Cutting velocity = 0.020 ipm
Depth of cut = 0.010 in., width of cut = 0.100
Rake angle = +10 deg

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DISCUSSION

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The authors have done a great service in the field of metal cutting by carrying out investigations on such a broad basis. It speaks well for their ability as experimenters that the authors have obtained correlation and have established the dependence of machinability on physical properties of workpiece materials. The tables presented can be appreciated by anyone who has worked with the alloys used in their tests. While of great interest to other researchers, the results should also find application soon to practical metal-cutting problems.

This investigation has provided a wealth of new information that will help to explain some techniques which have been found to be beneficial in metal-cutting practice. Questions such as the

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influence of various tool materials with regard to interaction with different workpiece materials and crystalline structures and the effects of surface finishes and treatments of tools now should be answered better than before.

Authors' Closure

The authors would like to thank all of the oral discussers of this paper and Dr. A. O. Schmidt for his kind comments based on many years of experimental metal-cutting research. The authors agree with Dr. Schmidt that the dimensionless groups presented in the machinability equation should be of considerable help to metal-cutting sesearchers who are trying to improve the machinability of any work material. The authors are presently modifying the machinability equation to put it into a form containing a group of tabulated constants so that the equation will be more useful to production and process engineers.