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Standard Practice for EVALUATING SHEET METAL FORMING LUBRICANT¹

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INTRODUCTION

A selection of tests is recommended. The major purpose is to standardize the variables possible with available equipment and procedures and to provide data significant to lubrication during press forming. More than a single test will be required to completely evaluate a product.

Prediction of a lubricant's effectiveness in making a specific part has been based mainly on prior experience with similar processes. This has led to empirical formulations, occasional lubricant failures, and high plant inventories of drawing compounds of similar formulations. Pretesting with procedures effective to lubricant selection relating to end use should make lubricant selection and factory testing more efficient.

Existing tests were examined as they related to manufacturing processes. Friction in some metal-forming processes may be reflected to some extent in the four-ball test, disk and ball, pin and ring, etc., but they do not include vital factors such as appropriate sheet material used in stampings. Only tests that include sheet stock and that reflect other conditions in forming presses are considered to be realistic.

It is recognized that a single type of simulative laboratory test cannot closely correspond to the variety of parameters encountered in drawing various parts. Some relationships exist between some laboratory tests and major forming parameters such as stretch and draw. Studies using these tests have led to analytical methods such as shape analysis and forming limit diagrams. Lubrication variations during these tests have been found to rank the lubricants, and a number of industries have been using these rankings in preliminary evaluations. However, care is required to separate the tests significant to lubrication from those portions of the tests which test the mechanical properties of the metal in use.

The laboratory tests presently tend to fall into two groups based on sliding of strip stock and cup-forming tests. In the first group are strips sliding between flat blocks or draw beads. The second group includes stretching over punch nose, deep drawing, and bending.

Factors observed in press forming include:

1. Sliding of sheet metal over tooling surfaces = friction
2. Pressure variations on the sheet surface
3. Speed variations during a forming stroke
4. Elongation of sheet metal in one direction only = plane strain
5. Elongation of sheet metal in two directions = biaxial stretch

¹ This practice is under the jurisdiction of ASTM Committee D-2 on Petroleum Products and Lubricants: Current edition approved Aug. 27, 1982. Published December 1982.