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DEPARTMENT OF COMMERCE
BUREAU OF STANDARDS

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THE APPLICATION OF CHROMIUM PLATING TO GAGES

In connection with an investigation of the "Wear of Steels with Particular Reference to Plug Gages"(1) a number of experiments were made upon the wear resistance of chromium plated steel plug gages. This letter circular summarizes the results of these tests and the conclusions that may be drawn from them. For further details the above publication should be consulted. Much further work is required for an exhaustive study of this subject and hence many of these conclusions are tentative, and subject to revision in the light of further experiments and experience.

(1). H. J. French and H. K. Herschman, Published as Preprint 18 for the September 1926 meeting of the American Society for Steel Treating, (Secretary's address, 4600 Prospect Ave., Cleveland, O.).

The methods used for the chromium plating are discussed in Bureau of Standards letter-circular 177 on "The Application of Chromium to Printing Plates". As there indicated, it is possible in a given solution according to the temperature and current density employed to produce three principal types of chromium plating, viz: (1) a "milky" deposit, (2) a bright deposit, and (3) a deposit ranging from "frosty" to gray. Experience

with printing surfaces indicates that of these, the milky deposit is least resistant, and the bright deposit most resistant to that type of wear. The experiments on gages were accordingly made with bright deposits. Further tests will be required, however, to define the optimum conditions for plating gages to best resist any given type of service.

The experiments at the Bureau upon plug gages and upon different wear testing machines, indicate that a chromium plate, produced by the present methods of deposition is not well suited to resist wear under high pressures, owing to the tendency under such conditions for the deposit to crack and flake from the base metal. Much more study will be needed to determine whether this limitation can be overcome, e.g., by changing the methods of preparation for plating, the conditions of deposition or the method of finishing the gage after plating.

Under low pressures (for example up to 30 lb/sq.in.) and the type of sliding friction to which plug gages are ordinarily subjected chromium plate was found to be several times more resistant to wear than the commonly used steels, provided that no abrasives such as emery are present. In the presence of such abrasives its wear resistance was slightly better than the customary steels. Previous work done at the Bureau using a different type of wear machine showed that chromium plate is from two to four times as resistant to wear as commonly used hardened steel when in contact with abrasives on a cast iron lap. Deposits may subsequently be found that will better resist abrasives under a wide range of conditions.

A few experiments indicated that under sliding, unlubricated friction the wear resistance of the chromium surface as deposited, was not nearly as good as that of the same deposit after grinding and lapping. Further experiments will be needed to determine whether this difference is due to a variation in the smoothness of the two surfaces, or to intrinsic differences in their hardness. Other things equal, it would be more simple and economical to deposit a relatively thin chromium coating, e.g., 0.0003" on a finished, properly under-dimensioned gage, which could then be used without further treatment than, as was done in most of these experiments, to produce a fairly thick deposit (about 0.0008") and to grind and lap off a large part of this chromium to produce the finished gage. Whether the first procedure is feasible, must be determined by further experiments and observations. If so, it has the advantage that when the chromium is nearly worn through, it may be dissolved off and the gage re-plated at a relatively small expense.

Observations on chromium plated gages in commercial plants indicate that while the results have sometimes been unsatisfactory this method has sufficient promise to warrant its further development, especially upon some of the lines indicated in this circular. Wherever chromium plating is found to increase the service of gages, it is advantageous because then a relatively soft metal base may be chosen which is readily machinable and has a higher degree of dimensional permanence than is usually found in hardened steels.