June 1974 B74-10020

NASA TECH BRIEF

Lewis Research Center

Process to Restore Obliterated Serial Numbers on Metal Surfaces

The Problem:

To restore serial numbers that have been obliterated by grinding the surfaces of copper, brass, steel and aluminum.

The Solution:

An ultrasonically induced cavitation process in water by means of a piezoelectric transducer.

How It's Done:

Metal smeared into the grooves of serial numbers by grinding or filing can be cleaned out by a process called cavitation. This phenomenon, cavitation, occurs when tiny vacuum-like cavities are formed by uneven pressure gradients in a liquid. Normally, cavitation is avoided, since it can, for example, destroy the propellor blades of a boat or the liquid metal pump impellers of a space power system.

For serial number restoration, an ultrasonic vibrator (piezoelectric transducer) generates very high frequency vibrations in water which create millions of microscopic bubbles. These cavitation bubbles impact the metal surface at thousands of pounds per square inch pressure. The metal particles filling the serial number grooves, which are weaker than the surrounding metal, are broken away.

Conventional methods of restoring serial numbers involve chemical or mechanical treatment such as grinding, polishing or etching, but these methods may obliterate the remaining traces of the numbers, and are different for each material. This new ultrasonic cleaning restoration technique has the following advantages over chemical or mechanical methods: (1) no prior surface preparation is required before the restoration process begins; (2) the method appears to work on a very wide variety of materials; (3) restoration is usually permanent (unless cavitation attack is carried too far); and (4) only water is needed as the cavitation liquid.

Tests have been conducted on copper, aluminum, steel and brass specimens. Plates of each metal were stamped with identifying letters and numbers, and these characters subsequently ground off. Using the ultrasonic etching technique, the characters were completely restored on the samples of copper, brass, and steel, and eight out of twelve characters were successfully restored on aluminum.

As expected, cavitation removed metal in the grooves very rapidly in the softer materials. In the case of copper, the characters were completely restored in 20 minutes. Steel, the strongest of the metals tested, required 220 minutes for complete restoration.

A surprising phenomenon was discovered in studying the cavitation of the brass sample which was ground most deeply. In this case, the numbers appeared as a "ghost image" rather than a cleaned-out groove. In this instance, the cavitation attack appeared to be sensitive to the microstructural changes caused by the number stamping process. Thus, for such materials, the process can restore numbers at depths at least as deep as the bottom of the stamped grooves.

Notes:

1. The feasibility of this technique as a low-cost tool for crime laboratories has been clearly demonstrated; a machine to generate ultrasonic vibrations can be purchased commercially for $1200 to $1500.
2. This new technique was previously described in Tech Brief 71-10099, "Ultrasonic Metal Etching for Metallographic Analysis."
3. Further information is available in the following reports:

   NASA TM-X-68257 (N73-27866), The Restoration of Obliterated Stamped Serial Numbers by Ultrasonically Induced Cavitation in Water (submitted for publication in the Journal of Forensic Sciences)

   NASA TM-X-52929 (N71-12961), Etching of Metallographic Specimens by Cavitation (also published in the Proceedings of the International Metallographic Society, Inc., 1970)

   Copies may be obtained at cost from:

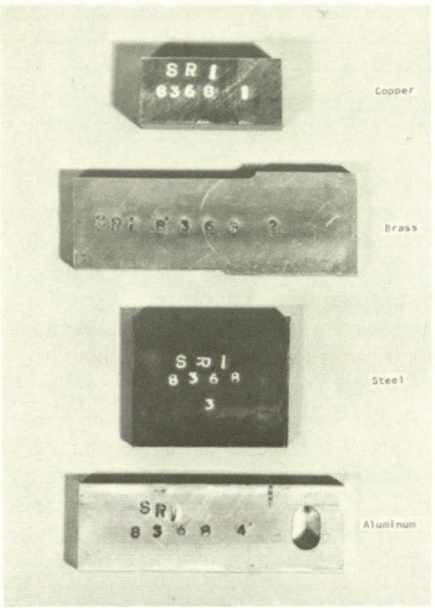
   Aerospace Research Applications Center
   Indiana University
   400 East Seventh Street
   Bloomington, Indiana 47401
   Telephone: 812-337-7833
   Reference: B74-10020

(continued overleaf)

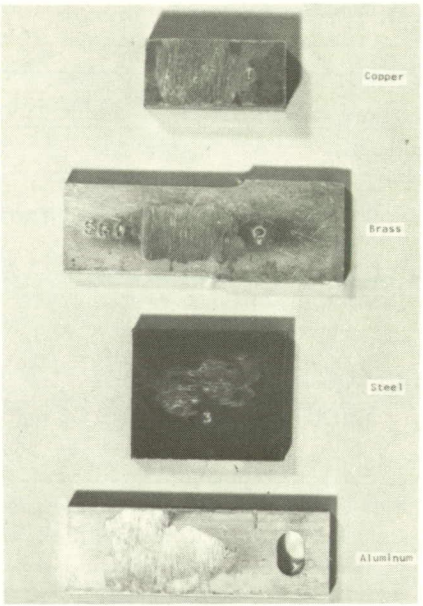
4. Specific technical questions may be directed to:
Technology Utilization Officer
Lewis Research Center
21000 Brookpark Road
Cleveland, Ohio 44135
Reference: B74-10020

Patent Status:
NASA has decided not to apply for a patent.

Source: Stanley G. Young
Lewis Research Center,
Brian Parker
Sacramento State University, and
W. Jerry Chisum
California State Dept. of Justice
(LEW-12085)

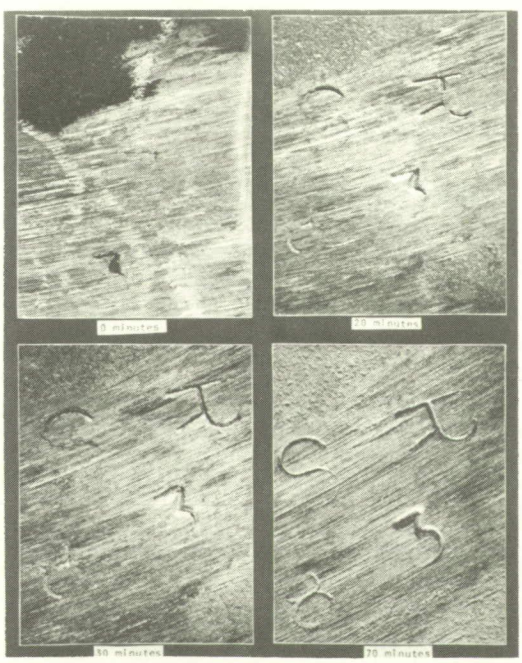


Stamped



Obliterated

Restored - Copper



Restored - Steel

Test Results of Obliterated and Restored
Serial Numbers on Metal Specimens