

METALLURGICAL EXAMINATION OF UNKNOWN MATERIALIntroduction

A request was made to examine a piece of metal to establish if the metal has unusual characteristics that would classify it as a foreign material. Utilization of the electron probe micro analyzer and the optical metallograph provided the necessary instruments to identify the metal.

Discussion

The metal was mounted using the standard metallographic technique and the metal surface was polished to a smooth finish. Figure A shows a low magnification micrograph of the etched surface of the sample showing various phases. The electron microprobe, an instrument that provides chemical analysis of areas on the order of 1 micron (.000039") in size was used to establish the chemistry of the metal. The results of the microprobe analysis is as follows:

Carbon	1.47%
Manganese	12.5%
Iron	84.6%
Chromium	0.56%
Silicon	0.10%

Other elements less than 0.06%, if present, cannot be detected with the microprobe.

The results of the microprobe analysis strongly indicates the metal to be a austenitic-manganese steel. To establish a more positive conclusion in identifying the steel lets look at the microstructure and relate the various phases present to a austenitic-manganese steel. In Figures A, B, and C we see heavy cementite precipitation in the form of needles in preferred orientation in the austenitic grains and also as a network at the grain boundaries. Considerable grain coarsening of the austenite is seen due to the slow cooling, thus the steel remains in the austenitic range for a very long time. If the steel is cooled very slowly, an unusual morphology of precipitation of the proeutectoid $(\text{Mn, Fe})_3\text{C}$ carbide occurs which was found in this steel.