E SPARK TEST OF METALS

E.1 BACKGROUND

Ferrous metals can be roughly classified by observing the sparks given off when the surface of the metal is touched by a high-speed grinding wheel. This method was originally developed systematically in the early part of the 20th century.

On iron and steel bridges, this simple method can be used to rapidly categorize the relative carbon content of the different structural members, such as pins, eyebars, and rolled sections.

Chemical elements in the metal influence the appearance of the spark stream. Pure iron exhibits a drop or bud formation near the end of the spark stream, without branching or bursting. Carbon causes the spark stream to burst. At carbon contents in the range 0.05 to 0.08 percent, there are only a few bursts visible in the stream, and the number of lines in each burst is two to three. As the carbon content increases, the number of bursts, and the number of lines in each burst increase.

E.2 PROCEDURES

A portable grinder capable of achieving at least 4500-feet per minute at the wheel edge is required. For example a portable 4.5-inch angle grinder running at 6500-rpm, or a small cordless high-speed rotary tool with a ½-inch disk at 35,000-rpm, can be used.

Both the grinding wheel and the metal being tested must be clean. If not, the contaminants will alter the spark character. Remove paint and rust in the area of the metal to be tested. Then dress the grinding wheel using a dressing tool.

Spark steams can be photographed successfully with a digital camera (flash turned off). Best results are obtained on an overcast day, or at dawn or dusk. Use a matt-finish black or dark gray fire-resistive board as a background for the sparks.

E.3 REFERENCE DIAGRAMS AND SAMPLES

Most welding textbooks contain spark diagrams for common ferrous metals. Spark Atlas of Steels (Tschorn) published in translation in 1963 contains a comprehensive study of carbon steels and alloys, and provides color images correlated with chemical analysis and cross-referenced to U.S. and European steel standards.

For practical field use, it is best to have a set of samples with known material type and chemical analysis. The spark characteristics can then be compared directly with the unknown material on the bridge.

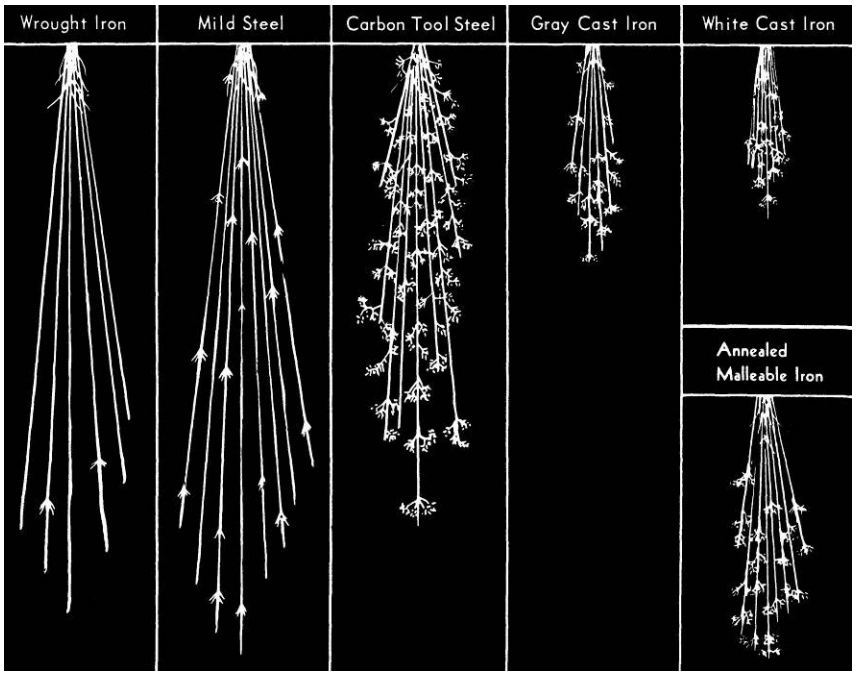

Figure A.1 Spark patterns for ferrous metals, Norton Abrasives

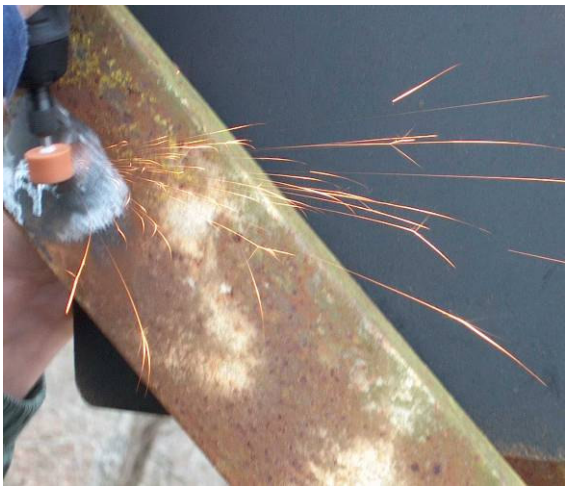

Figure A.2 Truss diagonal with 0.08% carbon content

Figure A.3 Pin with 0.19% carbon content

E.4 BIBLIOGRAPHY

The Lincoln Electric Company, *New Lessons in Arc Welding*, various editions beginning 1940.

Tschorn, Gerhart, *Spark Atlas of Steels: Cast-Iron, Pig-Iron, Ferro-Alloys and Metals*, The MacMillan Company, New York, 1963. *This book is out of print, and is not generally available from used book dealers. However, many major university libraries have a copy and it can be obtained through Inter-Library Loan.*