

Steel Elements

E
X
P
E
R
I
M
E
N
T



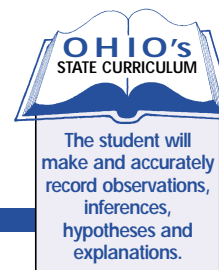
Spark Testing for Mystery Metals

Materials required:

- ✓ Grinding Wheel
 - ✓ Scrap Metal
 - ✓ Identification Chart (pages 2-3)
- } Both easy to get. We'll show you how!

Background:

Spark testing is an old method of identifying the chemistry of ferrous (iron-based) materials. At some steel mills, there is still a spark tester or two around. They are called on when the exact composition of a sample is unknown. They may be asked, for instance, to find the bad batch of steel tubing in a group of generally good steel tubing. Today, high-tech instruments more precisely measure the constitution of metals.



Steps to follow:

1. Secure mystery metals. You will need three or four pieces of ferrous metal that you, as the teacher, can positively identify. Here are a few suggestions: **(1)** wrought iron (horse shoes, ornamental iron work); **(2)** stainless steel (knives, table utensils); **(3)** high-speed steel (drill bits); **(4)** carbon tool steel (hammers, chisels); **(5)** cast iron (old cast iron skillet). For additional materials, visit a local scrap yard, junk yard or manufacturing facility. For a scrap yard near you, call the Institute of Scrap Recycling Industries at 740-397-7680.
2. Rent a hand-held or stationary die grinder (not a Dremel) from a tool rental store at a cost of about \$10. You will probably need to buy a grinding wheel (an attachment) at a cost of about \$5. Buy a wheel large enough to produce at least 5,000 surface feet per minute. Calculate surface feet per minute in this way:
$$\frac{(\text{RPMs}) \times (\text{Circumference of Wheel in Inches})}{12} = \text{Surface Feet Per Minute}$$


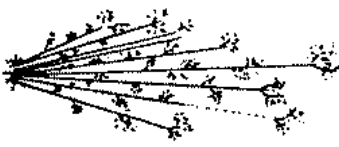




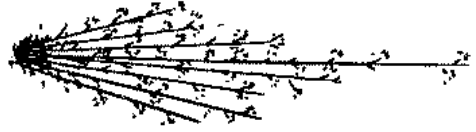
(Caution: Do not exceed maximum recommended RPM rating for grinding wheel selected.)

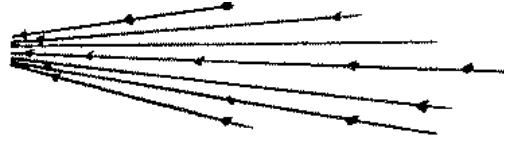




3. Divide the students into small groups of three to five students.
4. Print out the spark identification tables on the following pages. Distribute the documents to students. The documents contain spark properties for 11 steel materials. Explain to students how the sparks are classified. Make sure they understand each of the six properties to be observed and recorded.
5. Ensure that all students have adequate eye, face and hand protection. Have them stand back for safety and so all present can see the sparks.
6. Secure each of the mystery metals in a vise and gently apply the grinder. Pause between each application to allow each student group time to record the spark properties. (You might consider concealing the samples in such a way that students will not be able to identify them by sight.)
7. Once the groups have recorded the properties of each piece of metal, they should attempt to identify the four mystery metals, using the chart.
8. After all groups have completed their identification of the mystery metals, discuss the spark properties of each metal one by one. Have a spokesperson from each group explain the group's observations, decision process and conclusion.
9. When each group has committed to an identification, reveal the actual identity of the steel sample.
10. Proceed with discussion on the next steel sample.

Analysis:

The benefit of this exercise lies in the process of observation. Students learn to compare subtle differences in spark streams, to record properties of spark streams and to use their records to draw conclusions. Each time a student evaluates a spark stream, he or she is looking at six different properties. Great attention to detail is necessary for accurate results.

Spark Identification Illustrations

Material	Spark Illustration
Wrought Iron	
Carbon Tool Steel	
Gray Cast Iron	
White Cast Iron	
Annealed Malleable Iron	
High-Speed Steel	
Austentic Manganese Steel	

Material	Spark Illustration
Stainless Steel	
Tungsten-Chromium Die Steel	
Stellite	
Cemented Tungsten Carbide	
Nickel	
Copper, Brass, Aluminum	

Spark Testing Identification Table

Material Type	Volume of Stream	Relative Length of Stream in Inches	Color of Stream Close to Wheel	Color of Streaks Near End of Stream	Quantity of Spurts	Nature of Spurts	Used For ...
Wrought Iron	Large	65	Straw	White	Very few	Forked	Shipbuilding, farm equipment and ornamental work
Carbon Tool Steel	Moderately large	55	White	White	Very many	Fine, repeating	Hammers, chisels, dies, drills, cutters, taps and wood-cutting tools
Gray Cast Iron	Small	25	Red	Straw	Many	Fine, repeating	Auto cylinder blocks and heads, crankcases, crankshafts, brake drums, camshafts, pipes, auto and locomotive castings
White Cast Iron	Very small	20	Red	Straw	Few	Fine, repeating	Rolls used for rolling steel
Annealed Malleable Iron	Moderate	30	Red	Straw	Many	Fine, repeating	Gears, universal joints, connecting rods, differential cases, steering gear housings, flanges, pipe fittings and valve parts
High-Speed Steel	Small	60	Red	Straw	Extremely few	Forked	Drill bits
Austenitic Manganese Steel	Moderately large	45	White	White	Many	Fine, repeating	Railroad switches, rock crushers, grinding mills
Stainless Steel	Moderate	50	Straw	White	Moderate	Forked	Cooking utensils and flatware, fasteners, chemical, health, sanitation and petrochemical equipment
Tungsten-Chromium Die Steel	Small	35	Red	Straw	Many	Fine, repeating	Engine valves, gun barrel liners and rifling, dies and punches for steel materials
Stellite	Very small	10	Orange	Orange	None		Cast pipe valves and pumps for chlorine resistance in chemical plants
Cemented Tungsten Carbide	Extremely small	2	Light orange	Light orange	None		Mining, rock drilling and metal cutting
Nickel	Very small	10	Orange	Orange	None	None	Plating
Copper, Brass, Aluminum	None	None	None	None	None	None	Piping, plumbing, ornamentation, cans