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The Stainless Steel Inspector's Kit

No. 1499

Includes Tests For:

- Standard Stainless Steels; 300 & 400 Series
- 316 vs. 304 Stainless "The Moly Test"
- Common Steels
- Nickel Alloys

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Kit Contains

1	The ElectroSpot Model 5 Alloy Extractor
8	Solutions – #1, 2, 3, 4, 5, 6, 9 & 10
400 pcs.	Test Papers - #0100
1	Aluminum Cathode lead wire
1	Alligator Clip lead wire
1	Metal Standard Sample - Incoloy 825
3	Eye Droppers
3	Packing Foam
1	Hard Kit Case

Introduction

Alloy identification by chemical color tests is a simple and versatile technique. Identification is based on the level of various components in the alloy. Sensitive and interference-free chemical color tests detect the alloying components. A color develops as a result of the chemical reaction and, generally, the intensity of the color can be used to estimate the amount of alloying component present.

Spot tests are easier, faster, and cheaper than chemical analysis. The results are not as exact, but estimates of the concentrations can be made. This is usually sufficient for alloy identification, differentiation and verification.

The **KOSLOW 1499 Stainless Steel Inspector's Kit** is designed for the rapid identification of steels and nickel alloys. It is comprised of individual tests for these common alloying components: Chromium (Cr), Nickel(Ni), Molybdenum(Mo), Copper(Cu), Iron(Fe). Identification of most stainless alloys is possible with only these tests. In cases where a group of alloys are of almost identical composition, individual identification may not be possible, although the group to which the alloy belongs can be determined.

Standard Coupon

The Inspectors Kit includes a metal sample to be used as a testing reference. Incoloy 825 was selected as a standard because it contains each of the five distinctive elements that can be identified using this kit. Working side by side with a known sample will show what a positive result looks like before attempting tests on lesser known materials. It also assures that the equipment, testing solutions and procedures are working as they should. Part No. 1499 S.

COMPOSITION CHART OF INCOLOY 825

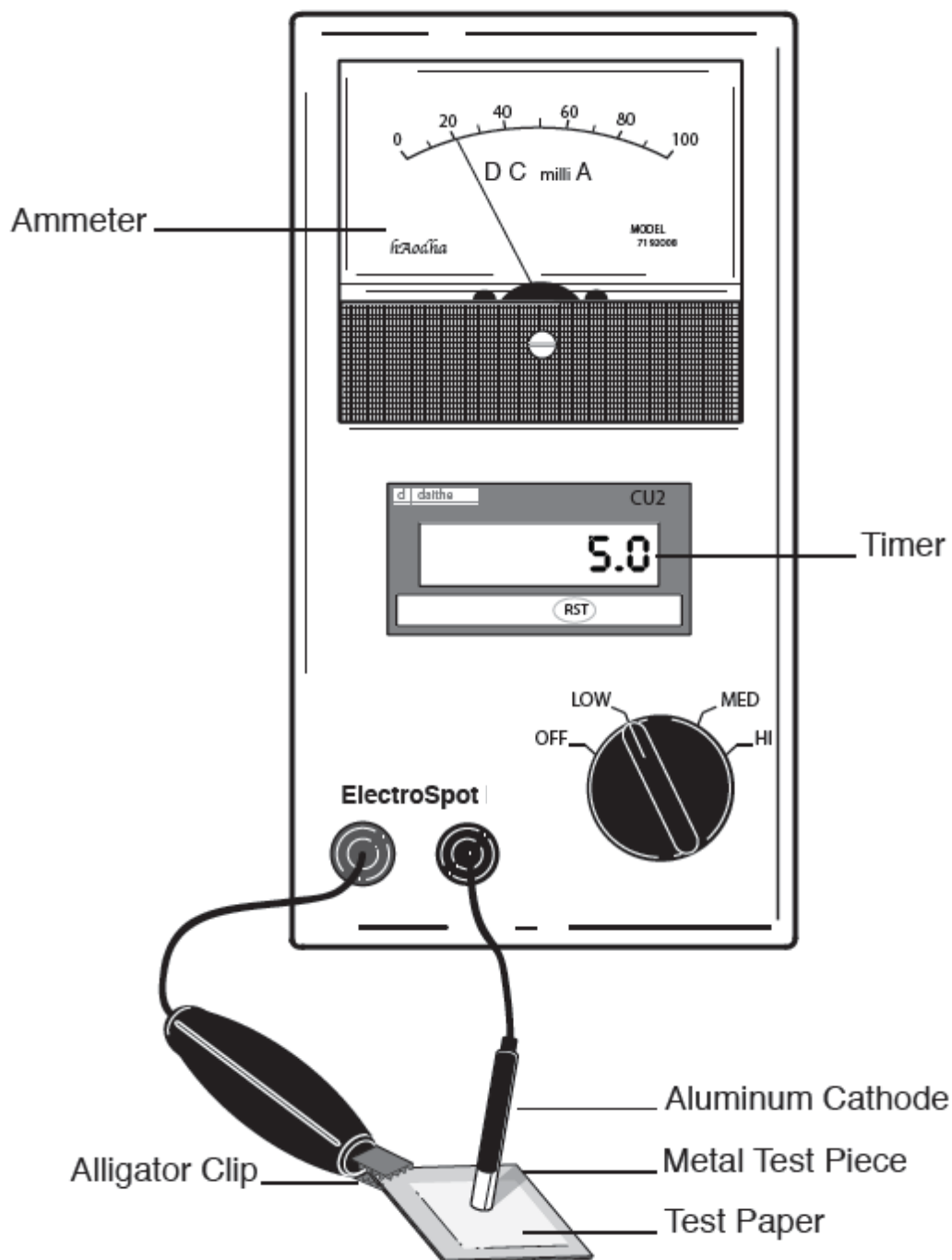
Chromium	Nickel	Iron	Moly	Copper
21%	42%	30%	3%	2%

ElectroSpot Sampling

To learn how to perform the test, see the demonstration video and photos at: <http://koslow.com/method.html>

To perform a test:

Attach the clip lead to the test metal, or hold to the piece if too large for the alligator clip to "bite." Add the solution to the test paper and place it on a cleaned, sanded area of the metal surface. Select the appropriate current range and gently press the aluminum rod into the test paper as described below holding for the prescribed time. Remove the test paper, turn it over, and add the color developer solution. Concluding a test, Wipe test surface and equipment clean with a damp paper towel. The use of de-ionized water is recommended.



Alloying Element Level	Set Current Range	Time in Seconds
0.3% - 2%	HIGH	10 Seconds
1% - 10%	MEDIUM	5 to 10 Seconds
10% - 100%	LOW	5 to 10 Seconds

Comparison of the relative intensities of highly colored spots is difficult. Therefore, sampling time and current should be as small as possible, yet long enough to result in a clearly recognizable color. Experimentation with known alloys will make this clear. When testing an alloy of unknown composition, use the high current range first so that traces will not be missed. Avoid unnecessarily high currents because the tests are "cleaner" when not too much of the alloy dissolves in the paper. When in doubt, use the medium current range and sample for 10 seconds. The panel meter is used to visually check the current range fall, if any, and also to insure that current is flowing. If no current flows, the instrument may be in the "off" position, or the clip is not making good electrical contact. Alternatively, it may indicate that the battery is dead. Turn the ElectroSpot Alloy Extractor apparatus off when not in use. Avoid shorting the leads together which is harmful to the battery and the meter.

General Test Procedure

Spot testing may be used to answer anyone of the following questions:

1. Is this metal alloy A? (For example, is this 316 stainless?)
2. Is this metal alloy A or alloy B? (For example, is this 316 or 304?)
3. What is this unknown metal?

Is the metal alloy A?

The first step is to consult a table giving the chemical composition of alloy A. Note the amount of chromium, nickel, molybdenum, copper, & iron. Suppose alloy A were SS316: The table shows that it contains high chromium, high nickel, high iron and a moderate amount of molybdenum. Test for each of these four elements as described in the individual test procedures. If the alloy is indeed high in chromium, nickel and iron and has molybdenum, it is SS316. Testing for copper will rule out Carpenter 20 as a possibility. Compare the test results with a known piece of Stainless Steel 316.

Is this metal alloy A or B?

Consult the table of chemical compositions. Alloys A and B must differ in one component or in the amount of one component. A difference of at least times two in one component is necessary for identification of A and B. For example, SS304 and 316 can be distinguished by a molybdenum test since only 316 contains moly. Inconel differs from 300 series stainless in the amount of nickel and iron. Spot testing will not distinguish between 201 and 202 because the chromium, nickel and iron contents are too similar and give equally intense color tests for each component.

Which alloy is this unknown metal?

Perform the tests for each element, starting with chromium, nickel and iron. Determine which components are present and whether the amount is high, medium, or low. The test procedure is described in the section for each component. Then go through the tables and note the possible steels. For example, if chromium and nickel are absent or low, the unknown is a low alloy steel. If chromium and nickel and iron are high, it is probably a 300 series stainless. If chromium is high and nickel low or absent it is a chromium steel (400 series). High chromium and high molybdenum indicates a Hastelloy. High copper indicates a cupronickel or Monel. And, high cobalt indicates a Stellite cobalt alloy. With a little practice and careful testing, most common alloys can be identified as to group and often to individual alloy. Comparison with a known alloy helps to confirm the identification.

A clean, bare metal surface must be exposed for each test. Sand the surface with emery paper if necessary, and wipe completely clean of filings. Select the current range of the ElectroSpot apparatus for the amount of component expected. Use the high current range for low concentrations (0.3-2%), the medium range for concentrations (1-10%), and the low current range for high concentrations (10% or higher). Establish the best current range by trial-and-error, to give a reasonably intense colored spot. If the spot is too intense, it will be difficult to estimate the amount of the component by comparison. Weakly colored spots are easier to compare.

A file of properly labeled alloy standard should be maintained. The best spot testing results are obtained by comparing test results of unknown and known metals. A Metal Standards Collection #1900 is available from Koslow, consisting of coupons of common alloys.

How to prepare a separation or sequence of testing steps:

If you need technical assistance, please contact us at 201 541-9100. You may also contact us by email - info@koslow.com Visit our website at www.koslow.com

Screening many pieces of metal:

The test time for each piece can be significantly decreased by testing 10 or more pieces at the same time. Place the pieces on a conducting surface, such as a large sheet of steel or aluminum foil. Clip the test lead to this metal conductor. Now add the appropriate solution on to 10 test papers and place one paper on each metal. Press the probe into each paper for the required length of time, then turn each paper over on a paper towel and add the color developing solution. It is then possible to sort those metals which did show color development from those which did not. Of course, this procedure can only be used with relatively small pieces, and is not limited to only 10 test pieces.

Small Parts

Small parts can be tested similar to the above method. So the alligator clip is not needed to make contact with small part. 1) Lay a sheet of aluminum foil (or any other type of conductive plate) over your work bench area. 2) Attach the alligator clip to the foil. 3) Perform tests as prescribed. Very tiny metal chards, splinters and parts can be tested using the Speck Checker 1224 accessory. <http://www.koslow.com/1224.html>

A sampling of the metals which can be identified

Metals which can be identified are the following: 303, (302, 304), (309, 310), (316, 317), 316L, (414, 431), (400 Series), (Monel), (Nickel Silvers), Inconel 600, Inconel 625, Inconel 750, Incoloy 825, Carpenter 20Cb3, (Incoloy 800 Series), Crucible 26-1, Hastelloy 8, Hastelloy C, Hastelloy X and many others. Note: Alloys in brackets are indistinguishable from each other, but can be distinguished from the other alloys in this list.

Maintenance

Maintain kit by storing in a cool dark place. Keep parts in carry case with protective foam. Each bottle of Test Solution has an expiration date printed on the label. Annual battery checks and calibration cycles (when applicable) can be logged on the last page of this instruction manual. Maintenance items are the responsibility of customer/user. Failure to observe these recommendations may adversely effect operation of equipment.

The ElectroSpot current source is virtually maintenance-free. The battery is good for over one year or about 10,000 tests under normal use. It is tested by shorting the leads together. The current reading should be about 20-25mA on the medium range and over 100mA on the high scale. (Caution: do not leave the switch in the Hi setting for more than a few seconds to avoid damaging the meter). In the Lo range, the current is about 510mA. When the battery needs replacement, use an alkaline 9v battery only. Remove the battery gently to avoid loosening the bracket from the plastic case. The timer has its own internal batteries. The aluminum cylinder cathode probe should be cleaned with emery paper occasionally, especially when dull looking or having a black deposit on the testing surface.



Safe Handling

- Like the handling of any chemical, good industrial hygiene practices are imperative
- Kit solutions may be hazardous. Caution should be exercised in kit use
- Wear a shop coat or protective clothing. Some solutions can stain or damage clothing
- Use eye protection or splash resistant goggles
- Use gloves to prevent unnecessary exposure to skin
- Do not intentionally inhale vapors
- Wash hands after kit use
- Wipe spills quickly
- Only use solutions for metal testing purposes
- Dispose of kit contents according to local regulations
- Consult your physician immediately if ingested
- For complete information, consult the M.S.D.S. sheet

Chromium - Stainless Steels and Nickel Alloys

Solutions required: 1 and 2; Test Papers

Surface preparation: abrade with emery paper if the surface is dirty.

Add to test paper: 1 drop Solution 1

ElectroSpot: Medium range, 1-5 seconds as in the illustration. Then add: 2-4 drops Solution 2

Observe: an intense violet spot, usually yellow in the center.

Nickel-Steels - Nickel Alloys

Solutions required: Solutions #3 and #4; Test Papers.

Surface preparation: Clean metal surface removing paint or rust to insure electrical contact. Wipe away any metal dust with a cloth or paper towel. Abrade the surface if necessary to remove any scale.

Add to the test paper: 2 drops Solution 3

ElectroSpot: As in the illustration.

10% Ni and up - lo current, 5-10 seconds

2-10% Ni - Med current, 10 seconds

0.2-2% Ni - Hi current, 10-30 seconds

Then add: 2-5 drops Solution 4, gradually, drop-by-drop

Observe: A pink circle or spot is a positive test, showing that the steel contains nickel. Examine the test paper in good light and compare it with a standard prepared from a known alloy. Alloys with lower nickel content tend to produce a pink-orange color and higher alloys are pink-crimson.

Molybdenum - (The Moly Test) for SS316

Solutions required: 1 and 5; test papers

Surface preparation: If the metal has scale or is otherwise dirty, abrade with emery paper and wipe grit away with a paper towel. No treatment is needed for clean steel.

Add to test paper: 2 drops Solution 1

ElectroSpot: 3% moly, such as SS316 or 20Cb3, Med current, 5-10 seconds.

Add: 1-2 drops Solution 5, followed by drop-by-drop addition of Solution 1, up to 5 drops.

Observe: development of a pink color, in 1-5 seconds for SS316.

Copper-in-Steel

Solutions required: 3 and 9; test papers

Add to test paper: 2 drops Solution 3

ElectroSpot: 10% copper and up, Lo current, 5 seconds

1-5% copper, Med current, 5-10 seconds,

Less than 1% copper, Hi current, 10 seconds.

Then add: 2-5 drops Solution 9, gradually, drop-by-drop

Observe: a pink color (violet at high copper levels) is a positive test for copper.

Iron

Solutions required: 6 and 10; test papers

Add to test paper: 1 drop Solution 6

ElectroSpot: 10% iron and up, LO current, 5 seconds

1-5% iron, LO current, 10 seconds; Less than 1% iron, Med current, 10 seconds

Then add: 5 drops Solution 10, gradually, drop-by-drop until the color persists.

Observe: a pink-red color is a positive test for iron.

Note: This test is used to identify nickel alloys, because of the low iron content, generally.

L-Grade Test: Stainless Steel 304/304L and 316/316L Test

1. Solution required: 6; Test papers
2. Surface preparation: The test results are much improved by prior sensitization of the test stainless. Heat the piece or a portion of a large piece in the flame of a propane torch to redness and hold there for about one minute. Quench in water (or, if not possible, in air). The sample should be at room temperature before continuing. Abrade with emery paper and remove all grit by rubbing clean with a paper towel.
3. Add to the test paper: 2 drops Solution 6
4. ElectroSpot: Hi range, 15 seconds. The current should read between 80-100mA, at least initially. If it reads near 60mA or less, the battery may need to be replaced. Do not press the probe too firmly, denting the paper and causing shadows.
5. Then add: to side of paper facing the metal, gradually, 3 drops Solution 6 and place the paper, face up, on a fresh dry square of test paper. Now add 3-5 drops of tap water with a medicine dropper, the bottom paper acting as an absorbent.
6. Observe: View the test paper from an angle, that is, not straight down. Notice a brownish-black spot in the center of the paper, which is more intense for 304 than 304L or for 316 than for 316L. The difference is more easily seen after about 1-2 minutes. If too much bluish-green or yellow color obscures the dark spot, add an additional 1-2 drops of water to disperse the color.
7. Comparison with known samples of 304L or 316L is essential for the proper interpretation of the results. A normal grade 304 or 316 has a maximum carbon content of 0.08%; if it should be much lower than this, say 0.04-0.05%, it could be confused with "L" grade having 0.03% maximum. The dark spot due to grains of stainless steel exfoliated by sensitization is clearly visible. The scale remaining on the steel after heating can be removed with emery paper or any accepted descaling bath.

Accessorize Your Inspector's Kit

For testing very small parts, ask about our Metal Speck Checker 1224.

For fast testing of many known materials inquire about our Electronic Alloy Sorter TE-3000.

For stainless steel passivation testing check out the Passi-Flash 3036

Metal Standards Collection - #1900

Applications

- + Reference material for metal identification with the Alloy ID Lab
- + An aid in familiarizing personnel with spot test techniques
- + Compact, convenient
- + Testing of spot test solution shelf-life

Kit Contents:

Steel, Nickel, Copper and Aluminum Alloy Standards, 24 pieces, 1" x 1" x 1/16", each stamped with alloy identification number.

List of Alloys:

Monel, Inconel 600, 625 & 718, (F11) 1 1/4 Chrome, (F22) 2 1/4 Chrome, Incoloy 825, Carpenter 20Cb3, 4140, 4340, 17-4 PH, Hastelloy B2, C-276, and X, 410 SS, 303, 304 SS, 316 SS, 321 SS, Haynes 25 (Cobalt), Admiralty Brass, Aluminum Bronze CDA 614, Aluminum 7075 and 2024.

Refill Information

Qty.	Description	P/N
30 mL	Solution 1	0001
30 mL	Solution 2	0002
30 mL	Solution 3	0003
30 mL	Solution 4	0004
30 mL	Solution 5	0005
30 mL	Solution 6	0006
30 mL	Solution 9	0009
30 mL	Solution 10	0010
1,000	Test Papers	0100
1	Metal Sample – Incoloy 825	1499S

For current prices and availability

Customer Service 201 541-9100 Visit – www.koslow/refill.com

ALLOY COMPOSITION GUIDE

Alloy Name	Chrome	Nickel	Iron	Moly	Cobalt	Copper	Sulfur	Carbon	Other Elements	TE Reading
202	18	5	Bal.	0	0	0	0.03	0.15	Mn. 8.5 N.25	-3
303	18	9	Bal.	0.6	0	0	0.15	0.15	0	4
304	19	9	Bal.	0	0	0	0.03	0.08	0	4
316	17	12	Bal.	2.5	0	0	0.03	0.08	0	4
321	18	10.5	Bal.	0	0	0	0.03	0.08	Ti5XC Min.	4
410	12.5	0	Bal.	0	0	0	0.03	0.15	0	150
17-4 PH	16	4	75	0	0	4	0	0	0	72
17-7 PH	17	7	75	0	0	0	0	0	0	X
20Cb3	20	34	36	2.5	0	3.5	0	0	0	20
26-1	26	0.5	75	1	0	0	0	0	0	X
304L	19	10	Bal.	0	0	0	0.03	0.03	0	4
316L	17	12	Bal.	2.5	0	0	0.03	0.03	0	4
904L	20	25	50	4.5	0	1.5	0	0	0	9
Hastelloy B	1	64	5	28	2.5	0	0	0	0	135
Hastelloy D	1	92	2	0	1.5	3	0	0	0	X
Hastelloy X	22	50	18	9	1.5	0	0	0	0.6 Tung.	37
Hastelloy C276	15	60	5	16	2.5	0	0	0	4 Tung.	60
Haynes Stellite	20	10	3	0	52	0	0	0	15 Tung.	X
I-600	15	76	8	0	0	0	0	0	0	125
I-625	21	61	2.5	9	0	0	0	0	0	60
I-718	19	52	18	3	0	0	0	0	0	50
I-800	21	32	25	0	0	0	0	0	0	X
I-804	29	42	46	0	0	0	0	0	0	X
I-825	21	42	30	3	0	2	0	0	0	32
I-840	20	20	60	0	0	0	0	0	0	X
Invar	0	33-42	Bal.	0	0	0	0	0	0	X
I-X750	15	73	7	0	0	0	0	0	0	X
Kovar	0	29	Bal.	0	17	0	0	0	3 Ti	X
Monel 400	0	66	1	0	0	31	0	0	0	-225
Monel K500	0	66	0	0	0	29	0	0	3 Alum.	-275
Nichrome	20	80	0	0	0	0	0	0	0	X

The above data is a useful as a guide for the chemical spot test method.

***Thermoelectric readings are obtained from actual samples. Refer to KOSLOW Alloy Sorter TE-3000.**



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K O S L O W . C O M

SCHEDULED MAINTENANCE LOG

[illegible]

The above log is to properly maintain and service your test kit. It is imperative to keep current with your kit's contents. Suggested fields may include: annual battery test, Test Solution expiration dates, and calibration cycles.