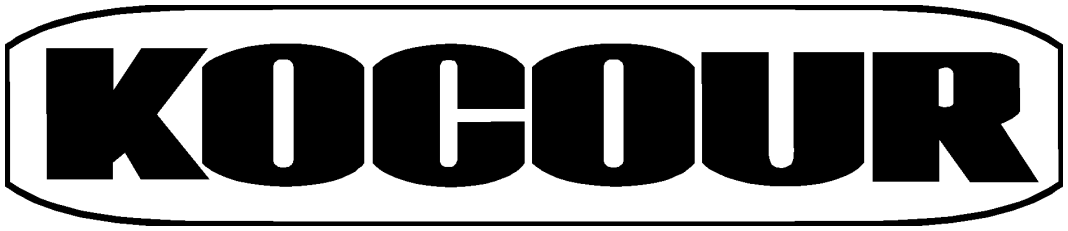

OPERATION MANUAL
MODEL KOCOUR 6000
THICKNESS TESTER

V. 5.11(04/01/11)

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NOTE: This document is hyper-linked where page numbers are underlined.

PRINCIPLE OF OPERATION

COULOMETRIC METHOD

The Kocour 6000 Thickness Tester operates by anodically de-plating a small area of the specimen. The cell which holds the test solution also serves as a cathode, and the article to be tested is made the anode.

At the start of the test and until the substrate is exposed, a voltage characteristic of the plating exists across the cell. When all of the plating has been removed from the test spot, this voltage changes sharply and assumes a new value characteristic of the substrate. This rapid voltage change is the endpoint of the test, and is amplified and used to operate a relay which terminates the test.

The time required to dissolve the plating on the test spot is proportional to the thickness of the deposit. By correlating the area of the test spot with the current used to strip the plating, the counter is made to read directly in units of thickness. Most coatings do not require calculations or references to graphs or charts to obtain thickness.

The test solutions used are specifically designed to give 100% anodic current efficiency. They do not attack the plating unless current is flowing through the test cell. The anode efficiency is further maintained by providing agitation of the solution in the test cell.

The test spot is defined by means of a small rubber gasket having an accurately dimensioned perforation. The diameter of the test spots available range from 0.030" (0.76 mm) to 0.136" (3.4 mm) in diameter.

The coulometric method meets the requirements of ASTM B504, ISO 2177, DIN 50932, DIN 50955 and BS5411-Part 4.

Please note that all references to chromium deposits in this document refer to a deposit plated from an hexavalent (+6) chromium plating process.

INITIAL PREPARATIONS

To operate the instrument properly it is essential that the operator be thoroughly familiar with the material presented in this manual. Do not use the instrument until you have read this material.

LINE VOLTAGE

The Kocour 6000 is a 120V/240V dual voltage unit. The voltage is displayed on the voltage selector/fuse holder that is located in the AC receptacle on the back panel. The voltage input can be changed by removing the fuse drawer and turning the fuse holder until the desired line voltage appears in the display window.

CLIP

The rubber insulated alligator clip attached to the red lead wire MUST be kept clean. If the clip becomes corroded, poor connection to the samples may result in fluctuation of the BALANCE meter indicator or may even cause a premature endpoint. Open the jaws of the clip and use an abrasive to remove rust and corrosion.

RUBBER GASKET

The rubber gasket determines the exact area to be tested. Handle it with care. Occasionally, remove the rubber gasket from the cell and examine it carefully. Do not allow any solid material to accumulate. This might obstruct the gasket hole. It is suggested that the gasket be examined periodically under a magnifying glass for possible deterioration.

TEST CELL

The test cell MUST be kept clean. Wipe bottom of gasket with a damp absorbent tissue and proceed with next test.

When tests are made, metal dissolved from the specimen will be deposited on the inside of the cell. An accumulation of such deposits may interfere with tests and should be cleaned by the method listed below. Remove the cell from the cell holder by loosening the set screw in the rear of the cell block holder. REMOVE THE RUBBER GASKET BEFORE DIPPING THE CELL IN ACID.

CLEANING PROCEDURE

CAUTION: 20% HNO_3 solution is corrosive. Gloves, aprons and face shields are recommended for safe handling.

The accumulated deposits from these coatings may be removed by first rinsing thoroughly in D.I. water. Then soak in a solution of 1 part Nitric Acid (conc) and 4 parts D.I. water until you are

prepared to use it again. Then simply remove cell from the solution with Stainless Steel tongs or tweezers, rinse with tap water and dry. The accumulated deposits may also be partially removed by reaming the I.D. of the cell with the cell cleaning brush.

AGITATOR

Agitation is required for many of the coating/substrate combinations. Refer to the Test Solutions/Application chart for instructions.

Agitation is provided by a calibrated pulsating air column. The dimensions and position of the agitator tube in the cell are important. For this reason, it is imperative that the gasket and the agitator tube assembly be matched. For example: An "A" gasket must be used with the "A" agitator tube assembly.

CLEANING THE TEST SPOT

The spot to be tested must be clean. Fingerprints can interfere with the test; however, they are easily removed by wiping with a solvent such as alcohol or acetone. If the plated surface is lacquered, remove the lacquer with a solvent before cleaning the test spot. Chromate films on zinc or cadmium deposits must be removed prior to testing. The film may be removed by LIGHTLY rubbing the test spot with a pencil eraser. Chromate films on zinc or cadmium are more precisely removed using an electro-chemical method. This method requires modification of the test stand. Call the Kocour Company for information. Tin and nickel plated samples may acquire a passive film on standing. This film can be removed by placing 2 drops of R-50 on the test area, rinse, then wipe dry immediately and proceed with the test.

SUBSTRATES

The term SUBSTRATE as used in connection with this instrument refers to the metal immediately underneath the plating being tested; not necessarily the metal from which the article is fabricated. For example, consider a piece of steel which has been copper plated, then nickel plated and finally chromium plated. When testing the chromium, the substrate is nickel; when testing the nickel, the substrate is copper; and when testing the copper, the substrate is steel.

Where steel is referred to as a substrate, the reference is generally to polished, cold-rolled mild steel. Satisfactory tests have been made with other types of steel as the substrate, including stainless steels. In most cases where the substrate is other than mild steel, it is recommended that representative samples be submitted to Kocour Company for evaluation. These remarks also apply in any case where steel or another substrate has been subjected to any special processing (such as heat-treating) which may result in a radical alteration of the surface prior to plating. Difficulty may be encountered in testing deposits over soft, gray and cast iron.

THICKNESS RANGE

The minimum thickness of deposit which can be tested with the basic instrument is 2-3 µin for chromium and gold and 20 - 30 µin for other metals. If deposits less than the minimum thicknesses specified above are tested, the endpoint will develop before the instrument can detect it. In such cases, the instrument will continue to run indefinitely. If this occurs, the test should be stopped manually by depressing the GO/NOGO key and the test spot examined. If the deposit has been removed from the test spot, its' thickness is less than the specified minimum.

The maximum thickness of chromium which can be tested is approximately 2 mil. For gold, the maximum thickness is 80 - 100 µin. For other metals, satisfactory results may be expected up to approximately 1 - 2 mils depending upon the type of plating and substrate. Generally, for coatings greater than 1.0 mil, it is suggested to stop the test, remove the cell solution, record the test result and re-run the test adding the recorded test results. If deposits of appreciably greater thickness are to be tested, it is suggested that a representative plated sample be submitted to Kocour Company for evaluation and recommendations.

This instrument indicates essentially local thickness. It is recommended that at least three tests be made on significant surfaces to obtain a better estimate of the average thickness.

BALANCE KNOB

Periodically, the Balance should be checked. For proper operation of the instrument, the Balance indicator should be centered on the meter face. The Balance adjustment procedure is outlined in the "Calibration" section.

During an actual thickness test, small

fluctuations of the Balance Meter indicator are normal and may be disregarded.

Improper cleaning of the test spot, faulty connection to the specimen, cell leakage, or air bubbles on the test spot may cause the meter indicator to fluctuate wildly during a test. DO NOT TURN THE BALANCE ADJUSTMENT KNOB DURING AN ACTUAL THICKNESS TEST.

CALIBRATION KEY

This key is used to display the amperage during the "Daily Check-List" and "Calibration". See these sections for proper usage.

CALIBRATION KNOB

The Kocour Thickness Tester is equipped with a calibration adjustment which will permit correction of errors of approximately 10% in either direction. Directions for calibrating the instrument against Kocour Thickness Standards are given under "Calibration" section; however, the following general points should be noted:

1. If the 6000 has not been calibrated with a Kocour Thickness Standard, the amperage should be set to the value assigned to that coating in the "Calibration" section.

2. It is recommended to check the instrument against a Thickness Standard daily, at the beginning of each working period or when the plating application has changed. If doubtful results are obtained subsequently, the instrument should be re-checked against the standard.

3. A check against a Kocour Thickness Standard will provide a positive indication as to whether or not the instrument is functioning properly. If a calibration is made as described, certain general sources of error will be compensated for. However, the calibration figure obtained for a particular plating-substrate combination may not apply exactly to a different combination. For example, if the instrument is calibrated against nickel on steel thickness standard the calibration may not necessarily apply exactly to silver on copper. It is recommended to calibrate the instrument against a standard corresponding to the type of work being tested. (see ASTM B504-90(1997, Sub¶ 6.4) A variety of thickness standards, listed elsewhere, are available from Kocour Company.

SENSITIVITY KNOB

The normal (minimum) sensitivity position is full counter-clockwise. The thickness test endpoint is indicated by a large deflection of the BALANCE METER indicator, at which time the instrument will turn off. Certain plating-basis metal combinations will at times give rise to weak endpoints in which case the BALANCE meter deflection will not be sufficient to turn the instrument off. In such cases increase the sensitivity by turning the SENSITIVITY knob clockwise 1/8 to 1/4 turn and repeat the test. Repeat this procedure until proper end point occurs. This will be your setting until plating-basis metal combinations change. In general all tests should be made with the sensitivity at the normal (minimum) standard setting, and the sensitivity should be increased only when required as noted above. DO NOT ADJUST SENSITIVITY DURING AN ACTUAL THICKNESS TEST; TEST WILL TERMINATE.

E/M KEY

The E/M key permits the choice of English units (mils) or Metric units (micrometers). This choice has to be made prior to testing. The key cannot be used to perform units conversion after the test is made.

GO/NOGO KEY

This key is used to start the test after the sample has been set-up according to the instructions in the "Specimen Set-Up" section. Pressing the GO/NOGO key automatically removes existing data from the display and starts the test. This key also terminates the test. When the GO/NOGO key is engaged, the green LED on the key will light.

SEL KEY

The coating selector key is used to access the proper amperage for testing that coating. The list below is a reference for the coating to the chemical symbol on the key.

KEY	COATING	KEY	COATING
Au	GOLD	Zn	ZINC
Cr_2	DECORATIVE CHROMIUM(+6)	Brs	BRASS
Ag	SILVER	Cu	COPPER
Sn	TIN	Ni	NICKEL
Cd	CADMIUM	Cr_1	INDUSTRIAL CHROMIUM(+6)

L/O KEY

This key is used to lockout the Automatic Termination Circuit. When this key is engaged, an "LO" will appear on the lefthand side of the display. This feature is used in conjunction with the "STEP TEST".

STORE KEY

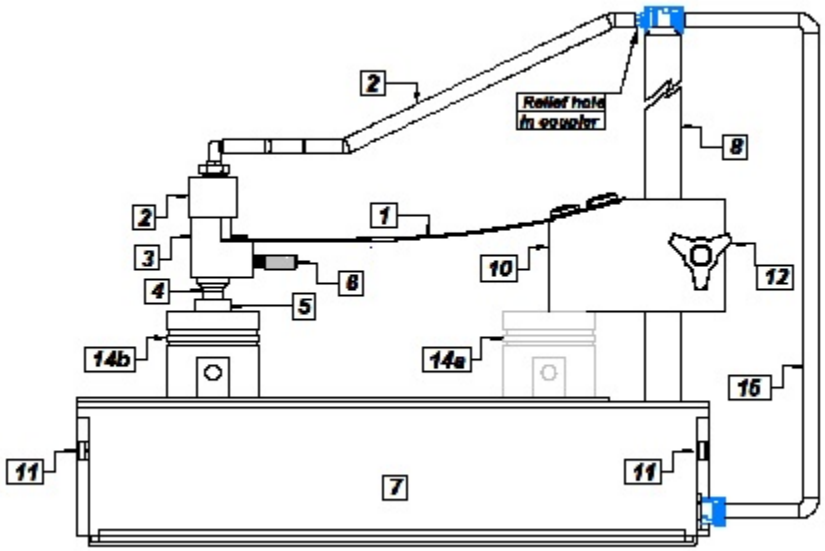
This key is used to send the display readings to the memory.

PRINT KEY

This key is used to send the contents of the memory to the printer.

ACCESSORY PORT

The Accessory Port is located on the front panel in the lower left-hand corner. It is used to connect the various measuring stands and WT accessory.



LAYOUT DRAWING

EQUIPMENT REQUIRED

1. Kocour 6000 or K 5000
2. NF6M Stand

PROCEDURE FOR TEST STAND SET-UP

(Numbers in parentheses “(4)” below refer to parts in schematic, above.)

1. Connect black patch cable to the 9 pin receptacle at the rear of the NF6M stand and to the 9 pin accessory port on the left hand side of the Kocour 6000 front panel or cell receptacle on rear of K-5000.
2. Insert cell (4) with cell washer (not shown) and gasket (5) into the cell holder (3). Lock into position with cell set screw (6).
3. Connect the black lead wire as follows: Insert banana plug into the head of the cell set screw (6). Insert the pin connector to one of the black pin receptacles (11) on the NF6M stand.
4. Insert the connector on the red lead wire to one of the red receptacles on the NF6M stand. The alligator clip at the other end of this lead wire is used to connect the part (14b) being tested.
5. Connect agitator assembly (2) to the rear of the stand base (7) or to the optional port extension (15) coupler at the top of stand post (8).

NOTES:

a) Agitator assemblies are color coded by color tubing w/relief hole (**keep hole clear for proper agitation**) in coupler and must remain as a set. Assembly ”A”, w/clear tubing w/relief coupler; “B”, w/green tubing w/relief coupler; “C”, w/yellow tubing w/relief coupler and “A STEP”, w/white tubing w/relief coupler.

b) **Do not let liquids or any material run back down tubing as liquids will destroy pumping assembly and agitation will quit.**

c) Specify if using R-48 as special agitator assembly is required.

d) Solution level in cell should be kept just under ½.

SPECIMEN SET-UP (see NF6M drawing above)

1. Set the test sample at position (14a) under the Height set slider gauge (10).
2. Lower the Height set slider gauge (10) until it touches the test area on the sample. Lock the Height gauge in this position.
3. Carefully lift the Cell Holder (3) and slide the test sample from position (14a) to position (14b) under the gasket (5). Center the gasket on the test area. The steps 1 - 3 assure that the pressure on the gasket is proper for testing.
4. A liquid barrier may form in the agitator head assembly and must be removed prior to use. This is accomplished by tapping the grey tip to release this barrier.

Note: When using standard or part under 1" thick, set standard or part up on a 1" block before bringing height set slider block (10) down for positioning. When a test part (14) is too tall or too large for a proper set-up on base (7), place the test part behind the stand, swing the height set slider (10) around facing the part and continue with step 2 above. If additional room is required, an optional bumper block assembly can be purchased.

DO NOT ALTER ANY PART OF AGITATION SYSTEM AS TEST RESULTS WILL BE INVALID!

DAILY CHECKLIST

1. Press the toggle switch located in the AC receptacle on the rear panel to the "ON" position. The red power indicator on the front panel will light at this point.
2. Press the "SEL" key until the desired coating appears on the extreme left side of the display.
3. Insert terminals on yellow shorting cable into red and black jacks in the front of measuring stand.
4. Press "GO/NOGO". **
5. Center the indicator on the balance meter with the balance knob. **
6. Find the recommended current for your coating/module combination in the list on page 10. Then press and hold the "CAL" key while you adjust the cell current to that value. Hold the "CAL" key for 3-5 seconds after the adjustment to guarantee that the current has stabilized, then release key.
7. Remove yellow shorting cable. Termination should occur.

Note: If the end-point does not occur at this point, refer to the "Problems and Servicing" section.

**** If the 6000 shuts off before or when adjusting the balance.....**

a. Press the "L/O" key. "LO" will appear in the center of the display.
b. Press "GO/NOGO".
c. Center the indicator on the balance meter with the balance knob.
d. Press "GO/NOGO".
e. Press "L/O". "LO" will be removed from display.
f. Return to step 4 and continue with "Daily Checklist".

SET-UP CHECKLIST

1. Perform DAILY CHECKLIST.
2. Set calibration to the listed amperage or to the adjusted amperage obtained as the result of the calibration procedure. (see Calibration, page 10)
3. Select Units - Press "E/M" key until the desired unit appears on right-hand side of the display.
4. Set "SENSITIVITY" to full counter-clockwise position, or to a position determined during the calibration procedure. (see Calibration, page 10)
5. Choose the agitator that matches the gasket; i.e., the "A" gasket requires the "A" agitator tube assembly and the "A" module.

MAKING THE TEST

1. Position specimen according to measuring stand instructions.
2. Fill the cell approximately ½ full with the PROPER test solution as determined from the Test Solution/Application Chart. Make certain that no air bubbles remain attached to the test spot. To avoid this, it is helpful to insert the "fill bottle" carefully into the cell until the tip touches the test spot and then gently squeeze the bottle to expel the solution from the "fill bottle" to the desired volume in the cell.
3. Insert agitator assembly (2) into Cell Holder (3). **NOTE:** Some tests do not require agitation. Refer to the Test Solution/Application Chart starting on page 12.
4. Press the "GO/NOGO" key firmly to start the test. When the test is complete the instrument will shut off automatically and the thickness will appear on the display.
5. Carefully remove the agitator assembly (2) from Cell Holder (3).
6. Use the wash bottle labeled "WASTE" as a suction device to remove and store spent test solution.
7. Remove test specimen.
8. Wipe the bottom of the gasket with a damp absorbent tissue. The cell is ready for additional testing. If deposits remain in cell, use the cell cleaning brush supplied with the NF6M measuring stand.

CALIBRATION

1. For best results, the 6000 should be calibrated at the beginning of a work period and when:
   a) the gasket is changed
   b) changing the coating being tested
2. Use a Kocour thickness standard with the same coating/substrate combination as the sample to be tested.
3. Make at least three random tests on this standard and calculate the average of these tests. If this average agrees with the value on the face of the standard, the unit is calibrated.
4. If this average disagrees with the value on the face of the standard, use the formula below to calculate the new cell current.

   CALIBRATION SETTING = CURRENT x (AVERAGE (of three tests) ÷ THICKNESS)

   EXAMPLE CALCULATION: CALIBRATION SETTING = 34.9 x (0.497 ÷ 0.51) = **34.0**
   where:

THICKNESS on standard	= 0.51 mil
AVERAGE of three tests	= 0.497
CURRENT used for tests	= 34.9 ma
CALIBRATION setting	= **34.0** ma

5. Use steps 2-7 in "Daily Checklist" to set cell current to the calibration setting and the Kocour 6000 is re-calibrated. The calibration should be verified by re-testing the standard.

PROGRAM MODULE DE-PLATING CURRENTS

All currents listed are in DC milliamps. Adjustments must be made with yellow shorting cable in place.

COATING	MODULE A	MODULE B	MODULE C	MODULE MA	MODULE MB
Cr_1 (+6)	46.0	23.0	9.67	0	0
Ni	34.9	17.5	7.55	3.49	1.76
Cu	32.2	16.0	6.80	3.22	1.61
Brs	30.0	15.0	6.27	3.00	1.49
Zn	24.2	11.8	4.99	2.51	1.25
Cd	17.6	8.8	3.55	1.76	0.87
Sn	14.0	7.0	2.79	1.40	0.69
Ag	11.2	5.6	2.66	1.12	0.55
Cr_2 (+6)	10.2	4.5	1.97	0	0
Au	2.67	1.4	0.61	0	0

CERTIFICATION

The Calibration Method above will verify that your instrument set-up is correct. Measurements made with the calibrated instrument will be traceable to N.I.S.T. In the absence of an internal gage calibration program, the Kocour Company recommends Kocour Factory re-certification to be performed annually.

KOCOUR THICKNESS STANDARDS

KOCOUR Thickness Standards are intended to be used as a periodic check on the operation of the KOCOUR 6000 Thickness Tester and to calibrate the instrument (see Calibration section).

KOCOUR Thickness Standards cannot be given a protective coating because of the manner in which they are used. Therefore, standards are subject to corrosion as are all metals. For this reason and because of variations in handling and storage in the field, no definite useful life can be specified. KOCOUR Thickness Standards will retain their usefulness for a maximum period, if the following precautions are observed:

1. Always store standards in the plastic re-usable box or bag provided.
2. DO NOT clean the standards with abrasives, acids or other strong chemicals.
3. After use, the thickness standard should be rinsed with water, dried immediately and replaced in the container. DO NOT store wet standard in container.
4. Avoid touching the standard with your fingers.

Before making a test on a standard, wipe the standard gently with facial tissue soaked with acetone or alcohol.

Choose your standards from the "Stock Standards" list. These standards are adequate to calibrate the Kocour 6000 for most common plating thickness ranges. If the coating you are testing is thinner than 0.05 mil (1.3 microns) or thicker than 1.0 mil (25 microns), contact Kocour Company at (773) 847-1111 for recommendations.

The Kocour Company manufactures a complete line of calibration standards. A brochure with descriptions and prices is available.

Please note that all chromium plating of Kocour Standards is from an hexavalent (+6) chromium process. All references to chromium within this document refer to hexavalent (+6) chromium plating.

STOCK STANDARDS

PLATING/ SUBSTRATE	NOMINAL THICKNESS
Cadmium/brass	500 µin (12.7 µm)
Cadmium/copper	500 µin (12.7 µm)
Cadmium/steel	500 µin (12.7 µm)
Chromium/brass	200 µin (5.0 µm)
Chromium/copper	200 µin (5.0 µm)
Chromium/nickel	20 µin (0.5 µm)**
Chromium/steel	200 µin (5.0 µm)
Copper/steel	500 µin (12.7 µm)
Copper/zinc	250 µin (6.2 µm)
Gold/brass	25 µin (0.6 µm)**
Gold/copper	25 µin (0.6 µm)**
Gold/nickel	25 µin (0.6 µm)**
Nickel/brass	500 µin (12.7 µm)
Nickel/copper	500 µin (12.7 µm)
Nickel/steel	500 µin (12.7 µm)
EN/steel	200 µin (5.0 µm)
Silver/brass	500 µin (12.7 µm)
Silver/copper	500 µin (12.7 µm)
Silver/steel	500 µin (12.7 µm)
"STEP"/copper	600 µin (15.0 µm)
"STEP"/steel	500 µin (15.0 µm)
Tin/copper*	500 µin (12.7 µm)
Tin/brass *	500 µin (12.7 µm)
Tin/steel	500 µin (12.7 µm)
Tin/steel	30 µin (0.8 µm)**
Zinc/brass	500 µin (12.7 µm)
Zinc/copper	500 µin (12.7 µm)
Zinc/steel	500 µin (12.7 µm)

Thicknesses listed above are nominal

* These standards are made to order, due to the formation of a copper-tin inter-metallic layer that interferes with the calibration.

** Example: 20 µin = 0.000020" = 0.020 mil

MULTILAYER STOCK STANDARDS

Chromium/Nickel/Copper on Zinc
Chromium/Nickel/Copper on Steel
Chromium/Nickel on Copper
Chromium/Nickel on Steel

Thicknesses for above: Cr: 0.02mil (0.5 µm)
Ni: 0.6mil (15.0 µm)
Cu: 0.2mil (5.0 µm)

TEST SOLUTIONS AND APPLICATIONS

TEST SOLUTIONS

The test solutions are generally stable and not subject to deterioration on standing unless contaminated or subjected to excessive evaporation. Some of the test solutions may crystallize on standing, especially if cold. This does not indicate decomposition. Avoid transfer of solid to the test cell. Pour from bottle into beaker and warm slightly, then transfer solution back into bottle and mix until crystals dissolve.

After each test, remove the solution from the cell. Test solutions can be used one time only. Flush the cell with water, then wipe the bottom of the gasket with a piece of damp absorbent tissue. This procedure removes loose particles that may interfere with the next test and prepares the gasket for proper sealing.

APPLICATIONS

The TEST SOLUTION/APPLICATION CHART lists the correct test solution for a particular plating/substrate combination and other instructions necessary for making the test properly. Where a plating/substrate combination is not listed, this indicates that the combination may not have been evaluated. The Kocour Company should be consulted concerning such applications.

Test solutions are not supplied with the instrument and should be ordered as specific applications require. Order a 250ml Dispensing bottle of each solution initially, and 250ml, 500ml, 1000ml or gallon quantities as needed.

TEST SOLUTION/APPLICATION CHART (All require agitation, unless otherwise stated: "DO NOT USE AGITATION")

BRASS[1]		
SUBSTRATE	SOLUTION	TEST INSTRUCTIONS
Aluminum	R-44	[1] see "ACCURACY... ALLOY COATINGS
Non-metallics	R-44	
Steel	R-44	
Copper	R-44H	

CADMIUM (Agitation required, unless otherwise specified)	
SUBSTRATE	SOLUTION
Aluminum	R-45
Brass	R-45
Copper	R-45
Nickel	R-45
Non-metallics	R-45
Steel	R-45
Tungsten	R-45

CHROMATE		
R-2 removes the chromate without attacking the cadmium or zinc. The displayed reading is not a thickness measurement.		
SUBSTRATE	SOLUTION	TEST INSTRUCTIONS
Cadmium	R-2	Refer to Chromate strip procedure, available upon request.
Zinc	R-2	

CHROMIUM (+6)		
Use Cr_2 setting for 2-80u-in. Use Cr_1 setting for 90u-in and above.		
SUBSTRATE	SOLUTION	TEST INSTRUCTIONS
Aluminum	R-51	AGITATION FOR R-51 (CHROMIUM) IS RECOMMENDED FOR THICK DEPOSITS
Brass	R-47	
Cobalt	R-47	
Copper	R-47	
Nickel	R-51	
Nickel-silver	R-47	
Non-metallics	R-51	
Stainless Steel	R-51	
Steel	R-51	
Zinc Die Cast	R-58	For Chromium(+6) direct on Zinc Die Cast
Inconel	R-51	AGITATION FOR R-51 (CHROMIUM) OPTIONAL
Nickel-Iron Alloy	R-51	

Inconel '600'	R-51	
304 Stainless Steel	R-51	
Cadmium	R-47	

COBALT		
SUBSTRATE	SOLUTION	TEST INSTRUCTIONS
Brass	R-54	For testing Cobalt, set selector at Nickel ... reads direct
Copper	R-54	
Steel	R-54	

COPPER (Agitation required)		
SUBSTRATE	SOLUTION	TEST INSTRUCTIONS
Aluminum	R-44	* Set selector to "Cd" Set amperage at: A - 16.10 mA B - 8.05 mA C - 3.40 mA MA - 1.61 mA MB - 0.81 mA Note: Copper on steel standards can or should be used with all R-44 solution testing
Aluminum-bronze	R-44	
Beryllium-copper	R-52*	
Brass	R-52*	
Iron-Nickel alloy	R-44	
Kovar	R-44	
Lead	R-52*	
Molybdenum	R-44	
Nickel	R-44	
Non-metallics	R-44	
Steel	R-44	
Tungsten R-44	R-44	
Uranium	R-44	
Zinc Die Cast	R-52*	
Cadmium	R-52*	
Silver	R-44	

ELECTROLESS NICKEL PHOSPHOROUS ALLOY (1)		
Not applicable to deposits which have been heat treated.		
SUBSTRATE	SOLUTION	TEST INSTRUCTIONS
Aluminum	R-57	Set selector as indicated in next column. Set amperage (milliamps) to the value listed for that Phosphorous %. Use agitator.
Kovar	R-57	
Non-metallics	R-57	
Steel	R-57	
Silicon	R-57	
Mag. Stainless Steel	R-57	
Copper	R-1	

Sel. Set	Nickel			Chromium					
Thk. =	Direct			Display X 2					
% Phos.	4%	5%	6%	7%	8%	9%	10%	11%	12%
A amp.	38.7	39.8	40.5	41.5	42.6	43.3	44.0	44.7	45.4
B amp.	19.4	20.0	20.3	20.8	21.4	21.7	22.1	22.4	22.8
C amp.	8.4	8.6	8.8	9.0	9.2	9.4	9.5	9.7	9.8

GOLD		
SUBSTRATE	SOLUTION	TEST INSTRUCTIONS
Brass	R-56	All tests ... readings are in micro-inches (millionths of an inch). Make certain cell is clean and rinsed after each test.
Copper	R-56	
Electroless Nickel	R-56	
Nickel	R-56	

NOTES:
1. Rub lightly with a non-abrasive eraser prior to testing.
2. Test is based on pure gold (density of 19.3 g/cm^3). To convert to milligrams per square centimeter, divide micro-inches by 20.
3. Maximum Gold thickness 80 - 100 micro-inches.
4. Not recommended for gold deposited directly over steel, Kovar or Silver.
5. Solution R-56 is very sensitive to contamination. When testing Gold, the cell, rubber gasket and the agitator should be thoroughly cleaned and rinsed free of any solution remaining from previous tests. When contamination occurs, the Gold is not dissolved and the test will continue to run indefinitely.
6. Do not use M" Modules for Gold.

INDIUM		
SUBSTRATE	SOLUTION	TEST INSTRUCTIONS
Steel	R-59	All tests ... set selector at ZINC. Set amperage at: A - 22.0 mA B - 10.7 mA C - 4.54 mA Readings are direct
Copper	R-59	
Brass	R-59	
Nickel	R-59	

IRON		
SUBSTRATE	SOLUTION	TEST INSTRUCTIONS
Copper	R-51	Set selector at Copper. Readings are direct.

LEAD		
SUBSTRATE	SOLUTION	TEST INSTRUCTIONS
Aluminum	R-55	All tests ... set selector at TIN. Set amperage at: A -12.7 mA B - 6.35 mA C - 2.54 mA Readings are direct
Brass	R-55	
Copper	R-55	
Kovar	R-55	
Non-metallics	R-55	
Silver	R-55	
Steel	R-55	
Tin	R-55	
Nickel	R-55	

LEAD-TIN 40/60(1)		
SUBSTRATE	SOLUTION	TEST INSTRUCTIONS
Aluminum	R-49	All tests ... set selector at TIN. Set amperage at: A -13.7 mA B - 6.86 mA C - 2.74 mA Readings are direct, Sensitivity at MAX
Brass	R-49	
Copper	R-49	
Non-metallics	R-49	
Steel	R-49	

NICKEL-IRON ALLOY(1)		
SUBSTRATE	SOLUTION	TEST INSTRUCTIONS
Steel	R-54	Set selector at Nickel
Copper	R-54	
Brass	R-54	

NICKEL		
SUBSTRATE	SOLUTION	TEST INSTRUCTIONS
Aluminum	R-54	* ASTM Spec. B-355 for Wire with Accessory WT, set Sensitivity at MAX
Brass	R-54	
Copper	R-54*	
Inconel	R-54	
Kovar	R-54	
Molybdenum	R-54	
Nickel-silver	R-54	
Non-metallics	R-54	
Steel	R-54	
Tungsten	R-54	
Uranium	R-54	
Silver	R-54	
Chromium	R-54	

SILVER		
SUBSTRATE	SOLUTION	TEST INSTRUCTIONS
Aluminum	R-44	+ For use with test cell, must use Special Agitator 370R33 or 370R34 * ASTM spec. B-298 for wire with Accessory WT
Brass	R-48+	
Copper	R-48+	
Copper	R-48*	
Nickel	R-48+	
Nickel-silver	R-48+	
Non-metallics	R-44	
Steel	R-44	
Tin	R-48+	
Copper-tungsten	R-48+	
Silver-tungsten	R-48+	

TIN		
Aluminum	R-51	◆ Using accessory WT for Wire and small parts only. Measure free Tin only ● No agitation. Thickness includes copper from tin/copper inter-metallic layer. Tin checked with R-47 measures free tin only.
Brass	R-47	
Brass wire	R-50◆	
Cadmium	R-47	
Copper	R-47	
Copper wire>32G	R-50◆	
Nickel	R-47	
Nickel-silver	R-4	
Non-metallics	R-47	
Steel	R-47	
Copper	R-50●	
Copper wire<32G	R-50◆	

TIN 95% SILVER 5%	
SUBSTRATE	SOLUTION
Copper	R-1

TIN-COBALT 80/20 ALLOY	
SUBSTRATE	SOLUTION
Nickel	R-2

TIN-NICKEL 65/35 ALLOY	
SUBSTRATE	SOLUTION
Steel	R-2
Nickel	R-2
Copper	R-3

TIN-ZINC 78/22 ALLOY(1)		
SUBSTRATE	SOLUTION	TEST INSTRUCTIONS
Brass	R-47	All tests ... set selector at TIN. Set amperage at: A -16.8 mA B - 8.4 mA C - 3.35 mA Readings are direct
Copper	R-47	
Non-metallics	R-47	
Steel	R-47	

ZINC	
SUBSTRATE	SOLUTION
Aluminum	R-46
Brass	R-46
Copper	R-46
Nickel	R-46
Non-metallics	R-46
Steel	R-46
Tin	R-46

(1) ACCURACY....ALLOY COATINGS

The Kocour Thickness Tester has been used to test alloy coatings such as tin-lead (solder), tin-zinc and brass, however, the accuracy of such tests depends upon the composition of the deposit which may vary with the process variables. Certain alloy coatings may tend to migrate or diffuse into certain substrates, thus introducing another complication. The usual degree of accuracy therefore, is not claimed for the measurement of alloy coating thickness and when the required accuracy is critical, other appropriate methods should be used.

PROGRAM MODULES

PROGRAM MODULE “A” FOR 0.136" DIAMETER TEST AREA

While the Program Module "A" is adequate in many thickness operations, the 6000 is provided with the capability to determine coating thickness within various ranges by inserting program modules specific to each range.

The program modules will fit snugly into the opening at the lower right of front panel. A minimum amount of force is necessary for insertion and removal.

NOTE: Do not insert or remove program modules while GO/NOGO indicator is illuminated when testing.

PROGRAM MODULE “B” FOR 0.100" DIAMETER TEST AREA

Program Module B provides a means for testing smaller areas, smaller parts, curved surfaces and recessed ledged areas which are either not accessible or do not offer a sufficient area to accommodate the instruments standard gasket A. This Module is supplied with the special Test Cell B, Gasket B and B agitator assembly.

PROGRAM MODULE “C” FOR 0.063" DIAMETER TEST AREA

Program Module C provides a means for testing very small areas which are not accessible to either the standard and the Gasket A or optional Gasket B. The test procedure for C is identical to that of Module B with one exception, Test Cell B is used with Gasket C and the C agitator assembly.

PROGRAM MODULES “MA” AND “MB” FOR THIN DEPOSITS

Program Modules MA, MB & MC are intended for testing deposit thickness in the general range of 5 µ-in (0.012 µm) to 0.1mil (2.5 µm). If the deposit thickness is more than 0.1mil (2.5 µm), use the Module A, B or C. The MINIMUM THICKNESS to be tested with the Program Module MA, MB & MC is 3 µ-in (0.075 µm). Program Module MA should be used only with Test Cell A. **Do not use for Gold or heavy Chrome.**

PROCEDURE FOR TESTING USING PROGRAM MODULE “MA” AND “MB”

1. Insert Program Module.
2. Select appropriate coating.
3. Procedures for making tests are the same as with the Program Module A, B & C except that the AGITATOR SHOULD NOT BE USED.
4. When using Module MA or MB all displayed readings should be divided by 10 to give correct figure.
5. If the balance indicator deflects but the Kocour 6000 does not terminate the test, increase the SENSITIVITY control. (see page 5, SENSITIVITY KNOB)

SPECIAL APPLICATIONS AND ACCESSORIES

MULTIPLE LAYER COATINGS

The Kocour 6000 permits testing of all the layers of a Multiple Layer Coating. A general procedure is listed below. A list of procedures for specific multiple layer coating combination follows the general procedure.

CAUTION: Take care that the specimen is properly positioned before starting the test. Be very careful that the cell and specimen are not moved during the filling, solution removal and rinsing of the cell.

1. For greatest accuracy, calibrate the Kocour 6000 for every coating layer to be tested. (record calibrated amperage)
2. Set-up specimen. See SPECIMEN SET-UP, page 8.
3. Remove red pin connector on red cable from red receptacle in front of NF6 stand. Take the yellow jumper cable and insert one pin connector in the red receptacle and the other into the black receptacle in the front of the NF6 stand.
4. Select coating for the first layer to be tested.
5. Press "GO/NOGO".
6. Press and hold the "CAL" key while you adjust the cell current to the value determined in step # 1. Hold the "CAL" key for 3-5 seconds after the adjustment to guarantee that the current has stabilized.
7. Remove yellow jumper cable and replace the red pin connector into the red receptacle.
8. Test the coating using steps 2 through 6 of "Making the Test". Rinse cell 3 times without moving the cell or specimen. Use the following rinse procedure:
   a) Aim the flow from a wash bottle at the test area in the bottom of the cell.
   b) Remove rinse water by using the "WASTE" bottle.
   c) Repeat 9a and 9b two more times for a total of three rinses.
9. Repeat steps 3 through 9 for the 2nd layer.
10. If a 3rd layer is to be tested, repeat steps 3 through 9.

ACCESSORIES (purchased separately):

WIRE TESTING (supplied when purchased)

STEP TEST (supplied when purchased)

PRINTER (supplied when purchased)

RS232 INTERFACE (supplied when purchased)

MAINTENANCE

PROBLEMS AND SERVICING

Most problems can usually be remedied by comparing test conditions against the Checklist provided below. If however, a problem persists after going over the entire check list below, factory service may be required.

1. Pack the instrument well and ship Freight Prepaid.
2. FOR FACTORY SERVICE SHIP TO:

SERVICE DEPT.
KOCOUR COMPANY
4800 S. St. Louis Avenue
Chicago, Illinois 60632 (USA)
Phone: 773-847-1111
Fax: 773-847-3399

TROUBLESHOOTING CHECKLIST

BE SURE THAT THE ....

1. Instrument is connected to the line voltage specified on the name plate.
2. Balance indicator is centered between black index lines.
3. Sensitivity is set full counter clockwise. If meter deflects at or near expected thickness but test does not terminate, increase sensitivity.
4. Calibration knob has not been disturbed. Re-adjust cell current to initial setting.
5. Specimen is clean.
6. Proper test solution is used.
7. Gasket, module and agitator assembly match; that is, "B" gasket must be used with "B" module and "B" agitator assembly.
8. Coating thickness is in the range of application.
9. Selector is set to the proper coating.
10. Coating/substrate combination is applicable.
11. Specimen is set-up to insure proper placement.
12. Test cell is clean.
13. Cell connector screw is clean & dry.
14. Gasket is clean & dry.
15. Cell washer is in place in the cell block.
16. Red lead wire is attached to specimen.
17. Clip is clean and free of corrosion.
18. Chromate films are properly removed prior to testing. (see Test Solution/Application Chart)
19. Agitator is necessary for your application.
20. Proper solution level in cell and no air bubbles.
21. Air relief hole for agitation is clear.
22. Remove liquid barrier in agitator tip.

REPLACEMENT PARTS

370T04	Rubber Gasket "A" (package of 5)
370T05	Rubber Gasket "B" (package of 5)
370T13	Black Cell Connector Screw Lead
370T15	Stainless Steel Beaker WT
COL0001	Rubber Collar WT
370T17	Neoprene Cell Washer
370T20	Operation Manual
370T21	Rubber Gasket "C" (package of 5)
MFG0004	Test Cell "A" Stainless Steel
MFG0005	Test Cell "B" Stainless Steel
370R33	“A” Agitator Assembly for R-48
370R34	“B” Agitator Assembly for R-48
370T33	"A" Agitator Assembly for NF6
370T34	"B" Agitator Assembly for NF6
370T35	"C" Agitator Assembly for NF6
370T38	"A" Agitator Assembly for STEP
370T41	Fuse 1.2 Amp Slo-Blo (package of 5)
370T43	STEP Stand replacement electrode Kit
270T74	17" Port Extension
STP0002	Cell Holder Block
CAB6000	RS-232 Patch Cable
BRU0001	A cell cleaning brush
BRU0003	B cell cleaning brush
BOT0126	Wash bottle, 126 ml
TOP1001	Chart Pens, Black - Pkg. of 4
TOP1003	Chart Pens, Red - Pkg. of 4
TOP1101	Chart Recorder Paper - Pkg. of 4

Contact Kocour Company at (773)847-1111 for the following procedures:

A. Chromate Strip Procedure
B. Copper Plating on Brass Substrate
C. Test Tin and Copper Thickness after inter-metallic layer has formed (over 40 µ-in) (1 µm)
D. Test Tin and Copper Thickness after inter-metallic layer has formed (under 40 µ-in) (1 µm)
E. Cell voltage monitor assembly instructions
F. Tin pounds/base box
G. "STEP" Stand Instructions
H. Immersion Tin on Aluminum
I. Wire Test Accessory Instructions
J. RS232 interface
K. SPC printer-processor
L. Special application stands

SERVICE & WARRANTY

WARRANTY

Your Kocour instrument has been built to the highest quality standards in the industry. Each unit has been tested, operated under power for at least 24 hours, and then retested on every function and range to insure it meets all design specifications after aging. Your instrument is fully protected with a 90 day warranty.

SERVICE

The Kocour Factory Service Department provides all in or out-of-warranty service and complete re-calibration services for Kocour instruments. NO THIRD PARTY ENTITIES ARE AUTHORIZED TO REPAIR KOCOUR INSTRUMENTS. Factory service assures you of the highest quality work, the latest circuit improvements, most reasonable cost and the fastest turnaround time possible because every technician specializes in Kocour instruments. Kocour's Service Department can usually repair your instrument and return it to you faster than a local facility servicing many brands of instruments, even when shipping time is included.

YOU DO NOT NEED AUTHORIZATION TO RETURN AN INSTRUMENT TO KOCOUR FOR OUT OF WARRANTY SERVICE. Please include complete billing and shipping information along with a description of the symptoms if it should ever be necessary to return your instrument. Ship your instrument by United Parcel Service prepaid or air freight if possible. Use parcel post only when absolutely necessary.

IMPORTANT: Immediately inspect all items. If shipping damage is visible please contact carrier. All warranty repairs **MUST** be returned in original box & packing material. Please retain this packaging for future returns.

We reserve the right to examine defective components before an in-warranty parts replacement is issued.

KOCOUR SERVICE DEPARTMENT
4800 S. St. Louis Avenue
Chicago, IL 60632 (USA)
PH: (773) 847-1111
FAX: (773) 847-3399

Fill in for your records:

Date Purchased: _____

Model: _____ Serial Number: _____

SERVICE RETURN INFORMATION

PLEASE NOTE THAT ANY SERVICE ON ANY UNIT WILL NOT BE PERFORMED UNTIL THE FOLLOWING INFORMATION HAS BEEN COMPLETED IN FULL AND RETURNED WITH THE UNIT.

Company Name: _____ Signature: _____

Ship to Address: _____ Bill to Address: _____

_____ _____

_____ _____

Phone Number: _____

Fax Number: _____

Tester Model # _____ Serial # _____

Purchase Order # _____ **Required at time of service request.**

Specify: ☐ **Estimate — Charge will apply for estimate if service is refused.**
☐ Estimate not required.

Service Requirements: ☐ Repair ☐ Calibration/Certification

If the following information is not supplied then all testers will be tested with a nickel on steel N.I.S.T. Standard.

List One (1) Coating: _____ Thickness Range: _____

List One (1) Substrate: _____

If thickness tester results are believed to be in error, the following information is needed:

Standard Serial #: _____

Three (3) test results from this Standard: ① _____ ② _____ ③ _____

State exact nature of difficulty: _____

_____

_____

_____

_____