

SUBJECT APPLYING INSULATING COATING
TO FILAMENTS BY HAND SPRAY

SUPERSEDED DATE 11/10/41

The hand spraying of (a) single and two-segment helical, (b) double helical and (c) V and M shaped folded filaments is described under sections listed below. Most filaments or coils are currently machine-sprayed but due to the thickness of wire and the form of certain coils or filaments, hand spraying is necessary. Since the variables in such spraying are so numerous, no rigid schedules can be set up. Those listed below are intended primarily as guides to indicate the approximate conditions the operator should observe.

1. Schedules
2. Spray Diagrams
3. Coating Procedure
4. Firing
5. Inspection
6. Packing
7. Comments
8. Reclaiming Coil Procedure
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10. Equipment Requirements
11. Spray Terminology

1. SCHEDULES

	#5	#13	#13A	#29	**#4
Initially used for	MCF212D	MCF52	MCF167;351	FF218D	MCF295C & D
Gun Setting	10-20	0-5	0-5	20	10-20
Gun Opening (turns)	1-3/4	2	2-1/4	2	2
Dist. of nozzle from coils	2-4	3-6	3-6	2-3	2-4
Air pressure	30 psi	12-16 psi	12-16 psi	30 psi	40 psi
Type of spray	Wet	Wet	Wet	Wet	Wet
Spray Diagram	#5	#13	#13	#29	#4
Rate of pass	1/sec.	1/2 3 sec.	1/2 3 sec.	1/sec.	1/sec.
Number of passes	§24	48	48	24	24
Oven dry 80-90°C	3 min.	5 min.	5 min.	3 min.	air dry
Fired in humidified hydrogen	3 min. at 1800°C	- - -	4 min. at 1750°C	3 min. at 1700°C	4 min. at 1750°C

§When core rods are used in assemblies, give a preliminary light spray to inner surfaces of coils before inserting core rod. This may be accomplished by making four passes on each side of holder, holding gun in such a manner that spray will reach such surfaces.

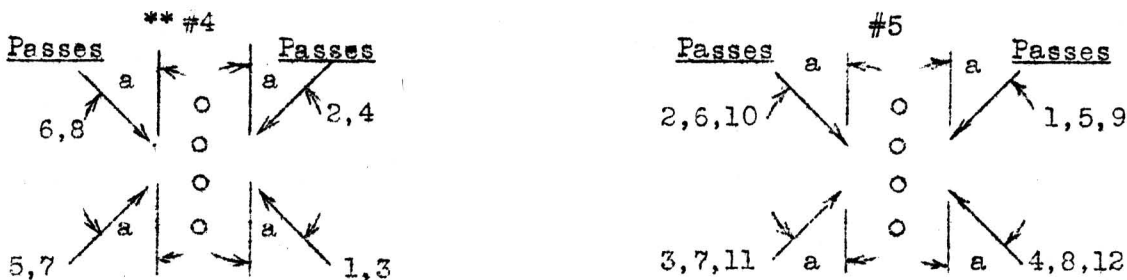
NOTE: Coils for MCF52 or other types not fired after coating must be fired in humidified hydrogen for 10 min. at 1200°C before spraying.

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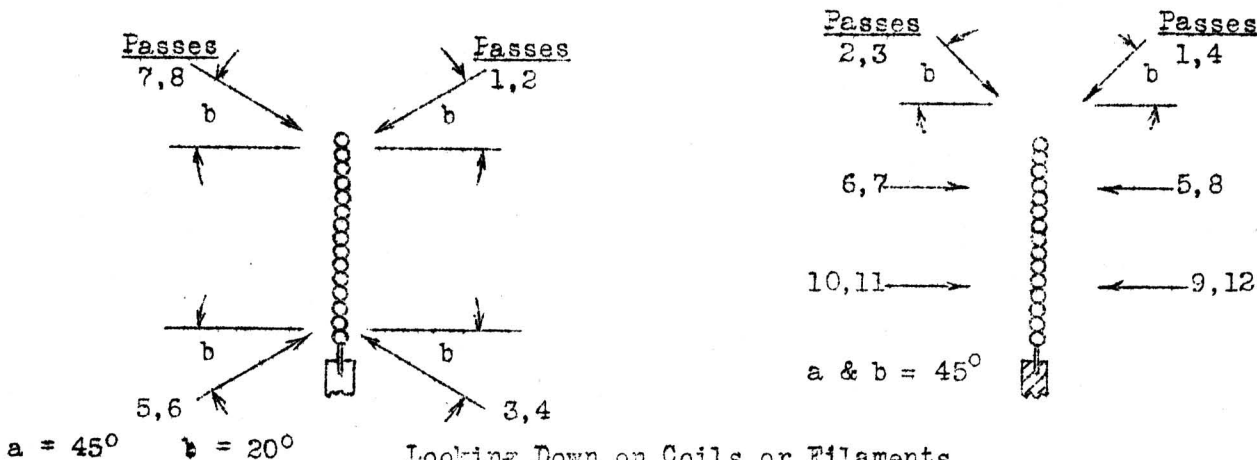
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2. SPRAY DIAGRAM

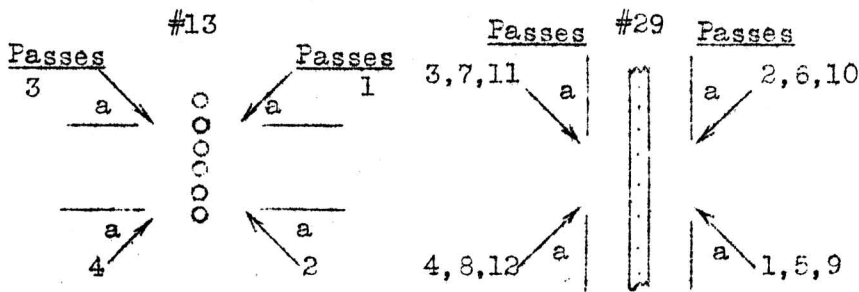
Looking Down on Coils or Filaments



Looking At End of Row of Coils or Filaments

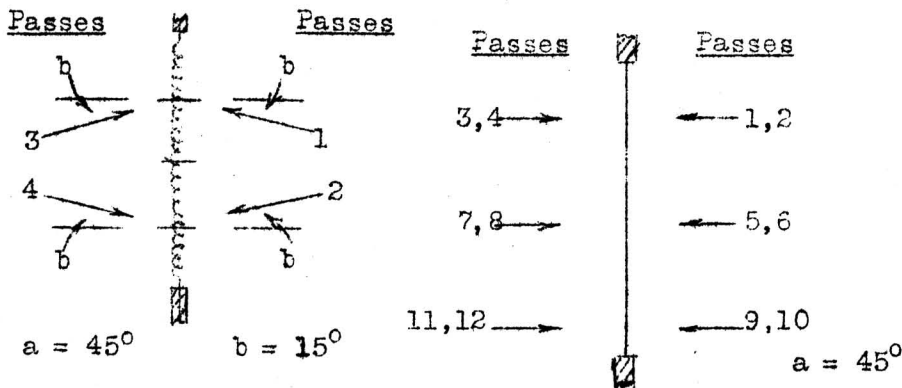


Looking Down on Coils or Filaments



Note: Where filaments are observed to be insufficiently coated at certain points or sections, a shot or pass may be made at these points or sections to bring coating to desired thickness. Each of the above diagrams represents the passes in 1 covering. To bring coating diameter to specified limits, more than one coating may be required.

Looking at End of Row of Coils or Filaments



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3. COATING PROCEDURE

A. This process begins with the assumption that the coils, at the coil winding machine, have been placed in racks from which they can be picked up by clamping the legs.

Using a clip type paper holder, brass clamp, or clamping fixture with 2 clips, position coil legs so that they are in the same plane, then pick up coils by legs, clamping over the length which is not to be sprayed. Extreme care must be exercised in this operation as the length of legs covered has an important bearing on the relationship between coil weight and diameter.

Note: Prior to racking, coils must have an inspection of a few coils for coil length, leg length, paired turns, uneven spacing, square shoulders of legs, twisted or wide legs, etc. This inspection must occur at the start of each coil winding operation and at the start of a new bundle of wire. A mm. scale is preferable to a standard coil chart. Operator must check all coils which appear to be out of size limits.

B. Inspect coils for uniformity of spacing, adjust paired turns and reject crossed legs which cannot be rearranged properly. **DO NOT USE TWEEZERS ON THE BODY OF THE COIL.**

C. If paper clips are used, slip two clips over each arm of 'T' shaped holder Model 782U. Brass clamp can be placed in notched standard in spray chamber. Clamping fixture can be directly transferred to bushed holder in spray chamber.

D. Spraying

1. Roll a bottle of coating preparation at least 3/4 hour.
2. Immediately pour coating preparation into spray gun cup, filling cup only 2/3 full.
3. Adjust air pressure.
4. Set nozzle for spray form.
5. Set gun opening for type of spray.
6. Spray as per schedule and diagram.

4. FIRING **Unless otherwise specified on heater specification, fire coated coils in deoxidized and humidified hydrogen. Temperature of deoxidized hydrogen entering humidifier is 55-65°C, (For operation of humidifier refer to 34-38-34B.)

A. Firing Sequence - Heaters with Core Rods (Furnace, item 7-a) - Hand Stoking

1. Place boat into warming position in entrance tube of furnace.
2. After specified firing time, push boat into firing position in center of heating tube. Load another boat into entrance tube.
3. After specified firing time, pull boat from heating tube into cooling chamber. Repeat step 2 above.
4. After specified firing time, pull boat out of cooling chamber. Repeat step 3 above.
5. Continue sequence of firing by repeating step 4 above.

DO NOT PUSH A WARM BOAT INTO THE HEATING TUBE BEFORE PULLING THE HOT BOAT INTO THE COOLING CHAMBER.



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4. FIRING (Cont'd)

B. Firing Sequence - Coreless Heaters (Furnace, item 7-a)-Hand Stoking

1. Push boat directly into center of heating tube.
2. Wait specified firing time.
3. Push boat into cooling chamber.
4. Wait specified firing time.
5. Remove boat from cooling chamber.
6. Without any delay repeat step 1 and continue firing in sequence given above.

C. Firing Sequence - Using Mechanical Stoker (& Furnace, item 7-2).

1. At beginning of firing operation, place 3 empty boats into entrance tube and then a loaded boat. Place stoker piston into entrance tube and engage rack (pusher rod) with driving gear. The latter should operate at a rate of speed depending on specified firing time. In current practice stoker rod has a speed of 6" per min.
2. Add another boat each time after piston has advanced one boat length.
3. When boats approach end of cooling chamber, pull a boat out of cooling chamber each time before putting a boat into entrance tube.
4. If work is insufficient to permit loaded boats to be fed continuously, empty boats should be used in their place, to maintain continuity of operation.
5. To empty furnace, feed empty boats until last loaded boat can be removed from cooling chamber. Then pull out boats from both entrance tube and cooling chamber and push remaining hot boats into cooling chamber, so that they also can be removed when cool.

5. INSPECTION

- A. INSPECTION AT CLIPPING should include length of legs, position of legs with respect to each other and also to line running thru center of coil, (this is done to prevent chipping at mounting, when mounting operator must move legs to leads on welding), excessive camber, damaged coils, etc,
- B. INSPECTION AT SPRAYING - As spraying nears completion, as determined by experience, check 1 coil from each holder for weight. Coils should fall within limits specified. If coils are overweight, check diameter with micrometer or slip proper cathode over one coil from middle and each end of holder to check excessive diameter. If 2 coils are out of limits, reject the lot. If 1 coil is found out of limits check 3 additional coils and if another coil is found outside of limits reject the lot.
- C. FINAL INSPECTION - At this inspection coils are rolled to loosen turns and are given a casual inspection for bare wire, chips, cracks, irregularities such as bumps, depressions, porous coating, color, paired turns, crossed, uneven, long or short coated legs, etc. Uncoated legs must be free of insulation matter to prevent burnouts at mounting, Pass coils which have a grayish color and also paired turns which have sufficient coating between turns. If rejects run above normal, as determined by experience, give coils a 100% inspection. Coils rejected for coating defects should be reclaimed by washing in acetone and then respraying in the usual manner.

7-20-48 STANDARDIZING SEC., ENG. DEPT. EEE
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5. INSPECTION (Cont'd)

D. INSPECTION DEVICES

1. Regular hand, barrel and dial micrometers.
2. Magnifying reading glass for inspecting sprayed coils.
3. Tubing or cathode sleeve, the size of the cathodes into which the various coils are to be inserted.
4. Nile green cardboard for background for inspecting bare and coated coils.
5. Torsion balance of a capacity depending on sprayed coil weight and method of holding coil.

6. PACK HEATERS as specified in 29-0-9.

7. COMMENTS

A. It is important that the coating be uniform so that the coated coil will be round.

B. All solid material in the coating preparation should be in suspension before it is used. Except when pouring from them, keep bottles rolling continuously. Any empty bottles to be returned to the supplying division should be cleaned with acetone immediately after emptying.

C. Allow space in the spray gun cup to permit the solution to be well agitated by shaking frequently during spraying or by the movement imparted by the motion of the gun. If the cup is to be left standing or has stood for more than five minutes, shake well and pour back into the bottle. No sediment should be left in the cup. Roll the bottle again to bring all the solid material into suspension.

D. The coating remaining in the spray tank should be emptied into bottles at the end of each day, these bottles to be rolled and the coating added to the next day's batch.

E. To Obtain a More or Less Fluid Spray

1. Turn knurled nut at back of spray gun in a counter-clockwise or clockwise direction, respectively.
2. Hold gun closer or at a greater distance from spray bar.
3. Increase or decrease, respectively, the air pressure on gun.
4. Increase or decrease, respectively, the amount of spray material in gun jar.
5. Increase or decrease, respectively, the speed of passage across spray bar.
6. Use old fluid tip and needle or new fluid tip and needle, respectively.

F. In order that the above adjustments give the predicted results, it is necessary that the gun be cleaned at least twice daily, by flushing it with acetone, and at least once a day by disassembling it and scrubbing all parts with a rag soaked in acetone, or a bristle brush and acetone. Accumulations of dried spray material on the end of the fluid tip should be removed continually.

7. COMMENTS (Cont'd)

G. The abrasive action of ceramic materials in spray mixtures results in wearing of the spray gun parts. In time, the orifice of the fluid tip becomes enlarged, allowing the fluid needle to extend farther and farther out of the fluid tip at end of the gun, and the fluid needle itself is reduced in diameter, making the effect more pronounced. The ball on the tip of the fluid needle also wears off, finally leaving the end sharply pointed.

H. When a high pressure wet or medium wet spray is required, the gun parts should be changed when the fluid needle, in closed position, protrudes more than 0.5mm from the end of the fluid tip.

I. For a low pressure medium dry spray, the gun parts should be changed as soon as there is any appreciable clearance between any part of the fluid needle, in closed position, and the orifice of the fluid tip. Otherwise, two undesirable conditions may result, viz:

1. If the fluid needle is worn on one side, it will produce a fine mist of spray at the edge of the spray stream proper.
2. If the fluid needle clears the orifice at all points and the ball at the tip is worn off, a delicate adjustment of the spray stream will not be possible, and a single turn of the nut at the back of the gun will result in approximately the same fluidity as four or five turns.

Each of the above factors tends to produce the stated change, only if all of the others remain constant.

J. The character of spray on filaments after drying in air for 3 minutes and in air oven for 3 minutes at 90°-110°C is described below:

<u>Type Spray</u>	<u>Character Finish</u>
a. Wet -	A satiny finish, with a suggestion of lustre; very adherent and fluid enough at the time of application to fill in irregularities of surface on the subject being sprayed, and give uniform finish.
b. Medium Wet -	A dull, egg-shell surface, very adherent and sufficiently fluid at the time of application to cement the turns of coreless heaters together.
c. Medium Dry -	A dull, matte surface, quite adherent.
d. Dry -	Granulated, flaky surface, fairly non-adherent.

K. Coil holders should be buffed with a bristle brush to remove spray material from the edges of the jaws and the rubber lining. Good practice requires a minimum cleaning of twice a day. An excess of spray material on clips tends to shield cork along the line of the legs and may even affect the bottom turns as well.



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8. RECLAIMING COIL PROCEDURE

Note: Remove core rods from coils and use them in subsequent assemblies.

- A. Place coated coils on grooved rack (Equipment item 10B1a.)
- B. Stack racks on one another using an empty rack to hold coils in place on top rack. About 33 racks are used currently in a single washing operation.
- C. Place a fixture alongside stack of racks and fasten it to stack with rubber bands. Invert assembly so that legs point downward and immerse in tank with A55 acetone. Fixture is made of wood with the same length as racks and has spacing blocks at each end. Height of spacing blocks should be about one-third length of coils, so that coils do not escape from grooves when swirled occasionally in solvent.
- D. Allow coils to soak from 5 min. to 2 days, depending on quantity and age of coating. It is easier to remove recent coatings than older ones.
- E. Remove assembly from tank and, holding it over tank, spray coil legs with clean solvent, under the following conditions: (Coil legs must be free of insulating material to prevent burnouts at mounting).

Air pressure on gun	20-35 lb.
Gun setting	18 on dial
Gun opening	Wide open
Distance gun to filaments	4-5

- F. Allow filaments to dry in oven (110°C.) After a casual inspection, they may be resprayed in the usual manner.

- Notes: 1. Add solvent when required to keep liquid at desired level.
2. Once a week allow solids to settle in tank, pour off clear solvent, clean tank, and replace solvent, adding additional liquid to the extent required,

9. RECLAIMING INSULATION MATERIAL - Refer to 34-14-13D.



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10. EQUIPMENT REQUIREMENTS

- | | |
|-----------------------------|---|
| A. Coil Holders | E. Drying Oven |
| B. Coil Racks | F. Sleeve Containers for Coils |
| C. Spraying Chamber and Gun | G. Furnace and Boats |
| D. Bottle Rolling Device | H. Coated Coil Reclaiming
Equipment. |

A. Holders (For supporting coils while being sprayed)

1a. For holding straight coils: Model No. 782-K holder having capacity for 50-75 filaments with a sprayed length of about 35 mm.

A brass loading rack, supplied with above holders, should be used to space coils in holder. It is of a size to fit between opposing jaws and, depending on coil size and tendency to bow, has 50-75 parallel slots 1/32 - 1/16" wide, spaced approximately 3/32 - 1/8" c to c. The rack may be placed on a table top and the holder placed over it, loaded, and removed. Construction of rack is such that, when holder is placed over it, the bottoms of grooves in in rack are even with top of stationary jaws.

1b-1. For holding spring-back paper clip filament holders, 1c or 1c-1, when loaded with double helical or two-segment single helical coils: This holder, Model 728U, is 'T' shaped and holds 4 clips.

1b-2. For holding spring-back paper clips, '1c' or '1c-1'; when loaded with double helical or two-segment single helical coils: This holder, model 782B, is comprised of two model 782U holders, brazed or welded together at handles to give two parallel bars about 7/16" apart for holding eight clips instead of four.

1c. For holding double helical and two-segment coils during spraying: This holder is a spring-back paper clip (Esterbrook #3) having 2-1/2" width jaws, one of which is lined with rubber. Four of such clips may be loaded on bars of holders '1b' or '1b-2'.

Modified 1c clips - Each clip is provided with a post on under side for holding clip upright in head on spray machine rotor. A cross pin through the post prevents it from turning inside the head. Clips should be of a uniform height, say to within ±1/16". Tops of clips must be at right angles to posts.

1c-1. For holding double helical and two-segment coils (during spraying): This holder, model No. 782W (Dwg. No. B-93), consists of a standard spring-back #3 paper clip, the same as used for item '1c', which has been reinforced by riveting a cold rolled steel plate to the inside of each jaw. One jaw is rubber lined; and a small steel post between arms of clip gives it added rigidity

Modified 1c-1 Clip - Spring-back No. 3 paper clips with jaws lengthened and reinforced (steel plate riveted to each jaw) and arms of clips reduced in size to fit slots in fixture for holding 2 clips.

Double rack filament spray fixture Model 782NN - Holds two modified 1c-1 clips paralalled to each other.



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10. EQUIPMENT REQUIREMENTS (Cont'd)

A. Holders (Cont'd)

ld. For spraying double helical and two-segment coils: This holder consists of two brass jaws, about 9 1/4" long, which are drawn together against spring pressure with a wing nut. One jaw is lined with 1/8" sheet rubber. With this holder all of the coils in a rack, such as item 'la' under "Racks", Section 2, may be evenly clamped at one time after resting the open jaws directly on the surface of the rack on both sides of the holes containing the coils. During the spraying operation, the holder is supported in notches in a standard within the spraying booth.

B. Racks - (For lining up coils to be picked up by holders)

1. For double helical coils: A rack may be made of fibre or other suitable material, about 9 1/4" long x 1/2" wide x a height approx. equal to length of coil. Holes about .010" larger than diameter of coil should be of a depth to allow legs of coil to protrude and should be spaced 1/8" center to center, the capacity of such a rack being approx. 75 coils. It is very essential that holes in rack be of uniform depth and preferably have square bottoms.

1a. For double helical coils: Model No. 782Y coil rack (Dwg. No. C102):

The grooved rack of metal has a capacity of sixty coils in three sections of twenty coils. each. The grooves are about 1/8" apart and are deep enough to permit the free movement of the coils when the rack is clamped in the coil-loading fixture, which must later be used for aligning coils before transferring them to spraying clips 'lc' or 'lc-1'.

2. For straight coils: See under "Holder" - Section 1a.

3. For two-segment coils: This rack should be a device upon which the coils may be placed in an inverted "V" shape with the segments of each coil spaced approximately 3/16", depending on the nature of the coil, and the segments of adjacent coils spaced 1/8". A board with vertical pins near the edge to contact the segments near the ends may be suitable.

C. Spraying Chamber and Gun

1. Chamber: For a 10" length rack, a spray chamber should be approx. 22" wide x 21" high x 20" deep with a 12" width x 3" height opening in bottom of back wall. The spray chamber, thru opening in back wall, should be connected to a blower of sufficient capacity so that no odor, dust or vapor can be detected outside of chamber during spraying.

2. Spray Gun: DeVilbiss type CV, with No. 90 air cap, letter F fluid tip and fluid needle, spray gun attached to glass cup.

D. Bottle Rolling Device

A bottle rolling device should be capable of rolling 16 oz., 32 oz. or gallon bottles and should have a capacity depending upon quantity of coating material used. The speed should be such as to roll gallon bottles at about 30 R.P.M.

Change

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10. EQUIPMENTS REQUIREMENTS (Cont'd)


E. Drying Oven

Drying ovens should be capable of producing a uniform temperature up to 110°C.

Equipment Model No. 730M is a drying oven combined with the spraying booth described in Section 6c. Commercial ovens suitable for drying coils are made by following manufacturers: Eimer & Amend, Central Scientific Co., Fisher Laboratory Supply Co., Arthur H. Thomas Co., and N.J. Laboratory Supply Co.

F. Sleeves for Holding Coils During Firing

Sleeves used for containing coils during firing, to prevent coils from warping excessively, should be made of ceramic insulator preparation No. 13C-46-1 and as described in insulator manufacturing process 34-13-10A, (formerly 13-10-2). Generally, the inside diameter of sleeves should be about .005" larger than coil, the wall thickness about .015-.025", and the length the same as or longer than the coil. In addition to regular firing schedule for insulators, sleeves should be fired for 10 minutes at 1800°C and then selected for straightness.

Dimensions are given below for 2 sleeves in current use for holding coils during firing. Both sleeves are  shaped in cross section.

Sleeve No.	Length (mm)	O.D. (in.)	O.D. (in.)	Wall (In.)
1	42(+1/2)	.072x.111	.032x.701	.020
2	41 "	.102x.152	.052x.102	.025

{ - Tolerance ±.002"

G. Furnaces and Boats

1. Furnace Model No. 780-F, for firing coated coils (in humidified hydrogen) at temperatures of 1700-1800°C. The operation of furnace is described in 49-2-7. Boats may be pushed thru the furnace manually or by means of a mechanical stoker. Unless otherwise specified, the firing of coils should be in sequence specified under item 4,

2. Boat Model No. 706-N, made of 1/32" sheet molybdenum, is 6" long x 1" wide x 3/4" deep (inside dimensions), and used with above furnace. The bottom of the boat is rounded, and curved upward at one end.

Keeping bottoms in boats clean reduces the tendency for coated coils to stick to boats after firing. For cleaning boats, a fine india stone or a piece of alundum, preferably the latter, may be used. A suitable stone is one about 1/2" square in cross section and rounded off at one end to suit contour of boats. Boats and covers must be cleaned twice a week. Do not sand blast.



RADIO CORPORATION OF AMERICA

RCA VICTOR DIVISION

5/3/49 TUBE DEPT. STANDARDIZING

HARRISON, N. J.

LANCASTER, PA. PRK34S

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10. EQUIPMENT REQUIREMENTS (Cont'd.)

H. Coated Coil Reclaiming Equipment

1. Spray Gun - DeVilbiss Type CV, with No. 90 air cap and letter F fluid tip and fluid needle.
2. Tank - Sheet metal, 4-1/2" depth x 8" x 16". Tank should be provided with a hinged cover which may be closed down during the soaking of filaments.
3. Fume Hood - Tank should be used in a standard spray booth which is connected to an exhaust system.

(Cont'd on next page)

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11. SPRAY TERMINOLOGY

Terms peculiar to the technique of spraying, and used to identify phases of the processes employed in spraying filaments with insulating coating material, are herein defined and pertinent spray application details are given.

- A. A "shot" is used to designate any motion partially traversing the length of the spray bar, as for example, at a point where filaments are observed to be insufficiently coated and thus require the application of additional spray material.
- B. A "pass" is executed when the spray has traversed the distance from a point two or three inches out from one end of the spray bar to a point the same distance beyond the other end, along a single side of the bar.
- C. A "covering" is equivalent to a completion of the specified spraying cycle, i.e., the number of passes required thru a 360° rotation of the spray bar times the number of segments at which the spray is directed on the filament being coated.
- D. By "Gun setting" is meant the relation of the movable part of the Spreader Adjustment Valve Assembly to the stationary part. The gun setting on the Type CV DeVilbiss gun is obtained by setting any desired number from 0-20, inclusive, on the spreader adjustment valve assembly at a mark on the stationary portion of the valve. Two such marks, one each on diametrically opposite sides of the assembly, correspond to the two holes in the movable portion. The number may be set at either mark.

Three spray forms, on a flat surface at right angles to the direction of the spray, and the corresponding gun settings, are as follows:

<u>Form</u>	<u>Gun Setting</u>
1. Round -	0-5
2. Horizontal Ellipse	15-20 (with air cap holes in a vertical plane)
3. Vertical Ellipse -	15-20 (with air cap holes in a horizontal plane)

Note: Between the above geometric extremes in spray surface, are an infinite number of gradual variations, starting with a faintly suggested oval at a setting of 6, and progressing thru the decided oval to an ellipse, and finally to a somewhat flattened ellipse at 15.

- E. "Gun opening" refers to the permissible movement of the fluid needle as determined by the number of counter-clockwise turns of the knurled nut, at the back of spray gun, from its closed position.
- F. "Fluidity" of spray refers to the binder or moisture content during application of the spray. The following methods of altering fluidity without relation to other effects incidental to change in fluidity will be found generally applicable.