

ROYAL CANADIAN AIR FORCE



REPAIR & OVERHAUL
INSTRUCTIONS

REFINISHING OF AIRCRAFT
INSTRUMENT DIALS

"REVISION"
NOTICE

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SUPERSEDE THE SAME
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Insert revised pages into basic
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LIST OF RCAF REVISIONS

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INTRODUCTION

The purpose of this publication is to provide instructions and descriptive data for the refinishing of RCAF aircraft instrument dials and associated parts, i. e., pointers, sub-scales, hands, etc. At present there can be no hard and fast rules laid down that will cover new types of instruments and dials; therefore this publication will guide the overhaul contractor during the first overhaul, and this publication shall be revised and/or amended as circumstances dictate.

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PART 1

MINIMUM REQUIREMENTS GOVERNING THE HAND PAINTING OF OBJECTS WITH RADIOACTIVE MATERIALS

GENERAL

1 Persons intending to use radioactivated materials for the hand painting of objects shall first consult the local Department of Health authorities. It is to be noted that preparation of radioactivated powder, processes involving the use of dry radioactivated powder and/or processes for applying radioactivated paint other than by hand painting require special consideration. Such processes shall not be entered upon before consultation with local Department of Health authorities.

2 Before erecting, altering, or adding to any building to be used as a factory, plans of same, including the ventilation systems, must be submitted in duplicate to the local Department of Labour authorities.

PAINTING ROOM - EQUIPMENT -
FURNISHINGS, ETC

3 A separate room must be set apart as a painting room.

4 Not less than thirty square feet of floor area and three hundred cubic feet of room volume must be allotted to each painter.

5 The floor, walls, and ceiling of this room must be coved at the edges and constructed of smooth, water impervious materials so that they can be kept clean at all times and washed at frequent intervals.

6 All painting done with radioactive-containing paint must be done in this painting room under ventilated hoods approved by the Department of Labour authorities.

7 Each painting hood must be set on a drawerless metal table topped with one eighth to one quarter inch thick lead protection. The hood and working top of the table must be constructed of such material that they can be kept clean at all times. The working top of the table

should be of porcelain, glass or other non porous, solvent resisting substance.

8 Each painting hood must be exhausted so that a face velocity of not less than sixty linear feet per minute is provided over the whole opening.

9 Mixing of radioactivated powder with adhesive and thinner in the preparation of paint must be done under a special ventilated hood approved by the Department of Labour authorities.

10 An enclosed exhausted drying rack must be provided to which finished work must be removed as soon as possible. Large quantities of painted stock must be stored in a well ventilated room or enclosure distant from workers. Approximately five hundred cubic feet of air should be removed per minute for every thousand dials (or their equivalent) being dried or stored.

11 All radioactivated paint or powder must be placed in lead blocks providing not less than one inch lead protection and these blocks must be stored in a lead-lined safe or similar container which has not less than one inch of lead wall thickness. Exhaust arrangements must be made so that when the safe or container is opened the accumulated radon gas will not present a hazard to the person handling the material.

12 The exhaust equipment used in connection with the painting and mixing goods, drying racks, safe, and for increasing the air exchange in the painting room should be used for these purposes only.

13 To remove radioactive contamination which may accumulate in piping, etc., it should be possible to purge the exhaust system for twenty minutes before and after working hours.

Such purging would require an exhaust step-up of at least three times the normal requirements. Thus the exhaust fan should be so designed that the air handled through the exhaust system can be increased threefold for short periods.

14 The exhaust system should be designed according to good engineering practices. Pipes should be properly proportioned and should not contain places of lodgement for dust. Horizontal ducts should be avoided as far as possible. The air from the exhaust system must be exhausted in such a manner that it cannot re-enter the building. To replace the air removed from the room by the exhaust system, air entries must be provided.

15 Each operator must be provided with a chair which can be cleaned easily. If only wooden chairs are available they should be finished with a hard enamel surface which will withstand the action of solvents.

16 Since, in general, natural lighting is inadequate for such fine work as dial painting, artificial diffused lighting should be arranged to provide at least fifty foot-candles on the working plane.

NOTE

For very fine work it is suggested that a convex lens of at least three inches dia. be used. The lens should be of such focus that the face of the worker is not less than fourteen inches from the work.

17 Each operator must be provided with a rack for his (or her) brushes. This rack must be so designed that it can be readily cleaned.

18 The crucible or container used to hold the prepared radioactivated paint must be provided with a tight-fitting slip-on cover. These crucibles should be designed to hold not more than one gram of prepared paint each. They must also be of such form that they can easily be cleaned.

19 Each operator must be provided with a waste basket having coved edges, which can be kept free of contamination.

20 A darkroom must be provided to be used for the examination of personnel. This darkroom should adjoin the workrooms.

21 Each darkroom must be equipped with a sufficient number of Ultra-Violet lamps (Purple X or equivalent), so that the necessary examination for radioactive contamination of the workers can be carried out conveniently.

22 Each darkroom must be equipped with at least one Ultra-violet lamp (Purple X or equivalent) mounted in a reflector with sufficient flexible wiring to permit the use of this lamp for examining completely each worker exposed to radioactive compounds. Such lamp and reflector must be capable of easy manipulation.

23 Since extreme cleanliness is required on the part of the workers, washing facilities must be installed adjacent to the workroom.

24 Such washing facilities must provide hot and cold running water from mixing taps.

25 Paper towels, non-irritating soap, and individual nail brushes must be provided.

26 Tissue handkerchiefs in an inverted dispenser shall be available for the workers use.

27 Unless there is a separate room for protective clothing, then for every worker exposed to radioactive contamination, a hook, hanger, or preferably a ventilated locker must be provided in the workroom to accommodate the individuals protective working apparel.

28 A cloakroom must be provided for the worker's street clothing. This cloakroom must be remote from the areas which may be contaminated with radioactive materials.

29 At least one large covered trash can must be provided in each workroom and darkroom.

30 An angle jet drinking fountain shall be provided in each workroom.

MAINTENANCE

31 It shall be the responsibility of the facility to see that all areas subject to radioactive con-

tamination be kept scrupulously clean at all times.

32 A thorough examination for radioactive contamination of walls, ceilings, floors, and all equipment and furnishings in these areas must be made with a portable Purple X Ultra Violet lamp or the equivalent at least once a week. These examinations require that the room be completely darkened and hence may be made at night. Should traces of contamination be found they must be removed immediately.

33 All dusting must be done with damp dust-ers. Dry dusting must not be permitted.

34 Pails used for scrubbing and mopping are to be kept for this purpose only. After using, such pails are to be washed clean of any radioactive materials before being stored for further use.

35 Cloths or other materials used for scrubbing, mopping, and dusting must be washed free of all radioactive contamination or destroyed by burning immediately after use.

36 The workrooms must be free of all materials or equipment not immediately necessary for the carrying out of the process. Boxes, bottles, used containers, rags, papers, or debris of any kind must not be allowed to accumulate in darkrooms, workrooms, cloak-rooms, or lunchrooms. The contents of trash cans must be burned daily.

HANDLING OF RADIOACTIVE MATERIALS

37 The mixing of all paint containing radioactive materials must be done under a special exhausted hood by a trained operator and not by individual painters.

38 The operator assigned to mix paint shall be supplied with elbow length rubber gloves. These gloves shall be washed off after use and before being removed by the operator. After use all traces of radioactive contamination must be removed from these gloves as indicated by examination under the ultra-violet examining lamp.

39 All work tables shall be covered with paper at the beginning of the work period. Such paper must be removed and destroyed at the end of the work period by burning.

40 Not more than one container holding not more than one gram of radioactivated paint must be allowed on any one table at any one time.

41 All containers, pointing plates, stili, pen, etc., used for radioactive materials must be cleaned in a wet condition.

42 Wherever dust may arise from paint which has dried on the product, or on the working surfaces, such dust or dried paint must be removed under exhaust ventilation and by a wet method, e.g. from dials under inspection, or in re-mixing paint which has dried in the paint crucible.

43 All containers with radioactive materials whether in use or not, must be kept under exhaust ventilation at a safe distance from workers, and opened only under an exhaust hood.

44 All containers which have been used to hold radioactive materials must be cleaned upon emptying, by a wet method, or disposed of in a manner which will completely eliminate radioactive contamination of persons, premises or property. Such containers must not be allowed to accumulate in any part of the building, or where such containers may cause exposure to any person.

45 Pointing of brushes between the lips or fingers must not be permitted. A special glass plate or dampened pad shall be supplied for this purpose.

46 Operators must not be permitted to adjust the rate of flow of air passing through their painting or mixing hoods.

PERSONNEL, HOURS OF WORK, REST PERIODS, ETC

47 No person under eighteen years of age is to be employed as a painter or operator of

any process or of any job which will expose him (or her) to radioactive materials.

PERSONAL HYGIENE AND PROTECTIVE CLOTHING

- 48 Each person to be employed who will be exposed to radioactive materials must have explained to him (or her) before employment the various hazards encountered in the handling of radioactive materials.
- 49 Where male operators are employed in the handling of radioactive materials, a male supervisor shall be selected to inspect the male personnel and equipment and otherwise be responsible for the personal hygiene of those exposed to radioactive substances.
- 50 Where female operators are employed in the handling of radioactive materials, a female supervisor shall be selected to inspect the female personnel and equipment, and otherwise be responsible for the personal hygiene of those exposed to radioactive substances.
- 51 Each prospective painter or handler of radioactive materials, including those employed as cleaners, must have a complete medical examination prior to such employment, and a further examination twenty-one days after being so employed.
- 52 Subsequent medical examinations must be made every three months, unless otherwise recommended in writing by the local Department of Health authorities.
- 53 All medical examinations must be carried out to the satisfaction of the local Department of Health authorities. Records of these examinations must be submitted by the attending physician to this Department on the forms provided.
- 54 The recommendation of the attending physician or an authorized representative of the local Department of Health authorities for the removal of any operator from exposure to radioactive substances on health grounds must be acted upon without delay.
- 55 No person shall be exposed for more than eight hours per day, six days per week, to radioactive materials.
- 56 Protective clothing, approved by the supervisor, shall be provided for each worker. (The term protective clothing shall include smocks, coveralls, aprons, armllets, caps, gloves, respirators, and foot covering).
- 57 Workers shall wear the protective clothing supplied while in the workroom. On leaving the workroom they shall remove such clothing and leave it in the place provided, see para 27.
- 58 All personal clothing, excluding that required to be worn in the workroom, shall be left in the cloakroom, see para 28.
- 59 All personal effects, including purses, combs, cosmetics, candy, tobacco, chewing gum, lunches, food of any sort, fruit, drinks of any kind, medical remedies, and/or any article, matter or thing which may be instrumental in exposing the worker to radioactive contamination shall not be taken into the workroom.
- 60 The protective clothing, personal clothing, and person of each worker exposed to radioactive compounds shall be examined daily for radioactive contamination with the ultra-violet examining lamp see para 22. This examination shall be carried out by the appointed supervisor, see paras 49 and/or 50.
- 61 All protective clothing shall be washed at least once a week. Protective clothing which at any time shows evidence of contamination shall be immediately replaced.
- 62 Personal clothing which shows radioactive contamination shall be washed or dry cleaned within twenty-four hours of discovery. Evidence that this personal clothing has been freed of radioactive contamination shall be obtained by the supervisor.
- 63 Should the person of the employee show radioactive contamination such contamination must be removed before the employee leaves the premises. A follow-up examination shall be made by the supervisor upon the employee's return to work.

64 The detection of radioactive substance by the naked eye, during examination in a darkened room and using ultra-violet light, shall be considered radioactive contamination.

65 At the end of each working period or when required to leave the workroom for any reason, the workers shall carry out the following routine.

(a) Remove protective clothing and put it in place provided.

(b) Wash hands and arms thoroughly. Particular care shall be taken to remove all traces of radioactive contamination from beneath the fingernails.

(c) Examine clothing and exposed parts of the body under the ultra-violet lamps provided in the darkroom. This shall be done in the presence of the supervisor.

(d) Should the hands, arms, or other exposed parts of the body still show evidence of radioactive contamination, it shall be removed by a non-toxic, non-irritating solvent. All traces of the solvent shall be removed by a thorough washing with warm water and bland soap.

NOTE

To minimize radioactive contamination employees should avoid contact of the hands with exposed parts of the body, articles of clothing, or surrounding objects.

66 All requirements are subject to change at any time, if, in the opinion of the inspector, such change is necessary for the health and welfare of the employees.

PART 2

TYPES OF LUMINOUS COMPOUNDS

1 There are three distinctly different types of luminous compounds.

(a) FLUORESCENT COMPOUNDS emit a glow of vivid intensity only while exposed to ultra-violet (electric) rays. Immediately the ultra-violet source of activation is removed the glow ceases. Thus, fluorescent compounds are essentially a part of an electrically controlled lighting system.

(b) PHOSPHORESCENT COMPOUNDS are similar to fluorescent compounds in that they also respond to the application of ultra-violet rays. However, the compound may retain activation, after the source is removed, for a limited period of time. It is understood that a small amount of ultra-violet light is emitted by any light source, therefore phosphorescent compound may be exposed to any type of light

before its use in the darkness and evidence the same afterflow, again for a limited time depending, of course on the type of light used and the length of time exposed.

(c) SELF-LUMINOUS COMPOUNDS are those into which the source of activation is incorporated, the source generally being radium. These compounds are thus equipped to glow constantly in the dark for many years, independent of any form of external aid. Intensity of the glow is controlled by the amount of radioactivity in the compound, the quality of the basic materials (zinc, sulphide, strontium or cadmium) and their manufacture.

2 There are numerous grades of luminosity and colour in each of the three types of compounds described above. The uses to which these luminous compounds are put are governed by their characteristics.

PART 3

DIAL PRESENTATION

COMPOSITION

1 Information to be shown on the face of the dial is to be restricted to only that which is functional, i. e., name of instrument, numerals, graduations, etc. The following must not be imprinted in white, glossy black, or luminous paint manufacturer's name, trade mark, catalogue or reference numbers. It is desirable that the information on the dial be

standardized and reduced to a minimum (Table 1), but still allow for precise identification and interpretation.

LETTERING

2 The style, shape, and proportion of characters and numerals shall conform to AND 10400. Regard must be made for size of dial when determining dimensions of figures to be used.

TABLE 1

NOT ACCEPTABLE

Acceleration
Airspeed
Altitude
Amperes
Exhaust
Hydraulic
Inches of Mercury
lbs. per sq. in.
Manifold
Oxygen
Pressure
Port
Left
Stbd
Right
Temperature
Outside air temperature
Carburetor Temperature
Cyl. Head Temperature
True Airspeed
Vertical Speed
Suction
Gyro Magnetic Compass

ACCEPTABLE

ACC
Knots -mph - mach
Alt
amp
exh
hyd
ins Hg
psi
man
oxy
press
L
L
R
R
°C
°C Air
°C Carb
°C Cyl.
tas
Climb
Suc
Gyro Comp

PART 4

PROCEDURE AND SPECIFICATIONS FOR REFINISHING

STRIPPING

1 In removing the existing finish, it is important that the parts to be refinished are to be completely stripped. All surfaces must be chemically clean prior to application of the new finish. The parts are to be soaked in a caustic type cleaner until the paint lifts. Wash loosened paint off with hot running water. Remaining paint may be loosened and removed with a stiff brush or steel wool. Blemishes in the metal are to be removed or reduced to a point where they do not interfere with the precise interpretation of the instrument in the finished state. Parts which are so badly marred as to prevent proper refinishing are to be discarded.

DEGREASING

2 Using a mild (10%) sulphuric acid solution bath, or other approved degreasing agent, soak the clean metal parts for sufficient time to remove any existing greasy film, and to etch or condition the surface for refinishing.

DRYING

3 After degreasing, the parts to be refinished must be dried and handled carefully, avoiding any finger marks or foreign matter which may interfere with the bonding of the primer and background applications.

PRIMING

4 Some materials of which aircraft instruments are made, such as aluminum and brass, do not lend themselves readily to painting. Therefore, where necessary, parts to be refinished are to be primed with a material compatible to the background coating.

BACKGROUND

5 Except where otherwise specified, the instrument dials are to present an optical dull black background. It is desirable that matte lacquers be used throughout. The background

must be applied evenly and thoroughly, leaving no bare spots of the dial or parts showing.

UNDERCOAT

6 The graduations are placed on the dial by many different methods, such as printing, transferring, spraying, or screening. The means by which this is achieved is left to the discretion of the overhaul contractor. The important factor is that the material used for undercoating contains no lead. Lead will reduce the efficiency of the luminous compound that follows. The undercoating shall be a lead-free, zinc type white; and be compatible with the background and the vehicle or adhesive used with the luminous compound. The undercoat is to be as conscientiously applied as the luminous markings. The areas to be luminized must be thoroughly and evenly covered. The edges of graduations and characters are to be as regular as is required for the luminizing.

LUMINIZING

7 The luminous material shall be of two types. Self luminous compound, used in general for major graduations and characters, shall conform to RCAF Specification Mat. 1-2. Fluorescent compound, used in general for minor graduations, shall conform to MIL-L-25142 (ASG). The luminous pigment is to be mixed with the proper adhesives according to supplier's instructions. The adhesives are in all cases transparent and do not become luminous when mixed with the pigment. The quality is to be controlled at all times. The luminous compound is to be applied only where required, and by the latest instructions of the RCAF, and to the satisfaction of the Technical Services Representative. The luminous compound is to be applied in an even coat, sufficient to cover all of the undercoating, leaving no bare spots. The side planes of the graduations are to be parallel, each plane to be within tolerance of ten percent deviation of the width. A center line through the graduation must form a true angle at the pointer staff. The depth of the coating of luminous compound will of necessity

vary with the size of the letters or figures. As a guide the depth of the compound must not be less than .008" or more than .016". The depth of the luminous compound must not be confused with the total depth of the finished figure including the white background or the sealing lacquer.

SEALING

8 The final step in refinishing the dial parts is the application of a clear matte lacquer. This lacquer will protect the background and luminous markings on the dial. Thus if the dial should become dirty, it can readily be

cleaned by careful use of benzene naphtha.

STAMPING

9 A stamp, bearing the month and year of refinish, and contractor's name or code, is to be used on refinished parts. As all associated parts of each instrument are refinished during the overhaul the stamp may appear on any one part, preferably the reverse of the main dial. The stamp may be applied at any convenient time during overhaul, so long as the stamp or method of stamping does not affect the finish, or the balance or operation of the associated parts.