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Title

LETHAL WARNING

Safety Precautions

Technique No. Nil

LETHAL WARNING

1. RADIOACTIVE SOURCES AND X-RAY EQUIPMENTS USED FOR NON-DESTRUCTIVE TESTING IN THE ROYAL AIR FORCE PRODUCE IONIZING RADIATIONS WHICH HAVE AN ADVERSE EFFECT ON THE HUMAN BODY.

2. MAXIMUM PERMISSIBLE LEVELS OF PERSONAL DOSERATE ARE LAID DOWN IN CURRENT REGULATIONS (AP4687A VOL 2 LEAFLET C2 REFERS).

3. EXPOSURE TO RADIATION IS TO BE AVOIDED AND DOSERATE LEVELS ARE TO BE KEPT TO A MINIMUM.

Safety Precautions - General

1. Radioactive sources used for Non-Destructive Testing in the Royal Air Force are to be handled and operated in accordance with the instructions contained in AP4687A Vol 2 Leaflet F2, by Competent Persons qualified in accordance with AP4687A Vol 2 Leaflet M1.

2. These sources are generally of greater strength than sources used for other purposes in the Royal Air Force and consequently their use presents serious hazard to all personnel on establishments where NDT inspections are carried out. Maximum permissible levels of doserate are laid down in AP4687A Vol 2 Leaflet C1, but every effort is to be made to keep doserates below these levels.

3. A team of at least two trained persons is to be present at all times when a radioactive source is in use. The team supervisor is to ensure that all team members are fully conversant with the safety precautions and proposed inpsection technique, and are well practiced in the handling of the source and container to be used in the inspection, particularly with regard to emergency procedures.

4. Two film badges and a direct reading quartz fibre dosemeter are to be worn at all times when handling or operating a radioactive source. One film badge is to be worn on the front of the body outside the clothing and the other on the wrist of the hand normally used for manipulation, or on that part of the body immediately adjacent to the source container when it is being carried. The team supervisor is responsible for ensuring that all dosemeters are charged and zeroed before operations ccmmence. Dosemeters are to be checked at the end of each working period to ensure that an excessive radiation dose has not been received. Dosemeter readings do not need to be recorded.

5. A radiation monitor NIS 295B (6Z/1116865) or EMI 0030 (6Z/1086048) is to be available when handling or operating a radioactive source. 'Before Use Servicing' on these instruments is to be carried out in accordance with AP112G-1314-5F and AP112G-1303-5F respectively.

6. The team supervisor is to be aware of the doserates likely to be received by the operators and is to ensure that these doserates are not greater than those laid down under current regulations.

7. Immediately prior to exposure of a radioactive source the team supervisor is to:

a. Establish the limits of the radiation area in respect to incidentally exposed workers by calculating the safety distance in accordance with AP119A-0105-1 Chap 3 or, when using Iridium 192, referring to Fig 1. The radiation area is that area wherein the doserate exceeds the following:

Continued overleaf

7. a. (1) When the total exposure of the radioactive source will be in excess of 4 hours and not more than 8 hours, 0.25 mR/hr.

(2) When the total exposure of the radioactive source will be in excess of 2 hours and not more than 4 hours, 0.5 mR/hr.

(3) When the total exposure of the radioactive source will be less than 2 hours, 0.75 mR/hr.

At no time is the limit of the radiation area to be at a doserate level in excess of 0.75 mR/hr.

b. Clearly define the limits of the radiation area by erecting a safety barrier marked with the ionizing radiation symbol. Suitable warning notices are to be displayed on or near the barrier.

c. When using the lead container (12Z/53) calculate the maximum permissible handling times for the particular source in use.

d. Clear the radiation area of all personnel not actively engaged in the NDT inspection, paying particular attention to possible 'hideaways', eg bomb compartments, undercarriage compartments, cockpits etc.

e. On the initial exposure of each inspection, monitor the limits of the radiation area and adjust the safety barrier accordingly. It is not to be assumed that walls, floors, ceilings and other structures, within the radiation area, afford adequate protection from ionizing radiations. The area behind walls and structures is to be monitored and cleared of personnel if the doserate exceeds that laid down. If the gamma ray exposure is made in a closed room the external walls are to be monitored and safety barriers erected as necessary. Due attention is to be paid to scattered radiation from the structure being examined and from the building housing the structure. Where walls or structure form the boundary of the danger area, any doors or apertures in the wall or structure are to be locked, or other appropriate action taken, to preclude inadvertent entry to the danger area during radiation exposure.

8. Any exposure to ionizing radiations is potentially harmful and the effects may not be immediately apparent. The team supervisor is to ensure that the Radiation Safety Officer is immediately notified when any individual receives, or is thought to have received, any exposure greater than that laid down under current regulations. In the event of an emergency during the handling of a radioactive source; ie the source cannot be withdrawn into its container, the area is to be evacuated of all personnel. The team supervisor is then to initiate the 'Emergency Recovery Procedure' as laid down later in this chapter.

Continued

Safety Precautions (Contd)

Safety Precautions - R22B Container and Remote Handling Equipment

9. A radiation monitor is to be used to monitor all operations involved in the use of the R22B equipment containing a radioactive source.

10. One R22B equipment is to be operated by a team consisting of not less than 2 trained and practiced operators, one of whom is to be designated the supervisor. When 2 or more radioactive sources in their containers are being used the team is to consist of an overall team supervisor and 2 operators per container.

11. Immediately prior to using the R22B equipment inspect:

a. The container to determine if it contains a radioactive source. This will be indicated by a notice stating 'ACTIVE' in 2 inch Red lettering affixed to the side; if the container is empty a similar notice stating 'SAFE' will be displayed. Whenever a notice is not in evidence the container is to be treated as 'ACTIVE' until monitored.

b. The container for damage, and ensure blanking plugs are fitted to the guide tube and teleflex control connectors and that they are locked by the safety cable.

c. The teleflex remote handling assembly for damage and malfunction.

d. The guide tube for damage, obstruction and security of end cap.

e. The decay curve to ascertain the source strength.

12. The team supervisor is to retain overall control for operational sequences. He is to sign for and hold , when not in use, keys for all containers. The keys are not to be inserted into the shutter control lock until:

a. The container is vertical and firmly on its base.

b. The guide tube is in position and attached to the container.

c. The teleflex remote handling gear is connected with the control handle positioned at full length of cable from the container.

d. The film is in position.

e. All personnel not actively engaged in the operation have retired from the radiation area.

Continued overleaf

Safety Precautions - R22B Container and Remote Handling Equipment (Contd)

13. As there is an unrestricted emission of radiation from the outlet port of the R22B container once the shutter controls are unlocked and opened, the following precautions are to be observed:

a. Whilst operating the key and shutter control, no part of the limbs or body is to be forward of the lateral centre line of the container.

b. During the period the shutter control is unlocked and opened no personnel are to be allowed in line with the outlet port of the R22B container.

c. After the exposure has been completed and the isotope has been withdrawn into the container, no personnel are to be allowed in the vicinity of the R22B container until the shutter has been closed and locked and the key withdrawn, by the supervisor.

14. The team supervisor is responsible for ensuring that, immediately the guide tube and outer sheath connectors are disconnected from the container, the blanking plugs are fitted and locked into position by threading the safety cable through the holes in the 2 plugs and locking the end of the cable.

15. When two or more radioactive sources are being used, the containers are to be positioned so that their outlet ports are in line pointing in the same direction on parallel paths.

16. If more than one radioactive source container is used simultaneously and a jam occurs on one or more source containers, all sources that can be withdrawn are to be returned to their containers and their shutters closed and locked.

17. In the event of an emergency all personnel are to retire immediately to a safe area before discusssing the cause and course of action to be taken.

18. Emergency Recovery Procedure for R22B Remote Handling Equipment. If the source cannot be withdrawn into the container the following procedure should be attempted. Disconnect the outer sheath connector B (see Fig 2) from the operational connector A, grasp the exposed teleflex cable and walk away from the container. This should pull the source into the container.

19. In the event of the recovery procedure failing to withdraw the source into its container, the Radiation Safety Officer or his nominated deputy is to be informed. The Radiation Safety Officer will assume command of the situation and supervise the recovery of the source.

Continued

Safety Precautions - Lead Container (12Z/53)

20. A team consisting of not less than 2 men is required to safely operate the lead container, one of whom is to be designated the supervisor.

21. A radiation monitor is to be used to monitor all operations involved in the use of the lead container.

22. Inspect the container to determine if it contains a radioactive source. This will be indicated by a notice stating 'ACTIVE' in 2 inch Red lettering, affixed to the side, if the container is empty a similar notice stating 'SAFE' will be displayed. Whenever a notice is not in evidence the container is to be treated as active until monitored.

23. The key which releases the padlock on the handle of the container is to be signed for by the team supervisor and is to be kept in his possession at all times.

24. The padlock is not to be opened until the container is correctly positioned and firm on its base, and in the case where the source is removed from the container with the handling rod, the container is in a position where the source can be withdrawn and replaced easily and smoothly and positioned quickly.

25. When the handle is rotated and the source exposed there is an unrestricted emission of radiation from the outlet port at an included angle of 140 degrees, no part of the limbs or body is to be exposed to the outlet port.

26. The team supervisor is to ascertain the source strength from the decay curve and calculate the maximum permissible handling times for each operation prior to the commencement of an inspection.

Servicing Notes

R22B Container and Remote Handling Equipment Operation Procedure

27. The following sequence of operations is to be followed when using the R22B equipment:

a. Position film.

b. Place and secure the guide tube in position, check the end stop is securely attached to the guide tube.

c. Place the radioactive source container in position ensuring that it is vertical and firmly positioned on its base.

d. Position the teleflex operating cable in a straight line.

Continued overleaf

27. e. Operator to retire to winding handle and wind out approximately 6 inches of teleflex cable from conduit.

f. Supervisor removes safety cable and blanking caps, connects guide tube to container ensuring that the guide tube has no sharp bends between the end stop and the container.

g. The supervisor is then to check that the operational connector A is screwed to the outer sheath connector B (see Fig 2). Fit the threaded locking collar C over the extended cable. Mate the cable end G to the source holder pencil D and screw home the locking collar C.

h. The operator winds in cable G slowly and as the operational connector A abutts the container female thread E the supervisor will screw the connector into the container.

Note: This operation depressed the trigger that releases the source locking device.

j. The supervisor is to check for personnel in line with the outlet port and if clear unlock the shutter control and operate the shutter.

k. The supervisor retires from the area and the operator makes a final check for persons in the radiation area and when clear winds out the radioactive source.

l. After the exposure the operator will wind in the radioactive source.

Note: The winding in and out of the radioactive source is to be carried out quickly for the first 18 turns, the final turns are to be carried out slowly. There is a distinct 'feel' at the handle when the source pencil strikes the end cap of the guide tube.

m. The supervisor is to monitor to ensure the source has been fully withdrawn. He is to operate the shutter to the closed position, lock shutter control and remove key before allowing anyone into Radiation Area.

28. The teleflex operating cable and guide tubes are to be coiled and stored immediately the inspection is finished to prevent damage.

29. On an opportunity basis, ie whenever the container is 'SAFE' it is to be inspected for damage and malfunction and all electrical connectors checked.

Continued

Servicing Notes (Contd)

Lead Container (12Z/53) Operating Procedure

30. All operations involving the lead container and its source are to be monitored.

31. All measurements detailed in the inspection technique are to be taken with the container closed and locked, or where a handling rod is used, from the estimated position of the source on the rod.

32. The following sequence of operations is to be carried out when using the lead container:

a. Check the radiation area is clear of personnel.

b. With the container in position, 1st operator is to remove bung and unlock and remove padlock, lift the handle to a vertical position, rotate it through 180 degrees and replace it between the locking lugs, and retire from the radiation area.

c. On completion of the exposure the 2nd operator is to lift the handle to a vertical position, rotate it through 180 degrees, replace the handle between the lugs and lock handle to lugs with padlock.

d. Remove container immediately to an isolated area, ie place in a lead lined box, or behind a lead screen.

33. When the radioactive source is to be used on a handling rod it will not be necessary to unlock the container. The following sequence of operations is to be carried out:

a. Check bayonet fitting at end of handling rod for damage and malfunction.

b. Remove rubber bung from orifice in front of container.

c. With container in position 1st operator is to insert handling rod into orifice of container and engage bayonet fitting with source holder bayonet, unscrew anti-clockwise until source holder is free.

d. Check radiation area is clear of personnel, remove the source from container and place in position for exposure, retire immediately from the radiation area.

e. On completion of exposure 2nd operator is to replace source in container, screw home firmly and disengage handling rod.

f. Replace rubber bung in front orifice.

Continued overleaf

Servicing Notes (Contd)

34. On an opportunity basis, ie whenever the container is 'SAFE' it is to be inspected for damage and malfunction.

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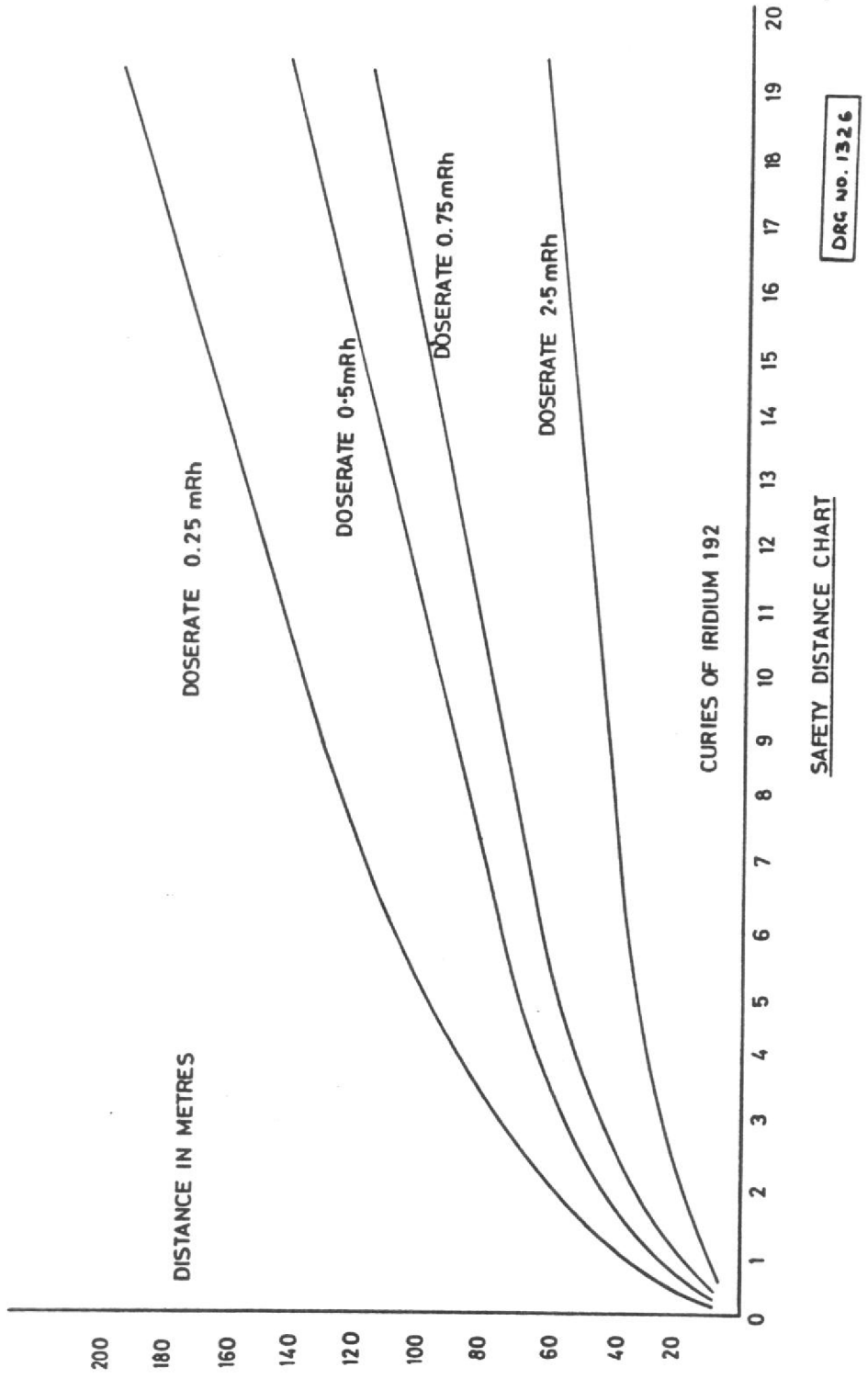

FIG 1

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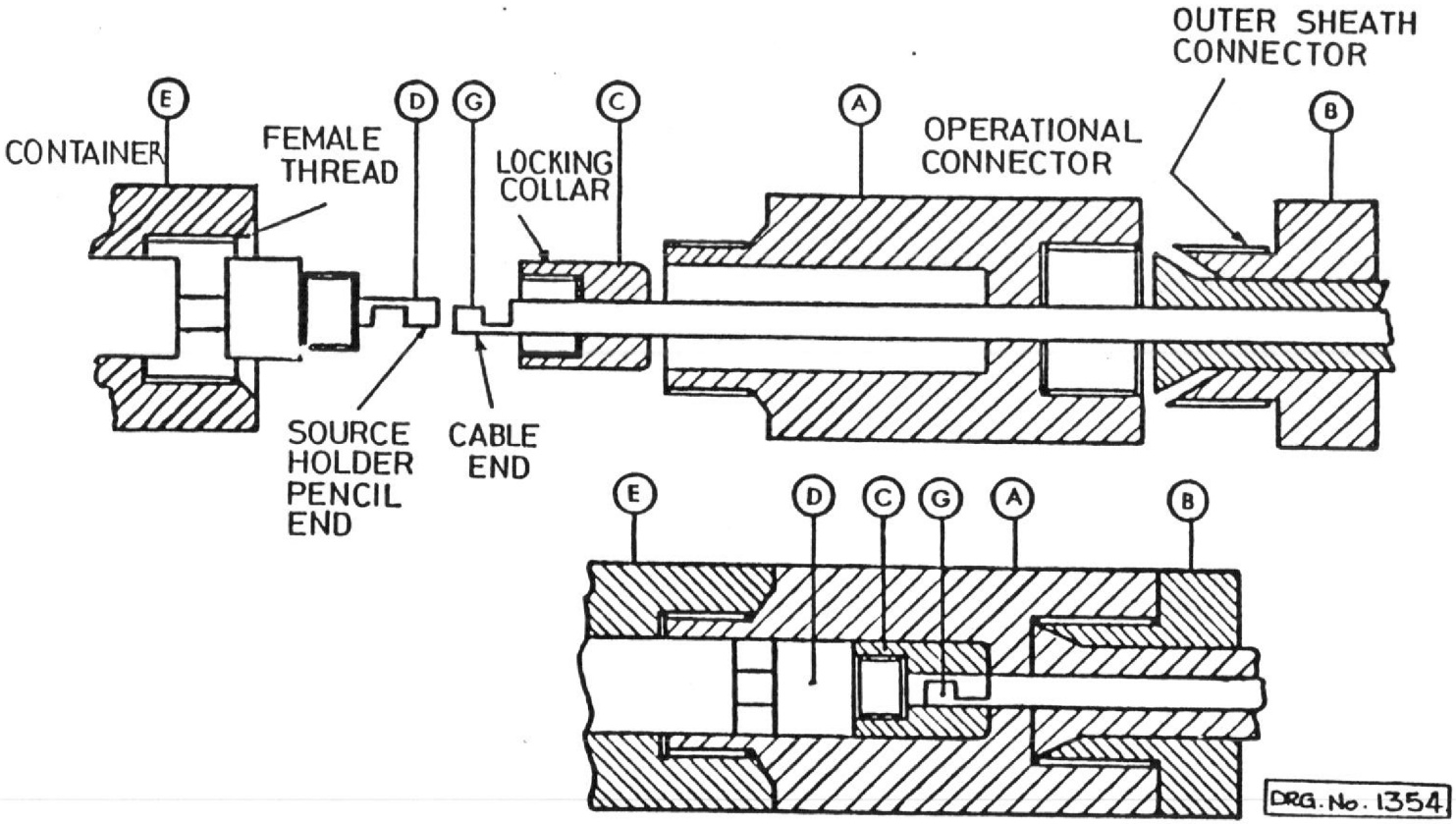
OUTER SHEATH
CONNECTOR
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FEMALE
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PENCIL
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CABLE
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FIG 2

NON-DESTRUCTIVE TEST SCHEDULE
RADIOGRAPHY
X-RADIOGRAPHIC TECHNIQUES
HUNTER ALL MARKS

TABLE 1

Shot No.	kVp	mA	Time (Sec)	Distance FOD (cm)	Beam to Film Angle	Remarks
1 and 4	135	5	120	122	75	Lead screened, FOD is from x-rad tube to centre of aileron torque tube between ribs 13 and 14.
2 and 5	135	5	120	71	Normal	Lead screened, FOD is from x-rad tube to aiming point on a/c skin (See Fig.4).
3 and 6	135	5	360	71	Normal	

Exposure calculated using Agfa D7 film and 200kVp X-Rad set to achieve a density of 2.0 in area of interest.

TABLE 2

Shot No.	Film Size (cm)	Remarks
1 and 4	10 X 15	Lead screen front and rear cut to size.
2 and 5	10 X 23	
3 and 6	10 X 23	

Continued

NON DESTRUCTIVE TEST SCHEDULE
RADIOGRAPHY
RADIOGRAPHIC TECHNIQUES
HUNTER ALL MARKS

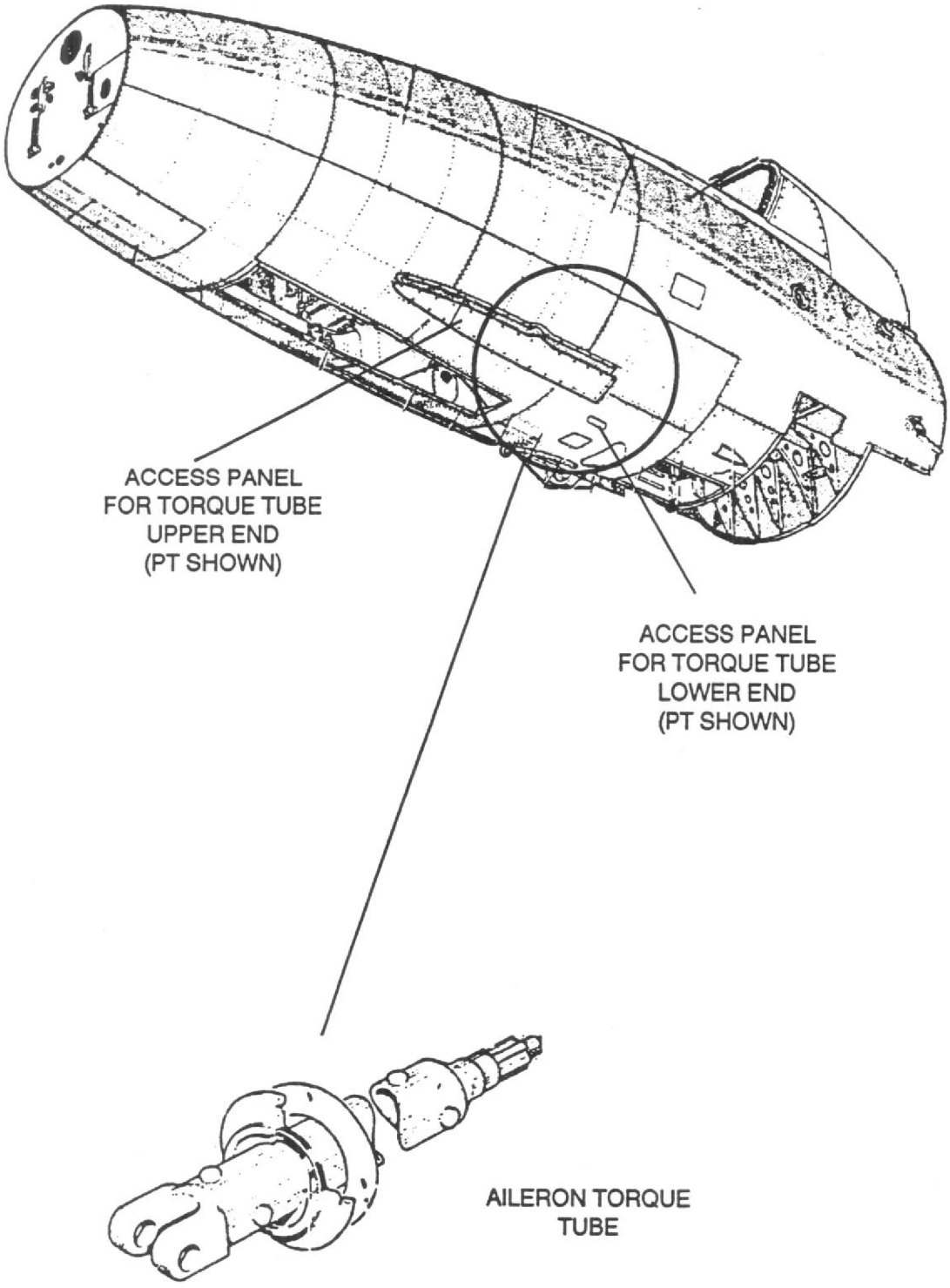
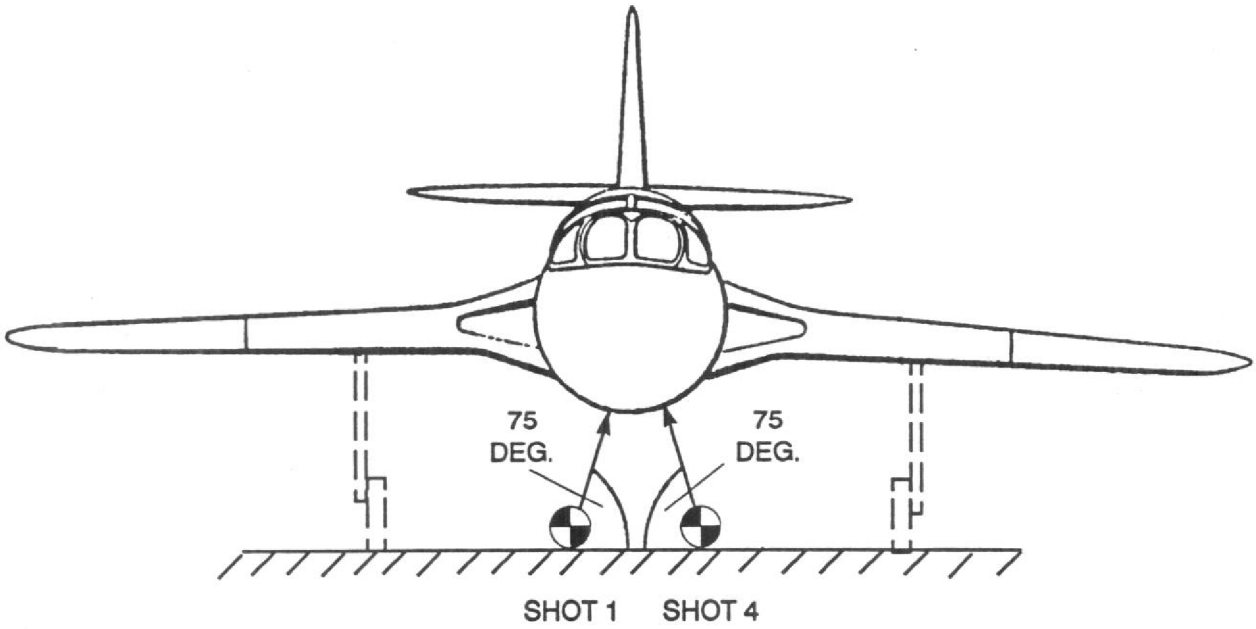


Fig.1 Aileron Torque Tube (Port shown Starboard similiar)

Continued

NON DESTRUCTIVE TEST SCHEDULE
RADIOGRAPHY
RADIOGRAPHIC TECHNIQUES
HUNTER ALL MARKS



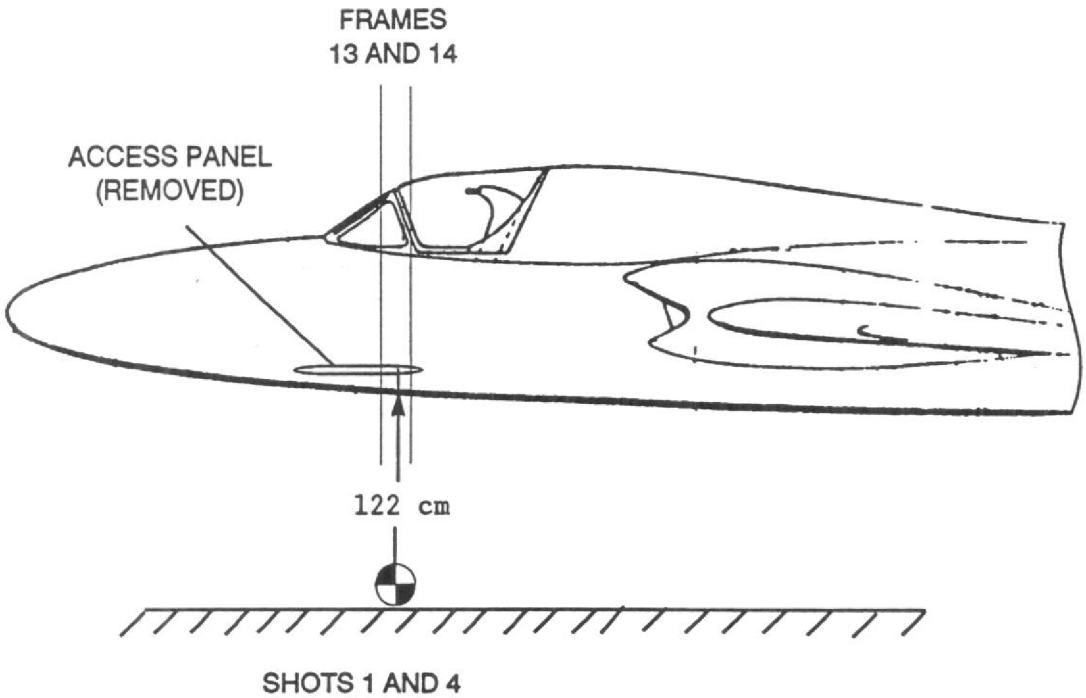


Fig.2 Tube position shots 1 and 4

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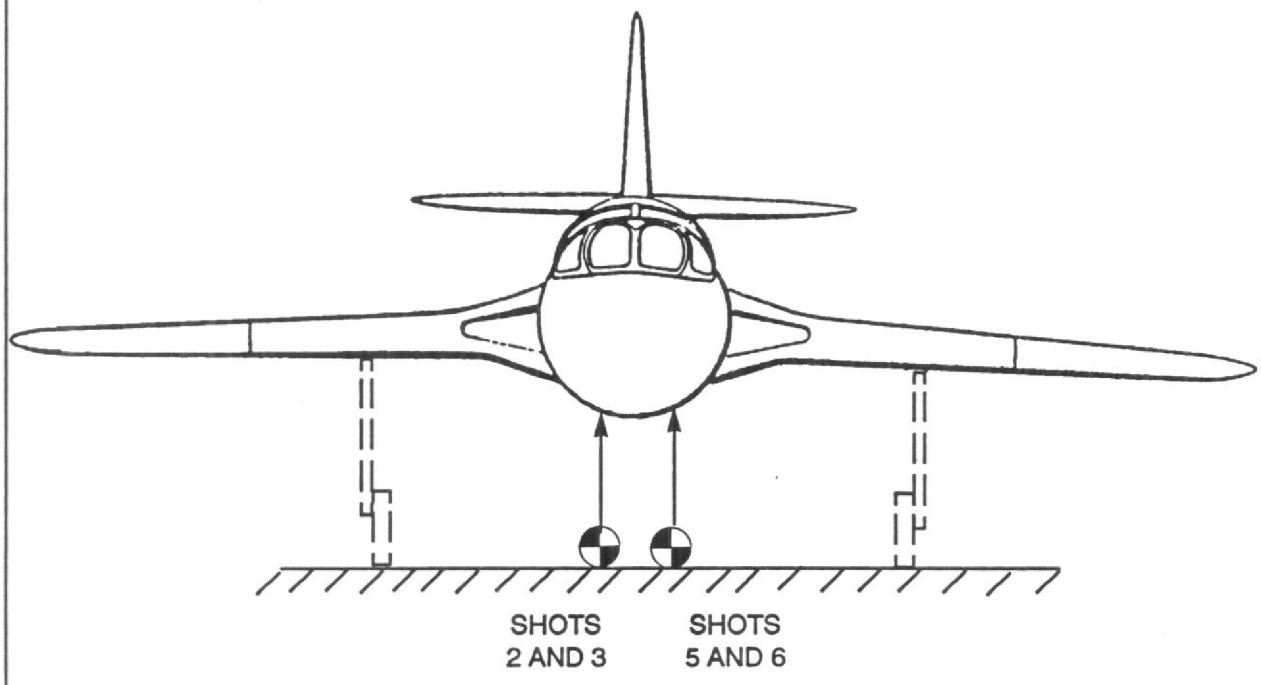
NON DESTRUCTIVE TEST SCHEDULE
RADIOGRAPHY
RADIOGRAPHIC TECHNIQUES
HUNTER ALL MARKS



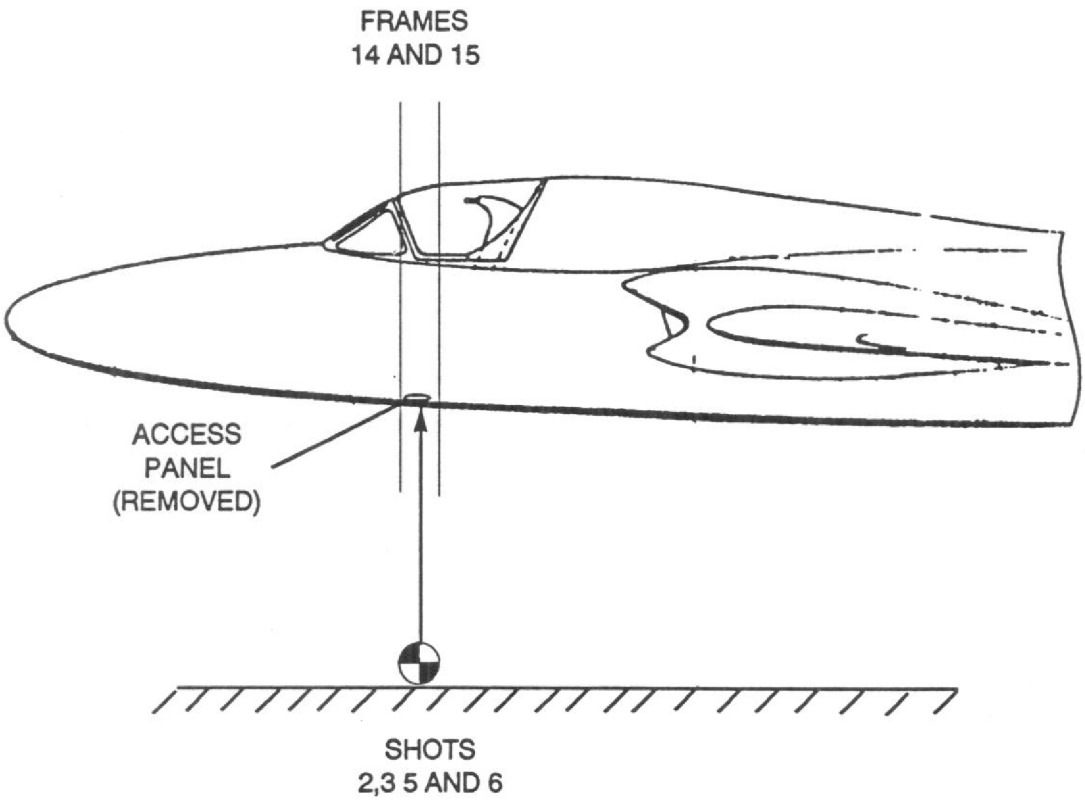


Fig.3 Tube position shots 2,3,4 and 5

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NON DESTRUCTIVE TEST SCHEDULE
RADIOGRAPHY
RADIOGRAPHIC TECHNIQUES
HUNTER ALL MARKS

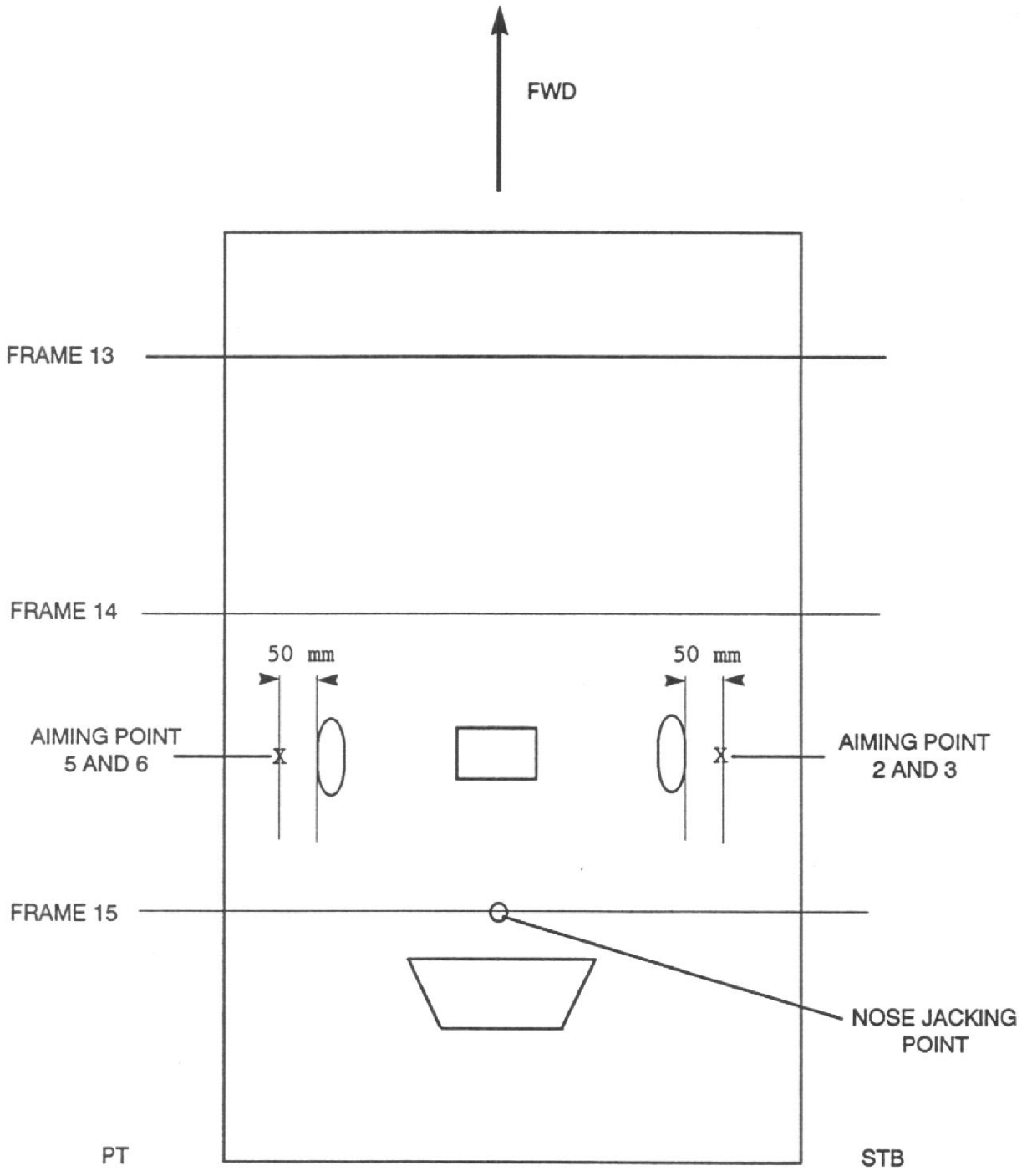

Fig.4 Aiming points Shots 2,3,5 and 6

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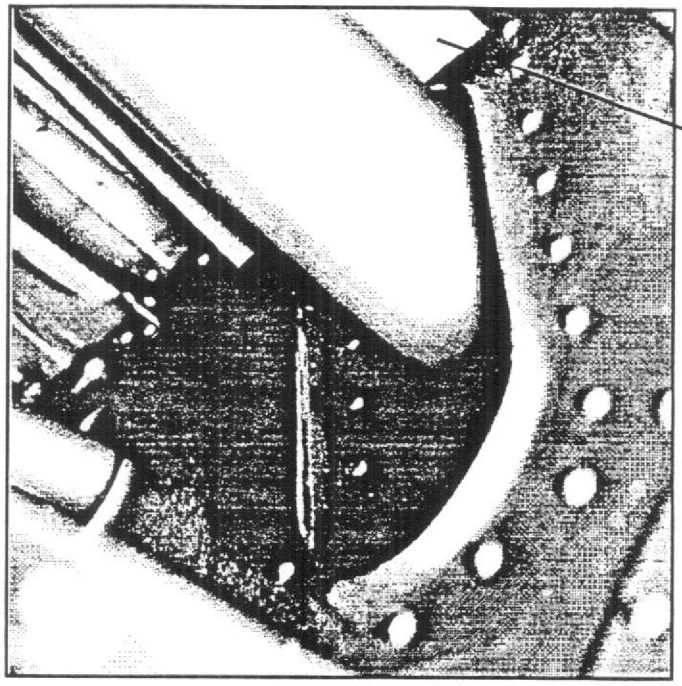
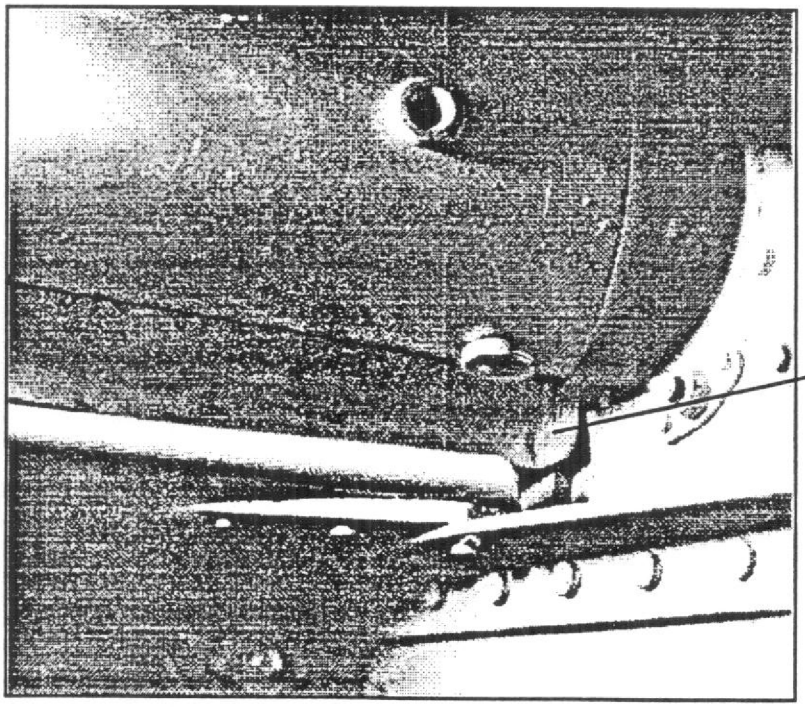
NON DESTRUCTIVE TEST SCHEDULE
RADIOGRAPHY
RADIOGRAPHIC TECHNIQUES
HUNTER ALL MARKS



FILM POSITION SHOTS 1 AND 4



FILM POSITION SHOTS 2,3,5 AND 6

Fig. 5 Film position

X-RAD/5(1)
(1 to 7)

NON-DESTRUCTIVE TEST SCHEDULE
RADIOGRAPHY
X-RADIOGRAPHIC TECHNIQUES
HUNTER ALL MARKS

Warnings, Cautions and Maintenance Notes are to be complied with throughout the work detailed in this technique.

1.	Technique	CSDE/HUNTER/X-RAD/5 (Category A).
2.	Component to be Examined	Aileron Torque Tube (Fig 1).
3.	Area of Examination	Internal Bore and End Caps.
4.	Purpose of Examination	To detect corrosion.
5.	Equipment Required	(i) Any 4XX/ x-ray set and associated equipment. (ii) Any medium speed, very fine grain film, 10cm x 40cm (cut to size) 14K/4086040. (iii) Lead screen (0.125mm) 4XX/6508071.
6.	Preparation	
6.1	Aircraft.	Ensure access panels removed.
6.2	Component.	Ensure clean.
7.	Examination Procedure	
7.1	Film Details.	See Table 2.
7.2	Film Identification.	As per standard system.
7.3	Film Location.	See Fig. 5.
7.4	Tube Location.	See Fig. 2 and 3.
7.5	Exposure Details.	See Table 1.
7.6	Processing Standard.	Techniques are developed using automatic processing. Where automatic processing is not available, then adjustments may have to be made to the standard time/temperature chart for hand processing to achieve the required density.
7.7	Examination Standard.	All faults are to be reported.
8.	Reporting Procedure	AP100B-01 Order No.0770 and relevant maintenance instructions.
9.	Estimated Technique Manhours	3.

Continued

10. Additional Information

(i) Due to the airframe structure the complete torque tube cannot be inspected. The lower end (Aft) of the torque tube must be fully inspected.

Prepared by:
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CSDE
17 June 1992

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Squadron Leader
for Officer Commanding

Continued