Safety Precautions

1. Industrial X-ray equipment used for Non-Destructive Testing in the Royal Air Force is to be operated, in accordance with AP4687A Vol 2 Leaflet G1 by Competent Persons qualified in accordance with AP4687A Vol 2 Leaflet M1.

2. A film badge is to be worn at all times by team members when operating or testing X-ray equipment. The film badge is to be worn on the front of the body, outside the clothing. In addition a radiation monitor, NIS 295B (6Z/1116865) or EMI 0030 (6Z/1086048) is to be available. "Before Use Servicing" on these instruments is to be carried out in accordance with AP112G-1314-5F and AP112G-1303-5F respectively.

3. The control panel is to be positioned as far as possible from the tube utilising the full length of a 60 ft connecting cable as follows:

a. Unidirectional tube - directly behind, or if impracticable, to the side of the useful beam.

b. 360 degree emitter - in line with the longitudinal axis, at the cable end of tube.

4. The operator at the control panel is to have a clear view of the radiation area. Where this is not possible, other team members or local personnel acting as 'Safety Men' are to be placed outside the radiation area in such a position that they can warn the control panel operator of the presence of persons in or near the radiation area prior to exposure and prevent the entry of persons into the radiation area during exposure. The control panel operator is not to leave the panel unattended at any time during the exposure.

5. Immediately prior to operating the X-ray equipment, the team supervisor is to:

a. Assess the area where the doserate is liable to be in excess of 0.75 mR/hr, designate this area as the radiation area and ascertain that it is clearly defined by the erection of a safety barrier marked with the ionizing radiation symbol. Suitable warning notices are to be displayed on or near the barrier.

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

6. During the first exposure the team supervisor is to ensure that:

a. The radiation level at the control panel is checked.

 Continued overleaf

Safety Precautions (Contd)

6. b. The limits of the radiation area are established (the area where the doserate will exceed 0.75 mR/hr).

c. The safety barriers are reset as necessary.

Establishment of doserates is to be carried out by a Class A radiation worker using a radiation monitor. 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 the walls and structures is to be monitored and cleared of personnel if the doserate exceeds 0.75 mR/hr. Due attention is to be paid to scattered radiation from the structure being examined, and from the building housing the structure. Under no circumstances is the radiation area limit to be set at a doserate level in excess of 0.75 mR/hr. 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 into the danger area during radiation exposure.

7. The team supervisor is to be aware of the doserates likely to be received by the operators, and is to ensure that the doserates laid down in AP4687A Vol 2 Leaflet C1 are not exceeded.

8. Any exposure to ionizing radiations in potentially harmful and the effects may not be immediately apparent. The team supervisor is to ensure that the Station Radiation Safety Officer is immediately notified when any individual receives, or is thought to have received any exposure greater than that laid down in AP4687A Vol 2 Leaflet C1.

9. The exit port of the X-ray tube head is to be covered with the lead cap during the warming up procedure. During exposure, limiting shutters are to be fitted to the exit port whenever practical.

10. The tube window of the 63A/220 X-ray set is made of sintered beryllium oxide. Although this is unlikely to present a problem to NDT teams, there could be a danger if the tube head was severely damaged. Personnel using this equipment are to familiarise themselves with the precautions contained in AP3158 Vol 2 (2nd Edition) Leaflet H37.

11. The X-ray tube head or control panel is to be earthed, using an external earth lead, to a point remote from the structure being inspected.

Servicing Notes

12. Before operating Andrex oil cooled X-ray equipment, the tube head is to be examined for signs of air in the oil. This should be carried out as follows:

a. Beryllium Window and 360 degrees Emitter Tube Heads. With the oil inspection window uppermost, shake the tube head and observe the inspection window for the presence of air bubbles.

Continued

Servicing Notes (Contd)

12. b. Other Tube Heads. With the radiation window uppermost, lift each end of the tube head alternately, shake the tube head and observe the radiation window for the presence of air bubbles.

13. The warming up procedure as detailed by the manufacturer is to be carried out prior to an actual exposure or a series of exposures.

14. The tank unit of the Andrex equipment is to be inspected for oil leaks prior to use, and the 'window' checked for damage.

15. All cables for X-ray equipment are to be electrically checked monthly. Check warning lights function correctly.

16. The timer is to be checked for accuracy prior to use. This may be carried out during the warming up period.

17. The exposures given in techniques will, unless otherwise stated, have been derived using standard non-beryllium window X-ray equipment. Beryllium window equipment may be used to carry out these techniques, but a reduction to the exposure will normally be necessary. Owing to the differences in X-ray equipment, no specific figure can be given for this reduction in exposure, but in certain instances it could exceed 15 kVp.

18. Exposures may be altered to cope with the differences in equipment and alterations to FFD provided that radiographic quality is not impaired.

19. It is important that the tube alignment and film positioning stated in the technique is followed, only slight re-alignment, to cope with differing aircraft configurations is permissible. Major re-alignments considered necessary are to be sumbitted to CSDE NDT Flight for approval.

LIST OF CONTENTS

LOCAL TEST PROCEDURES.

TSD/EFDC/HUNTER/XRAD/4. TAILPLANE ASSY.

INDEX TO C.S.D.E. SCHEDULES.

NON - DESTRUCTIVE TESTING TECHNIQUES.

SUBJECT:- X-RAD.	A/C TYPE:-HUNTER.	AP 101B-1300-5G. REFERS.

C.S.D.E. TECHNIQUE NUMBER.	TITLE.	CANCELLED BY AL No.
HUNTER LTP TSO/EFDC/HUNTER/XRAD/4	TAILPLANE UNIT. STRUCTURE. FRONT/REAR SPAR & CTR/LINE RIB.	
HUNTER X-RAD/5	AILERON TORQUE TUBE	

C.S.D.E. TECHNIQUE NUMBER.	TITLE.	CANCELLED BY AL No.

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

1.	Technique	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 (0.125 mm) 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	In accordance with AP 100B-01 Order No. 0770 and relevant maintenance instructions.
9.	Estimated Technique Manhours	3.

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.

TABLE 1

Shot No.	kV	mA	Time in seconds	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 1.75-2.25 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	

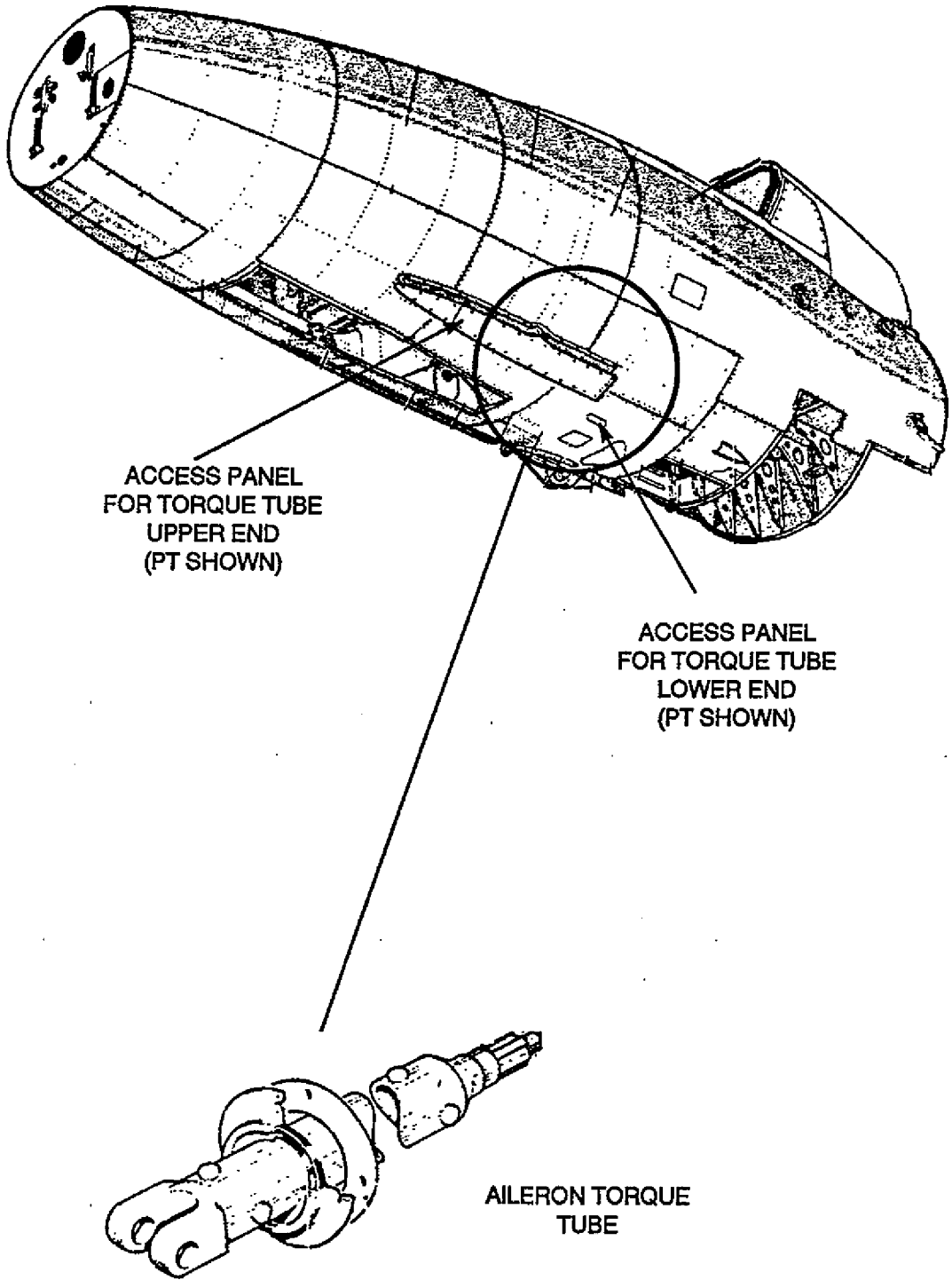
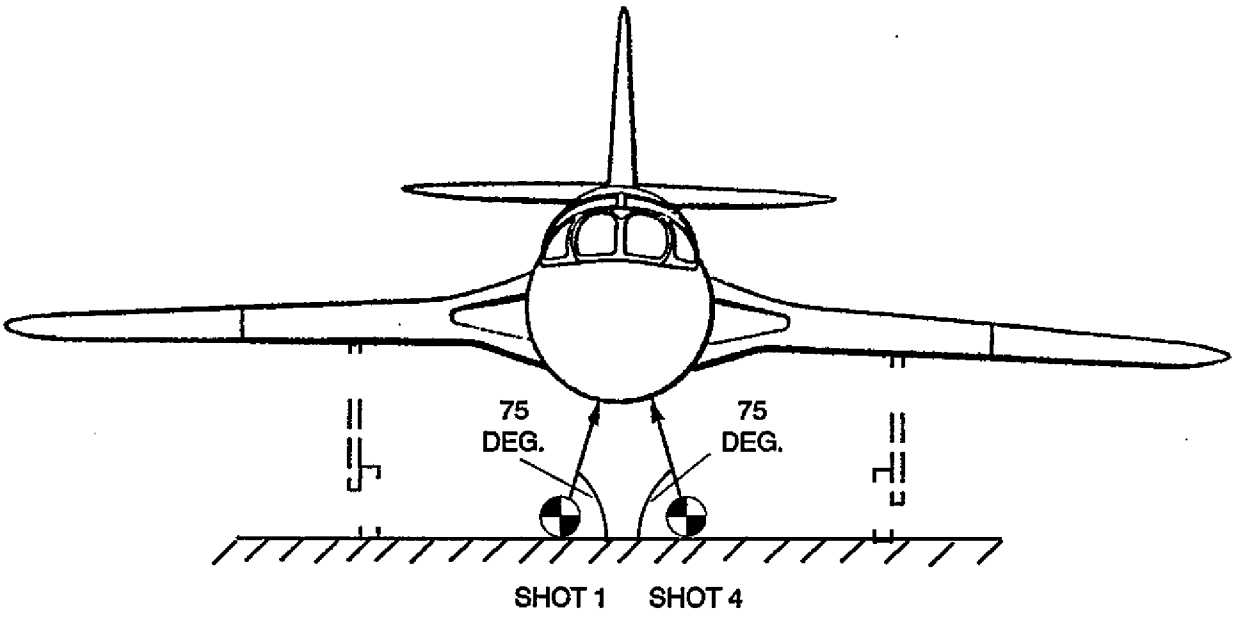


Fig. 1 Aileron Torque Tube (Port shown Starboard similiar)



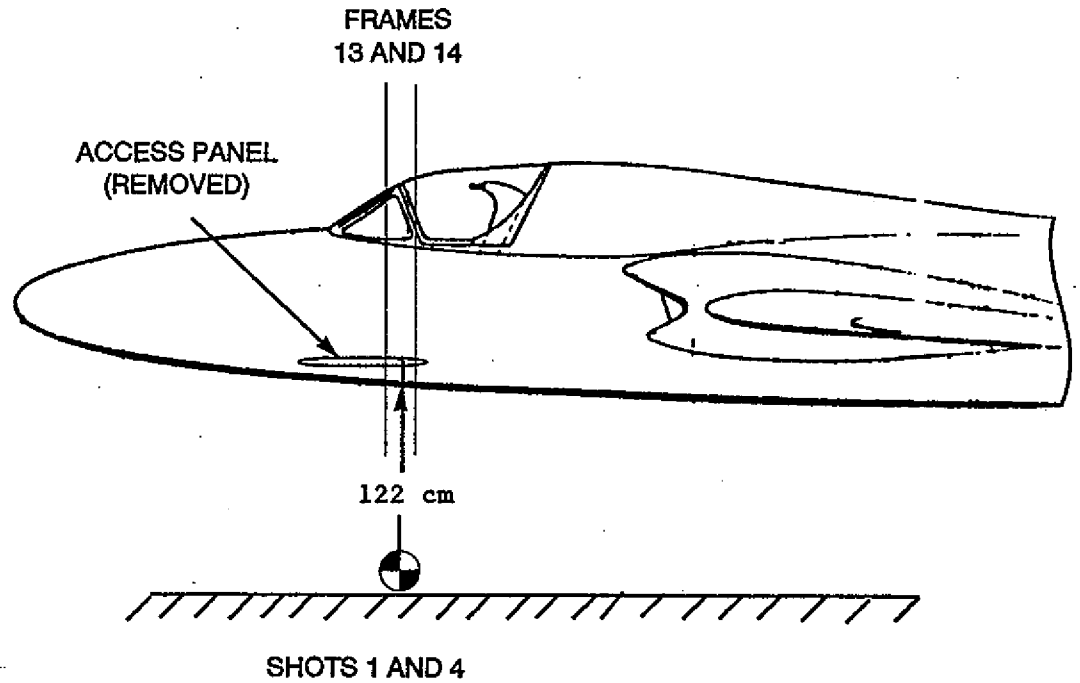
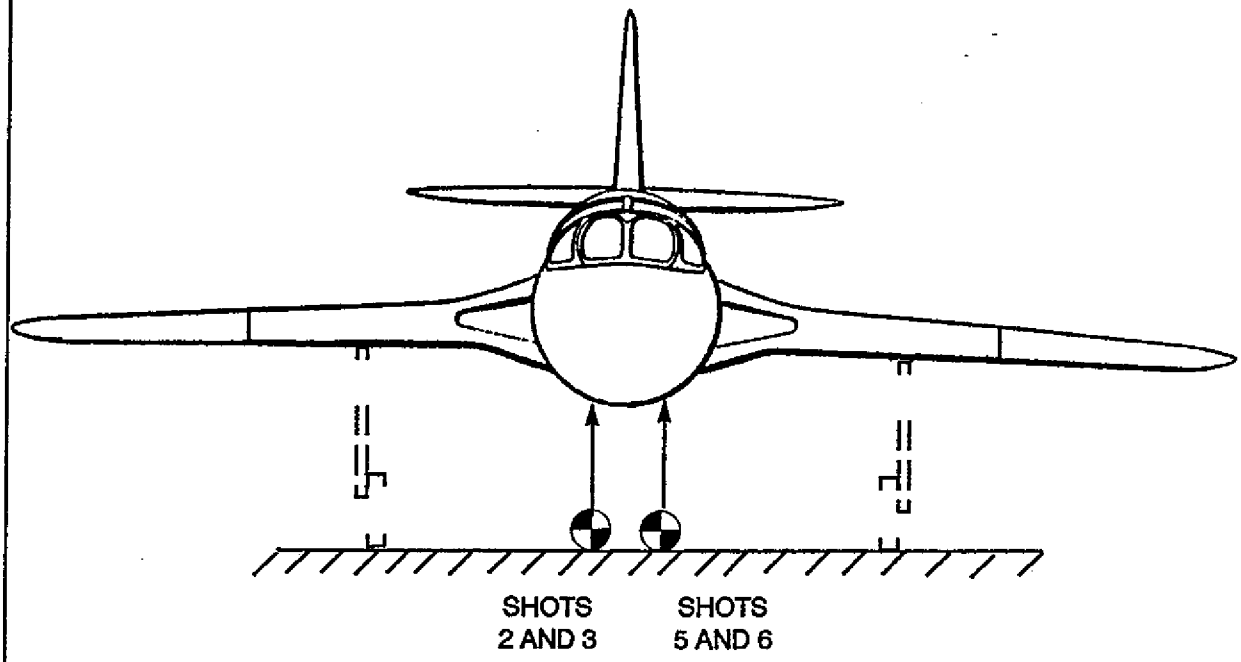


Fig. 2 Tube position shots 1 and 4

Continued



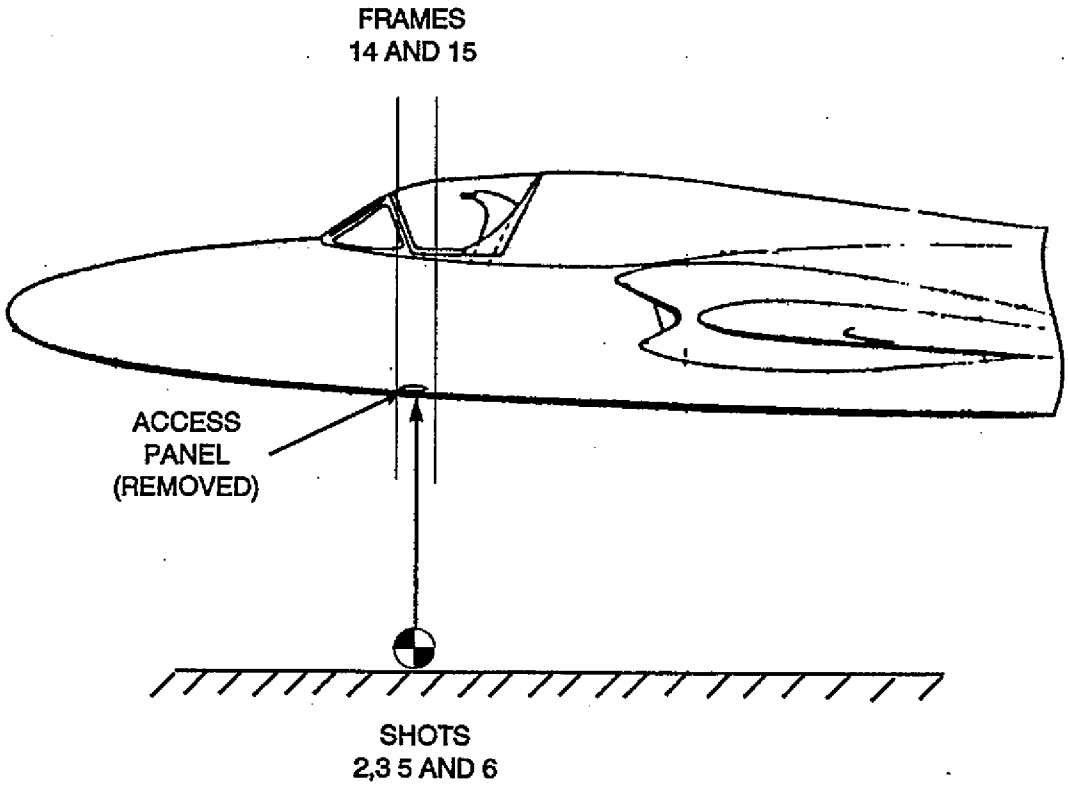


Fig. 3 Tube position shots 2,3,4 and 5

Continued

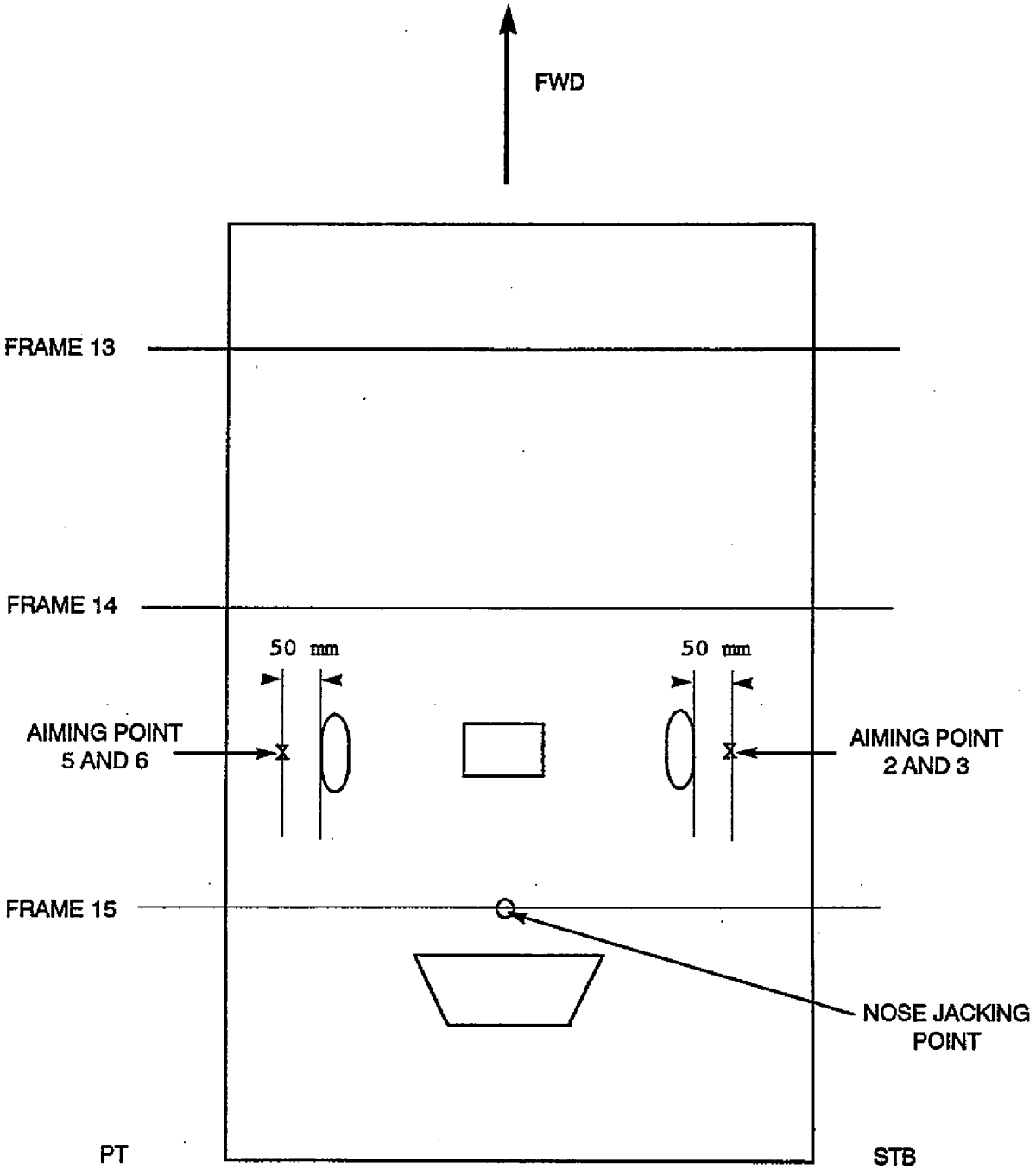
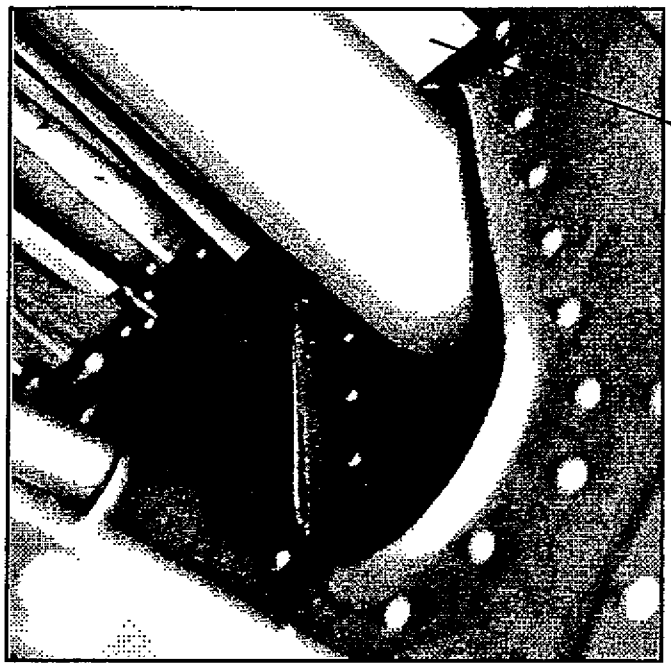
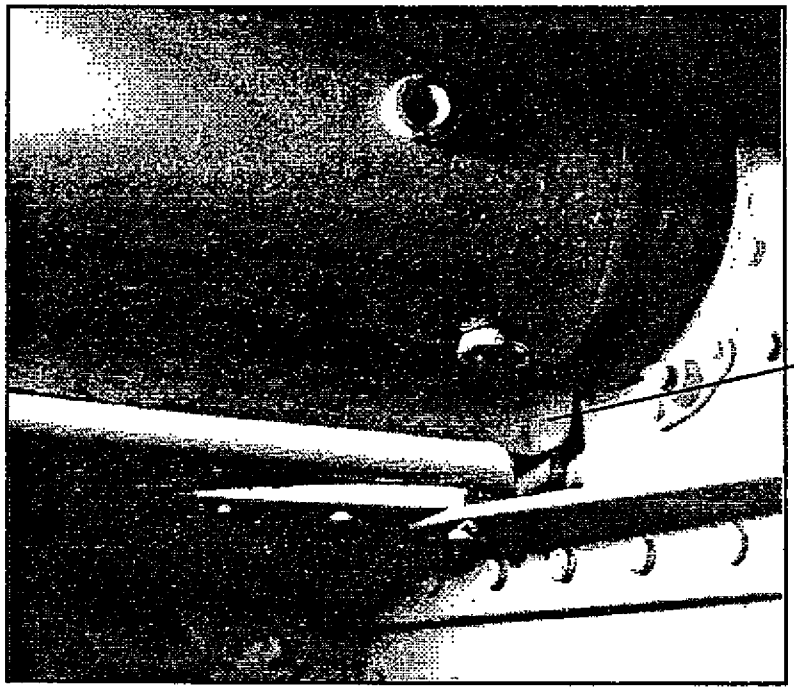


Fig. 4 Aiming points Shots 2,3,5 and 6



FILM POSITION SHOTS 1 AND 4



FILM POSITION SHOTS 2,3,5 AND 6

Fig. 5 Film position