ARROW 2

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METHODS OF RELOADING THE ARMAMENT

PRELIMINARY TIME STUDY

Report # 72/G.OPS/1

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1. PURPOSE OF REPORT

The purpose of this report is to show the two alternative methods of re-arming the Arrow 2 with Sparrow 2 missiles and to illustrate the time required in each case.

In July 1956 a preliminary estimate was made and presented in a report entitled "A preliminary study of the proposed armament storage and test facility" (AVRO report Log 105/36 chapter 6 para. 2).

2. METHODS OF LOADING

It will be possible to reload the Arrow 2 in either one of two ways:-

(a) By removing the used armament pack and replacing it with another which has been inspected, tested and loaded away from the aircraft, or

(b) By loading missiles directly into the armament pack while the pack is still installed in the aircraft.

3. SEQUENCE OF OPERATIONS

Method (a)

It has been demonstrated during the Arrow 1 mock-up conference that an armament pack can be removed and replaced in 4 to 5 minutes using a special hoist trolley.

This armament pack hoist trolley has been designed by AVRO Aircraft Ltd. for transporting the pack and hoisting it in and out of either the aircraft or the pack servicing stand.

The armament pack is hoisted into position by lifting the trolley, complete with the pack, with cables which attach to lifting points on the aircraft structure. The cables are operated by pneumatic actuators which are powered by 1800 psi air bottles carried in the trolley. Sufficient air is carried to hoist a loaded pack into the aircraft six times without recharging the bottles.

Four men are employed, one at each corner of the pack. The following nine operations only are required to complete the task.

1. Disarm the pack, by disconnecting the missile firing circuits.
2. Depressurize the aircraft utility hydraulic system.
3. Disconnect the hydraulic and electrical couplings between the pack and the aircraft.
4. Hoist an unloaded trolley into position under the armament pack and lower both from aircraft.
5. Hoist a second trolley complete with replacement pack into position in the aircraft.
6. Secure pack; lower trolley.
7. Make the hydraulic and electrical connections and reset the depressurizing valve in the utility hydraulic system.

3. SEQUENCE OF OPERATIONS

Method (a) (Continued)

8. Check the missile firing circuits for stray voltages with all other aircraft electrics and electronics switched on and operating.

9. Arm the pack by connecting the missile firing circuit at the safety disconnect.

This sequence has been shown to take 4 to 5 minutes to complete. No additional time is envisaged as necessary for a "mating" check between the missile auxiliaries in a pack and the parent fire control system in the aircraft.

Method (b)

For this method the following sequence of operations is necessary. Individual times have been calculated for each operation as all the necessary equipment is not available yet for a practical demonstration.

1. With engines still idling to provide hydraulic and electrical power, disarm the pack by disconnecting the missile firing circuits; ground crew operate manual selector on pack for lowering launchers (5 seconds).
2. Shut down engines.
3. Connect hydraulic and electrical power to aircraft (10 seconds).
4. Rotate each launcher latch hook into position (5 seconds).
5. Install loading pin, thus removing old shear pin from launcher latch hook (15 seconds.)
6. Inspect and function umbilical firing plug assembly, using a special test box (3 minutes).
7. Inspect launcher rails and pack for possible blast damage. (3 minutes).
8. Wheel two missile trolleys into position for loading one outboard and one inboard missile at a time. ($1\frac{1}{2}$ minutes).

Note: There is inadequate space for simultaneous loading of 4 missiles.

9. Unlock missiles on trolley.
Extend cables on winch assembly.
Attach bar and secure cable to launcher.
Position winch frame on C.G. of missile (2 minutes).
10. Winch missile into position on launcher (1 minute).
11. Unwind winch.
Disconnect cable.
Remove bar (30 seconds).
12. Attach bar and cable to second launcher.
Position winch frame on C.G. of second missile.
Winch missile into position (2 minutes).

13. Unwind winch.
Disconnect bar and cable from 2nd missile (30 seconds).

3. SEQUENCE OF OPERATIONS

Method (b) (Continued)

With two teams of two men each loading two missile simultaneously, 4 missiles have now been loaded in 14 minutes 5 seconds.

14. Remove the missile trolleys (20 seconds).
15. Install 4 wings and 4 fins in each missile (30 seconds).
16. Remove loading pin from launchers and install shear pin (30 seconds).
17. Attach umbilical cord to each missile (30 seconds).
18. Inspect the pack and launcher doors (30 seconds).
19. Retract the launchers and check door closing (10 seconds).
20. Having removed used cooling air shrouds fit new shrouds to each missile (2 minutes).

Note: This requirement is not yet firmly established.

21. Remove the hydraulic test rig (20 seconds).
22. Check compensator level in utility hydraulic system (20 seconds).
23. Check firing circuits for stray voltages (10 seconds).
24. Arm the pack by connecting the missile firing safety plug. (5 seconds).

The total time is estimated as 19 minutes 30 seconds, to which should be added a possible 2 minutes for replenishment of the hydraulic system compensators on occasions when this may be necessary.

Additional time should also be allowed when "hang fires" have first to be removed before loading can commence.

The times have been calculated from operational experience on loading missiles on the CF-100, with due allowance being made for known differences in design between the CF-100 missiles and those to be used in the Arrow 2.

CONCLUSIONS

1. It will take between 4 and 5 minutes to remove a used armament pack and replace it with another which has been inspected and loaded away from the aircraft.
2. It will take an estimated $19\frac{1}{2}$ to $21\frac{1}{2}$ minutes to inspect, test, reset the launchers and load missiles individually into an aircraft.
3. The aircraft turn-around time which may be achieved by changing armament packs will be about six minutes whereas about $22\frac{1}{2}$ minutes will be required if missiles are loaded directly into the aircraft.