UNCLAS

SECTION 12 AVRS

CF-105 SERVICE DATA

27 Sept 56

Flying Control Hydraulics

AVRS

ANALYZED

CONFIDENTIAL

CF-105 SERVICE DATA

SECTION 12.

FLYING CONTROLS HYDRAULIC SYSTEM

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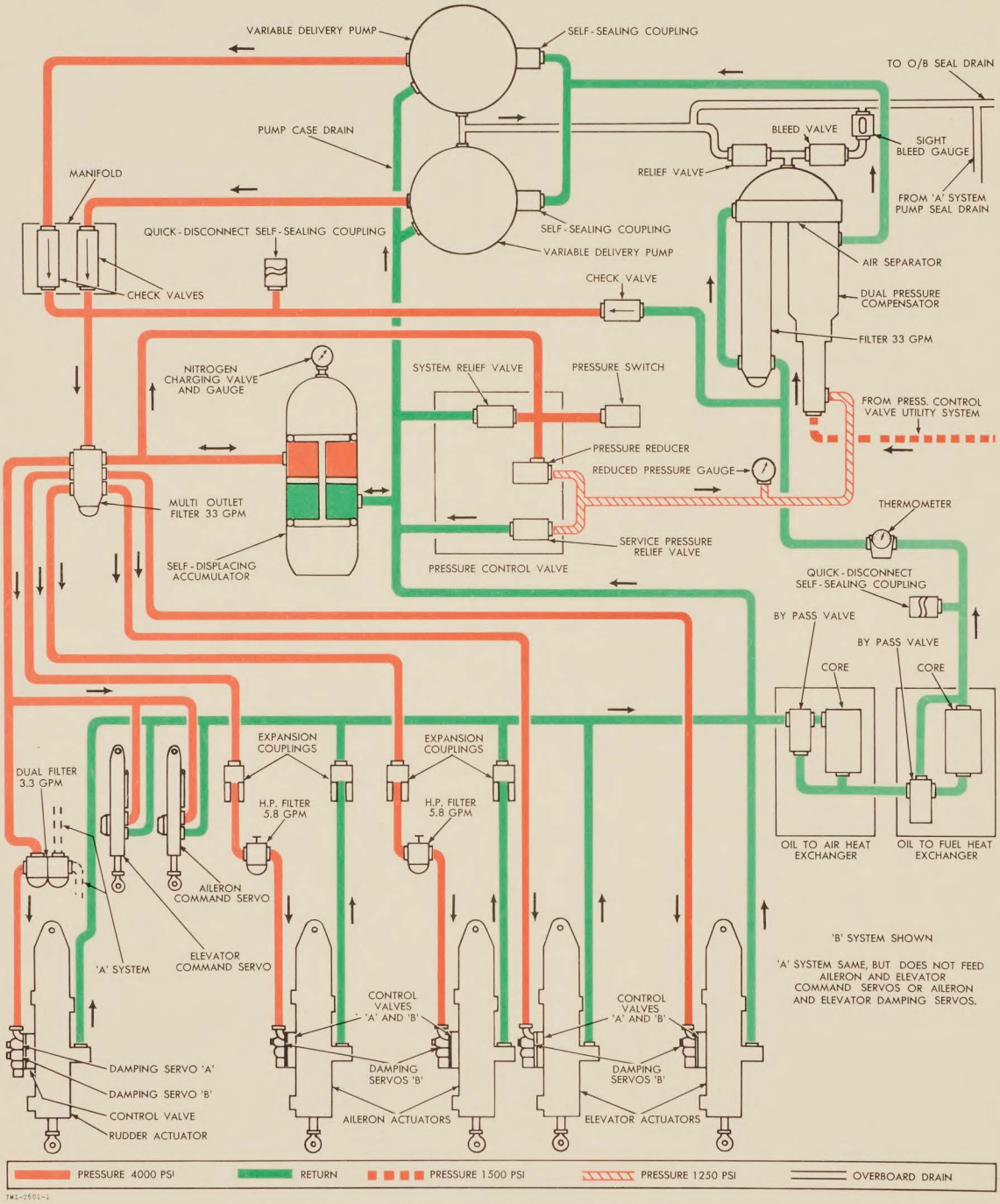

FIG. 1 FLYING CONTROL HYDRAULIC SYSTEM - SCHEMATIC

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SYSTEM DATA SHEET

SYSTEM	SUB-SYSTEM	AIRCRAFT EFF'TY	REF. NO.
FLYING CONTROLS HYDRAULICS		25201	32

DESCRIPTION

General.

1. The aileron, elevator and rudder flying control surfaces are operated by two self-contained airless hydraulic circuits, each pressurized by two engine driven pumps. The pumps supply hydraulic fluid at 4000 psi through filters and pressure control valves to the flying control surface actuators and their control valves and damping servos. The return fluid passes via heat exchangers and filters to the compensators and pump inleta at a pressure of 90 psi.

2. The two circuits are known as 'A' circuit and 'B' circuit. 'A' circuit supplies the control valves of the aileron and elevator actuators, and the control valve and damping servo of the rudder actuator. 'B' circuit duplicates the supplies of 'A' circuit and additionally supplies the damping and command servos for the ailerons and elevators.

3. Normal flight can be sustained with fluid temperatures ranging from -29°C (-20°F) to a maximum permissible temperature of 135°C (275°F). The hydraulic fluid when excessively heated, is cooled by oil-to-air and oil-to-fuel heat exchangers.

4. All pipeline connections are of the flareless type, giving greater resistance to fatigue. Quick-disconnect self-sealing couplings are fitted into the circuits to enable the system to be operated from a ground test rig. No flexible hoses are used in the pressure side of the circuits. Flexing steel pipelines are used to absorb movement between the flying control surface actuators and their filters.

Pumps

5. Two Vickers variable-delivery pumps, one for each circuit, are located on the aft face of each engine driven accessories gear box. The pumps supply each circuit with fluid at 4000 psi. The inlet of each pump is fitted with a quick-disconnect, self-sealing coupling to facilitate removal and to minimize loss of fluid during pump removal.

Manifold

6. The pressure lines from the two pumps in each circuit are connected to a manifold containing two check valves, one for each pump. These check valves prevent a back flow of fluid through an inoperative pump and also isolate the pumps and compensator when the system is being operated by a ground test rig. A common outlet from the manifold is fed to the inlet of a multi-outlet filter.

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Multi-outlet Filter

7. A multi-outlet high pressure filter with a maximum flow rate of 33 gpm is located at the lower, rear, inboard side of the engine bay. The filter passes fluid to the control valves at each of the five flying control surface actuators, and to the aileron and elevator command servos in 'B' circuit. A further outlet passes fluid to the self-displacing accumulator and to the pressure control valve. Cut off valves are fitted to minimize loss of fluid during removal of the filter bowl. A by-pass relief valve is incorporated which opens when a pressure differential of 45-55 psi exists across the in-line type filter element.

Accumulator

8. The self-displacing 100 cubic inch accumulator pre-charged with nitrogen to 1500 psi, is fitted below the multi-outlet filters and performs the following functions:

(a) Supplies immediate high pressure fluid to an actuator when its control valve is operated.

(b) Compensates for pressure variations caused by rapid movements of the controls.

(c) Maintains a atatic pressure on the pressure side of the circuit when the pumps are not operating.

Pressure Control Valve Unit

9. The pressure control valve unit, located between the accumulators, comprises three valves:

(a) A system relief valve for the pressure circuit. This valve commences to relieve at a pressure of 4315 psi. Full flow occurs at 4700 psi.

(b) A pressure reducer converting 4000 psi to 1250 psi for "Stand By" pressurization of the compensator.

(c) A service pressure relief valve for the "Stand By" circuit.

10. A pressure gauge is installed in the circuit to check the reduced pressure from the valve during ground test operations.

Dual Pressure Compensator

11. The dual pressure compensator, located aft and above the engine driven pumps, performs the following functions:

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SYSTEM	SUB-SYSTEM	AIRCRAFT EFF'TY	REF. NO.
FLYING CONTROLS HYDRAULICS (Cont'd)		25201	32

(a) Maintains a steady pressure on the return side of the circuit to ensure a constant supply of hydraulic fluid to the inlet ports of the pumps.

(b) Acts as a chamber of variable volume to compensate for fluid diaplacement or requirements during the operation of the various unita and for absorbing volumetric changes due to temperature changea.

(c) Maintains a static pressure of 90 psi over the return circuit when the pumps are not operating.

(d) Traps any air encountered in the circuit by meana of an air separator compartment in the head.

12. A pressure of 1500 psi is fed to the base of the compensator from the separate aircraft utility hydraulic system. Due to area difference on floating pistons in different sized cylinders in the compensator, the 1500 psi input gives a pressure of 90 psi on the return side of the circuit. A relief valve in the head relieves fluid into an overboard drain line if the pressure on the return side of the circuit builds up to over 165 psi. In the event of a failure in the utility system, a pressure of 1250 psi, which gives a pressure of 75 psi on the return side of the circuit, is delivered from the pressure control valve.

13. A manually operated bleed valve is incorporated in the air separator compartment in the head of the compensator for bleeding off any trapped air into the overboard drain line. A aight bleed gauge in this line gives a visual check that all air has been dispelled from the compensator.

14. A temperature calibrated rod indicates the correct position of the large piston during topping up operations. A bleed screw is incorporated at the bottom of this rod to bleed off air collected in the pressure side of the compensator during filling of the utility hydraulic system. A 33 gpm filter is fitted at the inlet side of the compensator. A self sealing arrangement is incorporated in this filter to minimize fluid loss during removal of the bowl. A by-pass valve is also fitted in the filter.

15. A pipeline from the inlet side of the compensator is connected to the common outlet of the manifold. This is to keep a static pressure of 90 psi on the pressure side of the circuit when the pumps are not operating and the accumulator piaton is at the bottom of its stroke. A check valve is fitted in the pipeline to prevent high pressure from reaching the compensator during normal operation.

Pressure Switch

16. A pressure switch which operates an amber cockpit warning light ia connected into the high pressure line to the relief valve. This light illuminates at a falling pressure of 1000 psi. A failure of any of the pumps will only be noticed when the controls are rapidly cycled.

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Expansion Couplings

17. Expansion couplings are installed in the lines between the multi-outlet filter and the aileron actuators and in the return lines from the aileron actuators. The couplings are variable in length by approximately one inch and their movement compensates for thermal expansion and contraction of the pipe lines and for any flexing of the wing during flight.

High Pressure Filter

18. A high pressure filter with a maximum flow rate of 5.8 gpm is installed in the pressure line to each aileron actuator. A by-pass relief valve is incorporated in the filter element.

High Pressure Dual Filter

19. A filter with twin elements situated side-by-side in a common casting, is installed in the pressure lines to the rudder actuator. One filter element caters to the 'A' hydraulic circuit and the other element caters to the 'B' hydraulic circuit. Each element has a maximum flow rate of 3.3 gpm. A by-pass relief valve is incorporated.

Control Surface Actuators

20. The hydraulic flying control surface actuators are tandem, dual piston and cylinder types. Each cylinder is supplied by a separate hydraulic circuit. There are five actuators in the system:

(a) Two aileron actuators, located in the outer wing, forward of the ailerons.

(b) Two elevator actuators, located in the inner wing, forward and inboard of the elevators.

(c) One rudder actuator, located in the vertical stabilizer, forward of the rudder.

Control Valves

21. A control valve is mounted on each flying surface control actuator. These valves are pressurized by both 'A' and 'B' circuits through individual pressure and return ports.

Elevator and Aileron Damping Servos

22. The damping servos are quick-acting, electro hydraulic actuators which

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FLYING CONTROLS HYDRAULICS (Cont'd)		25201	32

transform the electrical damping signals from the aircraft stabilization system into hydraulic power, thereby correcting pitch or roll of the aircraft.

23. The servos are identical and receive hydraulic fluid under pressure from the 'B' circuit through internal connections from the flying control surface actuator control valves.

Rudder Damping Servo

24. The rudder damping servo is similar in operation to the elevator and aileron damping servos, but it is a duplicated unit, receiving power from both 'A' and 'B' hydraulic systems at the same time.

Elevator and Aileron Command Servos

25. The elevator and aileron command servos, located beneath the lower skin of the inner wing in the engine bay, are electro-hydraulic actuators which transform the electrical signals from the normal stick force mode or from the automatic flight control systems, into hydraulic motion to operate the control surface actuator control valves through linkages. Hydraulic power is supplied from the 'B' circuit only. The servo can be disengaged at any time by a solenoid valve. It is possible to overpower the elevator command servo, by a force of 60 lbs on the stick grip, and to overpower the aileron command servo by a force of 30 lbs on the stick grip.

26. There is no command servo for the rudder actuator, as its operation is co-ordinated with the aileron movement by the aircraft damping system.

Heat Exchangers

27. The heat exchangers are utilised in the return circuits to dissipate the heat of the hydraulic oil generated by the system components. For efficient cooling, an oil-to-air heat exchanger and an oil-to-fuel heat exchanger are used.

Oil-to-air Heat Exchanger

28. The oil-to-air heat exchangers are located below the engines and use air flow through a hydraulic fluid filled core for heat dissipation. A by-pass valve diverts the hydraulic fluid past the core when the fluid temperature is below 90.5°C (195°F).

Oil-to-fuel Heat Exchanger

29. If the oil-to-air heat exchanger does not cool the hydraulic fluid sufficiently, the operation of a thermal element in the by-pass valve of the oil-to-fuel

heat exchanger diverts the hydraulic fluid through a fuel cooled core and thence to the compensator.

Thermometer

30. A thermometer located in the return line above the compensator indicates fluid temperature. This thermometer is used in conjunction with the temperature calibrated rod in the compensator, when topping the system up to the correct level.

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COMPONENT DATA SHEET

SYSTEM	SUB-SYSTEM	COMPONENT	REF. NO.
FLYING CONTROLS HYDRAULICS		Pump - Hydraulic	32-1

AVRO PART NO.	MANUFACTURER	MAN'F'R'S PART NO.	AIRCRAFT EFFECTIVITY
7-3258-13	Vickers Inc.	AA 60659-L2	25201

OVERHAUL LIFE: KNOWN- ESTIMATED- 500 hours

FUNCTION

To supply hydraulic pressure to the flying control system.

LOCATION

In the fuselage, station 621.

ACCESS — MEN X MINUTES

Through the No. 2 service door - 42 camlocs.

REPLACEMENT PROCEDURE — MEN X MINUTES

Position the pump.
Install and tighten nuts on to the flange mounting studs (six).
Left hand lower pump - install the section of the "A" system return pipe line that passes the pump.
Right hand lower pump - install the section of the "B" system return pipe line that passes the pump.
Connect the self-sealing coupling and the other three hydraulic pipelines to the pump.
Fill the pump with oil and bleed the air from the pump at the case drain port.

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INSPECTION	MEN X MINUTES	
Check for leaks, security, damage, cracks and corrosion.		

FUNCTIONAL CHECKS	MEN X MINUTES	

GROUND HANDLING AND GROUND TEST EQUIPMENT

Hydraulic hand filling pump.

SPECIAL TOOLS TO REMOVE OR SERVICE

REMARKS

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COMPONENT DATA SHEET

SYSTEM	SUB-SYSTEM	COMPONENT	REF. NO.
FLYING CONTROLS HYDRAULICS		Coupling - Quick-disconnect Self-sealing	32-2

AVRO PART NO.	MANUFACTURER	MAN'F'R'S PART NO.	AIRCRAFT EFFECTIVITY
7-3258-45,47,48	Eastern Aircraft Products		25201

OVERHAUL LIFE: KNOWN- ESTIMATED- 500 hours

FUNCTION

To seal the hydraulic pipelines when the pumps are removed.

LOCATION

In the fuselage, Station 621.5.

ACCESS — MEN X MINUTES

Through the No. 2 service door - 42 camlocs.

REPLACEMENT PROCEDURE — MEN X MINUTES

Install the halves on to the pump and the hydraulic pipeline.
Connect the coupling halves.
Bleed the system on engine run.

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INSPECTION	MEN X MINUTES	
Check for leaks.		

FUNCTIONAL CHECKS	MEN X MINUTES	

GROUND HANDLING AND GROUND TEST EQUIPMENT

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COMPONENT DATA SHEET

SYSTEM	SUB-SYSTEM	COMPONENT	REF. NO.
FLYING CONTROLS HYDRAULICS		Manifold - Pump Delivery	32-3

AVRO PART NO.	MANUFACTURER	MAN'F'R'S PART NO.	AIRCRAFT EFFECTIVITY
7-3258-16	Aviation Electric	AE1-417	25201

OVERHAUL LIFE: KNOWN- ESTIMATED- 500 hours

FUNCTION

To unite the feeds from the pumps and to isolate a failed pump.

LOCATION

Inside the fuselage - Station 658.

ACCESS — MEN X MINUTES

Through the No. 3 service door - 36 camlocs.

REPLACEMENT PROCEDURE — MEN X MINUTES

Attach the manifold to the bracket by three attachment bolts.
Connect the five hydraulic pipelines.
Connect the hydraulic ground test rig.
Prime the system.

INSPECTION	MEN X MINUTES	
Check for security, damage, cracks, corrosion, leaks.		

FUNCTIONAL CHECKS	MEN X MINUTES	

GROUND HANDLING AND GROUND TEST EQUIPMENT

Hydraulic ground test rig.
B4 stand.

SPECIAL TOOLS TO REMOVE OR SERVICE

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SYSTEM	SUB-SYSTEM	COMPONENT	REF. NO.
FLYING CONTROLS HYDRAULICS		Filter - Multi-outlet	32-4

AVRO PART NO	MANUFACTURER	MAN'F'R'S PART NO.	AIRCRAFT EFFECTIVITY
7-3258-43	Parmatic Engineering		25201

OVERHAUL LIFE: KNOWN- ESTIMATED- 500 hours

FUNCTION

Main pressure filter of the flying control hydraulic systems.

LOCATION

At rear of V strut. Station 697.

ACCESS | MEN X MINUTES

Through the No. 4 service door - 28 camlocs.

REPLACEMENT PROCEDURE | MEN X MINUTES

Attach the filter by three mounting bolts.
Connect the seven hydraulic pipelines.
Connect the hydraulic test rig.
Prime the system.

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INSPECTION	MEN X MINUTES	
Check for security, damage, cracks and leaks. Clean the element.		

FUNCTIONAL CHECKS	MEN X MINUTES	

GROUND HANDLING AND GROUND TEST EQUIPMENT

Hydraulic ground test rig.

SPECIAL TOOLS TO REMOVE OR SERVICE

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COMPONENT DATA SHEET

SYSTEM	SUB-SYSTEM	COMPONENT	REF. NO.
FLYING CONTROLS HYDRAULICS		Accumulator	32-5

AVRO PART NO.	MANUFACTURER	MAN'F'R'S PART NO.	AIRCRAFT EFFECTIVITY
7-3258-41	Aviation Electric		25201

OVERHAUL LIFE: KNOWN- ESTIMATED- 500 hours

FUNCTION

To provide quick response control movements.

LOCATION

Inside the fuselage. Station 690-715.

ACCESS

MEN X MINUTES

Through the No. 3 service door - 36 camlocs
and the No. 4 service door - 28 camlocs.

REPLACEMENT PROCEDURE

MEN X MINUTES

Attach the clamps and position the accumulator.
Tighten the nuts onto the clamping bolts (two).
Connect the two hydraulic pipelines.
Charge with dry nitrogen to 1500 psi.
Connect the hydraulic ground test rig.
Prime the system.

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INSPECTION	MEN X MINUTES	
Check nitrogen pressure on gauge. (1500 psi). Check for security, damage, cracks, corrosion and leaks.		

FUNCTIONAL CHECKS	MEN X MINUTES	

GROUND HANDLING AND GROUND TEST EQUIPMENT

Air-nitrogen trolley.
Hydraulic ground test rig.

SPECIAL TOOLS TO REMOVE OR SERVICE

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SYSTEM	SUB-SYSTEM	COMPONENT	REF. NO.
FLYING CONTROLS HYDRAULICS		Valve - Presaure Control	32-6

AVRO PART NO.	MANUFACTURER	MAN'F'R'S PART NO.	AIRCRAFT EFFECTIVITY
7-3258-14	Vinson Manufacturing Co.	A-50029	25201

OVERHAUL LIFE: KNOWN- ESTIMATED- 500 hours

FUNCTION

To keep the system pressure below 4000 psi and to provide fluid at 1250 psi for standby pressurization of the flying control hydraulic compensators.

LOCATION

In the fuselage - Station 697.

ACCESS | MEN X MINUTES

Through No. 3 service door - 36 camlocs.

REPLACEMENT PROCEDURE | MEN X MINUTES

Replace three mounting bolts.
Connect the six hydraulic pipelines including the pipeline to the pressure switch.
Connect the hydraulic ground test rig.
Prime the system.

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INSPECTION	MEN X MINUTES	
Check for security, damage, cracks, corrosion and leaks.		

FUNCTIONAL CHECKS	MEN X MINUTES	

GROUND HANDLING AND GROUND TEST EQUIPMENT

Hydraulic ground test rig.

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SYSTEM	SUB-SYSTEM	COMPONENT	REF. NO.
FLYING CONTROLS HYDRAULICS		Gauge - Reduced Pressure	32-7

AVRO PART NO.	MANUFACTURER	MAN'F'R'S PART NO.	AIRCRAFT EFFECTIVITY
7-3258-29	Aviation Electric	AEP-20084	25201

OVERHAUL LIFE: KNOWN- ESTIMATED- 500 hours.

FUNCTION

Indicates the pressure in the compensator emergency pressurizing line.

LOCATION

On the V strut - Station 644.63.

ACCESS

MEN X MINUTES

Through the No. 2 service door - 42 camlocs.

REPLACEMENT PROCEDURE

MEN X MINUTES

Slide the gauge into the clamp.
Tighten the clamp.
Connect the hydraulic pipeline.
Connect the hydraulic ground test rig.
Prime and bleed the hydraulic pipeline.

INSPECTION	MEN X MINUTES	
Visual (Press-to-test). Check for security, damage, leaks, and discoloration of dial.		

FUNCTIONAL CHECKS	MEN X MINUTES	

GROUND HANDLING AND GROUND TEST EQUIPMENT

Hydraulic ground test rig.

SPECIAL TOOLS TO REMOVE OR SERVICE

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COMPONENT DATA SHEET

SYSTEM	SUB-SYSTEM	COMPONENT	REF. NO.
FLYING CONTROLS HYDRAULICS		Compensator - Dual Pressure	32-8

AVRO PART NO.	MANUFACTURER	MAN'F'R'S PART NO.	AIRCRAFT EFFECTIVITY
7-3258-123	H.W. Loud	7875	25201

OVERHAUL LIFE: KNOWN- ESTIMATED- 500 hours

FUNCTION

To compensate for volumetric changes in the system due to control actuation, temperature and leakage.

LOCATION

Inside the fuselage at Station 644.43.

ACCESS

Front compensator
Through the No. 2 service door - 42 camlocs.

Rear compensator
Through the No. 3 service door and the compensator removal panel - 36 camlocs.

MEN X MINUTES

REPLACEMENT PROCEDURE

MEN X MINUTES

Front compensator:
Raise the compensator through the access panel.
Locate the top lug of the compensator on the pin on the V support.
Attach the compensator to its bracket by the attachment bolt.
Attach the filter to the compensator.
Connect the six hydraulic pipelines.

Rear compensator:
Raise the compensator through the access panel.
Support the compensator with a crutch through the access hole and locate the top lug of the compensator on the pin on the V support.
Attach the compensator to its bracket by the attachment bolt.
Connect the six hydraulic pipelines.
Connect the hydraulic ground test rig.
Prime the system.
Manually bleed both of the compensators.

INSPECTION	MEN X MINUTES	
Visual, bleed air, check the fluid level. Check for security, damage, cracks and external leaks. Remove the drain plug to check for internal leaks; clean the air and fluid filters, bleed air and check the fluid level.		

FUNCTIONAL CHECKS	MEN X MINUTES	

GROUND HANDLING AND GROUND TEST EQUIPMENT

Hydraulic ground test rig.
Hydraulic filling hand pump.
Crutch to support the compensator.

SPECIAL TOOLS TO REMOVE OR SERVICE

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COMPONENT DATA SHEET

SYSTEM	SUB-SYSTEM	COMPONENT	REF. NO.
FLYING CONTROLS HYDRAULICS		Switch - Pressure P.1.	32-9

AVRO PART NO.	MANUFACTURER	MAN'F'R'S PART NO.	AIRCRAFT EFFECTIVITY
7-3258-35	Meletron Corporation		25201

OVERHAUL LIFE: KNOWN- ESTIMATED-

FUNCTION

To warn the pilot of malfunctioning of each flying control system.

LOCATION

At the flying controls system accumulator Station 702.

ACCESS — MEN X MINUTES

Through the No. 4 service door - 28 camlocs.

REPLACEMENT PROCEDURE — MEN X MINUTES

Slide the switch into clamp.
Tighten two bolts securing the switch to the clamp.
Connect the hydraulic pipeline.
Connect the electric cable.
Connect the hydraulic ground test rig.
Bleed the air at the hydraulic pipeline union.

INSPECTION	MEN X MINUTES	
Operation of pressure to be noted on shut down and starting of the engines. Check for security, damage, cracks, corrosion and leaks.		

FUNCTIONAL CHECKS	MEN X MINUTES	

GROUND HANDLING AND GROUND TEST EQUIPMENT

Hydraulic ground test rig.

SPECIAL TOOLS TO REMOVE OR SERVICE

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SYSTEM	SUB-SYSTEM	COMPONENT	REF. NO.
FLYING CONTROLS HYDRAULICS		Coupling - Expansion	32-10

AVRO PART NO.	MANUFACTURER	MAN'F'R'S PART NO.	AIRCRAFT EFFECTIVITY
7-3262-14, 16	Dowty Equipment	14XP3053	25201

OVERHAUL LIFE: KNOWN- ESTIMATED- 500 hours.

FUNCTION

To allow for the thermal expansion and contraction of the pipelines.

LOCATION

Inside the elevator control box.

ACCESS

By removing the lower skin of elevator control box (approximately 500 screws).

MEN X MINUTES

REPLACEMENT PROCEDURE

MEN X MINUTES

Connect the hydraulic pipelines.
Connect the hydraulic ground test rig.
Prime the system.

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COMPONENT DATA SHEET

SYSTEM	SUB-SYSTEM	COMPONENT	REF. NO.
FLYING CONTROLS HYDRAULICS		Filter - High Pressure 5.8 gpm	32-11

AVRO PART NO.	MANUFACTURER	MAN'F'R'S PART NO.	AIRCRAFT EFFECTIVITY
7-3264-65, 66,67,68	Avro Aircraft, Aircraft Porous Media		25201

OVERHAUL LIFE: KNOWN- ESTIMATED- 500 hours

FUNCTION

To filter the hydraulic fluid flowing to the aileron actuator.

LOCATION

Forward face of the outer wing rear spar.

ACCESS

MEN X MINUTES

Through the aileron actuator access panel - 106 screws.

REPLACEMENT PROCEDURE

MEN X MINUTES

Position the filter and attach by six attachment bolts.
Connect the hydraulic pipeline.
Connect the hydraulic ground test rig.
Prime the system.

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INSPECTION	MEN X MINUTES	
Check for leakage through the elevator control linkage inspection panels on the upper skin of the control box.		

FUNCTIONAL CHECKS	MEN X MINUTES	

GROUND HANDLING AND GROUND TEST EQUIPMENT

Hydraulic ground test rig.
B4 stand.

SPECIAL TOOLS TO REMOVE OR SERVICE

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INSPECTION	MEN X MINUTES	
Do not inspect unless the main 33 gpm multi-outlet filters show dirt, or trouble is experienced with the aileron actuators or the control valves. The elements may be cleaned and re-used.		

FUNCTIONAL CHECKS	MEN X MINUTES	

GROUND HANDLING AND GROUND TEST EQUIPMENT

Hydraulic ground test rig.
B4 stand.

SPECIAL TOOLS TO REMOVE OR SERVICE

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COMPONENT DATA SHEET

SYSTEM	SUB-SYSTEM	COMPONENT	REF. NO.
FLYING CONTROLS HYDRAULICS		Filter - High Pressure Dual 3.3 gpm	32-12

AVRO PART NO.	MANUFACTURER	MAN'F'R'S PART NO.	AIRCRAFT EFFECTIVITY
7-3283-11	Avro Aircraft. Aircraft Porous Media		25201

OVERHAUL LIFE: KNOWN– ESTIMATED– 500 hours

FUNCTION

To filter the hydraulic fluid flowing to the rudder actuator.

LOCATION

Aft face of spar No. 5 in the vertical stabilizer.

ACCESS — MEN X MINUTES

Through the rudder actuator access door in the vertical stabilizer. 114 screws.

REPLACEMENT PROCEDURE — MEN X MINUTES

Position the filter and attach the mounting bolts.
Connect the four hydraulic pipelines.
Attach the hydraulic ground test rig.
Prime the system.

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INSPECTION	MEN X MINUTES	
Do not inspect unless the main 33 gpm multi-outlet filters show dirt, or trouble is experienced with the aileron actuators or the control valves. The elements may be cleaned and re-used.		

FUNCTIONAL CHECKS	MEN X MINUTES	

GROUND HANDLING AND GROUND TEST EQUIPMENT

Hydraulic ground test rig.
B5 stand.

SPECIAL TOOLS TO REMOVE OR SERVICE

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CF-105 SERVICE DATA

COMPONENT DATA SHEET

SYSTEM	SUB-SYSTEM	COMPONENT	REF. NO.
FLYING CONTROLS HYDRAULICS		Actuator - Aileron	32-13

AVRO PART NO.	MANUFACTURER	MAN'F'R'S PART NO.	AIRCRAFT EFFECTIVITY
7-3264-23 LH, 24 RH	Jarry Hydraulics		25201

OVERHAUL LIFE: KNOWN- ESTIMATED- 500 hours

FUNCTION

Operation of the ailerons.

LOCATION

At the outer wing trailing edge.

ACCESS — MEN X MINUTES

Through the access panel in the outer wing lower skin. 106 screws.

REPLACEMENT PROCEDURE — MEN X MINUTES

Position the actuator at the pivot bearing and attach the actuator to the bearing by four bolts.
Align the piston end of the actuator with the bell crank and insert the bolt.
Connect the four hydraulic pipelines to the actuator.
Connect the electrical cables.
Connect the push rod to the bell crank arm.
Connect the hydraulic ground test rig.
Prime the system.
Function test the actuator.

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INSPECTION	MEN X MINUTES	
Check for security, damage, cracks and leakage.		

FUNCTIONAL CHECKS	MEN X MINUTES	

GROUND HANDLING AND GROUND TEST EQUIPMENT

Hydraulic ground test rig.
Electric ground power unit.
B4 stand.

SPECIAL TOOLS TO REMOVE OR SERVICE

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CF-105 SERVICE DATA

COMPONENT DATA SHEET

SYSTEM	SUB-SYSTEM	COMPONENT	REF. NO.
FLYING CONTROLS HYDRAULICS		Actuator - Elevator	32-14

AVRO PART NO.	MANUFACTURER	MAN'F'R'S PART NO.	AIRCRAFT EFFECTIVITY
7-3262-15	Jarry Hydraulics	1020	25201

OVERHAUL LIFE: KNOWN- ESTIMATED- 500 hours

FUNCTION

Operation of the elevators.

LOCATION

Inboard trailing edge of the L.H. and R.H. inner wing.

ACCESS

MEN X MINUTES

Through the access panel in the upper wing skin - 100 screws.

REPLACEMENT PROCEDURE

MEN X MINUTES

Position the actuator at the pivot bearing and attach the actuator to the bearing by four bolts.
Align the piston end of the actuator with the bell crank and insert the bolt.
Connect the electrical cables.
Connect the four hydraulic pipelines to the actuator.
Connect the push rod to the bell-crank arm.
Connect the hydraulic ground test rig.
Prime the system.
Function test the actuator.

TM1-3413-2-5

INSPECTION	MEN X MINUTES	
Check for security, damage, cracks and leakage.		

FUNCTIONAL CHECKS	MEN X MINUTES	

GROUND HANDLING AND GROUND TEST EQUIPMENT

Hydraulic ground test rig.
Electric ground power unit.
B4 stand.

SPECIAL TOOLS TO REMOVE OR SERVICE

REMARKS

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CF-105 SERVICE DATA

COMPONENT DATA SHEET

SYSTEM	SUB-SYSTEM	COMPONENT	REF. NO.
FLYING CONTROLS HYDRAULICS		Actuator - Rudder	32-15

AVRO PART NO.	MANUFACTURER	MAN'F'R'S PART NO.	AIRCRAFT EFFECTIVITY
7-3283-6	Jarry Hydraulics		25201

OVERHAUL LIFE: KNOWN- ESTIMATED- 500 hours

FUNCTION

Actuation of the rudder.

LOCATION

At trailing edge of the vertical stabilizer.

ACCESS | MEN X MINUTES

Through the access panel in the L.H. side of the vertical stabilizer. 114 x 1/4 inch screws.

REPLACEMENT PROCEDURE | MEN X MINUTES

Position the actuator with its mounting and connect with attachment bolt.
Align the piston end of the actuator with the bell-crank and insert the bolt.
Connect the four hydraulic pipelines to the actuator.
Connect the electrical cables.
Connect the push rod to the bell-crank arm.
Connect the hydraulic ground test rig.
Prime the system.
Function test the actuator.

TM1-3413-2-5

INSPECTION	MEN X MINUTES	
Check for security, damage, cracks and leakage.		

FUNCTIONAL CHECKS	MEN X MINUTES	

GROUND HANDLING AND GROUND TEST EQUIPMENT

Hydraulic ground test rig.
Electric ground power unit.
B4 stand.

SPECIAL TOOLS TO REMOVE OR SERVICE

REMARKS

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CF-105 SERVICE DATA

COMPONENT DATA SHEET

SYSTEM	SUB-SYSTEM	COMPONENT	REF. NO.
FLYING CONTROLS HYDRAULICS		Valve - Elevator Control	32-16

AVRO PART NO.	MANUFACTURER	MAN'F'R'S PART NO.	AIRCRAFT EFFECTIVITY
7-3262-33	Minneapolis Honeywell		25201

OVERHAUL LIFE: KNOWN- ESTIMATED- 500 hours

FUNCTION

To direct the flow of hydraulic fluid to the actuator.

LOCATION

Mounted on the elevator actuator.

ACCESS — MEN X MINUTES

Through the elevator actuator access door.
70 x 1/4 inch N.A.S. screws.

REPLACEMENT PROCEDURE — MEN X MINUTES

Mount the control valve on the elevator actuator and secure with four mounting bolts.
Mount the elevator damping servo
Connect the control valve rod end to the control linkage.
Connect the damping servo rod end to the control linkage.
Install the elevator actuator in to the wing.
Connect the hydraulic ground test rig.
Prime the system.
Function test the system.

TMI-3413-2-5

INSPECTION	MEN X MINUTES	
Check for security, cracks, corrosion, and leaks.		

FUNCTIONAL CHECKS	MEN X MINUTES	

GROUND HANDLING AND GROUND TEST EQUIPMENT

Hydraulic ground test rig.
Electric ground power supply.
B4 stand.

SPECIAL TOOLS TO REMOVE OR SERVICE

REMARKS

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CF-105 SERVICE DATA

COMPONENT DATA SHEET

SYSTEM	SUB-SYSTEM	COMPONENT	REF. NO.
FLYING CONTROLS HYDRAULICS		Valve - Aileron Control	32-17

AVRO PART NO.	MANUFACTURER	MAN'F'R'S PART NO.	AIRCRAFT EFFECTIVITY
7-3264-12	Minneapolis Honeywell		25201

OVERHAUL LIFE: KNOWN- ESTIMATED- 500 hours

FUNCTION

To direct the flow of hydraulic fluid to the actuator.

LOCATION

Mounted on the aileron actuator.

ACCESS

Through the aileron actuator access door - 106 x 5/16 inch screws.

MEN X MINUTES

REPLACEMENT PROCEDURE

MEN X MINUTES

Mount the control valve on the aileron actuator and secure with four mounting bolts.
Mount the aileron damping servo.
Connect the control valve rod end to the control linkage.
Connect the damping servo rod end to the control linkage.
Install the aileron actuator in to the wing.
Connect the hydraulic ground test rig.
Prime the system.
Function test the aileron actuator.

TM1-3413-2-5

INSPECTION	MEN X MINUTES	
Check for security, damage, cracks, corrosion and leaks.		

FUNCTIONAL CHECKS	MEN X MINUTES	

GROUND HANDLING AND GROUND TEST EQUIPMENT

Hydraulic ground test rig.
Electric ground power supply.

SPECIAL TOOLS TO REMOVE OR SERVICE

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CF-105 SERVICE DATA

COMPONENT DATA SHEET

SYSTEM	SUB-SYSTEM	COMPONENT	REF. NO.
FLYING CONTROLS HYDRAULICS		Valve - Rudder Control	32-18

AVRO PART NO.	MANUFACTURER	MAN'F'R'S PART NO.	AIRCRAFT EFFECTIVITY
7-3283-8	Minneapolis Honeywell		25201

OVERHAUL LIFE: KNOWN- ESTIMATED- 500 hours

FUNCTION

To direct the flow of fluid to the rudder actuator.

LOCATION

Mounted on to the rudder actuator.

ACCESS

MEN X MINUTES

Through the rudder actuator access door - 114 x 1/4 inch screws.

REPLACEMENT PROCEDURE

MEN X MINUTES

Mount the control valve on the rudder actuator and secure with four mounting bolts.
Mount the rudder damping servo
Connect the control valve rod end to the control linkage.
Connect the rudder damping servo rod end to the control linkage.
Install the rudder actuator in to the vertical stabilizer.
Connect the hydraulic test rig.
Prime the system.
Function test the rudder actuator.

7-3283-2-5

INSPECTION	MEN X MINUTES	
Check for security, damage, cracks, corrosion and leaks.		

FUNCTIONAL CHECKS	MEN X MINUTES	

GROUND HANDLING AND GROUND TEST EQUIPMENT

Hydraulic ground test rig.
Electric ground power supply.
B4 stand.

SPECIAL TOOLS TO REMOVE OR SERVICE

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CF-105 SERVICE DATA

COMPONENT DATA SHEET

SYSTEM	SUB-SYSTEM	COMPONENT	REF. NO.
FLYING CONTROLS HYDRAULICS		Servo - Elevator Damping	32-19

AVRO PART NO.	MANUFACTURER	MAN'F'R'S PART NO.	AIRCRAFT EFFECTIVITY
7-3260-11			25201

OVERHAUL LIFE: KNOWN- ESTIMATED- 500 hours

FUNCTION

To actuate the elevators in response to rate-gyro signals from the damping system.

LOCATION

Mounted on the elevator actuator.

ACCESS — MEN X MINUTES

Through the elevator actuator access panel - 100 screws.

REPLACEMENT PROCEDURE — MEN X MINUTES

Position the servo on to the control valve and attach by three bolts.
Connect the electrical connector.
Connect the mechanical links using two bolts.
Connect the hydraulic ground test rig.
Prime and function test the elevator hydraulic and electrical system.

TM1-3413-2-5

INSPECTION	MEN X MINUTES	
Check for security, damage, cracks, corrosion and leaks. Check the mechanical connections to the electrical feedback.		

FUNCTIONAL CHECKS	MEN X MINUTES	

GROUND HANDLING AND GROUND TEST EQUIPMENT

Hydraulic ground test rig.
Electrical ground supply unit.
B5 stand.
Wing mats.

SPECIAL TOOLS TO REMOVE OR SERVICE

REMARKS

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CF-105 SERVICE DATA

COMPONENT DATA SHEET

SYSTEM	SUB-SYSTEM	COMPONENT	REF. NO.
FLYING CONTROLS HYDRAULICS		Servo - Aileron Damping	32-20

AVRO PART NO.	MANUFACTURER	MAN'F'R'S PART NO.	AIRCRAFT EFFECTIVITY
7-3260-11			25201

OVERHAUL LIFE: KNOWN- ESTIMATED- 500 hours

FUNCTION

To actuate ailerons in response to rate-gyro signals from the damping system.

LOCATION

Mounted on to the aileron actuator.

ACCESS — MEN X MINUTES

Through the aileron actuator access panel - 106 screws.

REPLACEMENT PROCEDURE — MEN X MINUTES

Position the servo on to the control valve and attach by three bolts.
Connect the electrical connector.
Connect the mechanical links using three bolts.
Connect the hydraulic ground test rig.
Prime and function test the aileron hydraulic and electrical system.

INSPECTION	MEN X MINUTES	
Check for security, damage, cracks, corrosion and leaks. Check the mechanical connections to the electrical feedback.		

FUNCTIONAL CHECKS	MEN X MINUTES	

GROUND HANDLING AND GROUND TEST EQUIPMENT

Hydraulic ground test rig.
Electrical ground supply unit.
B4 stand.

SPECIAL TOOLS TO REMOVE OR SERVICE

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CF-105 SERVICE DATA

COMPONENT DATA SHEET

SYSTEM	SUB-SYSTEM	COMPONENT	REF. NO.
FLYING CONTROLS HYDRAULICS		Servo - Rudder Damping	32-21

AVRO PART NO.	MANUFACTURER	MAN'F'R'S PART NO.	AIRCRAFT EFFECTIVITY
7-3283-7	Minneapolis Honeywell		25201

OVERHAUL LIFE: KNOWN- ESTIMATED- 500 hours

FUNCTION

To actuate the rudder in response to the rate-gyro signals from the damping system.

LOCATION

Mounted on to the rudder actuator.

ACCESS

MEN X MINUTES

Through the rudder actuator access panel on the L.H. side of the vertical stabilizer. 114 x 1/4 inch screws.

REPLACEMENT PROCEDURE

MEN X MINUTES

Position the servo on to the control valve and attach by three bolts.
Connect the electrical connector.
Connect the mechanical links using three bolts.
Connect the hydraulic ground test rig.
Prime and function test the rudder hydraulic and electrical system.

TM1-3913-2-5

INSPECTION	MEN X MINUTES	
Check for security, damage, cracks, corrosion and leaks. Check the mechanical connections to the electrical feedback.		

FUNCTIONAL CHECKS	MEN X MINUTES	

GROUND HANDLING AND GROUND TEST EQUIPMENT

Hydraulic ground test rig.
Electrical ground power unit.

SPECIAL TOOLS TO REMOVE OR SERVICE

REMARKS

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CF-105 SERVICE DATA

COMPONENT DATA SHEET

SYSTEM	SUB-SYSTEM	COMPONENT	REF. NO.
FLYING CONTROLS HYDRAULICS		Servo - Elevator Command	32-22

AVRO PART NO.	MANUFACTURER	MAN'F'R'S PART NO.	AIRCRAFT EFFECTIVITY
7-3262-11	Minneapolis Honeywell	MG55B	25201

OVERHAUL LIFE: KNOWN- ESTIMATED- 500 hours

FUNCTION

To actuate the elevators in response to the signals from the automatic flight control system.

LOCATION

Near the lower wing skin at Station 668.

ACCESS

Through the No. 3 service door - 36 camlocs.

MEN X MINUTES	

REPLACEMENT PROCEDURE

Position the servo and attach using two bolts.
Attach the lever bolt.
Connect the electrical cable.
Connect the two hydraulic pipelines.
Connect the hydraulic ground test rig.
Prime and function test the elevator command system.

MEN X MINUTES	

TM1-3413-2-5

INSPECTION	MEN X MINUTES	
Visual Check for security, damage, cracks, corrosion, leaks and backlash.		

FUNCTIONAL CHECKS	MEN X MINUTES	

GROUND HANDLING AND GROUND TEST EQUIPMENT

Hydraulic ground test rig.
Electrical ground supply unit.
B4 stand.

SPECIAL TOOLS TO REMOVE OR SERVICE

REMARKS

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CF-105 SERVICE DATA

COMPONENT DATA SHEET

SYSTEM	SUB-SYSTEM	COMPONENT	REF. NO.
FLYING CONTROLS HYDRAULICS		Servo - Aileron Command	32-23

AVRO PART NO.	MANUFACTURER	MAN'F'R'S PART NO.	AIRCRAFT EFFECTIVITY
7-3262-11	Minneapolis Honeywell	MG55B	25201

OVERHAUL LIFE: KNOWN- ESTIMATED- 500 hours

FUNCTION

To actuate the ailerons in response to the signals from the automatic flight control system.

LOCATION

Near lower wing skin at Station 697.

ACCESS — MEN X MINUTES

Through the No. 3 service door - 36 camlocs.

REPLACEMENT PROCEDURE — MEN X MINUTES

Position the servo and attach using two bolts.
Attach the lever bolt.
Connect the electrical cable.
Connect the two hydraulic pipelines.
Connect the hydraulic ground test rig.
Prime and function test the aileron command system.

TMT-3413-2-5

INSPECTION	MEN X MINUTES	
Visual Check for security, damage, cracks, corrosion, leaks and backlash.		

FUNCTIONAL CHECKS	MEN X MINUTES	

GROUND HANDLING AND GROUND TEST EQUIPMENT

Hydraulic ground test rig.
Electrical ground supply unit.
B4 stand.

SPECIAL TOOLS TO REMOVE OR SERVICE

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CF-105 SERVICE DATA

COMPONENT DATA SHEET

SYSTEM	SUB-SYSTEM	COMPONENT	REF. NO.
FLYING CONTROLS HYDRAULICS		Heat Exchanger - Oil-to-air	32-24

AVRO PART NO.	MANUFACTURER	MAN'F'R'S PART NO.	AIRCRAFT EFFECTIVITY
7-3256-3	Garrett Corporation		25201

OVERHAUL LIFE: KNOWN- ESTIMATED- 500 hours

FUNCTION

Uses ram air to cool the flying control hydraulic fluid.

LOCATION

Underneath the engines at Station 577/581.

ACCESS

By removing the engine.

MEN X MINUTES

REPLACEMENT PROCEDURE

MEN X MINUTES

Position the heat exchanger and attach using four screws.
Attach the slip joint by four nuts.
Connect the two hydraulic pipelines.
Connect the hydraulic test rig.
Prime the system.
Install the engine.

TMI-3413-2-5

INSPECTION	MEN X MINUTES	
Check for security, damage, corrosion and leaks. Check for any internal leakage by observing the exhaust air exit. Check for obstruction of air flow.		

FUNCTIONAL CHECKS	MEN X MINUTES	

GROUND HANDLING AND GROUND TEST EQUIPMENT

Engine removal equipment.

SPECIAL TOOLS TO REMOVE OR SERVICE

"Wig-o-Flex" tools.

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CF-105 SERVICE DATA

COMPONENT DATA SHEET

SYSTEM	SUB-SYSTEM	COMPONENT	REF. NO.
FLYING CONTROLS HYDRAULICS		Heat Exchanger - Oil-to-fuel	32-25

AVRO PART NO.	MANUFACTURER	MAN'F'R'S PART NO.	AIRCRAFT EFFECTIVITY
7-3256-5, 6	Airesearch	151170	25201

OVERHAUL LIFE: KNOWN– ESTIMATED– 500 hours

FUNCTION

Uses the fuel to cool:
(a) the engine oil.
(b) the gearbox oil and the C.S.U. oil.
(c) the flying control hydraulic fluid.
(d) the utility hydraulic fluid.

LOCATION

Inside the fuselage at Station 538.

ACCESS

MEN X MINUTES

Through the hydraulics access door - 52 camlocs.

REPLACEMENT PROCEDURE

MEN X MINUTES

Position the heat exchanger and attach by one attachment bolt.
Attach the lower fourteen bolts and the six upper bolts at the fuel flange joints.
Connect the flying control hydraulic, the utility hydraulic, the gearbox and C.S.U. and engine oil pipelines to the heat exchanger.
Connect the electrical cables.
Prime all the affected systems.
Refuel the aircraft.

TM1-3433-2-5

INSPECTION	MEN X MINUTES	
Visual. Check for security, damage, cracks, corrosion. Check for internal and external leakage. Carry out a pressure test for any internal leakage.		

FUNCTIONAL CHECKS	MEN X MINUTES	

GROUND HANDLING AND GROUND TEST EQUIPMENT

SPECIAL TOOLS TO REMOVE OR SERVICE

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CF-105 SERVICE DATA

COMPONENT DATA SHEET

SYSTEM	SUB-SYSTEM	COMPONENT	REF. NO.
FLYING CONTROLS HYDRAULICS		Gauge - Sight Bleed	32-26

AVRO PART NO.	MANUFACTURER	MAN'F'R'S PART NO.	AIRCRAFT EFFECTIVITY
CS-G-108			25201

OVERHAUL LIFE: KNOWN– ESTIMATED– 500 hours

FUNCTION

Visual check for air during bleeding of the system.

LOCATION

In the fuselage at Station 644.43.

ACCESS

Through the No. 2 service door - 42 camlocs.

MEN X MINUTES

REPLACEMENT PROCEDURE

MEN X MINUTES

Install the gauge in to the mounting bracket with two bolts.
Connect the hydraulic pipelines to the upper end and to the lower end of the gauge.
Top up the system using the hydraulic hand filling pump.

TMI-3413-2-5

INSPECTION	MEN X MINUTES	
Check for leaks.		

FUNCTIONAL CHECKS	MEN X MINUTES	

GROUND HANDLING AND GROUND TEST EQUIPMENT

Hydraulic hand filling pump.

SPECIAL TOOLS TO REMOVE OR SERVICE

REMARKS

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CF-105 SERVICE DATA

COMPONENT DATA SHEET

SYSTEM	SUB-SYSTEM	COMPONENT	REF. NO.
FLYING CONTROLS HYDRAULICS		Couplings and Caps - Self-sealing	32-27

AVRO PART NO.	MANUFACTURER	MAN'F'R'S PART NO.	AIRCRAFT EFFECTIVITY
Coupling CSC-147-10) 4000 psi Cap CSC-138-10) Coupling CSC-149-12) 1000 psi Cap CSC-139-12)	Aeroquip		25201

OVERHAUL LIFE: KNOWN- ESTIMATED- 500 hours

FUNCTION

Connection points for attaching the hydraulic ground test rig for the ground operation of the flying controls hydraulic system.

LOCATION

On the fuselage at Station 644.43.

ACCESS — MEN X MINUTES

Through the No.2 service door - 42 camlocs.

REPLACEMENT PROCEDURE — MEN X MINUTES

Attach the coupling to the mounting bracket.
Connect the hydraulic pipeline to the coupling.
Connect the hydraulic ground test rig.
Prime the system.

TM1-3813-2-5

INSPECTION	MEN X MINUTES	
Visual check for leaks.		

FUNCTIONAL CHECKS	MEN X MINUTES	

GROUND HANDLING AND GROUND TEST EQUIPMENT

Hydraulic ground test rig.

SPECIAL TOOLS TO REMOVE OR SERVICE

REMARKS

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CF-105 SERVICE DATA

COMPONENT DATA SHEET

SYSTEM	SUB-SYSTEM	COMPONENT	REF. NO.
FLYING CONROLS HYDRAULICS		Indicator - Fluid Level	32-28

AVRO PART NO.	MANUFACTURER	MAN'F'R'S PART NO.	AIRCRAFT EFFECTIVITY
7-3258-145			25201

OVERHAUL LIFE: KNOWN- ESTIMATED-

FUNCTION

To indicate the quantity of hydraulic fluid in the flying control hydraulic system.

LOCATION

On the compensators at Station 644.13.

ACCESS

MEN X MINUTES

Front - Through the No. 2 service door - 42 camlocs.
Rear - Through the No. 3 service door - 28 camlocs.

REPLACEMENT PROCEDURE

MEN X MINUTES

Install the two bolts attaching the lower end of the indicator to the compensator. Install the bolt securing the upper end of the tape to the indicator rod.

TMI-3413-7-5

INSPECTION	MEN X MINUTES	
Check the fluid level. Check the indicator for security and legibility of the scale.		

FUNCTIONAL CHECKS	MEN X MINUTES	

GROUND HANDLING AND GROUND TEST EQUIPMENT

Hydraulic topping filler rig.

SPECIAL TOOLS TO REMOVE OR SERVICE

REMARKS

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CF-105 SERVICE DATA

COMPONENT DATA SHEET

SYSTEM	SUB-SYSTEM	COMPONENT	REF. NO.
FLYING CONTROLS HYDRAULICS		Thermometer - Fluid Temperature	32-29

AVRO PART NO.	MANUFACTURER	MAN'F'R'S PART NO.	AIRCRAFT EFFECTIVITY
7-3258-327			25201

OVERHAUL LIFE: KNOWN- ESTIMATED- 500 hours

FUNCTION

Indicates the temperature of fluid in the hydraulic systems.

LOCATION

In the fuselage at Station 644.

ACCESS

MEN X MINUTES

Flying control hydraulics - Through the No. 2 service door - 42 camlocs.

REPLACEMENT PROCEDURE

MEN X MINUTES

Locate the thermometer on to the hydraulic pipeline.
Clamp the thermometer by bolts on to the hydraulic pipelines.

7M1-3413-2-5

INSPECTION	MEN X MINUTES	
Check the temperature for comparison with the fluid level indicator. Check the thermometer for security, damage, and legibility of the scale.		

FUNCTIONAL CHECKS	MEN X MINUTES	

GROUND HANDLING AND GROUND TEST EQUIPMENT

SPECIAL TOOLS TO REMOVE OR SERVICE

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