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72/PROJ 7/13

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AVRO AIRCRAFT LIMITED

ARROW 2 CONTROL BOXES

DEVELOPMENT PROGRAM PROGRESS REPORT

Prepared by Arrow 2 Project Office

Date: July 11th 1958

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## 1.0 INTRODUCTION

A Report # 72/PROJ 7/3 dated May 1st 1958 was issued to discuss the life philosophy that has been adopted for the control box mechan-isms and to outline the Development Program required to establish the required level of performance.

This report is issued to cover the progress made on the Develop-ment Program up to the end of June 1958.

## 2.0 PROGRESS REPORT ON THE DEVELOPMENT PROGRAM

### 2.1 Summary

Due to the short period of time between the issue of the original report and this document, significant progress has only been made on two items, and these are discussed further in paras. 2.2 and 2.3.

The details for the running of the 200 hour duty cycles tests have been established, however before these tests can commence the B1 rig has to undergo a program of upgrading to be made more representative of the current aircraft system, i.e. steel instead of aluminium bellcrank levers. However, this mod-ification program is held up due to the B1 rig having to be constantly available for use on other programs associated with the early Arrow 1 aircraft.

Flying Control Improvement

### 2.2 Structures

#### 2.2.1 Control Box Structures

Further checks have been made by Quality Control Inspection during the build of the 3rd and 4th Arrow 1 airframes and these checks confirm the statements already made that interchangeability at the control box joints is virtually impossible.

#### 2.2.2 Fatigue Testing

45 specimens of the Elevator Hinge Joint have been ordered and testing has started, 2 static loadings are complete and 3 fatigue tests have been done using loads varying from 21% to 70% of ultimate.

continued/

2.2.2 Continued/

The R.T.'s have been issued for testing joints with increased hole tolerances .32 specimens representative of the Aileron Rear Spar joint have been ordered and are now in the process of manufacture.

A fatigue test has been called up for the elevator on the Static Test aircraft. This test involves applications of full limit load and will be done after completion of the landing gear spring back case. This will test elevator structure, hinge joint, control box structure and control box to spar joint, but not the flying control linkages.

2.3 Investigation into Maintenance Simplification

Our first approach to this problem has been concerned with investigating methods of simplifying the greasing tasks on the control boxes.

It is felt that if this task could be simplified to the state where all greasing points were on the surface of the control boxes, and were accessible without removing structure or fairings, the prime concern of the dangers associated with entry into the boxes for greasing would no longer be valid. The length of time required to perform the greasing task would also be considerably shortened and if after investigation, it is still found that the period between greasing cannot be lengthened, this simplification would overcome the Maintenance Appraisal Teams present objections.

On all three boxes the present solution has been to group the greasing points on the box skin connected to the bearing greasing point by a small dia flexible nylon tube. Each of the three boxes are discussed in more detail in subsequent paragraphs.

continued/

2.3.1 Elevator Control Box

A print of the scheme applicable to this box, # 7-0115-517 is enclosed with this report.

A section through the box at # 2 lever is given as typical for all levers, the section at each being constant, and shows the two internal greasing points connected to adjacent fittings on the top skin of the box. The top skin in this case has been chosen as the bottom skin of the box is removeable in situ and it is undesireable to have the greasing points complicating this feature.

Being on the top skin the grease nipples would be susceptible to dirt accumulation so they have been sunk into the skin and are covered by a "DOT" Plug Button which would be removed by a small screwdriver when greasing was in progress.

The main lever pivot bolt, which is greased from the top skin, and the attachment between elevator and link rod which is accessible by moving the elevators to the maximum UP position, remain unchanged.

2.3.2 Aileron Control Box

A print of the scheme applicable to this box, # 7-0115-518, is enclosed with this report.

A section through the box at the outboard lever # 7 is given, this being the thinnest section, and is similar for other levers except that they would have more clearance. The section shows the four internal greasing points connected to adjacent fittings on the top skin of the box. The top skin in this case has been chosen to avoid the removeable bottom link fairings.

The actual grease nipple is buried and covered as per the elevator control box.

2.3.3 Rudder Control Box

A print of the scheme applicable to this box, # 7-0115-519, is enclosed with this report.

2.3.3 Continued/

The scheme shows the method of connecting the various internal lubrication points to fittings on the skin. In this case, the grease nipples are not buried or covered as per the other boxes due to being in a vertical plane, and thereby less likely to be affected by dirt, however, the buried feature could be introduced if desired.

2.3.4 Conclusions

Advantages:

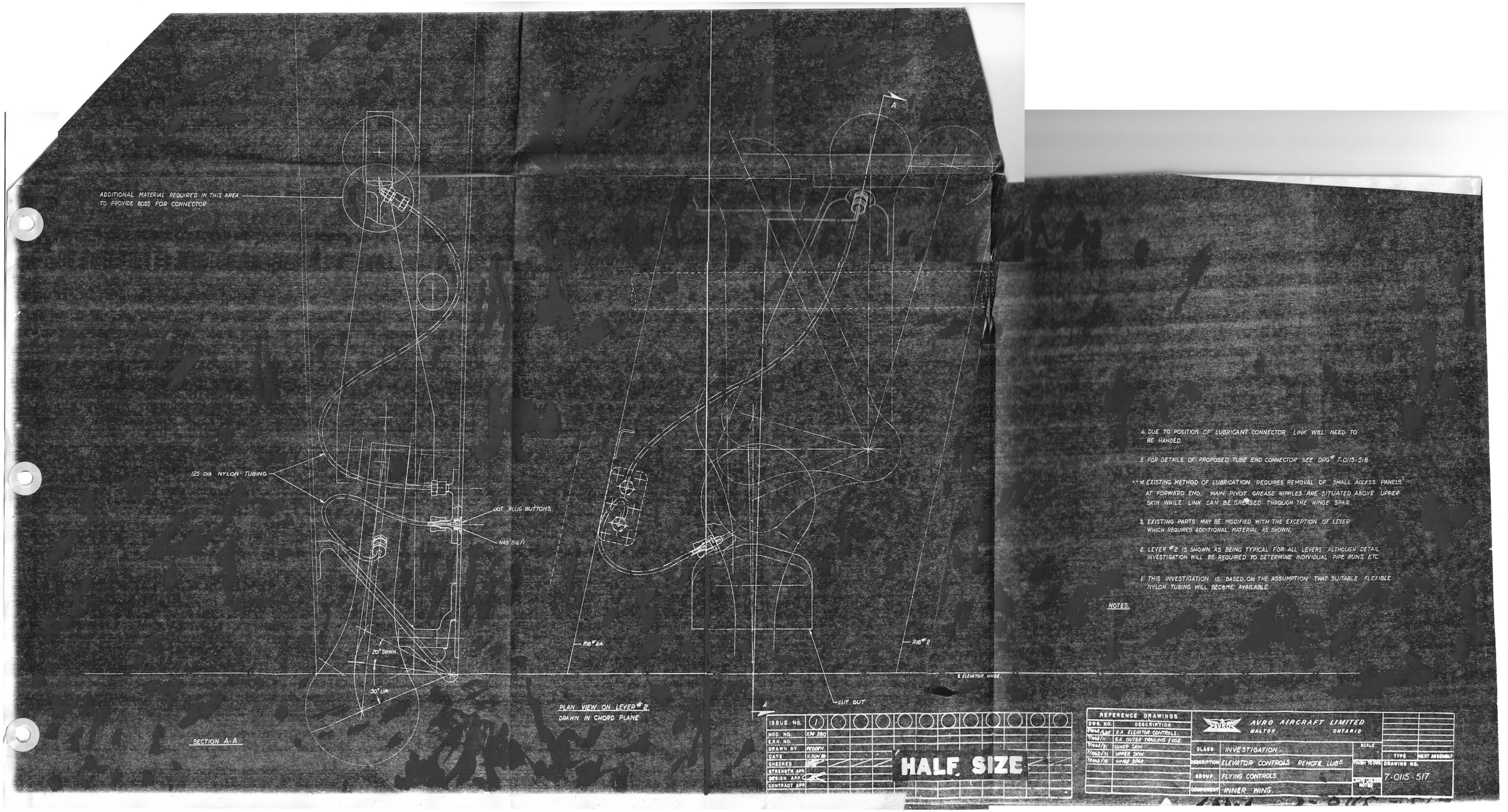
Ease of access to greasing nipples, no access required into control boxes, or removal of any structure to perform a greasing task.

Disadvantages:

No view of bearings when greasing is being done, therefore impossible to be sure that grease has reached the bearing, possibility of blocked or broken pipes greasing pipes going undetected until an internal inspection of the box is made.

Weight increase yet to be determined.

If the philosophy of this suggested change is adopted by the RCAF, a development and test program will be needed before it can be applied to an aircraft. This will ensure the satisfactory operation of the system, establish greasing proc-edures and confirm that through all ranges of travel the greasing pipes are free from snags and abrasion. It is desireable that comments on the above proposal be forthcoming as soon as possible, so that engineering work may proceed with the view to performing the test program on the B1 rig and clearing the system for incorporation in as early an aircraft as possible.




6. DUE TO POSITION OF LUBRICANT CONNECTOR LINK WILL NEED TO BE HANDED.

5. FOR DETAILS OF PROPOSED TUBE END CONNECTOR SEE DRG# 7-0115-518.

** 4. EXISTING METHOD OF LUBRICATION REQUIRES REMOVAL OF SMALL ACCESS PANELS AT FORWARD END. MAIN PIVOT GREASE NIPPLES ARE SITUATED ABOVE UPPER SKIN WHILE LINK CAN BE GREASED THROUGH THE HINGE SPAR.

3. EXISTING PARTS MAY BE MODIFIED WITH THE EXCEPTION OF LEVER WHICH REQUIRES ADDITIONAL MATERIAL AS SHOWN.

2. LEVER # 2 IS SHOWN AS BEING TYPICAL FOR ALL LEVERS ALTHOUGH DETAIL INVESTIGATION WILL BE REQUIRED TO DETERMINE INDIVIDUAL PIPE RUNS ETC.

1. THIS INVESTIGATION IS BASED ON THE ASSUMPTION THAT SUITABLE FLEXIBLE NYLON TUBING WILL BECOME AVAILABLE.

NOTES:

| ISSUE NO. | 1 |
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| MOD. NO. | XM 380 |
| E.N. NO. | |
| DRAWN BY | PEOOPN. |
| DATE | 11 JUN 58 |
| CHECKED | |
| STRENGTH APP. | |
| DESIGN APP. | |
| CONTRACT APP. | |

HALF SIZE

| REFERENCE DRAWINGS | |
|---|---|
| DWG. NO. | DESCRIPTION |
| 7/0627/AAE | G.A. ELEVATOR CONTROLS |
| 7/0627/11 | G.A. OUTER TRAILING EDGE |
| 7/0627/21 | LOWER SKIN |
| 7/0627/31 | UPPER SKIN |
| 7/0627/41 | HINGE SPAR |

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| | |
|---|---|
| CLASS | INVESTIGATION |
| DESCRIPTION | ELEVATOR CONTROLS - REMOTE LUB** |
| GROUP | FLYING CONTROLS |
| COMPONENT | INNER WING |

SCALE
TYPE
PRINT ASSEMBLY
PRINT TO DWG
DRAWING NO. 7-0115-517

ADDITIONAL MATERIAL REQUIRED IN THIS AREA TO PROVIDE BOSS FOR CONNECTOR

NAS 516/1

MS 20426 AD4

NYLON TUBING .125 DIA X .022 WALL (TYPICAL)

'DOT' PLUG BUTTONS

VIEW ON ARROW B

REAR SPAR DATUM

A

B

LOWER SKIN CUT-LINE

RIB #7A DATUM

RIB #7 DATUM

HINGE PLANE

℄ OF UPPER FAIRING

SECTION A-A

TUBING OMITTED FOR CLARITY

A

℄ OF LOWER FAIRING

PLAN VIEW ON LEVER #7

DRAWN IN PLANE OF SYMMETRY

.50

.31

.19

.06

¼ - 28 UNF. THREAD

.06 DIA

20° INC.

.88

PROPOSED TUBE END CONNECTOR

SCALE 4/1

5. DUE TO POSITION OF LUBRICANT CONNECTOR, LINK WILL NEED TO BE HANDED.

4. EXISTING METHOD OF LUBRICATION REQUIRES REMOVAL OF LOWER FAIRINGS ATTACHED BY MAXIMUM OF 15 COUNTERSUNK SCREWS.

3. EXISTING PARTS CAN BE MODIFIED WITH THE EXCEPTION OF LEVER WHICH REQUIRES ADDITIONAL MATERIAL AS SHOWN.

2. LEVER #7 IS SHOWN AS BEING TYPICAL FOR ALL LEVERS ALTHOUGH DETAIL INVESTIGATION WILL BE REQUIRED TO DETERMINE INDIVIDUAL PIPE RUNS ETC.

1. THIS INVESTIGATION IS BASED ON THE ASSUMPTION THAT SUITABLE FLEXIBLE NYLON TUBING WILL BECOME AVAILABLE.

NOTES

ISSUE NO | DESCRIPTION

HALF SIZE

REFERENCE DRAWINGS

A.V.R. AVRO AIRCRAFT LIMITED MALTON ONTARIO

CLASS INVESTIGATION

AILERON CONTROLS - REMOTE LINK

GROUP FLYING CONTROLS

SCALE FULL SIZE

DRAWING NO. T-0115-518

TYPE

NEXT ASSEMBLY

FIN 2

FIN 1

SPAR 2 DATUM

SECTION A-A
TYP FOR LEVERS

SECTION C-C
TYP FOR LINKS

SECTION B-B

DETAIL OF BOW ATT.
FULL SIZE

DETAIL OF SKIN ATT
FULL SIZE

HALF SIZE

4. ALL SKID LUBRICATION POINTS OF THIS INVESTIGATION ARE ATTACHED TO EXISTING DETACHABLE PLUGS, THESE WOULD REQUIRE MODIFICATIONS.

3. IT SHOULD BE POINTED OUT, THAT AT PRESENT LUBRICATION POINTS IN THE RUDDER CONTROL BOX ARE MODERATELY ACCESSABLE, WITH THE EXCEPTION OF THE POINT AT THE RUDDER JACK ②, WHICH NECESSITATES THE REMOVAL OF RUDDER JACK ACCESS DOOR.

2. DANGER EXISTS IN THAT THE TUBE MAY BECOME LODGED BEHIND ONE OF THE MANY HI-SHEAR PINS USED IN THE CONSTRUCTION OF CONTROL BOX, ALSO AS THE CONTROLS ARE ACTUATED, THE LUBRICATION TUBE WILL IN PLACES, RUB LIGHTLY ON THE STRUCTURE.

1. THIS METHOD OF LUBRICATION IS SUBJECT TO OBTAINING ¼" OD FLEXIBLE NYLON TUBE.

NOTES

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| MOD NO. | |
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| REFERENCE DRAWINGS | |
|---|---|
| DWG. NO. | DESCRIPTION |

AVRO AIRCRAFT LIMITED
MALTON ONTARIO

| | |
|---|---|
| CLASS | INVESTIGATION |
| DESCRIPTION | METHOD TO SIMPLIFY LUB'N OF |
| GROUP | RUDDER BEARINGS |
| COMPONENT | FIN |

SCALE: FULL
TYPE: NEXT ASSEMBLY
DRAWING NO.: 7-015-519