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C-105 COMPLETE AIRCRAFT SLING  
LOG/105/48

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C-105 COMPLETE AIRCRAFT SLING

LOG/105/48

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ENGINEERING DIVISION

AVRO AIRCRAFT LIMITED, MALTON, ONTARIO

## C-105 COMPLETE AIRCRAFT SLING

### Introduction

The R.C.A.F. have requested that a sling, capable of lifting the C-105 aircraft as a whole is provided as a part of the ground servicing equipment. It is intended that the sling shall be used in conjunction with a heavy mobile crane, such as the "Le Tourneau Retriever", which is currently being considered by the R.C.A.F. as standard salvage equipment.

The sling has been designed to hoist the aircraft from the various attitudes which would result from the failure of one or more undercarriage legs, or from a belly landing.

The equipment is primarily intended as a means of rapidly removing a crashed aircraft from an operational runway with a minimum of further damage.

The object of this report is to discuss the configuration of the equipment and its application. This is presented under the following headings.

- (1) Description Of Sling.
- (2) Aircraft Slinging Points
- (3) Slinging Procedure
- (4) Equipment
- (5) Drawing References - (a) Sling - 7-2700-6  
(b) Relationship of Sling And Aircraft - 7-4427-80  
(c) Rear Slinging Points - 7-4427-81

#### (1) Description Of Sling

Originally, consideration was given to a sling designed in the form of a rigid "T" shaped frame, the longitudinal beam of which was 28 feet long and the lateral beam 25 feet long. The disadvantages of this scheme were its weight, difficulty of providing an efficient transport joint between the main beams, and counter balancing so that the sling remained in a horizontal attitude when being offered up to the aircraft.

(1) Description Of Sling Cont'd.....

Alternative schemes have been considered, of which the proposal outlined below is thought to offer the best solution.

The proposed sling is made of the following components:-

A longitudinal boom, 24 feet in length, constructed from 4 aluminum corner angle sections, braced on all sides by secondary angle pieces and two lateral booms of 13 1/2 feet in length of similar construction.

The lateral booms are connected to one another and to the longitudinal boom by means of a "Finger" joint which incorporates a large diameter bolt for bearing purposes. By using this form of construction, the lateral booms may be swung aft until the sling takes up the form of a "Y", thus the over-balanced condition can be overcome by transferring the C/G of the sling until it coincides with the centre of the lifting shackle. A suitable arrangement of locking the lateral booms in their aft position will be provided to ensure the C/G of the sling remains fixed during the first stage of assembling it to the aircraft.

Lifting cables are attached to the extreme ends of each boom and terminate in a three point cable yoke, attached to the lifting shackle. At the forward end of the longitudinal boom, two vertical angles form the anchorage for a lifting shackle, over which the spliced end of the lifting cable is threaded. The lateral booms are also fitted with vertical angles at their extreme ends, in the latter case, a spool is bolted between them over which the spliced ends of the cables are placed.

It should be noted that two cables are required on either side of the cable yoke for attachment to the ends of the lateral booms, to cater for the high loads encountered at these points.

(1) Description Of Sling Cont'd.....

A vertical strut, in the form of a tube, connects the cable yoke to the boom and ensures the assembly remaining rigid during attachment of the sling to the aircraft. The strut is also intended to take out any vertical component loads occurring at this point, during lifting operations.

The forward lifting point on the longitudinal boom consists of an angle section yoke, suitably braced, on the ends of which are secured two 5/8 inch lifting chains, complete with the screwed attachment fittings for connection to the aircraft.

An out of balance support is located on the forward end of the boom and consists of rubber covered tubes which rest on the fuselage either side of the dorsal fin.

As previously mentioned, the lateral booms are fitted with vertical angle sections at their extreme ends. A second spool is inserted between the angles and secured by a bolt to carry the lower lifting cables. The cables are manufactured with spliced ends, one of which is threaded over the aforementioned spool, the other terminating in a metal strap fitting, for attachment around the main undercarriage pivot shaft on the aircraft.

The estimated weight of the proposed sling is 1,000 pounds, for the general arrangement, see drawing 7-2700-6.

(2) Aircraft Slinging Points

Forward Lifting Points.

The forward lifting points are machined from a solid aluminum alloy bar, and are located 26.25 inches on either side of the aircraft centre line, and at station 255.0 The block is bored and fitted with a steel insert at the top.

Forward lifting Points Cont'd....

end of the bore, and threaded at the lower end to receive the lifting adaptor, attached to the sling.

For attachment details, see drawing No. 7-4427-80

Rear Slinging Points

In the interest of weight saving, it has been agreed by the R.C.A.F. Maintenance Sub-committee to omit special lifting points in the vicinity of the main undercarriage of the aircraft, and to use the main undercarriage pivot shafts for this purpose. This method necessitates cutting a hole in the upper wing skin, directly above the point of lift on the pivot shaft, for attachment of the sling. As the sling may be required to salvage an aircraft that has made a landing with the undercarriage retracted, and with the undercarriage doors closed, the hole in the skin will need to be of sufficient area to allow the lifting strap to be inserted and manoeuvred around the shaft from above. It would seem the hole requires to be approximately 13 inches by 6 inches, to ensure easy access. Directly above the pivot shaft centre line and rivetted to the outer wing skin is a stiffening member in the form of two light channel sections, placed back to back on the lower flange of which is rivetted the wheel well inner skin, which extends over the rear portion of the cut out area. It will be necessary to cut through the channel members and into the inner skin for an approximate distance of 7.0 inches. (Note: This cut is part of and will be made at the same time as the 13 inch cut in the outer skin). At this stage, the portion of outer skin, channel section, and inner skin, may be removed in one piece. It will also be necessary to remove two hydraulic

Rear Slinging Points Cont'd...

pipes, either by cutting them away, or by disassembling them from the swivel couplings at the one end and the hydraulic transfer valve at the other.

When this is done, the metal lifting strap may be inserted and connected to the cable on the sling.

It is proposed to clearly mark on each upper wing surface, the area of skin to be removed.

For illustration of rear lifting points, see drawing No. 7-4427-81

(3) Slinging Procedure

3.1 Preparation Of Rear Lifting Points.

- (a) Drill hole in each corner of portion of skin to be removed.
- (b) Using reciprocating saw, with blade set to specified depth, cut along boundary lines marked on upper wing surface from corner to corner.
- (c) Remove section of skin, complete with stiffener and inner skin.
- (d) Cut or remove two hydraulic pipes to give access to undercarriage pivot shaft.
- (e) Insert lifting strap and manoeuvre into position ready for attachment to slinging cables.

3.2

- (a) With lateral booms of sling in aft position, lift the sling over the aircraft and attach the forward slinging adaptors to the forward pick up points on the aircraft.
- (b) Slacken off the holding device between the lateral booms and carefully swing booms into line with the rear lifting points on the aircraft.

Note: As the booms swing forward, the forward end of the longitudinal boom will tend to drop, due to over-balance, and the support cradle will rest on the aircraft fuselage.

- (c) Lower the sling until the rear attachment can be made to the lifting straps over the undercarriage pivot shaft, and insert the pins provided.
- (d) Take up the slack in the cable and check that the sling is correctly positioned above the aircraft to ensure no swinging occurs when the weight of the aircraft is taken by the crane. The aircraft is now ready for lifting.

4. Equipment

It is proposed to provide a salvage kit comprising an electric drill and a reciprocating saw which may be driven from an electrical power take-off on the salvage crane. The equipment will require to be compatible with the power available from the crane.



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