SHADOW D - SERIES

CONSTRUCTION MANUAL

WINGS CONSTRUCTION

SERIES D-D

WINGS - CENTRE SECTION - BOOM

GENERAL DESCRIPTION

The wings and centre section are supplied with the Main Spar and leading edge 'D' Section completed.

The trailing ribs and rear spar are constructed from foam covered fibreglass.

Flaps and Ailerons are fabricated from pre-cut and shaped aluminium parts which are then rivetted together. Wing tips are provided as moulded items.

The structure comprises a cantilever wing with the addition of struts.

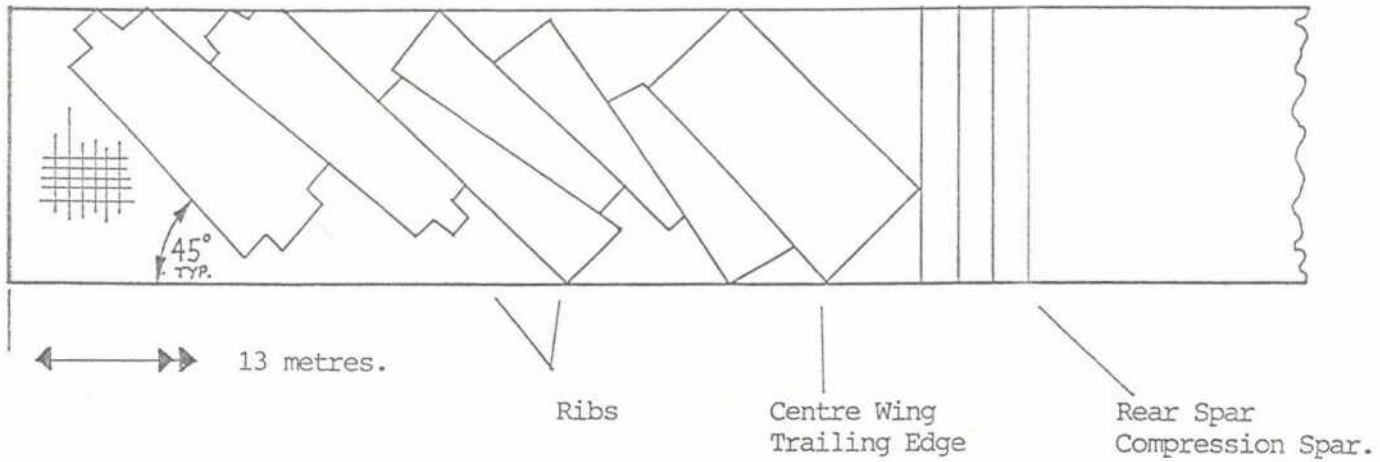
On completion it is covered with polyester fabric suitably doped.

The wings should be coloured only in a light shade (e.g. white) to eliminate heat build-up in high ambient temperatures. Remember paint is heavy so try to keep the colouring to a minimum.

When you have decided on the type of paint you require you MUST consult with CFM Metal-Fax Ltd. prior to proceeding with the covering and painting. (See page 5-13)

GLASS FIBRE CUT-OUT PATTERN

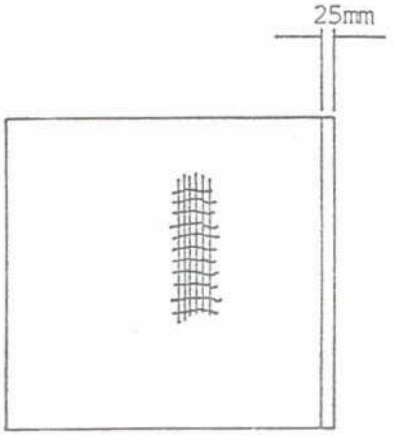
BI-DIRECTIONAL GLASS CLOTH (BID)



(Keep all spare glass for corners and minor items.)

UNI-DIRECTIONAL CLASS CLOTH (UND)

Pull one longitudinal strand out at 25mm and cut off with scissors.



WING – FIBREGLASSING PROCEDURES

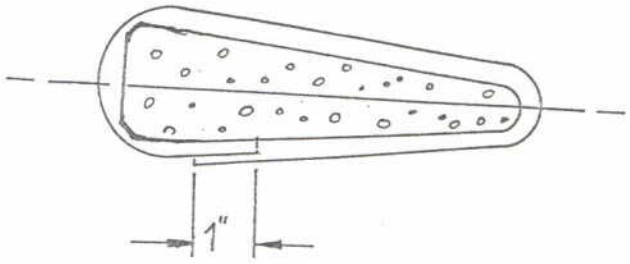
UNI-DIRECTIONAL CLOTH
BI-DIRECTIONAL CLOTH

PART No.	QTY.	PART DESCRIPTION	NOTE	PROCESS REF.
W201	2	Drag Spar	BOND	1.9
W196	2	T/E Centre Wing		
W197	1	Compression Strut cut into 3 parts later	BOND GLASS	1.9 3

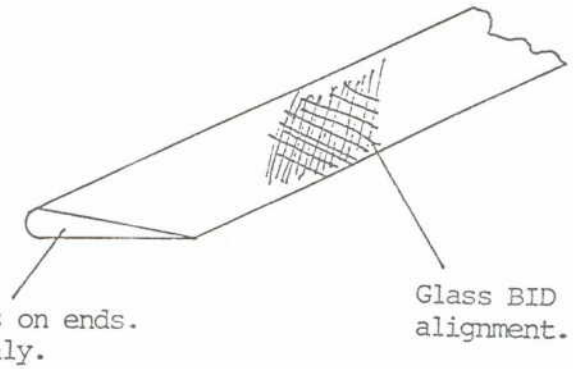
W201 - Drag Spar, W197 - Compression Strut Centre Wing and W196 -T.E. Centre Wing are glassed and cured before being fitted.

Cure on a flat surface, making sure the glass does not adhere to it. (eg. polythene surface)

T/E CENTRE WING - W196 (Glass before fitting)



OVERLAP



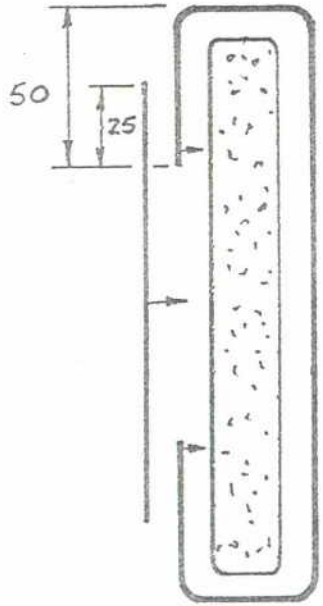
No glass on ends.
Epoxy only.

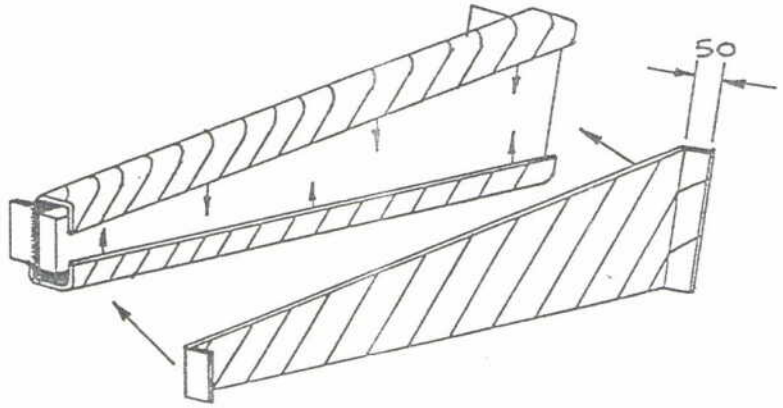
Glass BID alignment.

WING - FIBREGLASSING PROCEDURES

RIBS - W195 and W199 (Bonded in place)

Lay-ups on each side of the ribs form a sandwich construction which gives the required strength and rigidity. BID is applied at 45 degrees to the vertical on the ribs and wrapped around as shown below. An additional layer is added to the other side, ensuring that at least 2" is overlapped onto the rear face of the SHEARWEB either side of the rib and well adhered. A 2" overlap is similarly applied to the underside of the rear spar.

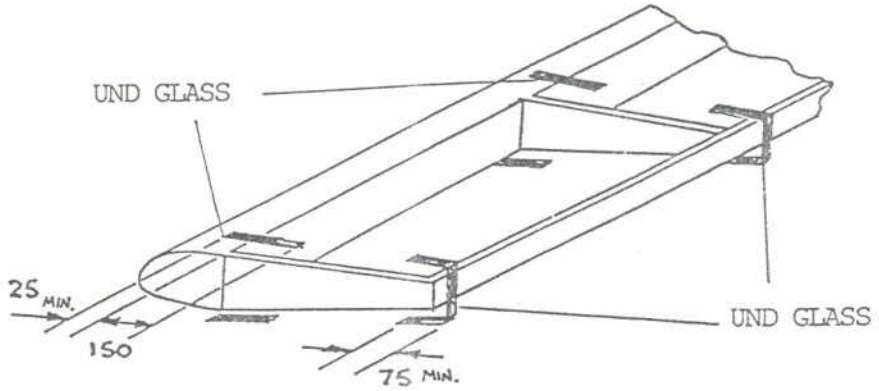




WING - FIBREGLASSING PROCEDURES

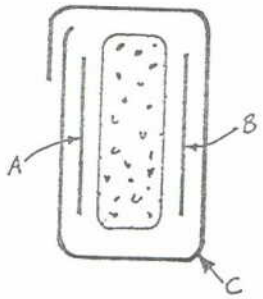
After curing, apply UNI-DIRECTIONAL cloth to the rib/shearweb as indicated.

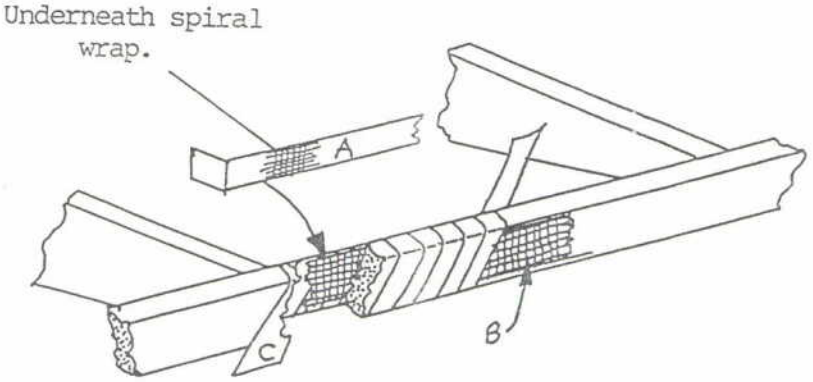
Glass on two UND straps to W199-1 only after assembly has cured and where indicated on Page No. 4-17



REAR SPAR - W200

After the ribs are glassed, the rear spar is spirally wrapped along its length with BID tape - CM91 - over a CAPPING of BID. This comprises of one lay-up of BID applied to the front and rear faces of the spar. The spar is then immediately wrapped spirally at 45 degrees to its length, overlapping by 60%.





WING - FIBREGLASSING PROCEDURES

DRAG SPAR - W201 and COMPRESSION STRUT - W197 (Before fitting)

Both the Drag Spar and the Compression Strut are spirally wrapped, at 45 degrees to their length, with BID tape - CM91, overlapping by 60%. See Rear Spar procedure for spiral wrap.

DRAG SPAR BID REINFORCING STRIPS

INSTALLATION OF DRAG SPARS:

After main assembly has cured, cut out the obliquely marked holes in Rib W199-2.

Bond into position the drag spars.

When cured, glass on the BID reinforcement strips as illustrated.

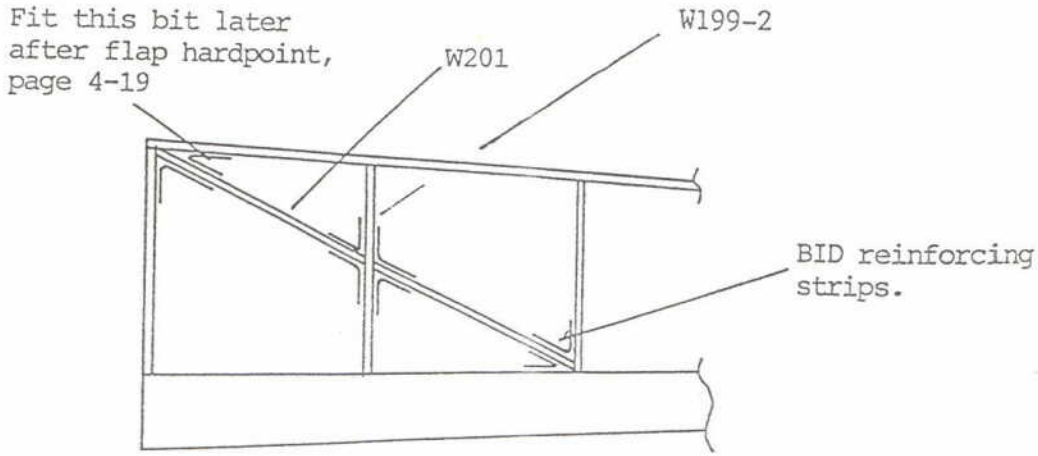


FIGURE 19

WING ASSEMBLY

RIBS
REAR SPAR

PART No.	QTY.	PART DESCRIPTION	NOTE	PROCESS REF.
W100	1	Wing Assy. Centre		
W242	2	Wing Assy. Outer	1LH/1RH	
W106	4	Wing Pin		
W195	4	Rear Rib Centre Wing	BOND	1.9
W199	12	Rear Rib Outer Wing	BOND	1.9
W200	2	Rear Wing Spar	BOND	1.9
W196	1	T.E. Centre Wing	BOND	1.9

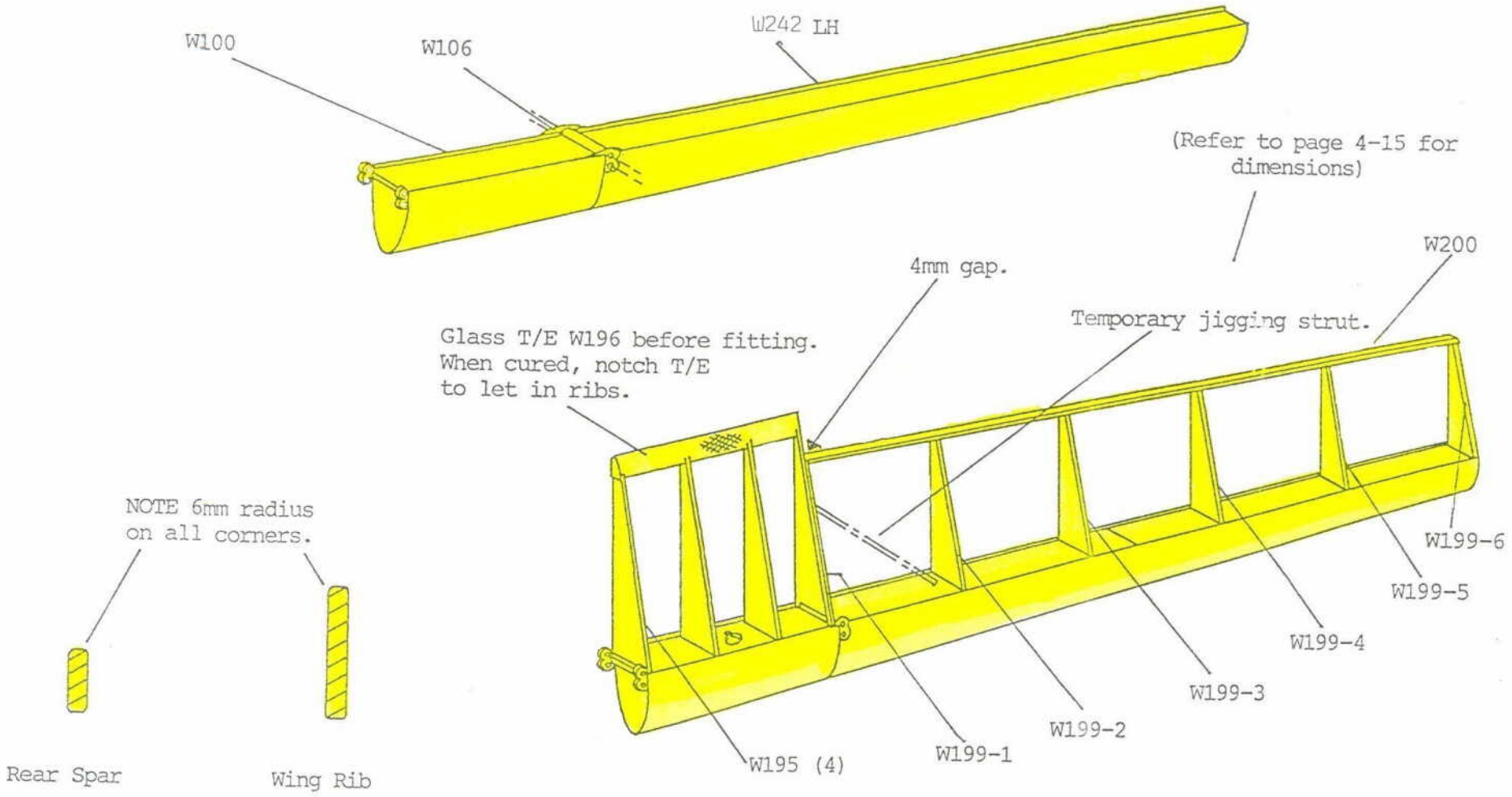
THIS PROCEDURE DETERMINES THE SYMMETRY OF THE WINGS. TAKE YOUR TIME AND BE SURE OF ALIGNMENT.

W196, Centre Wing T.E., W197, Compression Strut Centre Wing and W201, Drag Spar are glassed and cured before being fitted. See PROCESS SHEET No. 3 and ensure ALL foam edges are radiied to 6mm.

Attach the Centre Wing to the Outer Wing, making sure that they are flush at all touching points.
The Ribs are supplied cut to the exact size, fit these vertically from the 'D' section and check for alignment and symmetry.
Space the outer W195 and inner W199 at 4mm. When bonding, use a temporary jigging strut to keep the outer W199 at 90 degrees to the Shear Web.
Bond on the Rear Spar, W200, and ensure that it is PARALLEL to the main spar CENTRELINE.

When cured, the Centre Wing will be glassed and the Boom installed to form a rigid structure. The outer wings will then be glassed and the Centre Wing mated to the outer wing to determine the length of the Drag Spar, which is then bonded into position. When the Drag Spar has cured, the Wing Tips, W203, are bonded on to the outer wings to complete the rigid structure of the outer wings.

FIGURE 19


W100
W106
W242 LH
(Refer to page 4-15 for dimensions)
W200
4mm gap.
Temporary jigging strut.
Glass T/E W196 before fitting.
When cured, notch T/E
to let in ribs.
NOTE 6mm radius
on all corners.
W199-6
W199-5
W199-4
W199-3
W199-2
W199-1
W195 (4)
Rear Spar
Wing Rib

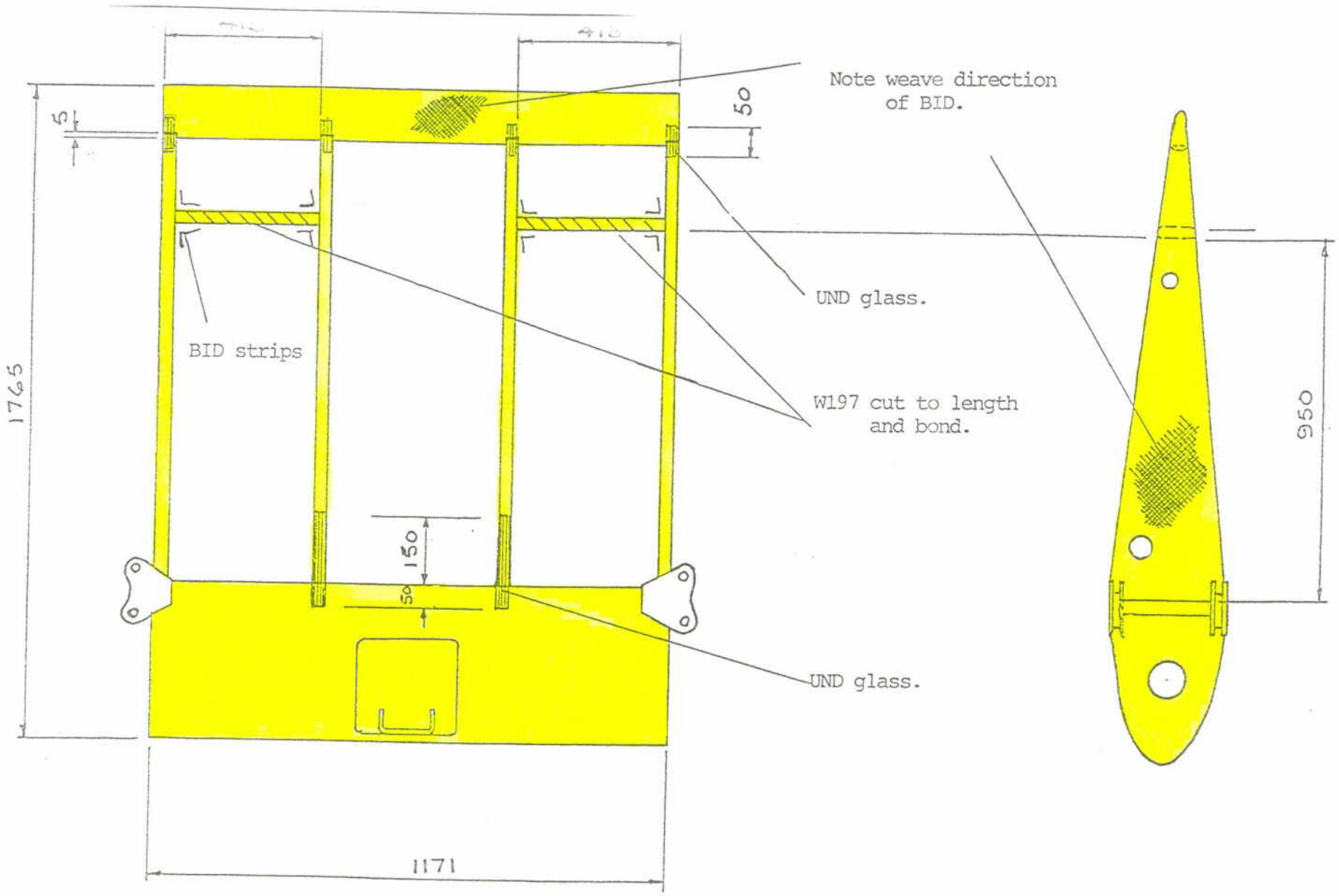

Note weave direction
of BID.
50
5
UND glass.
BID strips
W197 cut to length
and bond.
1765
150
50
UND glass.
950
1171

FIGURE 21

BOOM INSTALLATION

PART No.	QTY.	PART DESCRIPTION	NOTE	PROCESS REF.
W213	1	Cover Centre Wing	*1	
W125	2	Torque Plate Wing	BOND	1.2
W192	2	Torque Pin Wing	BOND	1.2
W106	4	Wing Pin		
F220	2	Boom/Key Stop		
W197	1	Compression Strut		
F263	1	Plate Boom Support	BOND GLASS	1.2 3
F262	1	Boom Support Rear		
W149	3	Horn Flap		
W191	4	Rib Cap Centre Wing	BOND GLASS	1.2 3
W144	1	Torque Tube Flap		
F373	1	Boom Tube		
F153	2	Bracket Hanger Tube		

PAINT BOOM BEFORE INSTALLATION.

(Do NOT paint the front 430mm)

NOTE *1 - Bond on only after INSPECTION

BOOM/KEY STOPS

Trial fit boom to centre section, bolt and secure. Put a tube/straight edge through the tailplane location holes in the boom and from the front or rear of the assembly, ensure that the centre section is parallel to the tailplane location holes. Fit the upper Key stop and rivet, making sure it butts to the shearweb. Mark for the lower Key stop and remove boom and install and rivet the Key stop halfway through the shearweb.
Fit lower Key halfway through shearweb drill/rivet rear holes. Remove boom, complete riveting.

Refit the boom for the final inspection.

FIGURE 21

BOOM INSTALLATION

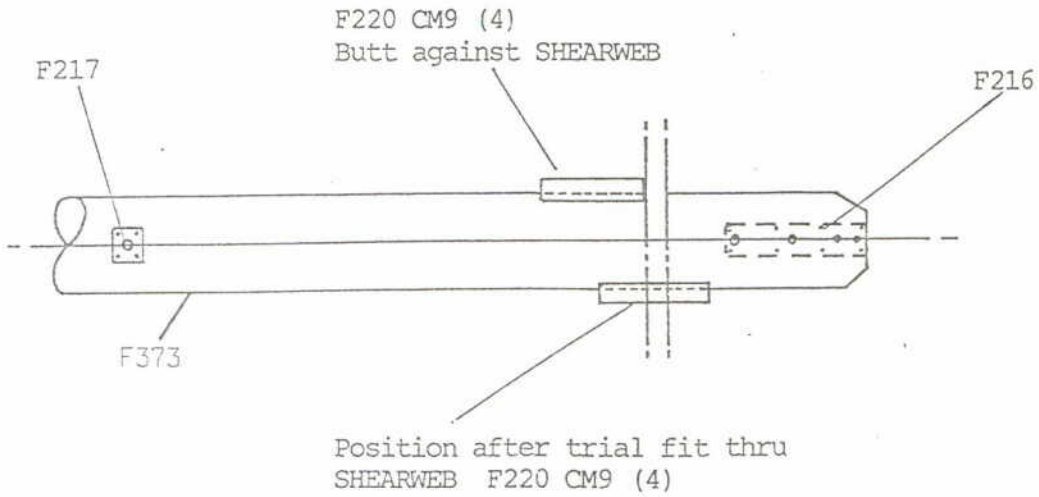
Make two holes through the centre section inner ribs either side of the location for the boom stud, for spanner/socket access in the future.

Bond together W197 (which is glassed) and F263. When cured spiral wrap with BID.

When cured rivet Boom Support Bracket F262 central on compression strut W197/F263.
Bond assembly in position onto ribs. When cured centralise rear ribs/trailing edge to boom and rivet F262 to boom.
Glass compression strut to ribs using BID strips - see page 4-9.

After bonding in place the bearings CM36, drill and bolt the (3) flap horns, W147, in line with each other.

Position bond and when cured, lay-up BID cloth over the Rib Caps, W191.



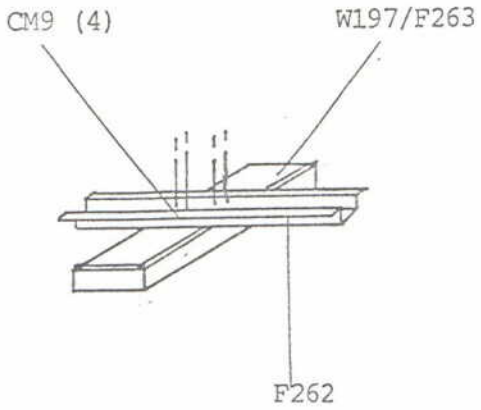
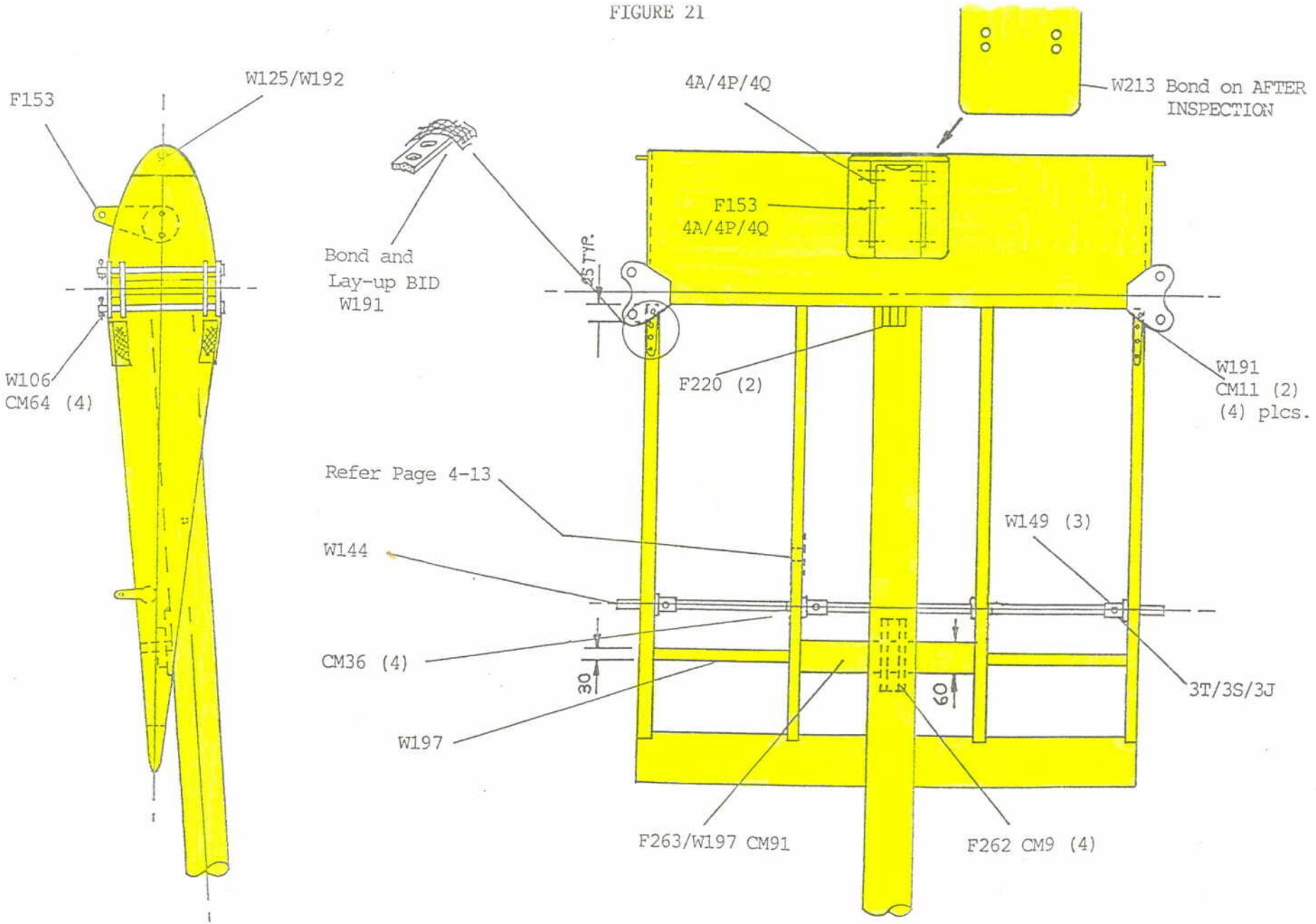


FIGURE 21

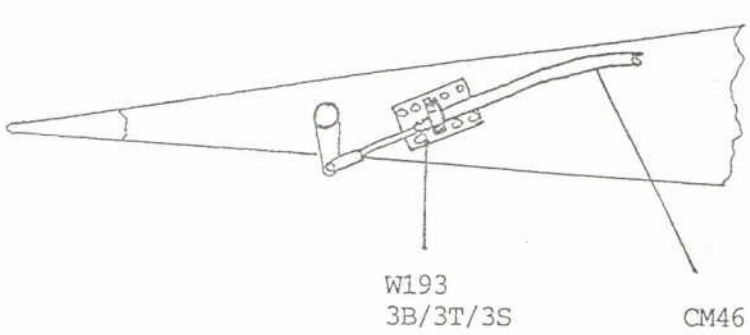

F153
W125/W192
W106
CM64 (4)
Bond and
Lay-up BID
W191
4A/4P/4Q
W213 Bond on AFTER
INSPECTION
F153
4A/4P/4Q
25 TYP.
F220 (2)
W191
CM11 (2)
(4) plcs.
Refer Page 4-13
W144
W149 (3)
CM36 (4)
30
60
3T/3S/3J
W197
F263/W197 CM91
F262 CM9 (4)

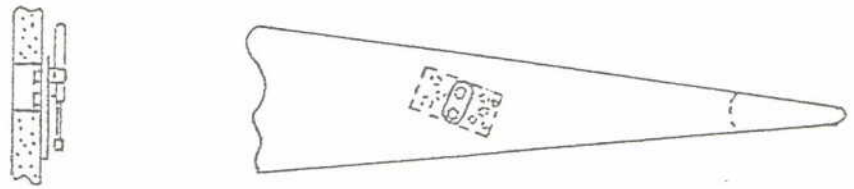
PART No.	QTY.	PART DESCRIPTION	NOTE	PROCESS REF.
W193	1	Bracket, Flap/Teleflex	BOND	1.2

Using the TEMPLATE on the next page, find the location of W193 and bond in place.

Remove rib glass and foam from the area behind teleflex clamp for bolt access.

Bolt together making sure of seating of teleflex collar in clamp.





(REF. 7-14)

FIGURE 22

FLAP/TELEFLEX BRACKET TEMPLATE

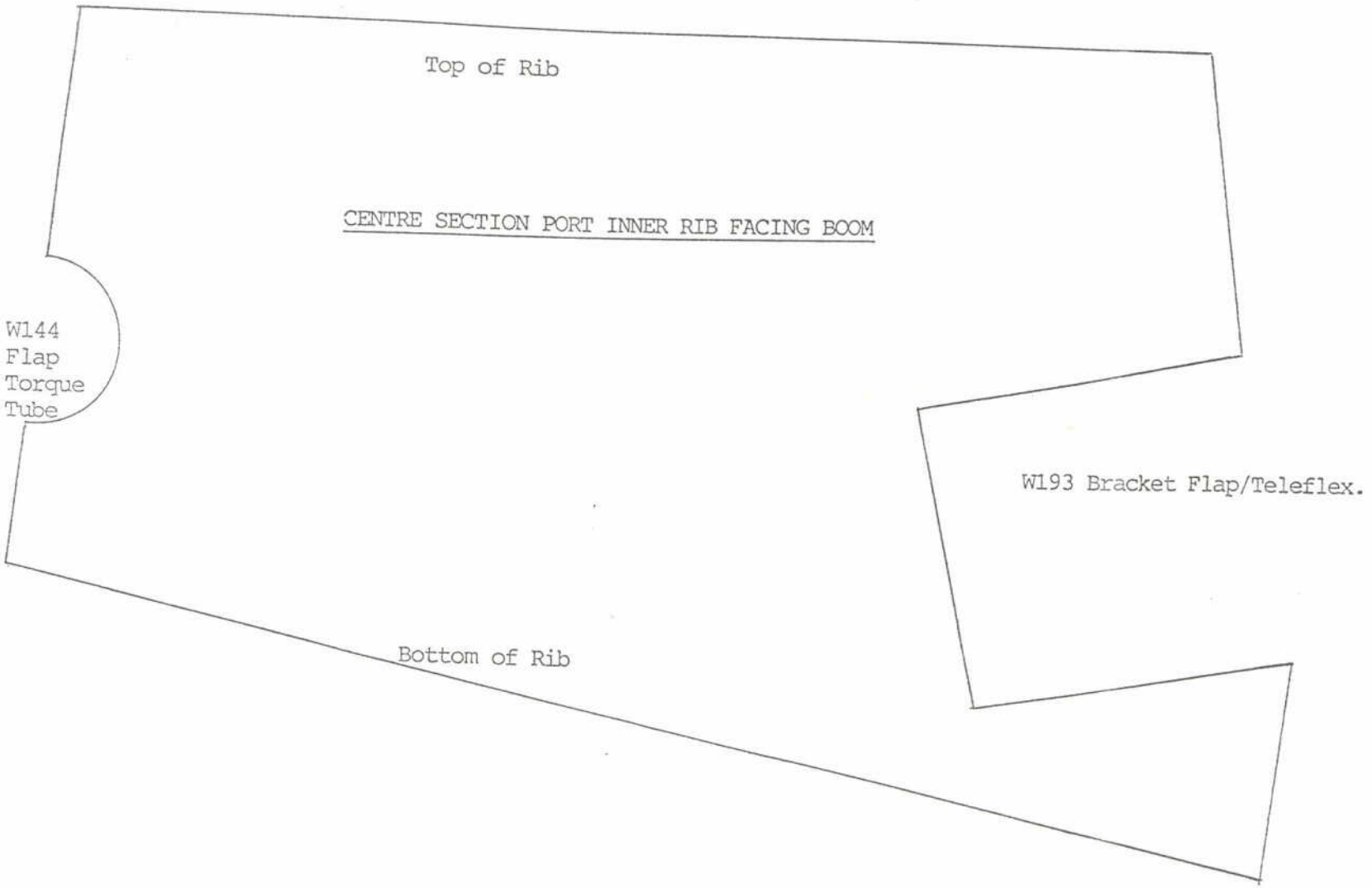
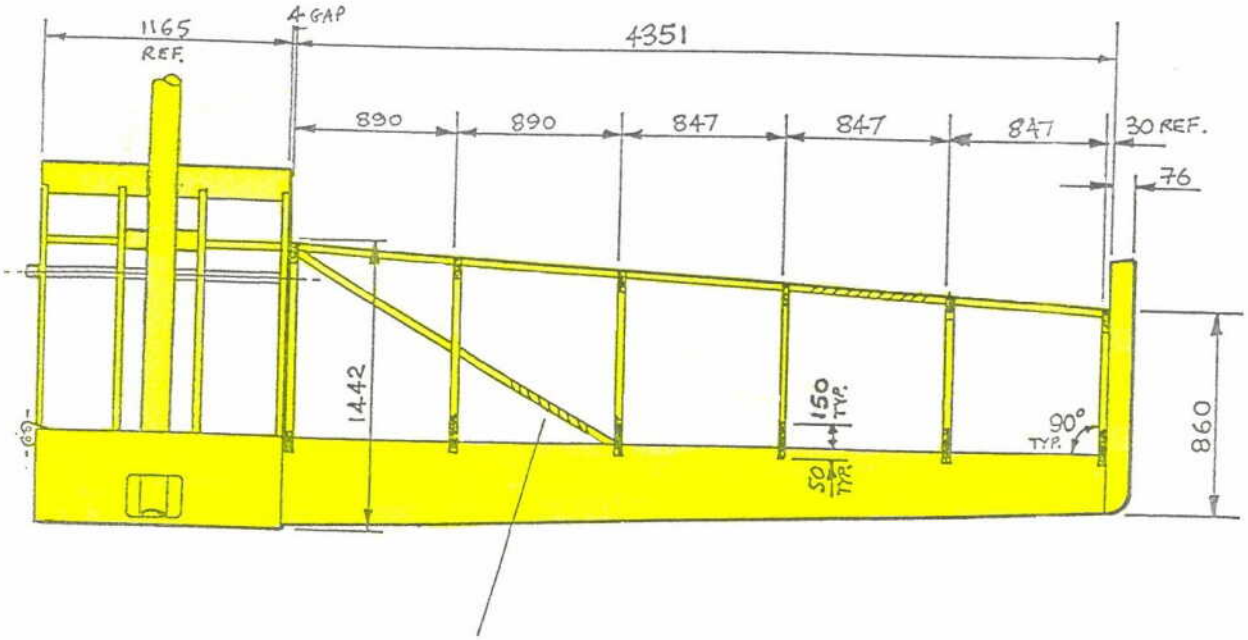


FIGURE 23



W201
Bond in AFTER main structure has cured.
Add BID reinforcing strips, page 4-6.

FIGURE 24

WING ASSEMBLY COMPONENTS

AILERON BELLCRANK
AILERON BEARINGS
DRAG PLATE - FLAP TORQUE TUBE

PART No.	QTY.	PART DESCRIPTION	NOTE	PROCESS REF.
W182	2	Bearing Push/Pull	BOND	1.7
W185	2	Drag Plate Wing	BOND	1.2
W151	2	Bracket Wing Bellcrank		
W161	2	Bellcrank Bracket Support		
F328	2	Spacer Bellcrank		
F329	2	Bearing Bellcrank	GREASE	
W218	2	Bellcrank		
W152	2	Tube Aileron	*	
W154	6	Insert Aileron Tube	LOCTITE	4.1
W153	2	Tube Aileron		

NOTE* - DO NOT fit W154 to the inboard end of the aileron tube, W152, which connects inside the centre section. When the aircraft is rigged this tube may be cut to length for setting up the control.

Bond the aileron push/pull tube bearings into the ribs where indicated, ensuring free movement of the tube.

Cut out hole for the flap torque tube bearings, CM36. Rig the outer wings to the centre section and install the wing pins. Align centre section to outer wings and ensure the wing pins can be removed and refitted with free movement. Providing the flap torque tube centralizes in the bearing, CM36, derig wings and bond bearing and drag plate W185 in position. If necessary, enlarge bearing hole in rib to allow for alignment, mark bearing position. Derig and bond in bearing using foam chippings mixed with the Araldite to pack the bearing out.

FIGURE 24

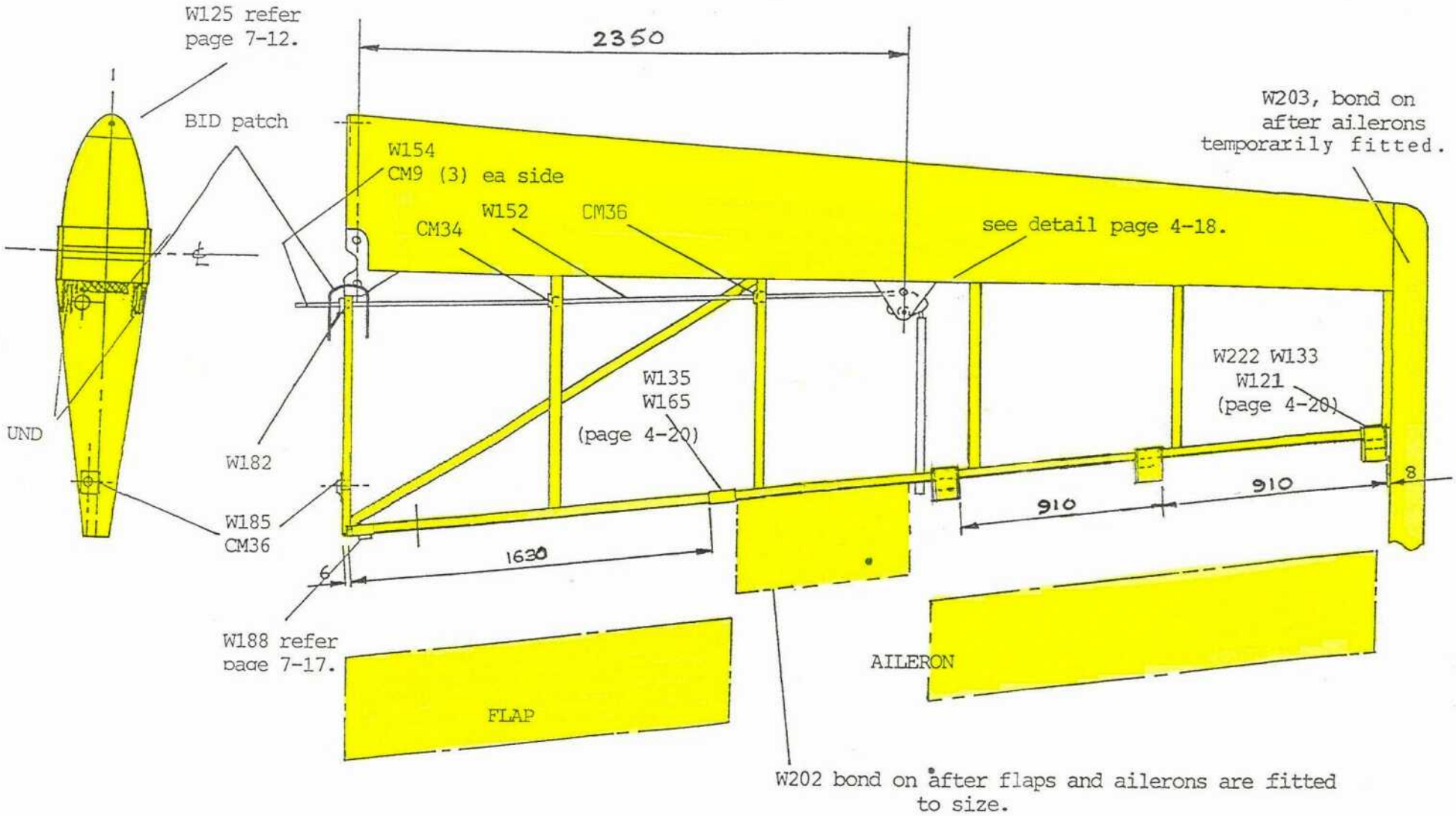
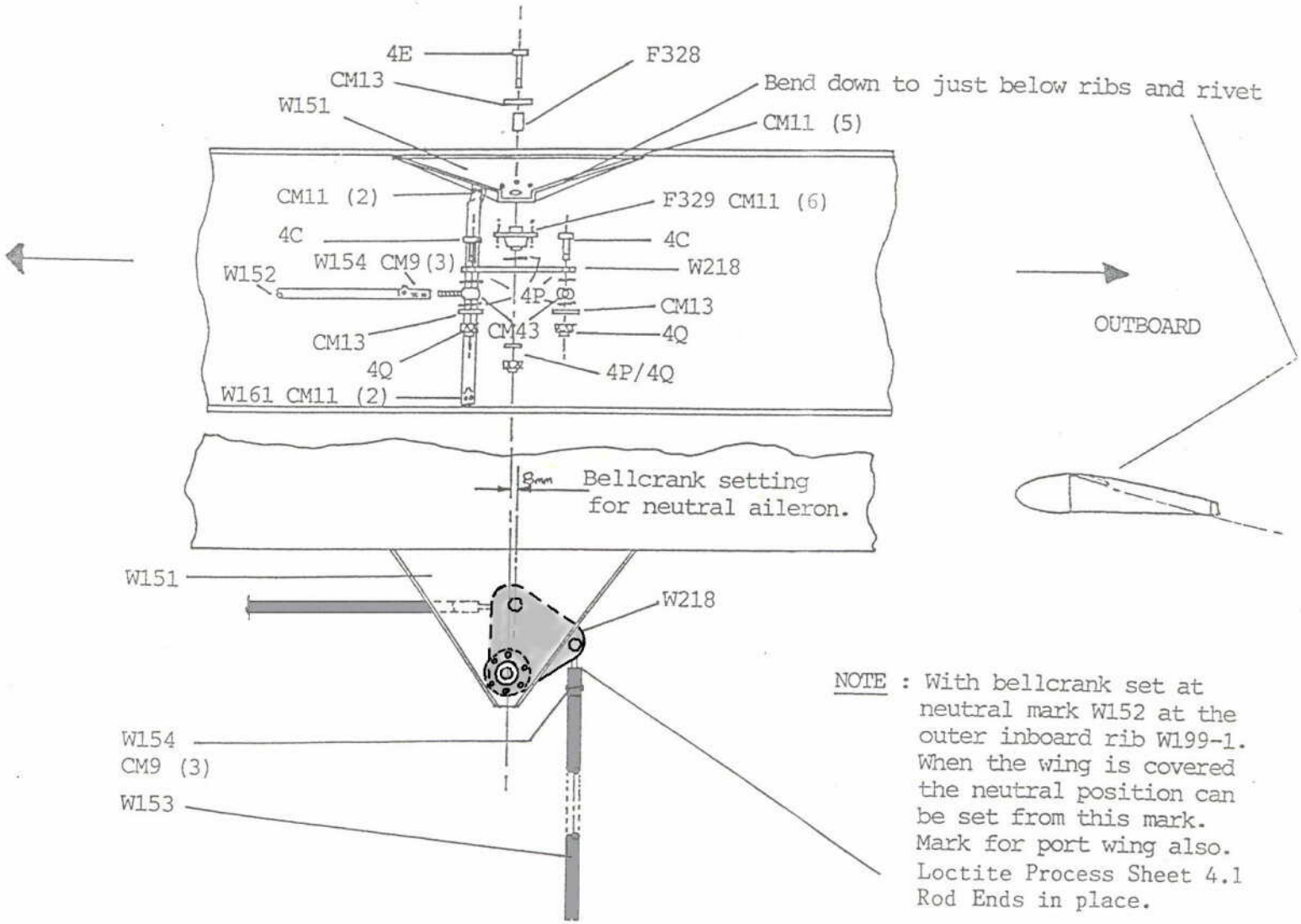

W125 refer page 7-12.
2350
BID patch
W154 CM9 (3) ea side
W152
CM34
CM36
see detail page 4-18.
W203, bond on after ailerons temporarily fitted.
W222 W133 W121 (page 4-20)
W135 W165 (page 4-20)
UND
W182
W185 CM36
910
910
8
1630
6
W188 refer page 7-17.
FLAP
AILERON
W202 bond on after flaps and ailerons are fitted to size.

FIGURE 24

STARBOARD WING.



BELLCRANK SETTING
FOR NEUTRAL AILERON.

VIEW FROM ABOVE
STB WING.

NOTE : With bellcrank set at neutral mark W152 at the outer inboard rib W199-1. When the wing is covered the neutral position can be set from this mark. Mark for port wing also. Loctite Process Sheet 4.1 Rod Ends in place.

FIGURE 24

WING - REAR SPAR HARDPOINTS

AILERON HARDPOINTS
FLAP HARDPOINTS

PART No.	QTY.	PART DESCRIPTION	NOTE	PROCESS REF.
W131	4	Bracket Aileron	BOND	1.2
W183	2	Bracket Aileron	BOND	1.2
W121	6	Bracket Aileron	BOND	1.2
W220	6	Bracket Aileron Hinge		
W222	6	Gusset Aileron Bracket		
W133	2	Hinge Bracket Flap	BOND	1.2
W165	2	Hinge Bracket Flap	BOND	1.2
W135	4	Hinge Bracket Flap	BOND	1.2
W202	2	Foam Spacer Rear Spar	*	

NOTE* - Bond on Spacer after determining width after fitting Flap and Aileron surfaces.
Glass and cover.

The top surface of the bracket assembly, W131/W121 x 2 and W183/W121, at the hinge point MUST follow in line with the upper surface of the rear ribs. Ensure that the three brackets are in line with each other along the rear spar.

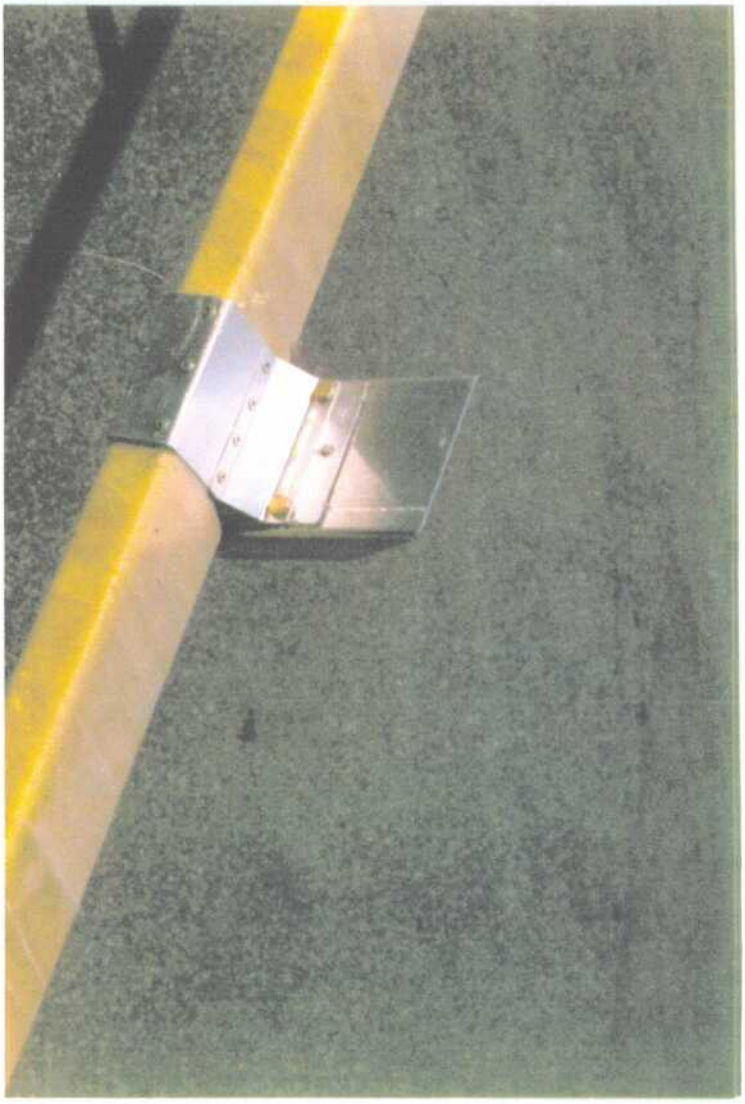
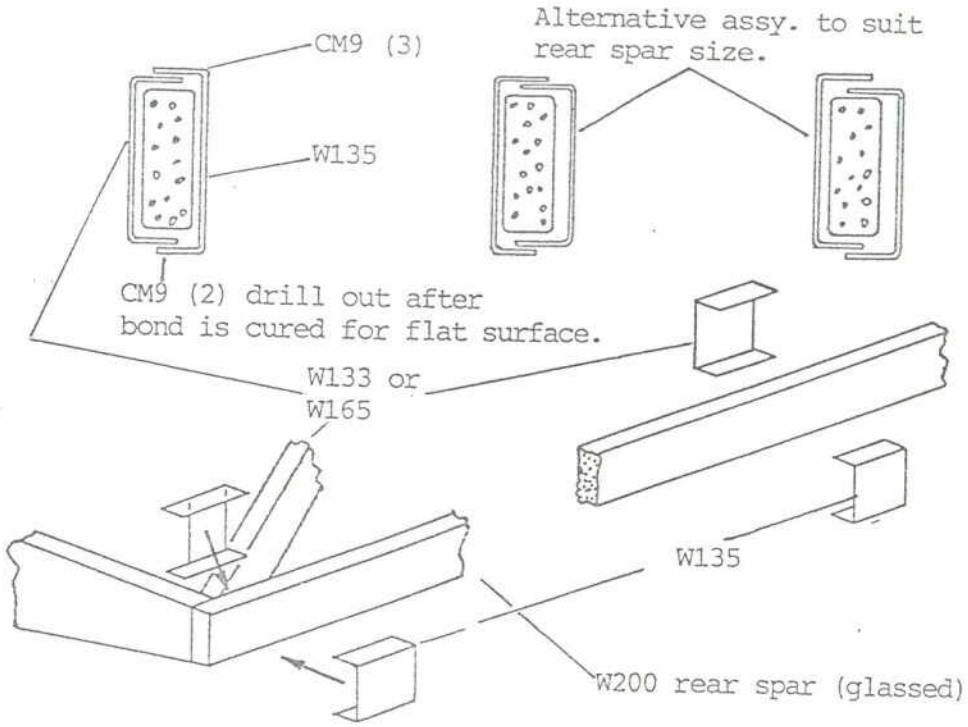


FIGURE 24



If necessary saw drag spar for clearance for bracket.

FLAP HARD POINTS ON REAR WING SPAR.

AILERON HARD POINTS ON REAR SPAR.

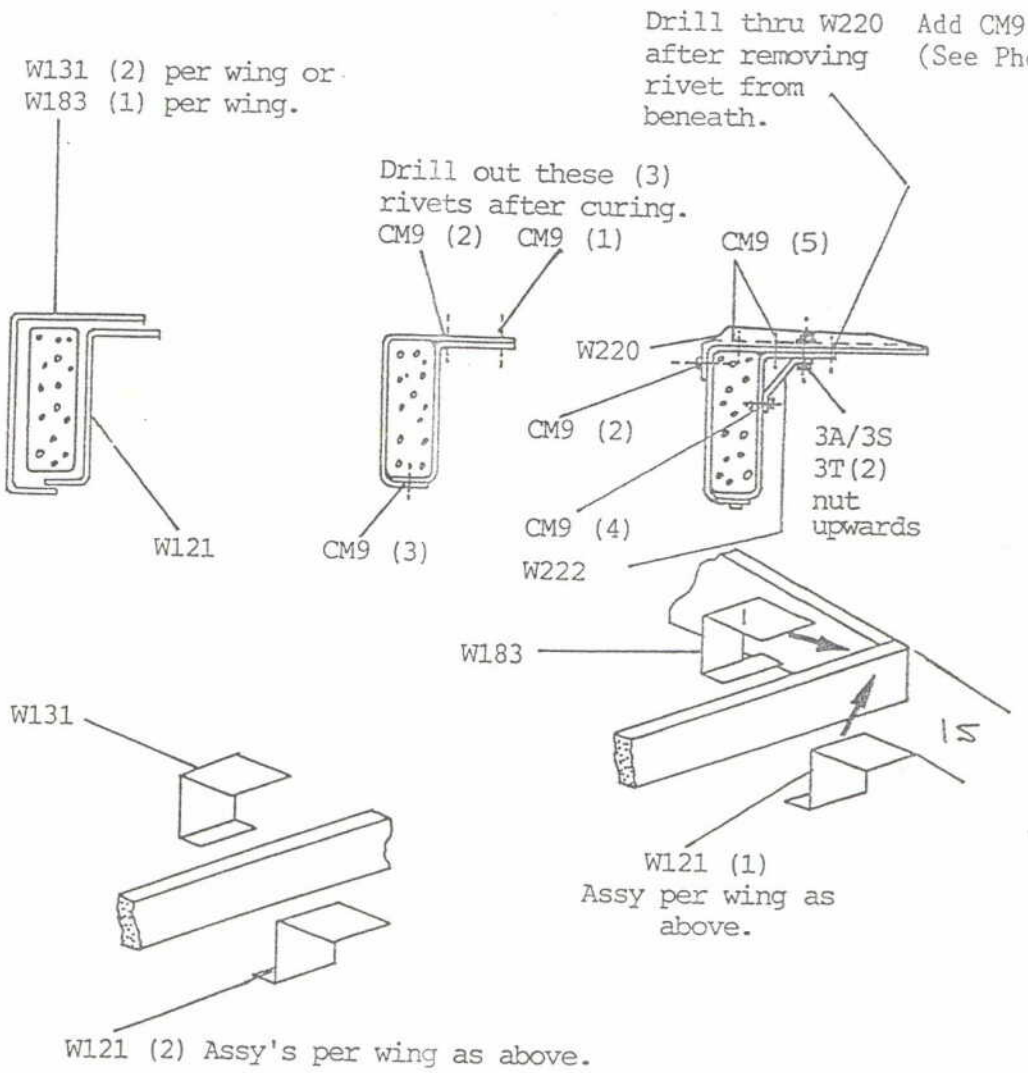


FIGURE 25

WING – FLAP ASSEMBLY

PART No.	QTY.	PART DESCRIPTION	NOTE	PROCESS REF.
W177	2	Flap L.E.	*1	
W178	2	Flap T.E.	*1	
W179	8	Flap Rib		
W180	2	Flap Rib		
W181	4	Flap Rib		
W173	4	Flap Gusset		
W174	4	Flap Gusset		
W175	4	Flap Gusset		
W176	4	Flap Gusset		
W132	4	Hinge		

NOTE *1 – are provided over length to assist in determining offset angle of surface.

NOTE *2 – fit only after INSPECTION and COVERING.

Wide edge of flap T.E., W178, uppermost on top of surface.

FIGURE 25

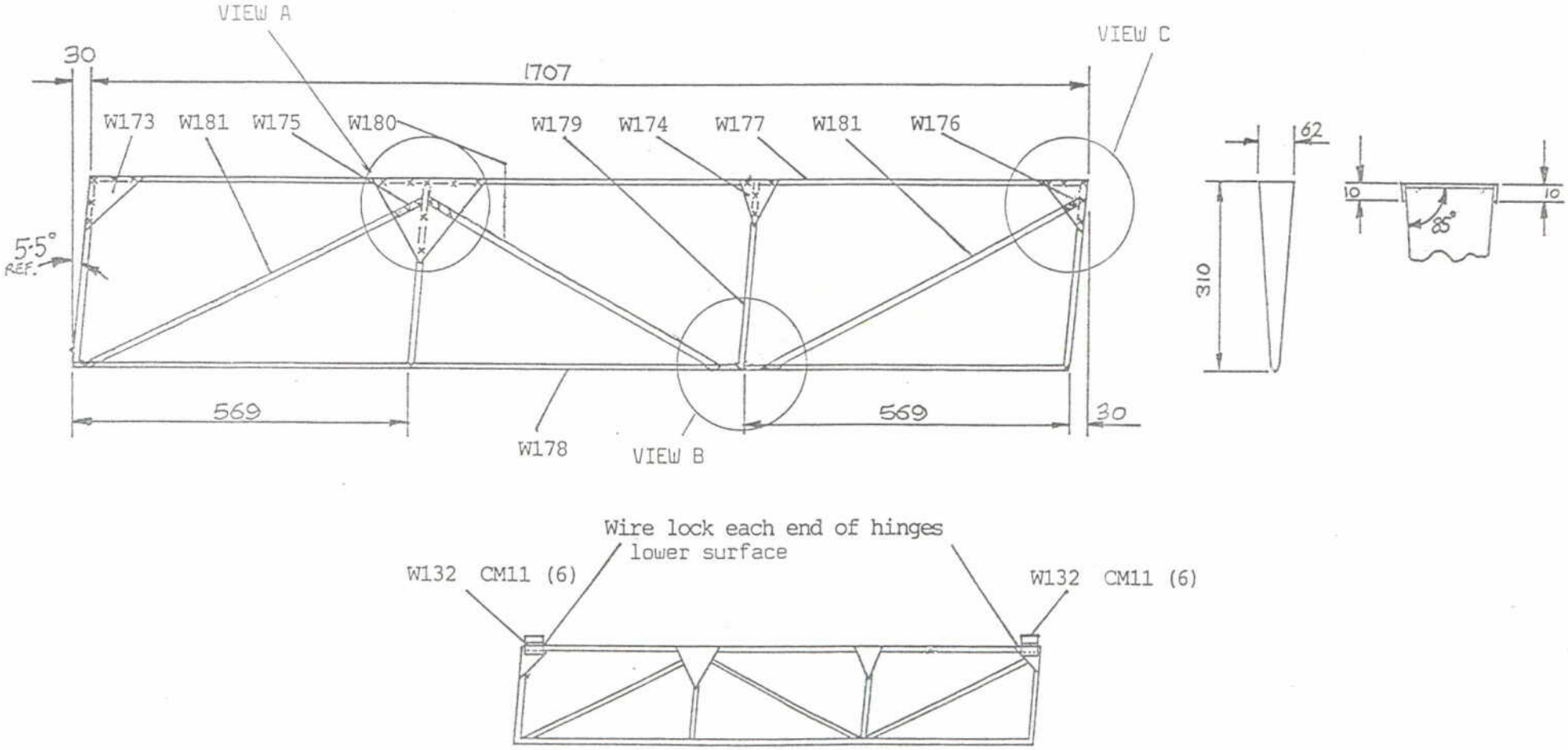

VIEW A
VIEW C
30
1707
W173
W181
W175
W180
W179
W174
W177
W181
W176
5·5°
REF.
569
569
30
W178
VIEW B
62
310
10
10
85°
Wire lock each end of hinges
lower surface
W132 CM11 (6)
W132 CM11 (6)

FIGURE 25

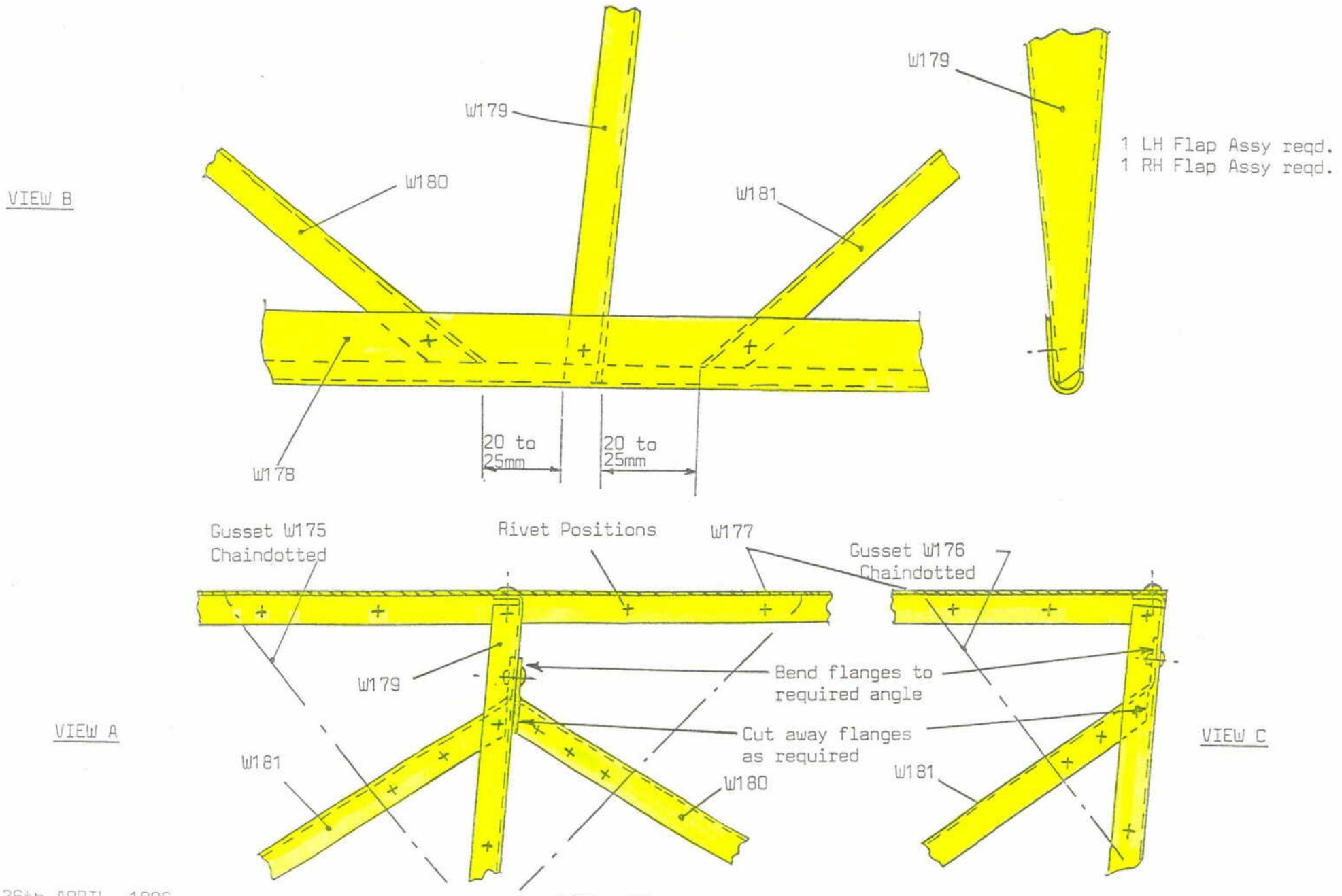

VIEW B
W179
W180
W181
W178
20 to 25mm
20 to 25mm
W179
1 LH Flap Assy reqd.
1 RH Flap Assy reqd.
Gusset W175 Chaindotted
Rivet Positions
W177
Gusset W176 Chaindotted
W179
Bend flanges to required angle
Cut away flanges as required
W181
W180
W181
VIEW A
VIEW C

FIGURE 26

WING - AILERON ASSEMBLY

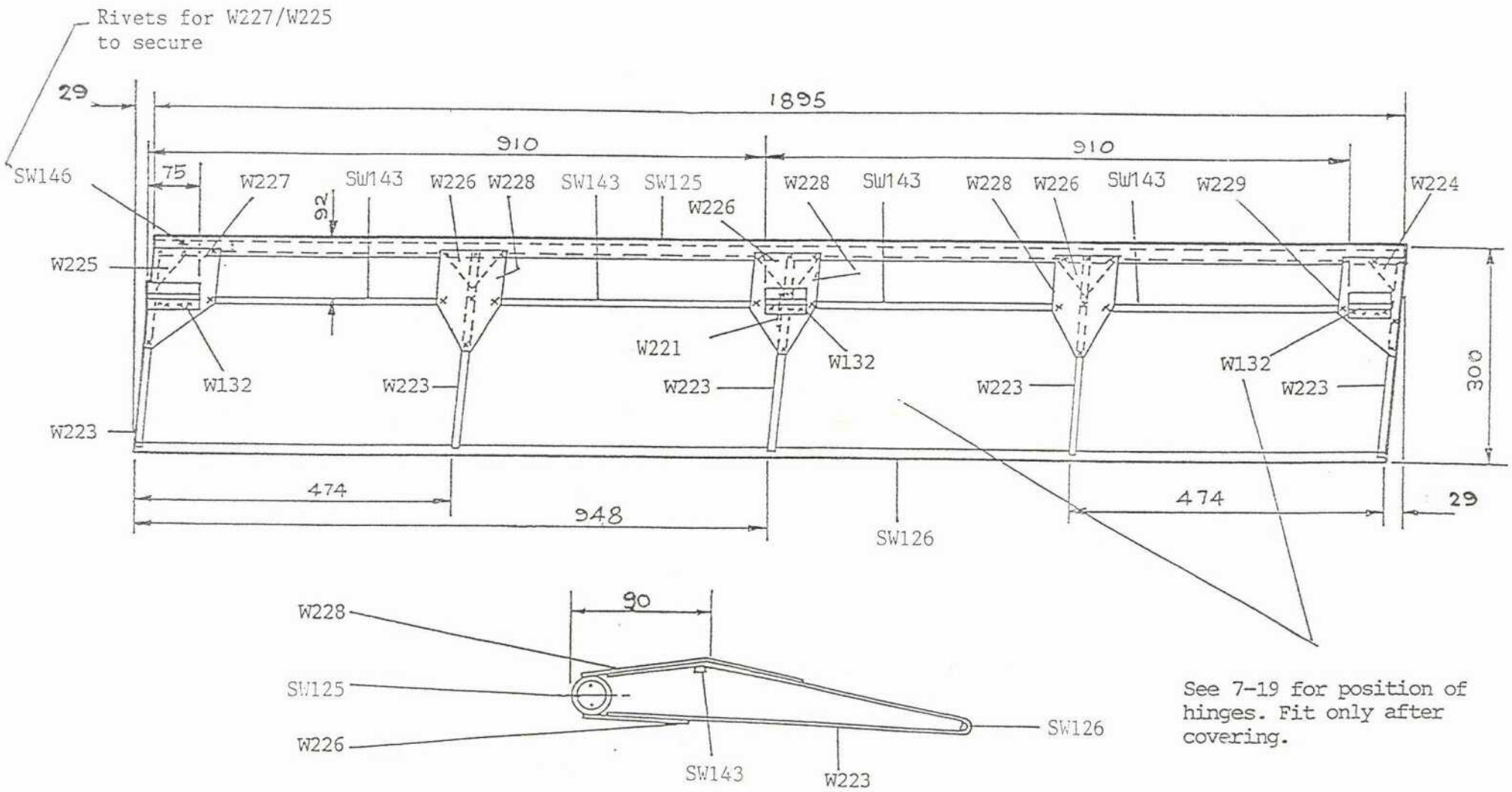
PART No.	QTY.	PART DESCRIPTION	NOTE	PROCESS REF.
SW125	2	L.E. Aileron	*1	
SW126	2	T.E. Aileron	*1	
SW143	8	Spine Angle		
W221	2	Horn Aileron		
W223	10	Rib Aileron		
W224	2	Gusset Aileron		
W225	2	Gusset Aileron		
W226	6	Gusset Aileron		
W227	2	Gusset Aileron		
W228	6	Gusset Aileron		
W229	2	Gusset Aileron		
W132	6	Hinge	*2	
SW146	2	Mass Balance		

NOTE *1 - are provided slightly overlength to assist in determining angle offset of surface.

NOTE *2 - fit only AFTER INSPECTION and COVERING with fabric.

Wide edge of aileron T.E., SW126, uppermost on top surface.

FIGURE 26



See 7-19 for position of hinges. Fit only after covering.

Fit Aileron Horn W221, REF 7-19

INSPECTION

Ensure this inspection is effected and recorded on page F before proceeding with covering and painting.

PAINT

'D' sections.
Wing Tips.

(Use Polyester filler to improve the appearance of the 'D' section over the UND glass strips prior to painting).