RESTRICTED

Job Sheet

AAF TECHNICAL SCHOOL
Willow Run, Ypsilanti, Mich.
B-24 Airplane School

Phase I.

FUEL CELLS

PRE-FLIGHT & DAILY

Drain main fuel strainers (including tank drains,) make sure that all drain cocks and plugs are properly resafetied.

Inspect self sealing gas tanks for evidence of deterioration.

WEEKLY

Visually inspect cells where possible thru fittings opening by means of a light and mirror. If raised or blistered areas, loose seams or other apparent defects are noted cell must be removed and repaired. Examine all fitting nipple for possible damage. (Remove clamps, tape fitting, replace clamp).

FUEL LINES; With "FUEL ON" and pressure built up, check all fuel lines and connections for leaks, security and anchorage, chafing and condition of hose connections and hose clamps.

25 HOUR

All drain lines must extend beyond cowling or fuselage.

FUEL TANKS: Inspect for deterioration and swelling of self sealing tanks. (T.O. 03-10-9)

SECTION 2 - FUEL AND OIL SYSTEM.

FUEL LINES: With "FUEL ON" and pressure built up, inspect all fuel lines for leaks (particularly at connections). Check for security of line anchorage, wear due to loose clamps, vibration or chafing. Check hose connections for condition and hose clamps for tightness.

50 HOUR

Check all fuel overflow and drain lines for security of mounting, and stoppage.

FUEL TANKS: Drain self sealing tanks and refill to check capacity. If capacity is more than 5% less than original cells will be opened to determine cause.

SECTION 2 - FUEL AND OIL SYSTEMS.

300 HOUR

FUEL TANKS; Inspect for signs of deterioration. (This is accomplished by probing the bottom of each cell with a round wooden stick to see that the cells are solid and springy. If soft and spongy, cell should be removed for further check.)

SEMI-ANNUAL

Check for deterioration.

A. Probe with stick (should be firm and springy).
B. Remove cell, thoroughly aerate and check weight. Should not have increased by over 4%.

RESTRICTED

9-8-44

Job Sheet

AAF TECHNICAL SCHOOL
Willow Run, Ypsilanti, Mich.
B-24 Airplane School

Phase I

TIRES

Tires for general condition, cuts, pulling away from rims and evidence of interference or chafing against other parts.

PRE-FLIGHT & DAILY

Check tires for proper inflation

Check for slippage.

25 & 50

TIRES: Inspect for external cuts, breaks, and other visible damage.

NOTE: Tires should be replaced PRIOR TO wearing through to fabric in order that tires may be retreaded.

When there is evidence of excessive rust or corrosion on visible outside portion of wheel rim, remove casing and inspect for possible damage.

Whenever the casing is removed check for the following:

(a) Inspect cord body for rupture or breakes.
(b) Inspect beads for physical damage extending thru outside rubberized chafer fabric.
(c) Inspect tread for cuts thru or cuts exposing fabric to moisture and dirt.

Check tubes for the following:

(a) Valves for physical damage.
(b) Tubes for evidence of wrinkles and creases.
(c) Tubes for evidence of cuts punctures or thinning adjacent to bead due to brake heat.

AAF TECHNICAL SCHOOL
Willow Run, Ypsilanti, Mich.
B-24 Airplane School

Phase I

FIXED SURFACES - MOVABLE - FUSELAGE

PRE-FLIGHT & DAILY

Inspect wings, ailerons, fuselage, stabilizers, elevators and rudder for damage or obvious defects.

Inspect wings, fuselage, vertical and horizontal stabilizers for general condition; distortion, pulled rivets or other evidences of failure; security of attachment, etc.

Inspect flight control surfaces (flaps, ailerons, rudders and elevators) for general condition. See that the wing flap tracks are free from mud, dirt, or oil. Tracks should be kept clean and polished.

SECTION 6 - MISCELLANEOUS.

FIXED SURFACES: Make inspection of wings, horizontal and vertical stabilizers and fairings for cracks, loose rivets, loose screws and general condition, corrosion, etc.

25 HOUR

FUSELAGE: Inspect for general condition, corrosion, pulled rivets rupture or distortion indicating failure, damage at cabin entrance. etc.

MOVEABLE SURFACES: Inspect ailerons, elevators, rudders, flaps and tabs for free and full movement, warping condition of covering, condition of hinges, and security of attachment. Lubricate per airplane handbook.

SECTION 6 - MISCELLANEOUS.

FIXED SURFACES -

1. Inspect wings, horizontal and vertical stabilizers for distortion, security of attachment, cracks, loose rivets, loose screws and general condition, corrosion, etc. Check landing light reflectors for discoloration.
2. MOVABLE SURFACES: Inspect ailerons, elevators, rudders, flaps and tabs for free and full movement, warping condition of covering, and security of attachment and proper lubrication.

50 HOUR

3. FUSELAGE: Inspect fuselage structure for distortion, check for loose or missing rivets, check inspection doors fairings and escape hatches for general condition and security of attachment.

AAF TECHNICAL SCHOOL
Willow Run, Ypsilanti, Mich.
B-24 Airplane School

Job Sheet

Phase I

DE - ICERS

PRE-FLIGHT & DAILY

Inspect de-icer shoes for punctures, loose patches or other obvious defects and for freedom from oil. Check the de-icer shoe inflation on both wings and empennage with the shop air supply as directed in handbooks. If these facilities are not available make this check during first engine run up of No. 1 or 2 engines. T.O. 03-35B-1.

AIRCRAFT -- GENERAL --

25 HOUR

DE-ICING EQUIPMENT: Check de-icing boot attaching screws for tightness. Check feed lines in both wings and tail for security and general condition. (T.O. 03-35B-1)

50 HOUR

DE-ICING EQUIPMENT: Check de-icing boot attaching screws for tightness. Check feed lines in both wings and tail for security and general condition (T.O. 03-35B-1). Check operation according to handbook.

Test conductivity of de-icer shoe with an ohmmeter and contact block test near ends and middle of shoe. If ohmmeter shows a resistance of over 15,000 ohms recoat with two coats of prenite graphite.

Job Sheet

AAF TECHNICAL SCHOOL
Willow Run, Ypsilanti, Mich.
B-24 Airplane School

PHASE I

PRE-FLIGHT & DAILY

See that all trim tabs are in their proper position.

Check all flight controls for freedom and for range of operation.

FLIGHT CONTROL MECHANISM-

1. At first 25 and subsequent 100-hour inspections check tension of control cables. If adjustments are necessary see airplane handbook.
2. Lubricate flight and flap control mechanism, as per airplane handbook.

25 HOUR

3. Make inspection of flight control mechanisms as follows:
   a. Inspect cables for frayed wires. (Not more than 6 broken wires per inch.)
   b. Inspect for broken, loose or misaligned pulleys.
   c. Inspect rods for freedom of movement and for condition of bearings and sliding surfaces.
   d. Inspect guides for general condition, proper alignment and security of mounting.
   e. Inspect brackets for security of attachment, cracks or other defects.
   f. Inspect rudder pedal assembly for proper functioning of the parts; lost motion or binding. Check for proper setting of the rudder pedals and the rudder when in neutral position and check that rudder does not interfere with the elevators when in extreme position.
   g. Inspect wheel control for condition and proper functioning of the parts. Check for lost motion or binding in the wheel assembly.
   h. Check tab mechanism for proper functioning.

   Refer to airplane handbook for adjustment instructions.
4. Lubricate wing flap control unit, per airplane handbook.

FLIGHT CONTROL MECHANISM -

1. All cables will be cleaned where they pass over pulleys or through fairleads and in areas where atmospheric conditions are conducive to forming corrosion, they will be covered with compound, heavy, rust preventive, Spec. AN-C-52.
2. Lubricate flight and flap control mechanism as directed in handbook.
3. Make inspection of flight control mechanism as follows:
   a. Inspect cables for frayed wires. (Not more than 6 broken wires per inch.)
   b. Inspect for broken, loose or misaligned pulleys.
   c. Inspect rods for freedom of movement and for condition of bearings and sliding surfaces.
   d. Inspect guides for general condition, proper alignment and security of mounting.
   e. Inspect brackets for security of attachment, cracks or other defects.
   f. Inspect rudder pedal assembly for proper functioning of the parts, lost motion or binding. Check for pr...

9-13-44

Job Sheet

AAF TECHNICAL SCHOOL
Willow Run, Ypsilanti, Mich.
B-24 Airplane School

Phase I

setting of the rudder pedals and the rudder when in neutral position and check that rudder does not interfere with the elevators when in extreme positions.

g. Inspect wheel control for condition and proper functioning. Check for lost motion or binding in the wheel assembly.

h. Check trim tab mechanism for proper funtioning.

Refer to airplane handbook for adjustment instructions.

4. Lubricate wing flap control unit. (Refer to handbook.)
5. Oil rack and pinion of aileron, rudder, and elevator locking pins with Spec. AN-O-6, grade 1100P.

100 HOUR

FLIGHT CONTROL MECHANISM: Check tension of control chain, sprockets, and cables. If adjustments are necessary, see handbook and T.O. 01-1-9 for details.

TAB GEAR CONTROL: Remove gear boxes from empennage for inspection
Apply grease, Spec. AN-G-3 to gears.
OIL 50 Hr. Spec. 2-27E (1) 2-27
Screw Jacks
Tab Universals
Tab Chains
Lock Pins
Rudder, Elevator and Tab Hinges

100 Hr.
Clean only:
Aileron Hinges
Control Column
Flap Tracks
Oil:
Rudder, Elevator, Aileron chains

300 Hr.
Aileron gear boxes (GREASE)
(Remove inspection plug in bottom of box while greasing)

AAF TECHNICAL SCHOOL
Willow Run, Ypsilanti, Mich.
B-24 Airplane School

PHASE I

Job Sheet

FUEL CELLS

Introduction

Fuel may be stored in the main fuel tanks, the auxiliary wing tanks, and the bomb bay tanks.

Most of the fuel in the B-24 is contained in the twelve main fuel cells. These cells, resistant to aromatic fuel, are located in the wing center section, six on each side of the airplane center line. The main cells have a maximum capacity of 2364 U.S. gallons. The cells are designated as Nos. 1,2,3,4,5 and 6 (left and right) with No. 1 cell the farthest inboard. The cells are connected to form four systems, two each side of the airplane, as follows: Cells Nos. 1, 3 and 5 (left) form the system for the No. 2 engine; cells Nos. 2, 4 and 6 (left) form the system for No. 1 engine; cells Nos. 1, 3 and 5 (right) form the system for the No. 3 engine; and cells Nos. 2, 4 and 6 (right form the system for the No. 4 engine.

There are six auxiliary wing cells. They are designated as cells 7, 8 and 9 (left and right) and are located just outboard of the wheel wells. Their maximum capacity is 450 gallons. For use, the fuel from these cells must first be pumped into the cross-feed line through the bomb bay pump located on the catwalk at Sta.5.0

The two bomb bay tanks, if installed, are located in the forward bomb bay. Their maximum capacity is 780 gallons.

To Remove Main System Fuel Cells

If all the fuel cells are to be removed, cell No. 3 or No. 4 should be removed first. If cells No. 1 and No.2 are to be removed, No.3 should be removed first. If cells 4,5 and 6 are to be removed, No.4 should be removed first.

Preliminary Procedure

Drain cells by closing the selector valve for the system to be drained and disconnect the cross feed line. Then attach a suitable drain tube and place the selecto valve handle in the position marked "No. X Tank To No. X Engine and Cross Feed."

Caution: Before draining the system, the airplane must be grounded from the receptacle tank and to the ground. Use every precaution against fire.

Remove the large and small access doors on the lower surface of the wing, betwee inboard nacelle and the airplane center line. Access to the cell No.6 manifold connection is through the access door on the inboard side of the inboard nacelle. To remove large access door, remove attaching screws around door both outside and inside fuselage. Also remove screws from plate below door on fuselage skin. Drop access door and remove outboard.

Through the small access openings remove the metal connector tubes from the manifold hose. When removing these tubes, be careful not to damage the manifold hose an cell fittings. Work the castings out of the hose by applying pressure to ends of the hose with a blunt tool. If metal connector tube has a tendency to stick, loosen by squirting benzene around it.

Remove the stainless steel center support plates (bed plates) from beneath cells Nos. 3 to 5 inclusive by raising the aft end of the plates until the dowel pins are clear of the holes. Remove the plates through the large access doors.

PHASE I

AAF TECHNICAL SCHOOL
Willow Run, Ypsilanti, Mich.
B-24 Airplane School

Job Sheet

To Remove Cell No. 3 and No. 4.

Detach and remove the filler cap and safety chain from inside the filler neck on the top surface of the wing. Then remove the countersunk screws from the upper surface of wing around the filler neck. The Technical Order will tell you that this will release the cell enough so that next it is possible to reach down through the hole and disconnect the bellows hose. While this work is being done another group may be removing the safety stitching from the bottom of the inboard and outboard stiffener tunnels and then by using long nose pliers, remove the stiffeners. Number the stiffeners and tape those from each side in a separate bundle. Disconnect the manifolds.

These cells can be removed without the use of straps. This can be accomplished by having a man put his shoulders to the cell and collapse the cell up against the top of the wing. Then reach into the wing and pull the forward end of the cell back until that end comes out through the main access door in the lower surface of the wing. Now if the bellows hose has not been removed, pull the forward end of the cell back until there is a hole large enough for a man to crawl into the wing and disconnect it. Pull the cell clear of the opening with the man in the wing assisting.

To Remove Cell No. 2.

After the preliminary work is done remove the bulkhead curtain. Disconnect the manifold connections on the bottom of the tank. Reach over from cell room No. 3 and disconnect vent fitting.

Remove the stiffener rods the same as cell No. 3 and tape them into bundles. Remove the bomb release control rods and disconnect the sight gage fittings attached to the lower surface of the wing in the bomb bay. Plug the tubes to keep out the dirt.

Remove the booster pump attaching studs which are on the lower surface of the wing in the bomb bay. Remove the pump, taking care not to damage the grommet.

In the model "E", disconnect the transfer tube and hose fittings from the top of the wing inside the fuselage and remove the nut fitting which holds the top of fuel cell No. 2 in position.

Pass two web straps as far from each side of center as possible around the cell. Collapse the cell and secure it in the collapsed condition by tightening the straps.

Push center of collapsed cell up as far as possible. Pull forward end of the cell back until it is over the access opening. Now turn the forward end of the cell so the top of the cell faces toward the center of the airplane in order to clear the fuselage and the control cables. Pull down the cell and remove it through the bomb bay opening.

To Remove Cell No. 1.

Remove the inboard and outboard curtains from wing bulkhead No. 1. After this has been completed, detach and remove the center truss by removing bolts from the top and bottom of structure from wing bulkhead 1.

Remove the safety stitching at the bottom of the outboard stiffener from the tunnels. Pull the top of the outboard cell so the inboard side is accessible Remove the safety stitching at the top of the inboard stiffeners and remove the stiffeners.

Remove the fittings on the bottom and the top of the wing the same as cell No. 2. Disconnect the vent connections at the top of the cell by reaching through station No. 2 opening [illegible] two web straps around the cell, collapse the cell, and secure it with the [illegible]

PHASE I

AAF TECHNICAL SCHOOL
Willow Run, Ypsilanti, Mich.
B-24 Airplane School

Job Sheet

Remove cell No. 1 from the wing by turning the cell on its side and passing the forward end through the bulkhead and out through the access opening.

To Remove Cell No. 6.

Remove curtains from both sides bulkhead 5. Now the center truss must be removed from bulkhead 5 by removing upper and lower bolts. The vent and manifold fittings are disconnected next.

Since cell No. 6 must pass through cell No. 5 opening, much difficulty has been encountered if No. 6 cell is folded the conventional way. Another method has been devised to simplify both removal and installation of cell No. 6.

Remove the top stiffeners leaving the side stiffeners intact. Deflate by applying pressure at upper inboard edge pressing it in until that edge rests parallel and alongside of the lower outboard edge. (Push it diagonally.) Then fold the ends in and down so that they lie as flat as possible on the cell. Then fold the outboard half over the inboard half and pass three straps around the cell and remove.

To Install Main System Fuel Cells

General Notes on Fuel Cell Installation

Inspect inside the cell for flaws and then install inspection doors. Tighten the screws with the required amount of torque stated on the inspection plate. This may vary from 35 to 75 in. lbs. Safety the nuts together using No. 32 safety wire.

Wherever possible, warm cell to room temperature (approximately 65 degrees to 100 degrees F.) before collapsing. Do not allow cell to remain in collapsed condition for more than 30 minutes. Dust all exterior surfaces of collapsed cell with talc or soapstone.

Be careful that the cell isn't bent at the inspection door or at any point where fittings join the cell.

Do not lift fuel cells by their fittings and do not allow cells to rest on fittings. Rest them on their sides.

Be sure that all openings in the cell are covered while cell is out of the airplane. Where clamps hold hose and fittings, the hose and fitting should be wrapped with tape and shellaced.

Cell stiffeners may be most easily replaced by coating with soapy water. Do not drive into place. The channel should face the cell. Do not use oil or grease on stiffeners.

The beveled end of each stiffener should be inserted first to make entrance easier and to prevent injury to the cell.

If the cell doesn't inflate easily after it is in the wing, inflate with compressed air through the manifold connection.

Install booster pumps carefully so that gaskets are not damaged. Do not pry on fittings or cells with sharp instruments of any kind.

No. 8 and No. 10 clamps are used on the bellows hose connections. No safety wire is used, but the clamp is taped so that no metal shows. Have the clamp parallel to the wing and the cell. Shellac is placed over the tape.

To Install Main Wing Cells

These cells are installed by reversing the removal procedure with the following exceptions:

Four web straps should be used to hold cell in collapsed position, except for No. 6 cell, where only three straps are necessary.

PHASE I

AAF TECHNICAL SCHOOL
Willow Run, Ypsilanti, Mich.
B-24 Airplane School

Job Sheet

It is best to install cells Nos. 1 and 6 first. However, No. 2 may be strapped down, placed in its compartment, and left resting on edge against the outboard bulkhead until No. 1 is installed. This provides a larger opening through which to put No. 2 cell. No. 1 must be installed as quickly as possible after No. 2 is placed in the wing so that No. 2 may be unstrapped.

After cells Nos. 1 and 6 have been installed, make certain that the removable bulkhead trusses are replaced and securely fastened.

With the exception of the last cell installed, always place one man in the leading edge and one man in an adjoining cell compartment to assist in putting in the cells. This man in the leading edge can also make the vent connection. He can crawl out of a lightening hole except in the last cell installed when he can slip out between the cell and the access door opering. He should take out the two forward straps

To Install Cell No. 1

Fold the cell in the regular manner, and strap it. This cell must go through No. 1 hole, and so special precautions must be taken. While the cell is lying on the floor, bend the cell about 1½ft. from the rear end, so it is very pliable and will bend easily.

Push the cell up in No. 1 hole, having one man in the rear of the No.2 and one in the front of No. 1 cell compartment. As the cell goes through No. 1 hole, fold the aft end forward and strap down. Twist the cell to the right and aft. Have one man inside push with his feet and the other man bend the cell against the bottom of Wing St. #1. Push the cell to the extreme end of the station, bend the end of the cell down and push the center upward against the top of the wing. Now push it into place.

Make the necessary connections, namely, booster pump, sight gage fittings, manifold connections, and vent fittings.

Installation of Cells 2, 3, 4 and 5.

Fold cell in the regular manner and tie down with four straps. Place men inside the wing as per preliminary instructions and with as many men as possible lying on their backs and pushing with their feet, push the cell up into the wing.

The man in the leading edge should make the air vent connection and then crawl out through a lightening hole or between the cell and the main access door opening.

Assist the cell the rest of the way into the wing and make proper connections.

On cells Nos. 3 and 4, the filler cap connections must be made. Put two studs across filler cap on fuel cell. Install the cell and insert the filler neck tool and pull up on the bag until studs come up through the wing. Put nuts on the studs and screw up tight if it is hard to line up the neck. Put all the Phillips screws in and place a bolt in the hole that is not countersunk and safety.

The shorter bellows hoses are used on the No.3 and 4 tanks and longer hoses on all the rest.

To Install Cell No. 6.

Fold the cell in the same manner as it was taken out and tie it down with three straps. (Use accompanying diagram). Always make certain that the cell is started to deflate from the inboard to the outboard side.

Replace stiffeners the reverse of which they were taken out.

PHASE I

AAF TECHNICAL SCHOOL
Willow Run, Ypsilanti, Mich.
B-24 Airplane School

Job Sheet

Replace Access Doors

Replace the large access doors on the lower surface of the wing. Four different type screws are used. In the blue colored area use 10-9. In the black area use 10-10. In the red area use 10-11, and in all others use 10-8.
In the small access plates use the following screws: Under the lock plates use 10-6. In the lock plates use 10-9. In the rest use 10-12. There are two exceptions in the trailing edge of the two outboard plates where 10-14 are used.

Manifold Connections (Fuel Cells)

1. Seat cell flat on floor of bay.
2. Put a #11 Phillips screw in 3rd screw hole from hose end of inspection door, one screw on each side of door.
3. Using a smooth wooden or fiber flock (2 X ½ X 12), bend the hose which connects the cells together down and back.
4. Slide a short stiffener (12") over both screws in front of the bent interconnecting hose, securing the hose in a bent position pointing downward.
5. Tape end of hose with from 2 to 4 wraps for a thin walled hose.
6. Inspect clamps carefully for edge straightness and condition of screw, washer, and clampers.
7. Put 2 clamps (32G9518) on hose.
8. Flatten or elongate clamps and hose to accomodate casting or "liner."
9. Grease one half of liner and inside of hose with vaseline.
10. Insert liner into hose, keeping part number on liner on the bottom for use as guide to center liner in hoses. A 10" steel bar 1/8" thick and about 3/4" wide with rounded corners will be helpful in placing liner in hose.

N.B. Manifold connection or "pouch" on the cells which point outboard take liners with drains. Cell pouches which point inboard take plain liners.

11. Insert liner into hose so that the part number on the plain liner almost touches the hose. Insert liners with drains into hose so that the hose just touches the beginning of radius of the drain.
12. Place clamps close together, parallel with end of hose, and 1/4" from end of hose. See that they are exactly centered with respect to oval liner and are exactly opposite each other.
13. Tighten both clamps evenly to 12 inch pounds torque. Five or 6 threads usually show on these hose clamps. Never have less than 3 threads showing. Add more friction tape under clamps if necessary.
14. Grease the other half ot the liner with vaseline. Use vaseline sparingly here.
15. Inspect clamps (32G9517) carefully.
16. Elongate and install clamps on cell pouch.
17. Remove stringer and adjust hose so that correct clearance will be obtained between the hose and the cell pouch.

N.B. Hose may be pulled away from cell pouch by attaching a web strap to the other end and pulling. Pounding on other end will drive hose closer to pouch if need be. Hoses are usually too long and these new hoses must be cut off to fit the next cell. Cut new hoses off squarely.

18. Slip casting into cell pouch using steel tool.
19. Place clamps close together, parallel with end of hose, and 1/4" from end of hose. See that they are exactly centered with respect to oval liner and that the screws are exactly opposite each other.

AAF TECHNICAL SCHOOL
Willow Run, Ypsilanti, Mich.
B-24 Airplane School

PHASE I — Job Sheet

20. Tighten evenly to 8 inch pounds torque.
21. Make sure upper arm of elbow of cell pouch hangs straight down. Do not allow any kinks to remain in pouch. Make sure that the ends of all four clamp screws are clear of the framework of the wing.
22. Place rubber protector on "Z" stringer at forward edge of manifold inspection door so that the cell pouch will not be cut on the stringer should the cell slip forward.
23. Replace inspection door.

TO DISCONNECT FUEL CELL VENT HOSE

T. O. Method:

1. Reach aft through filler cap opening on top of wing and remove tape from clamp holding hose to the fuel cell connection.
2. Loosen the clamp and slide bellows hose off leaving the hose attached to the vent in the top of the wing.
3. Remove cell.

Plant Method:

1. Force center of fuel cell to top of wing and pull forward end aft far enough to permit a man to stand between cell and front edge of wing opening. Be sure that the top of cell is kept near the top of wing to prevent damage to cell connection or hose until after hose is disconnected.
2. By reaching across top of cell, remove tape from clamp which holds the hose to the fuel cell connection. Loosen clamp and slide bellows hose from coupling leaving the hose attached to the vent in the top of the wing.
3. Remove cell.

TO CONNECT FUEL CELL VENT HOSE

T. O. Method:

1. To connect, reverse T.O. Procedure above and shellac tape.

Plant Method:

1. Bend cell upward to top of wing with forward end pulled aft sufficient for a man to enter between cell and front edge of wing opening. Keep top of cell near enough to top of wing to permit hose to be placed on coupling.
2. Place a No. 8 hose clamp on coupling, slide on hose and tighten clamp finger tight plus $\frac{1}{2}$ to $1\frac{1}{2}$ turns with pliers, or tighten so that it takes a strong hand to loosen it.
3. Tape clamp so that no metal shows.
4. Shellac the connection.
5. Put forward end of cell into wing but keep center of cell pushed up until filler connection is made. This prevents damage to connection.
6. Check connection through opening in top of wing.

9/6/44

AAF TECHNICAL SCHOOL
WILLOW RUN, YPSILANTI, MICH.
B-24 AIRPLANE SCHOOL

STRUCTURE

Cable Tensions

Cable tensions are taken with a cable tension indicator (tensiometer).

This cable tension indicator is not used on non-flexible cable nor should it be used within a foot from pulleys or fairleads. Use on non-flexible cable gives extremely high readings.

Non-flexible cable is used in the elevator and rudder systems through bomb bays. Aileron control cables are non-flexible back of the wing rear spar.

System	Code	Tension
Aileron	White	60# - 0 + 10#
Elevators	Yellow	75# + or - 5#
Rudder	Green	60# - 0 + 10#
Tabs	(As above)	35#
Lock	Blue	40#
Flaps	None	75#
A-5 Manual Emergency release) Bomb bay door)	None	

Following is the color code for the identification of surface control cables. Each fitting is marked with 1/2" color bands as noted.

Left Aileron Up ..... White

Left Aileron Down..... White & Black

Aileron Trim Tab Up..... Black - White

Aileron Trim Tab Down..... White

Elevator Up..... Yellow

Elevator Down..... Yellow & Black

Elevator Trim Down Tab Up..... Black & Yellow

Elevator Trim Up Tab Down..... Yellow

Rudder Right..... Green

Rudder Left..... Green & Black

AAF TECHNICAL SCHOOL
WILLOW RUN, YPSILANTI, MICH.
B-24 AIRPLANE SCHOOL

Rudder Trim Tab Right .....Black & Green

Rudder Trim Tab Left .....Green

Flare Release Cables .....Blue -Yellow -Blue

Lock) Surface .....Blue

Unlock) .....Blue & Black

Brake Lock.....Red

Brake Release.....Red & Black

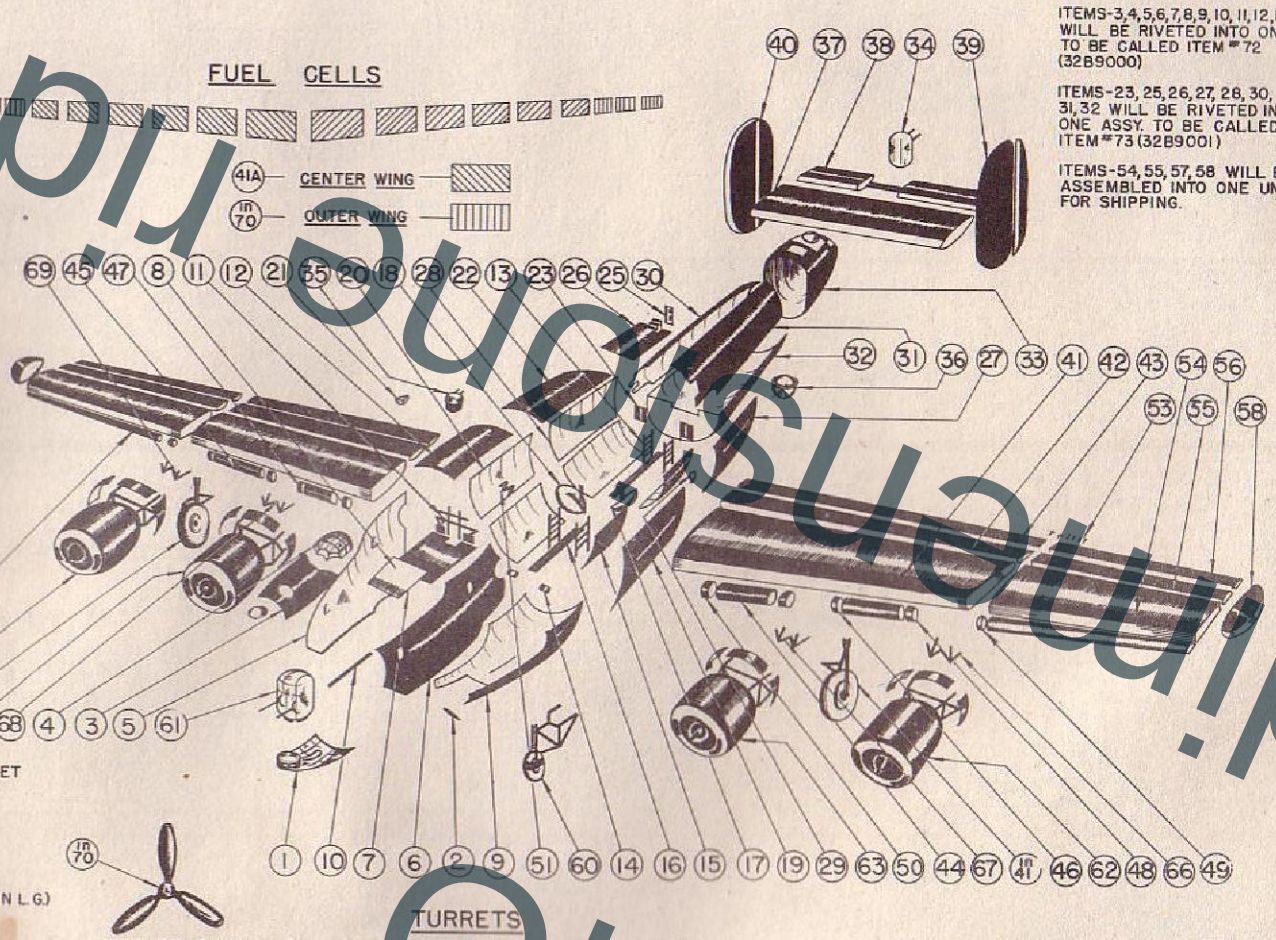
8-2-44

DEPT.	ITEM		
932	1	32B1709-P	BOMBARDIER'S ENCLOSURE
916	2	32F3135-3L/R	PITOT TUBES
938	3	32B1705-2	FUS. NOSE SECT. UPPER FRT. 0.1 TO 2.0
932	4	32B9144	PILOT'S ENCLOSURE
938	5	32B1737-2	FUS. NOSE SIDE PANEL R.H. 0.1 TO 4.15
938	6	32B1736-2	FUS. NOSE SIDE PANEL L.H. 0.1 TO 4.15
914	7	32B9146	PILOT'S FLOOR
914	8	32B9146	RADIO OPERATOR'S FLOOR
938	9	32B1716-2	FUS. NOSE BOTTOM PANEL
938	10	32F3294-2	HAND RAIL. ITEM 10 IS A GROUP OF SMALL PARTS INSTALLED INTO ITEM 5.
942	11	32B1741-0	TRUSS BLKHD. STA. 4.1
938	12	32B1727-2	FUS. NOSE SEC. UPPER REAR DECK. 2.0-4.0
930	13	32F4799-2-3-4-5	BOMB RACK
916	14	32B9145 L/R	-32 L/R SEGMENTS BLKHD. STA. 4.0 SEGM'TS.
930	15	32B046	(-139 L/R)(-140 L/R) BOMB BAY DRS.
942	16	32B9014-0	LOWER LONGERON 4.0 TO 6.0
942	17	32B1750-0L	BLKHD. 5.0 L.H. PORTION.
942	18	32B1750-0R	BLKHD. 5.0 R.H. PORTION.
938	19	32B1795-2	SIDE PANEL L.H. 4.15 TO 5.25
938	20	32B1796-2	SIDE PANEL R.H. 4.15 TO 5.25
941	21	32F9038	TRUSS REAR BOMB RACK.
938	22	32B1708-2	FUS. TOP DECK ABV. WING. 4.2 TO 5.1
942	23	32B9148 L/R	SEGMENT BLKHD. 6.0
	24		NOT REQUIRED
930	25	32B1218-6	DOOR BLKHD. 6.0
942	26	32B1755-2	FLOOR 5.1 TO 6.0
938	27	32B1784-2L/R	FUS. SIDE PANEL BELOW WING 5.25 TO 6.0 L.H.
938	28	32B1785-2	FUS. SIDE PANEL BELOW WING 5.25 TO 6.0 R.H.
933	29	32F9712	HYDRAULIC RESERVOIR TANK
939	30	32B1788	FUS. UPPER R.H. SECT. 5.0 TO 7.7
939	31	32B1787	FUS. UPPER L.H. SECT. 5.0 TO 7.7
939	32	32B1786	FUS. BOTTOM SECT. 6.0 TO 7.7
939	33	32B1794-0	FUS. TAIL SECT. AFT. STA. 7.7
947	34	32F5800-3	TAIL TURRET
947	35	32GF8227	G. L. MARTIN ELEC. PWR. DRIVEN TURRET SK 6276
947	36	32GF8673	SPERRY TURRET
945	37	32T9352	STABILIZER
945	38	32T10503-2L/R	ELEVATOR ASSEMBLY
945	39	32T8050-0	FINS
945	40	32T10115-3L/R	RUDDERS
936	41	32W9375	WING CENTER SECT. VERT.
937	41	32W1701-P	WING CENTER SECT. HORIZ. (INCL. MAIN L.G.)
937	41A	32G1039-4	FUEL CELLS L/R.
943	42	32W520-2L/R	WING CENTER SECT. TRAILING EDGE
943	42	32W9350 L/R	SHORT SECTION
943	43	32W500-2L/R	FLAP.
943	44	32W9337L/R	CENTER WING SECT. LEADING EDGE.
943	45	32W9339L/R	WING CENTER SECT. LEADING EDGE. BETWEEN NAC.
943	46	32W2067-2L/R	INBD. NACELLE TO WING L.E. FAIRING INBD.
943	47	32W2068-2L/R	INBD. NACELLE TO WING L.E. FAIRING OUTBD.
943	48	32W2069 L/R	NACELLE L.E. ATTACHING STUB INBD. SIDE OUTBD.
935	49	32W2070 L/R	NACELLE L.E. CONNECTION STUB & ACCESS PAN.
943	50	32W302-0L-0R	WING CENTER SEC. LEADING EDGE ATTACH. PANEL
932	51	32B045-2	TRUSS FUS. TO WING 4.1 TO 4.2 ITEM 51 IS A GROUP OF LOOSE PARTS INST. AT FINAL ASSY.
	52		NOT REQUIRED
947	53	32W521-3L/R	FLAP TRACK SUPPORTS
			GROUP OF LOOSE PARTS INST. AT FINAL.
935	54	32W12003-135L/R	WING OUTER PANEL.
935	55	32W026 L/R	WING OUTER PANEL TRAILING EDGE.
945	56	32W10573-2L/R	AILERON
935	57	32W9392 L/R	WING OUTER PANEL LEADING EDGE
935	58	32W1024-0L/R	WING TIP
	59		COMBINED WITH ITEM 32
947	60	32L003	NOSE LANDING GEAR

FUEL CELLS

41A — CENTER WING

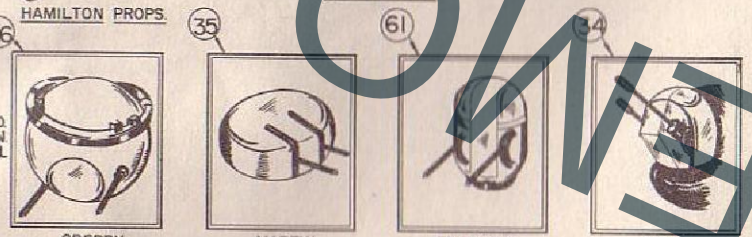
IN 70 — OUTER WING



IN 70

HAMILTON PROPS.

TURRETS



SPERRY — MARTIN — EMERSON — C.A.C.

947	61	32GF8687	EMERSON TURRET
944	62	32P9101	NAC. POWER PLANT INST. L.H. OUTBD.
944	63	32P9102	" " " " INBD.
944	64	32P9103	" " " " R.H. OUTBD.
944	65	32P9104	NAC. PWR. PLANT INST. R.H. INBD.
944	66	32P9111	TURBO INST. L.H. OUTBD.
944	67	32P9112	" " " INBD.
944	68	32P9113	TURBO INST. R.H. INBD.
944	69	32P9114	TURBO INST. R.H. OUTBD.
947	70		PTS. LIST MISC. LOOSE
	71		NOT REQUIRED PTS.
940	72	32B9000	NOSE ASSY.
940	73	32B9001	FUS. ASSY. STA. 5.1 TO 7.7 (NOTE)

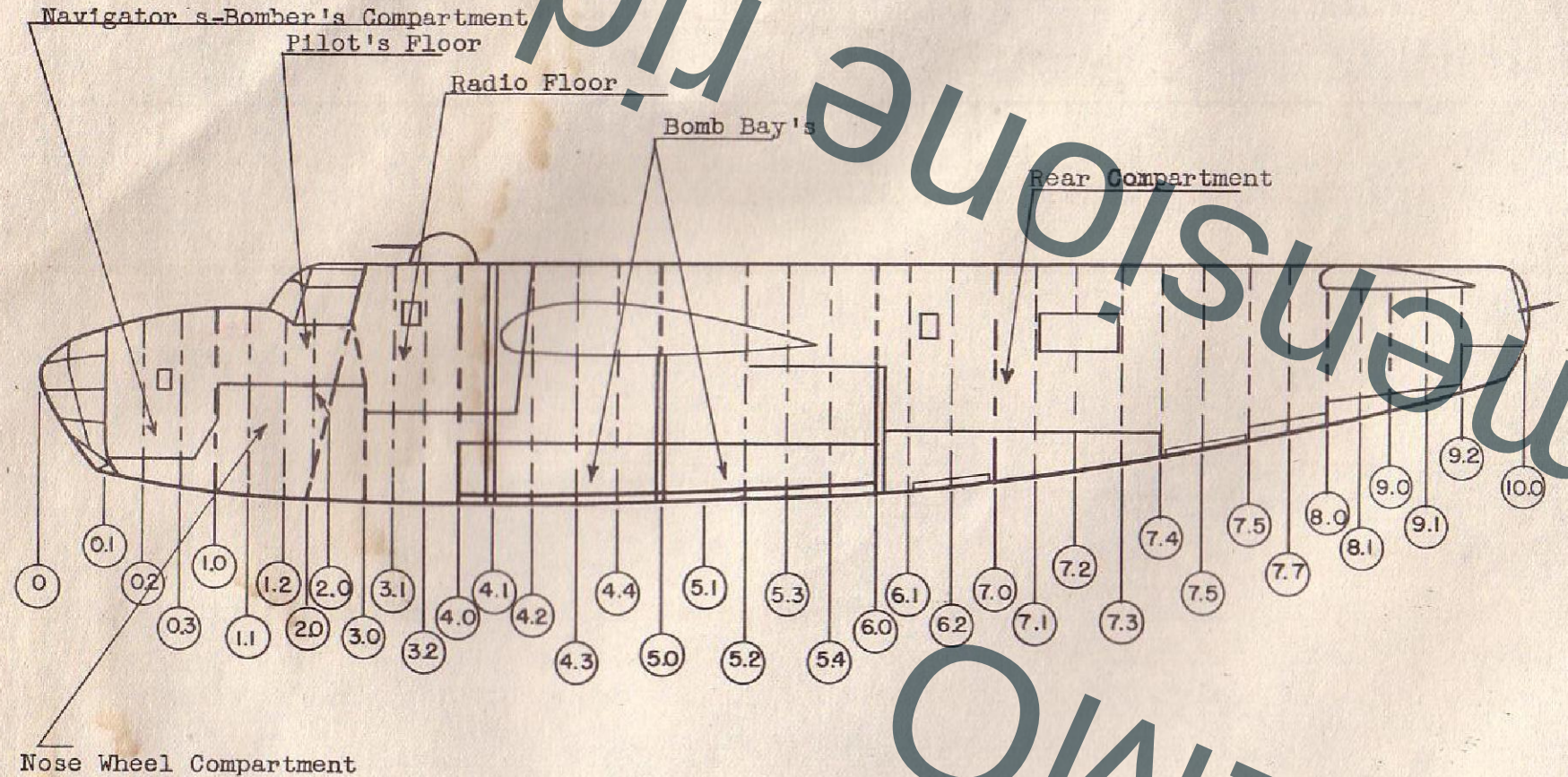
NOTE

ITEMS-3,4,5,6,7,8,9,10,11,12,14 WILL BE RIVETED INTO ONE TO BE CALLED ITEM #72 (32B9000)

ITEMS-23, 25, 26, 27, 28, 30, 31, 32 WILL BE RIVETED INTO ONE ASSY. TO BE CALLED ITEM #73 (32B9001)

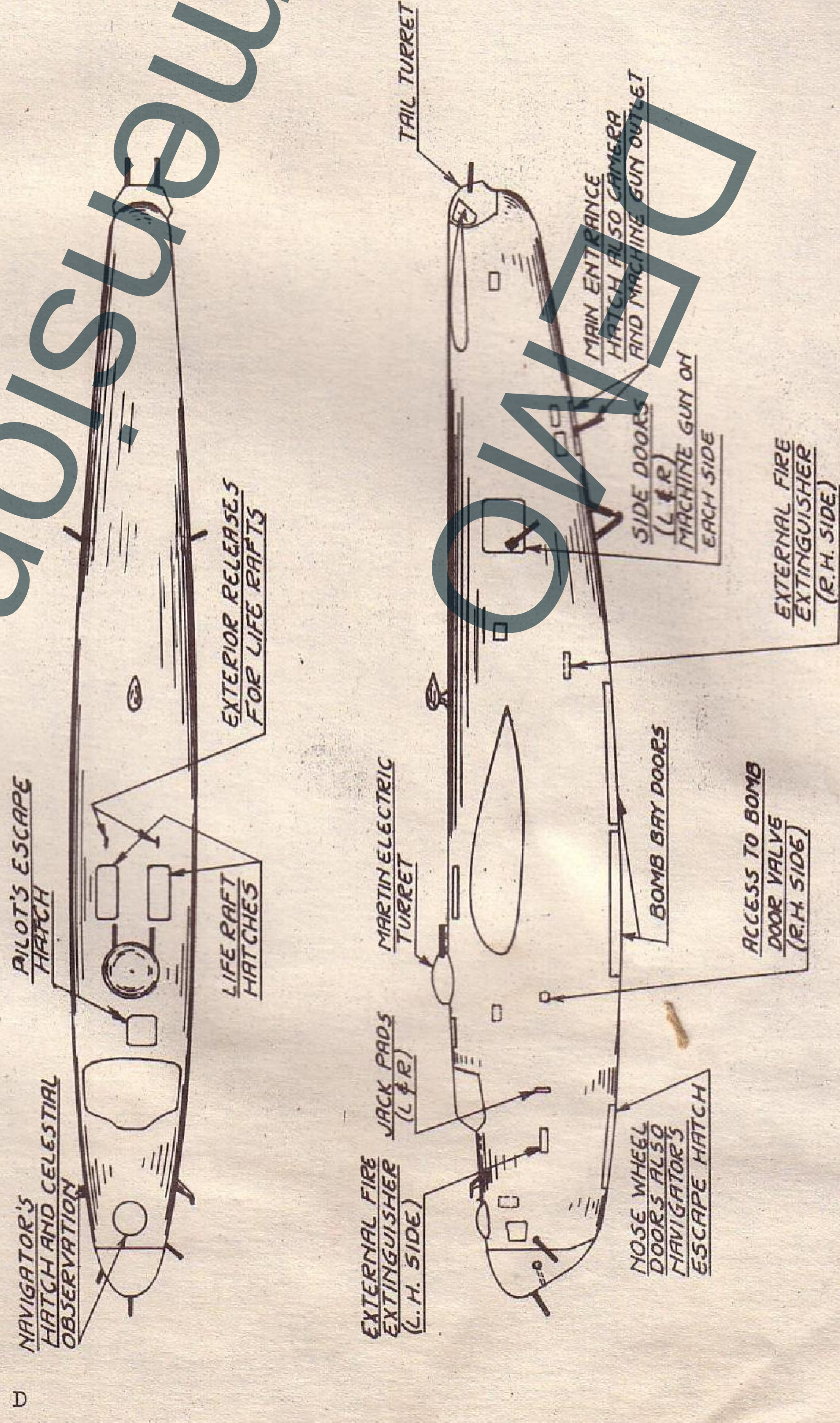
ITEMS-54, 55, 57, 58 WILL BE ASSEMBLED INTO ONE UNIT FOR SHIPPING.

FORD B24 BREAKDOWN



FUSELAGE STATIONS DIAGRAM

FUSELAGE ACCESS DOORS



TECHNICAL ORDERS TO BE PLACED IN STUDY HALL - PHASE I

1. T.O.#00-15-1 --The Army Air Forces Technical Inspections Manual.
   Part 1 Sections 1-2-3-4-5-6.
   Part 2 Sections 6.

2. T.O.#00-20A --Visual Inspection System for Airplanes.
   Sections 1-2-3-4-5-6.

3. T.O.#00-20A-1--Visual Inspedtion Systems for Airplanes.

4. T.O.#00-20A-2--Airplane Maintenance Instruction Forms.

5. T.O.#00-25-9 --Preparation of Freight for Air Shipment.
   Sections 1-2-3-4-5.

6. T.O.#00-40-1 --Silhoutte Handbook of U.S. Army Air Forces Airplanes.

7. T.O.#01-1-1 --Cleaning Aeronautical Equipment.

8. T.O.#01-1-2 --Anti-Corrosion for Airplanes Operating in Salt Water.

9. T.O.#01-1-3 --Airplane Finishes.

10. T.O.#01-5-6 --Airplane and Maintenance Parts (Adj. of Elevator Trim Tab Servo Movement and Elevator Control Tension).

11. T.O.#01-1-26 --Frayed Control Cables.

12. T.O.#01-1-29 --Use of Surface Control Lock and Inspection of Surface Controls.

13. T.O.#01-1-7 --General - Long Time Storage of Airplanes.

14. T.O.#01-1-8 --Ventilation of Airplane in Hot Weather.

15. T.O.#01-1-9 --Rigging Tension of Control Cables.

16. T.O.#01-1-12 --General - Inspection of Airfoils.

17. T.O.#01-1-50 --Towing - Mooring and Hnadling of Airplane.

18. T.O.#01-1-57 --Lubrication of Control Cables.

19. T.O.#01-1-67 --Arctic Operation.
    Sections 1-2-3-4-5.

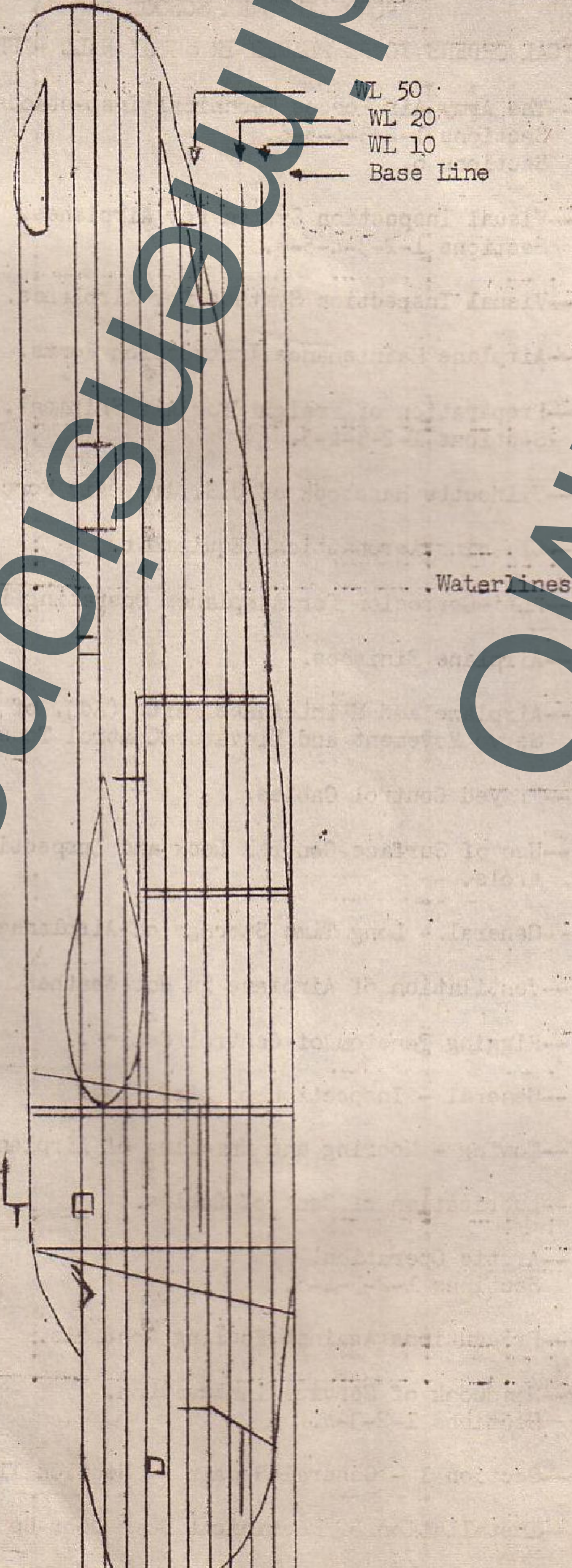
20.

20. T.O.#01-1-109--Precautions Against Fouling Controls.

21. T.O.#01-5EC-2--Handbook of Service Instnuction.
    Sections 1-2-3-4.

22. T.O.#01-5E-3 --Section I - General Repair -- Section II-Wing.

23. T.O.#01-5E-21--Installation of Mechanical Bomb Door Up Lock.


WL 50
WL 20
WL 10
Base Line
Waterlines

IDENTIFYING SERIES OF TECHNICAL ORDER NUMBERS

T. O. SERIES	EQUIPMENT
00	INDEXED AND MAINTENANCE PUBLICATIONS OF A GENERAL NATURE
01	AIRPLANES AND MAINTENANCE PARTS - GENERAL
02	ENGINES AND MAINTENANCE PARTS - GENERAL
03	AIRCRAFT ACCESSORIES
04	AIRCRAFT HARDWARE AND RUBBER MATERIALS
05	AIRCRAFT INSTRUMENTS AND LABORATORY TEST EQUIPMENT
06	FUELS AND LUBRICANTS
07	DOPES, PAINTS AND RELATED MATERIALS
08	ELECTRICAL EQUIPMENT AND SUPPLIES
09	GLIDERS, TARGET PLANES AND SPARE PARTS
10	PHOTOGRAPHIC EQUIPMENT AND SUPPLIES
11	AIRCRAFT COMBAT MATERIAL
12	FUEL AND LUBRICATING EQUIPMENT AND SUPPLIES
13	CLOTHING, PARACHUTES, EQUIPMENT AND SUPPLIES
14	HANGARS AND DEMOUNTABLE BUILDINGS
16	GAS CYLINDERS
17	MACHINERY, SHOP EQUIPMENT AND TOOLS
18	SPECIAL TOOLS
19	FLYING FIELD AND HANGAR EQUIPMENT
22	WOODS
23	METAL AND COMPOSITION MATERIAL
24	CHEMICALS
25	OFFICE EQUIPMENT AND SUPPLIES
29	COMMERCIAL HARDWARE AND MISCELLANEOUS SUPPLIES
30	PROCESS MANUALS

STRUCTURE

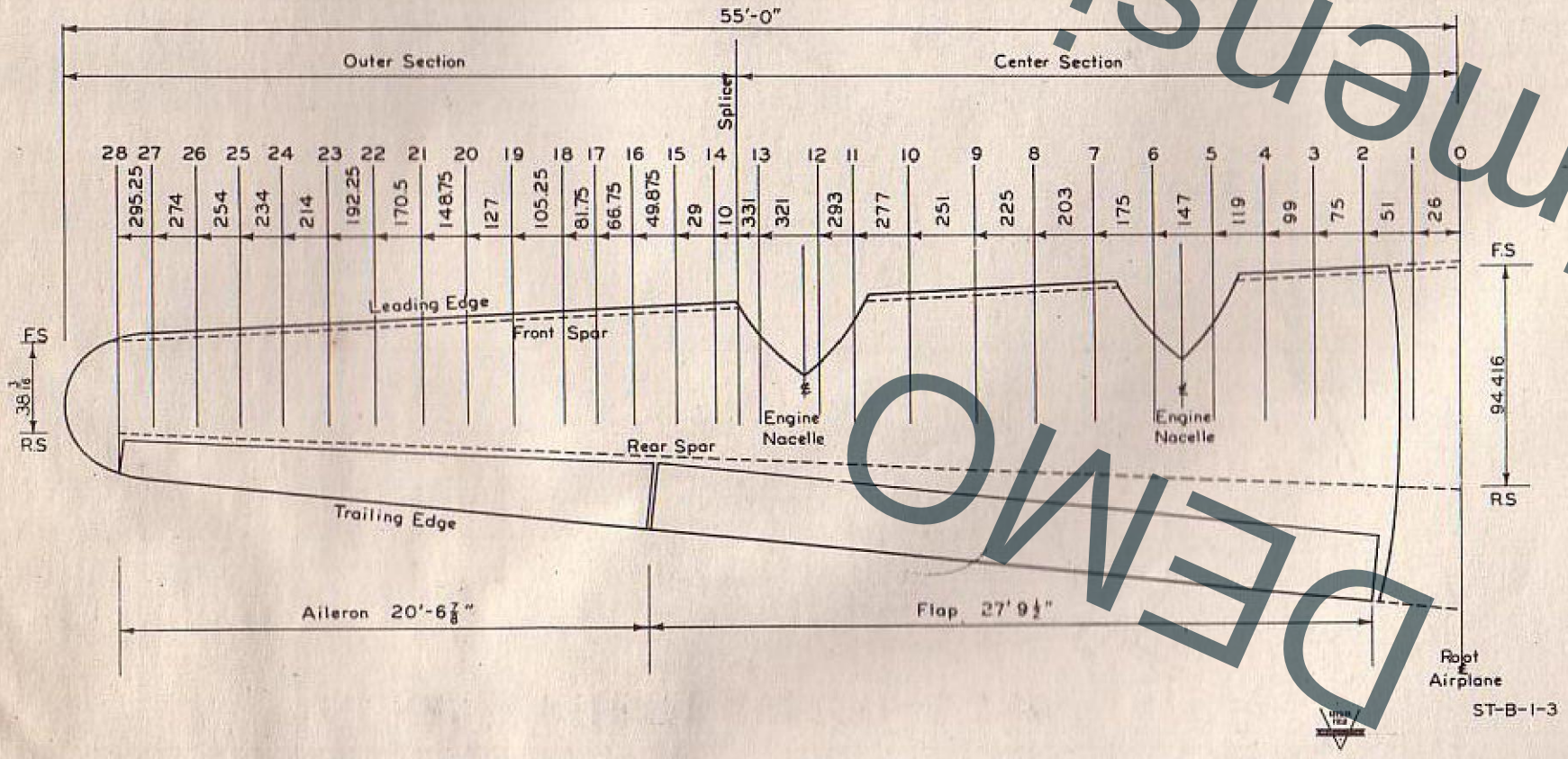
PHASE I

FORD AIRPLANE SCHOOL

ARMY AIR FORCES

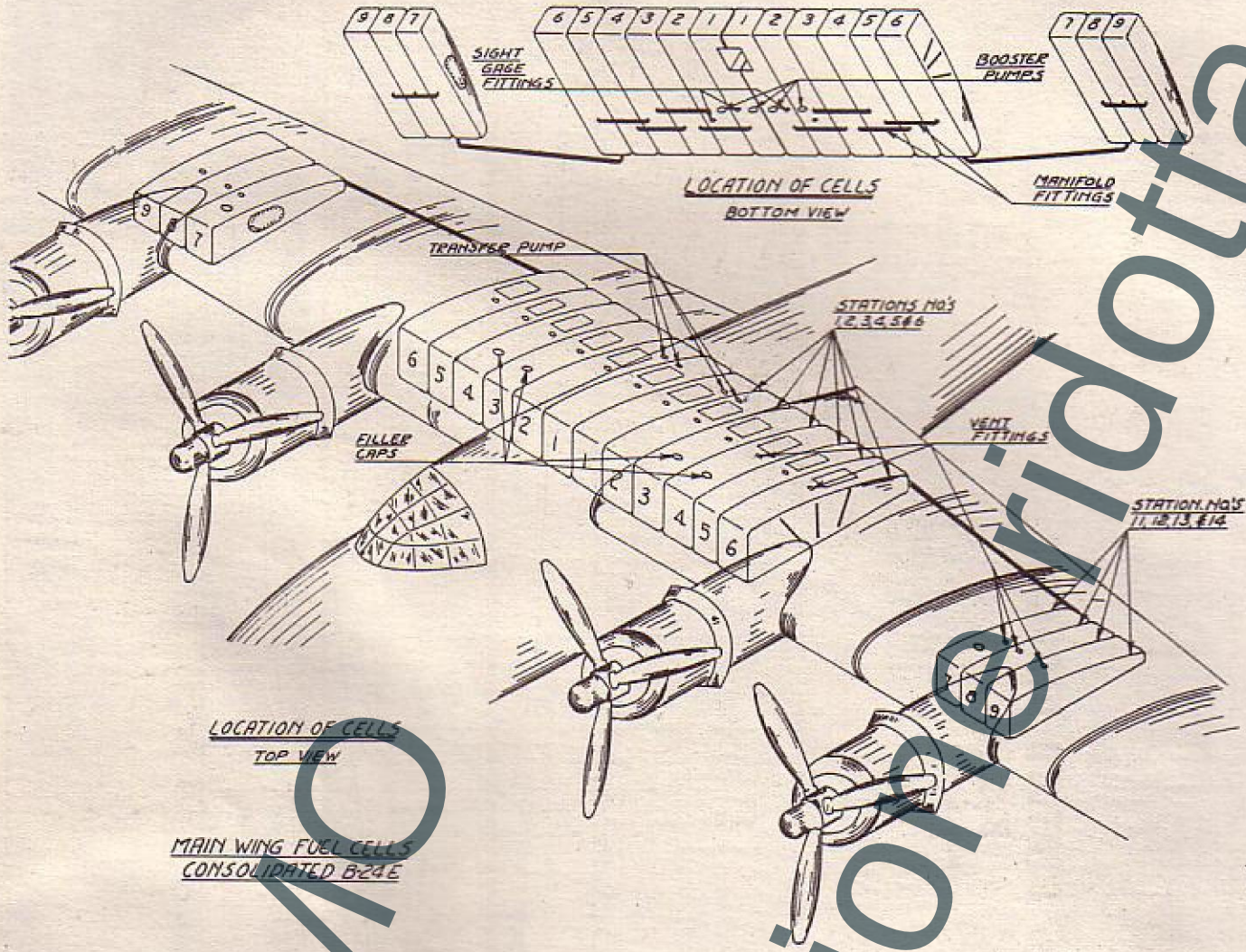
JOB SHEET

WING STATION DIAGRAM
B-24D
NOVEMBER 1, 1942



FORD AIRPLANE SCHOOL

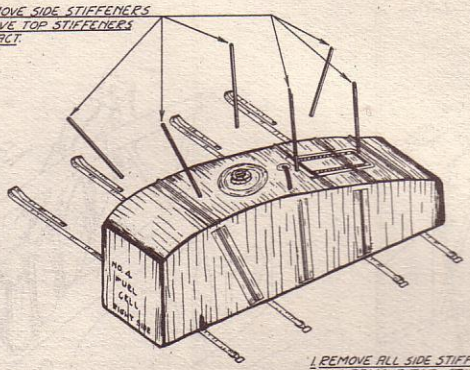
ARMY AIR FORCE



MAIN WING FUEL CELLS
CONSOLIDATED B-24E

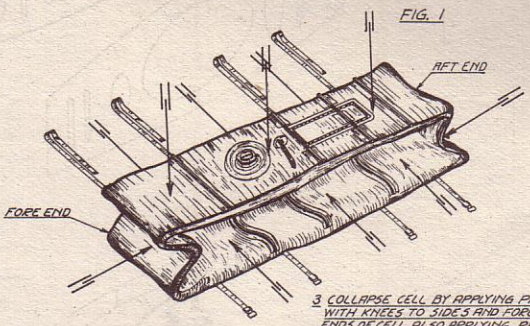
Airplane & Engine Mech Course (Special B-24)
FORD AIRPLANE SCHOOL

Waterlines



1. REMOVE ALL SIDE STIFFENERS. DO NOT REMOVE TOP STIFFENERS.
2. PLACE FOUR WEB STRAPS UNDER CELL. SEE ABOVE FIGURE.

FIG. 1



3. COLLAPSE CELL BY APPLYING PRESSURE WITH KNEES TO SIDES AND FORE AND AFT ENDS OF CELL. ALSO APPLYING PRESSURE TO THE TOP OF CELL AT THE SAME TIME TUCKING FORE AND AFT END OF CELL INWARD. ARROWS INDICATE POINTS WHERE PRESSURE MAY BE APPLIED.

USE 4 STRAPS AND SPACE APPROXIMATELY AS INDICATED IN DIAGRAMS.

ADJUST STRAP BUCKLES AT CENTER OF CELL.

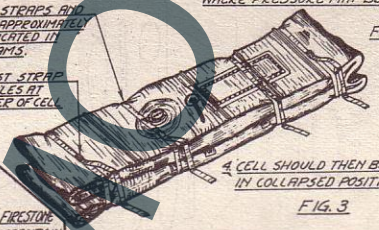


FIG. 2

4. CELL SHOULD THEN BE SECURED IN COLLAPSED POSITION.

FIG. 3

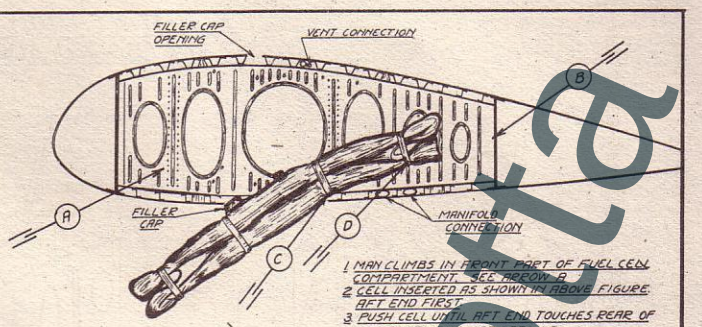
DRAWN 10-1-43 R. FREY

FUEL CELL CAPACITYS

NUMBER OF CELL	GOODYEAR CAPACITY IN GALLONS	FIRESTONE CAPACITY IN GALLONS
1	224	199
2	228	223
3	208	207
4	197	194
5	141	136
6	188	188
TOTAL	1186	1149

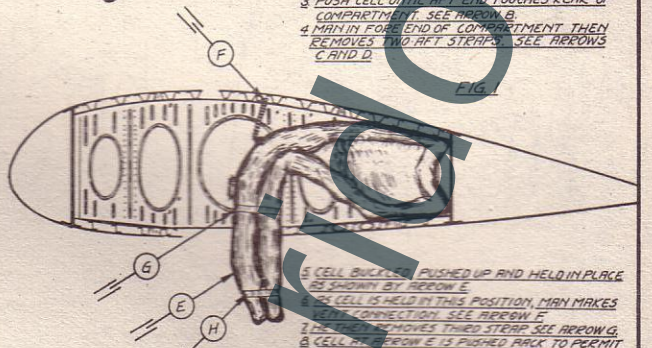
METHOD OF COLLAPSING AND INSTALLING MAIN WING CELLS CONSOLIDATED B-24

READ DIRECTIONS TOP TO BOTTOM



1. MAN CLIMBS IN FRONT PART OF FUEL CELL COMPARTMENT. SEE ARROW A.
2. CELL INSERTED AS SHOWN IN ABOVE FIGURE. AFT END FIRST.
3. PUSH CELL UNTIL AFT END TOUCHES REAR OF COMPARTMENT. SEE ARROW B.
4. MAN IN FORE END OF COMPARTMENT. THEN REMOVES TWO AFT STRAPS. SEE ARROWS C AND D.

FIG. 1



5. CELL BUCKLES PUSHED UP AND HELD IN PLACE AS SHOWN BY ARROW E.
6. AS CELL IS HELD IN THIS POSITION, MAN MAKES VENT CONNECTION. SEE ARROW F.
7. [illegible] REMOVES THIRD STRAP SEE ARROW G.
8. CELL AT ARROW E IS PUSHED BACK TO PERMIT MAN TO COME OUT.
9. AS FORE END OF CELL IS TUCKED IN, REMOVE FOURTH STRAP. SEE ARROW H.

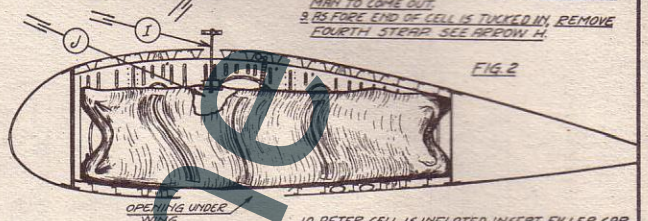


FIG. 2

10. AFTER CELL IS INFLATED INSERT FILLER CAP LIFTING TOOL FROM TOP OF WING. SEE ARROW I. AREA ABOUT CAP HAS BEEN LEFT OUT TO SHOW ACTUAL CONNECTION. SEE ARROW J.

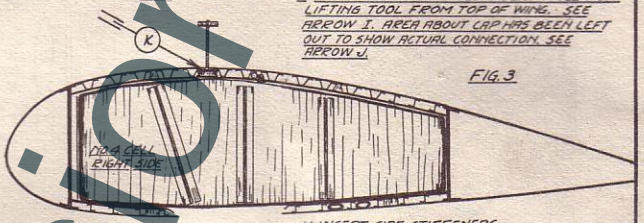


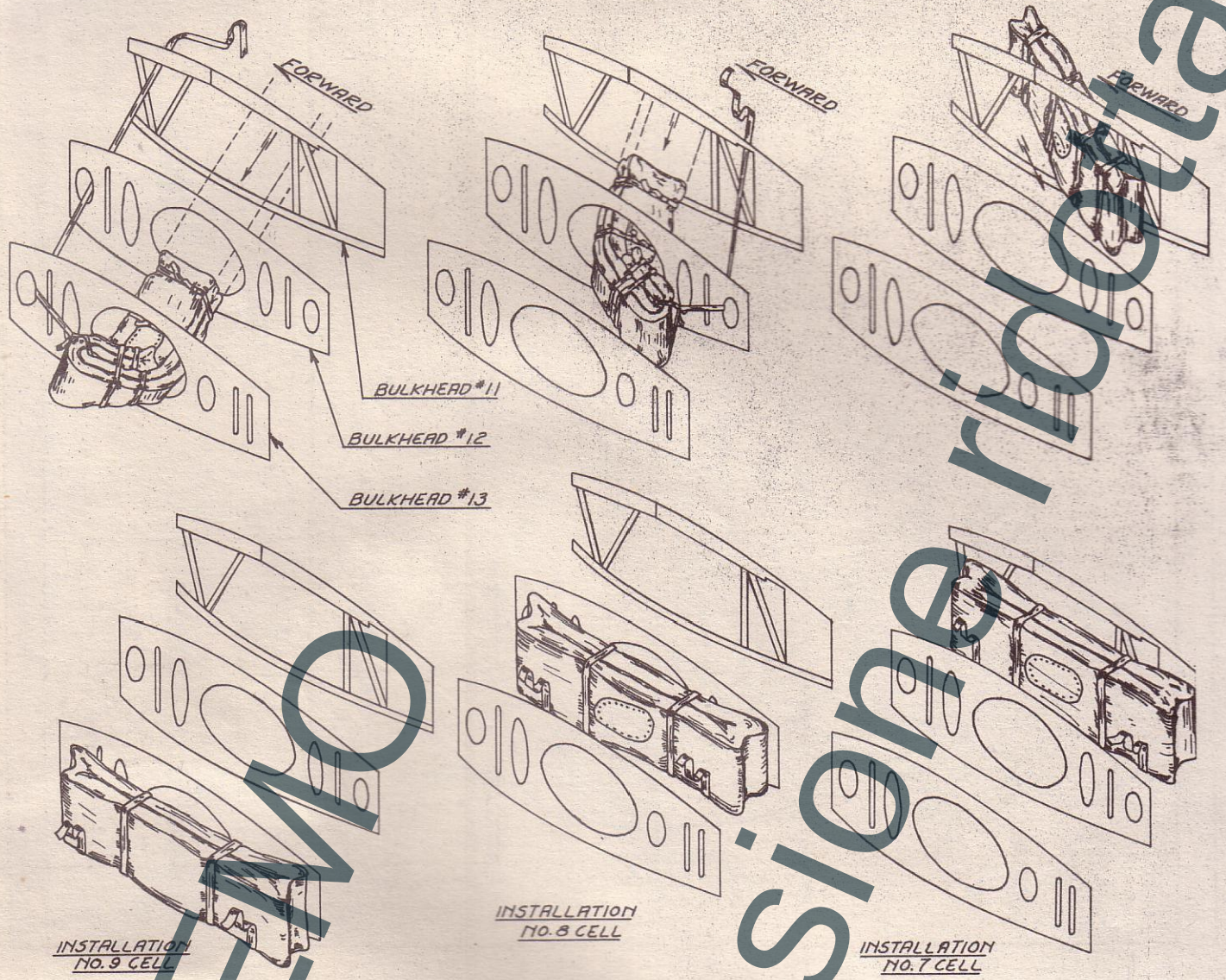
FIG. 3

11. INSERT SIDE STIFFENERS.
12. PULL UP ON FILLER CAP TOOL HANDLE UNTIL FILLER CAP IS FLUSH WITH WING. SEE ARROW K.

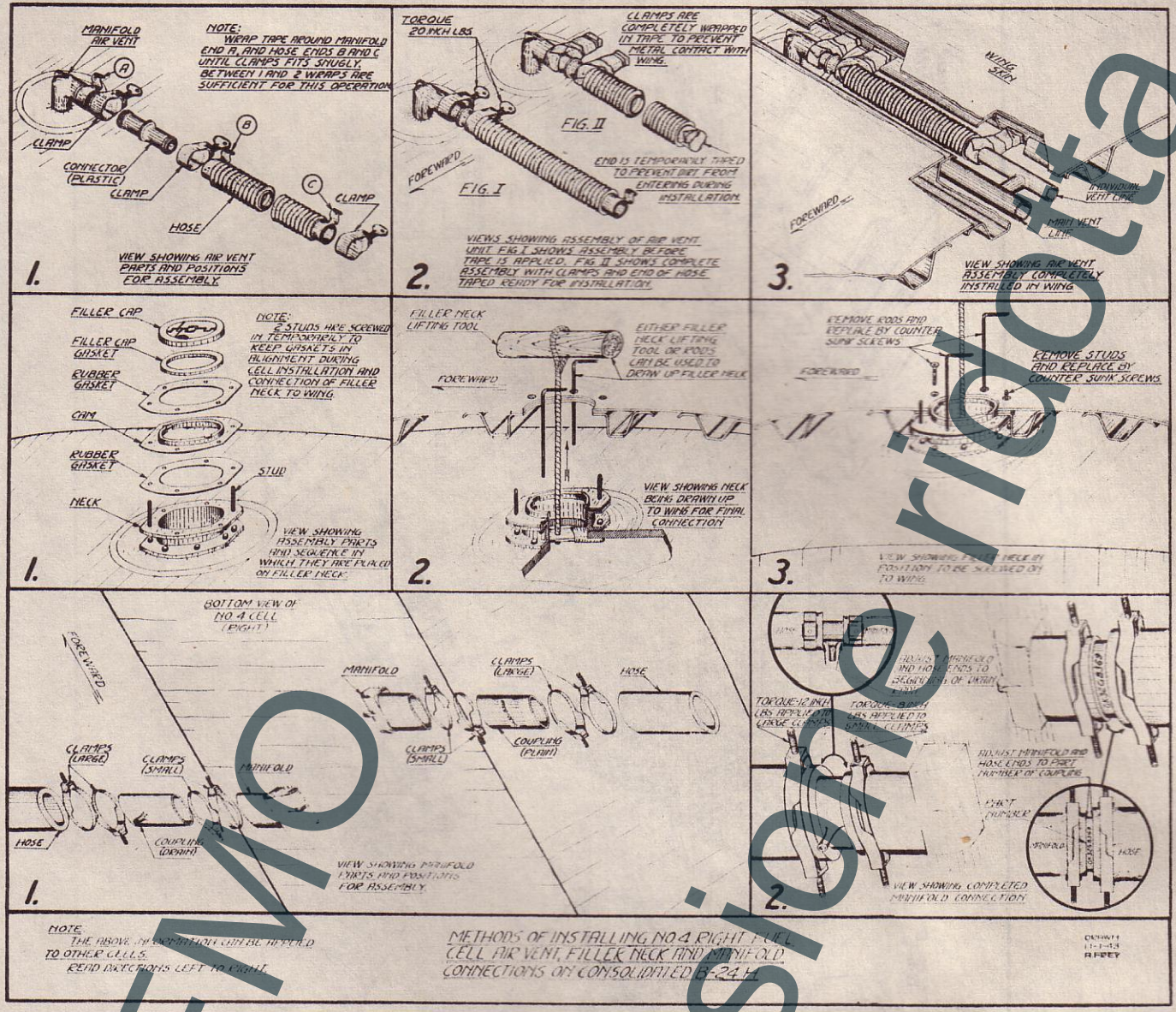
FIG. 4

FORD AIRPLANE SCHOOL
ARMY AIR FORCE

INSTALLATION OF NO.'S 7, 8 & 9 OUTBOARD FUEL CELLS

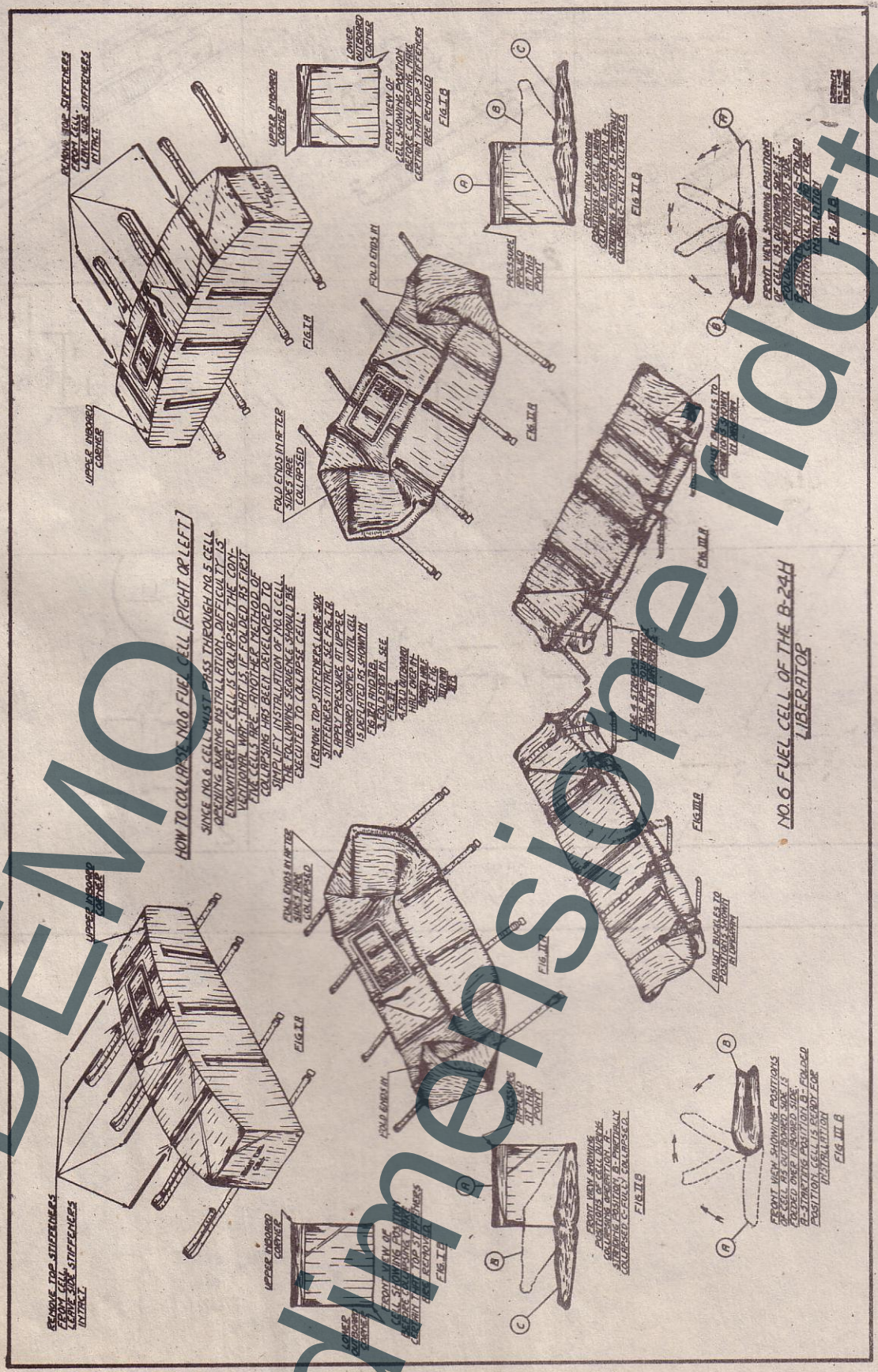


NOTE: READ FROM TOP TO BOTTOM



FORD AIRPLANE SCHOOL

ARMY AIR FORCES



FORD AIRPLANE SCHOOL
ARMY AIR FORCES

STRUCTURE

GENERAL PROCEDURE TO BE FOLLOWED WHEN REMOVING OR INSTALLING REMOVABLE SURFACES

Removal of Vertical Surfaces:

1. Loosen all bolts.
2. Remove center hinge holts.
3. Remove bottom hinge bolt.
4. Remove top hinge bolt LAST.

Installation of Vertical Surfaces:

1. Start bolt in top hinge FIRST. (Do not tighten)
2. Start bolt in bottom hinge.
3. Start remaining hinge bolts.
4. Tighten all bolts USING TORQUE WRENCH. (See table below)

Removal of Horizontal Surfaces:

1. Loosen all hinge bolts.
2. Remove center hinge bolts.
3. Remove inboard and outboard at the same time. LAST.

Installation of Horizontal Surfaces:

1. Start bolts in inboard and outboard hinge at the same time.
2. Start center hinge bolts.
3. Tighten all bolts USING TORQUE. (See table below)

TORQUE WRENCH TABLE

SIZE	STEEL IN.LBS.	AL. IN.LBS.	STEEL FT.LBS.	AL. FT.LBS.
3/16"	35-50	10-14	3-4	1
1/4	55-90	20-35	5-7	2-3
5/16"	90-150	50-75	8-12	4-6
3/8"	200-350	80-110	17-29	7-9
7/16"	350-600	100-140	30-50	9-11
1/2"	500-850		42-70	14-22
5/8"	850-1300	400-460	71-108	29-38
3/4"	1200-1750		240	

7-12-44

FORD AIRPLANE SCHOOL
ARMY AIR FORCES

STRUCTURE

RUDDER-REMOVAL AND INSTAILATION

Tools: 1/2" socket, ratchet, open-end wrench, 3/2" open end wrench, 7/16" open end wrench, 5" screwdriver, wire twister, safety wire, diagonal cutters, and cotter pins.

Removal:
1. Disconnect bonding wire.
2. Disconnect tab horn from tab push-pull tube.
3. Disconnect rudder horns from rudder push-pull link,
4. Remove bolts at four hinge points, detaching entire hinge from rudder spar.
5. Slide rudder aft until clear of brackets.

Installation:
1. Reverse steps of removal with following precaution: Before attaching rudder horns to rudder push-pull link, lock the rudder link in neutral position and line up the surface in neutral position to fin with a straight edge. If rudder horns and rudder link will not line up when they are both in neutral, make adjustment by screwing the rudder link T-head in or out until they do line up; after alignment tighten lock nut that locks the link T-head.
2. If tab is out of neutral when control at pedestal reads zero and rudder is locked, make adjustment as given under Installation of Tabs.
3. Safety all bolts with cotter pins or safety wire as required.

FORD AIRPLANE SCHOOL,
ARMY AIR FORCES

RIGGING RUDDERS ON B-24-E

To Rig the Rudder Surfaces: Lock the push-pull tube in the stabilizer. This is the neutral position.

The rudder surfaces can be trimmed for neutral position by placing a straight-edge alongside the fin at the first row of rivets under the stabilizer at the same level on each side. See Figure II. Measure at the trailing edge of the rudder. The measurement should be within 3/32 inch odemtocal on each side. See Figure II -(1).

Adjustment is made at the threaded end of rudder push-pull tube attached to the rudder horn. See Figure II - (2). After adjustment tighten lock-nut on push-pull tuhe. The same procedure is performed on both rudders, left and right.

To Rig the Rudder System: Lock the rudders in the neutral position, with the controls lock.

Tighten the two turnbuckles in the tunnel on left side between Station 3.0 and Station 4.1 so that the threads are even with the ends of the turnbuckle. See Figure I - (1).

Tighten the two turnbuckles in the bomb bay evenly until a tension of 60 lbs., (minus 0, plus 10 lbs.), at 70° F. is reached. See Figure I - (2).

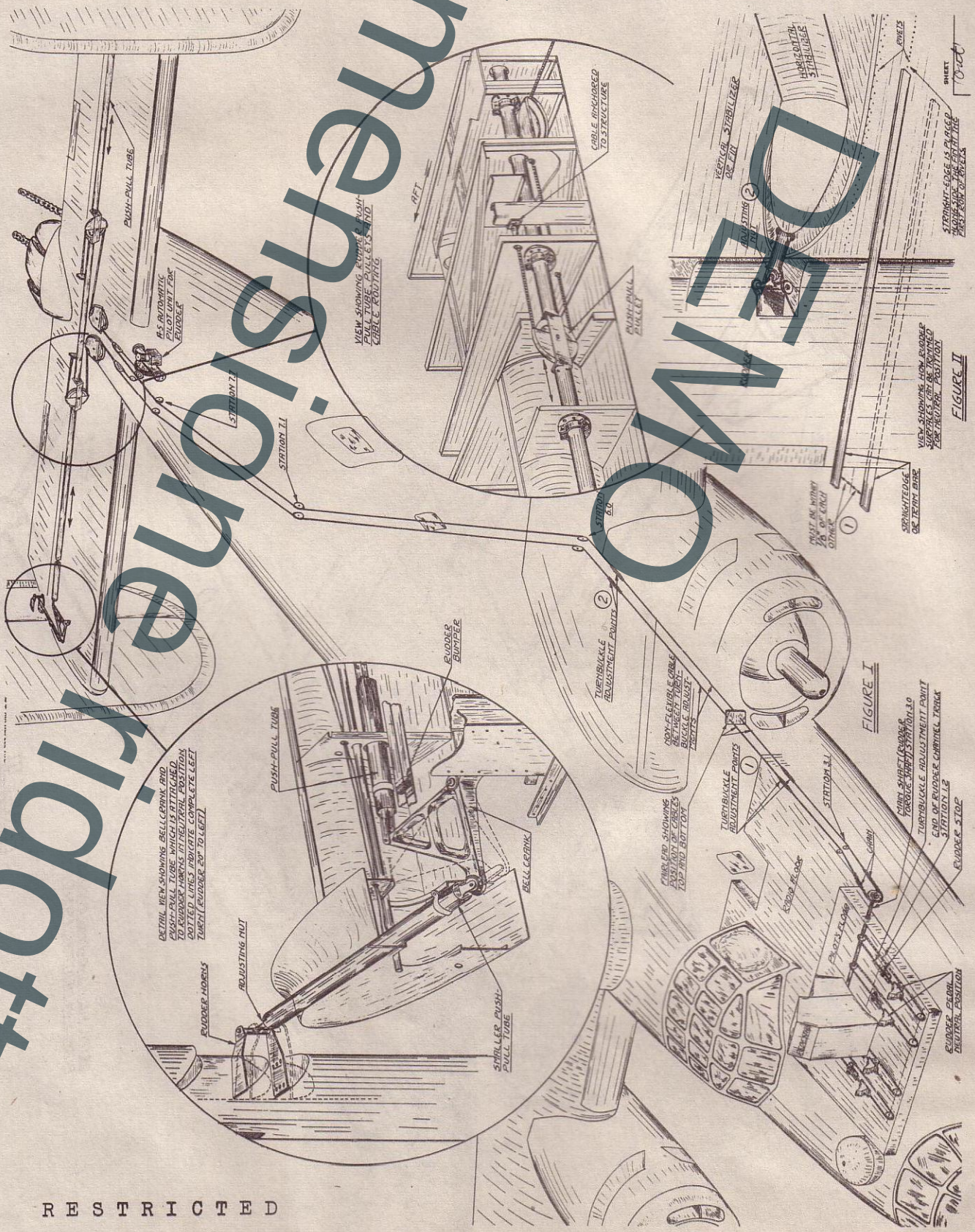
Rigging Rudder Pedals After Tension Has Been Applied to Main Cables: Adjust pedal carriages to neutral position which is reached when rear of carriage is 8 inches ahead of Station 1.2 by turnbuckles on pedal chains between idler pulleys and torque shaft. See Figure III - (1).

The rudder stops, Figure III - (2), are set at the factory to give 1/8 inch cushion of the rudder carriage at the stop. If the stabilizer has been changed in the field and the required cushion of 1/8 inch cannot be gained, the rudder pedal stop, (Figure III - (2), must be reworked to allow 1/8 inch cushion of the pedal, otherwise the rudder stops in the stabilizer would be ineffective, and full throw of the rudders could not be obtained This done by pushing the rudders to full throw, then set the stop by measuring back 1.8 inch from the aft end of the carriage. Push the pedal down against the stop and set the other stop.

If the pedals are set ahead of 8 inches for neutral position, they will strike the angle on the forward end of the cover plate between the rudder tracks. If aft of 8 inches, the chain will run too close to the end of full throw

Both extra flexinle 3/16 (7 x 19) and non-flexible 3/16 (1 x 9) cable is used.

Color Code: Ship to right - green
Ship to left - green and black.



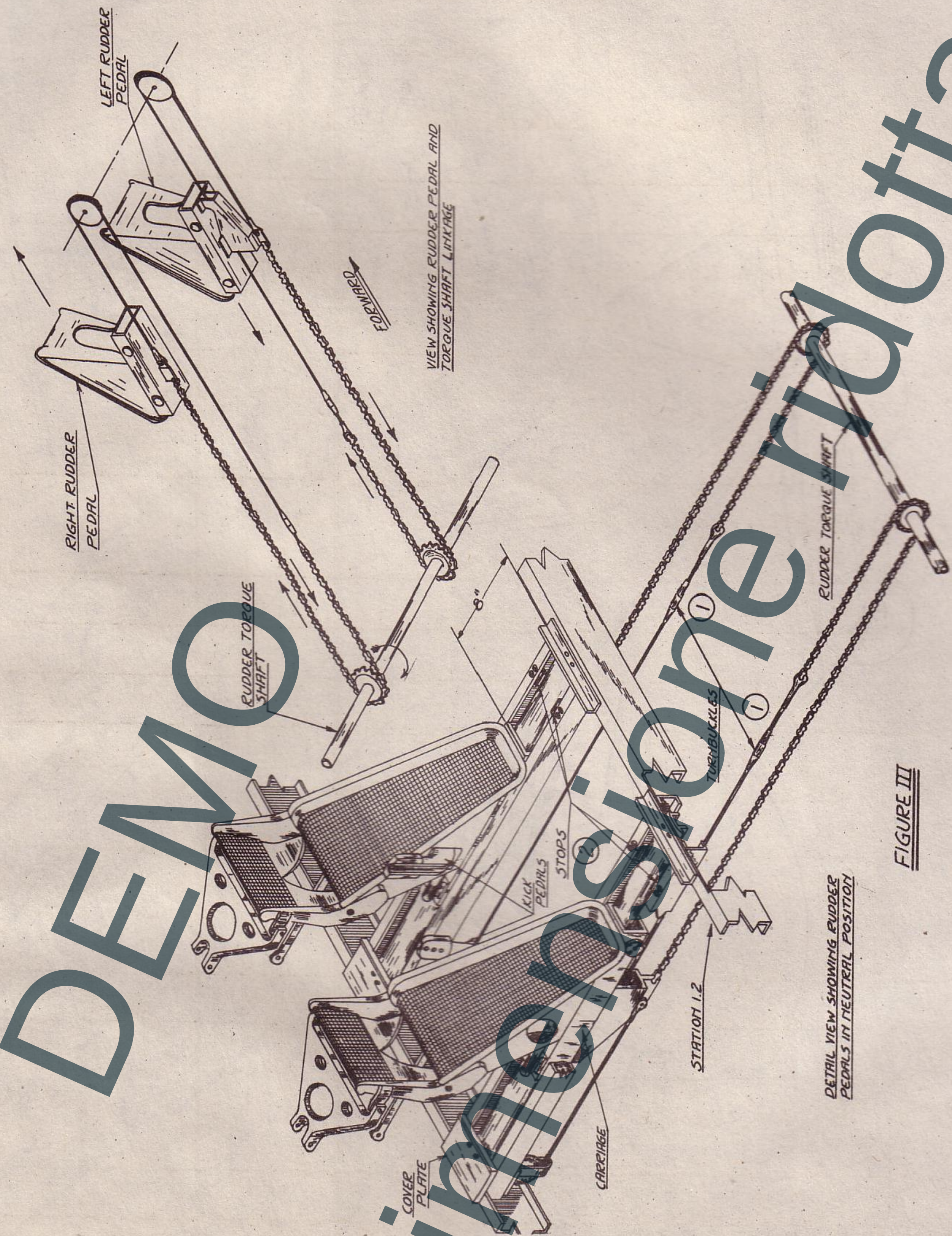


FIGURE III

RESTRICTED

Structure

AAF TECHNICAL SCHOOL
Willow Run, Ypsilanti, Mich.
B-24 Airplane School

RUDDER QUESTIONS

1. In order to interchange the rudders, what minor adjustments must be made?

2. Besides trimming the plane in level flight, how does the tab on the rudder help the pilot turn in the rudder surfaces?

3. What other aid, built into the structure of the rudder aids the pilot in turning the rudder surfaces?

4. List, briefly, t e main steps in removing a rudder.

5. When detaching the rudder from the stationary brackets, are the hinges left with the rudder or the vertical stabilizer?

6. When installing a rudder, in what position do we put the rudder to adjust it to line up with the corresponding positions of the rudder pedals? How do we make adjustments?

7. Why is it necessary to lock the rudder when aligning the rudder tab correctly?

8. I.f the tab is not in its correct neutral pos ition, when the main surface is is locked and the knob at the pedestal reads zero, where is the adjustment made?

9. How are the rudder pedals rigged so that one moves forward when the other moves backward?

10. What is the position of each rudder pedal assembly when the rudder system is properly locked in neutral? Is this the position of the pedal or the carriage?

11. How are the rudder pedals adjusted for pilot's leg length?

12. How can we adjust a pedal assembly if it is not properly aligned to neutral, or if the cushion is not the same for full left and right throw?

13. Briefly, trace the rudder cables from torque shaft to push-pull rod. Where are the bellcranks and what do they do?

FORD AIRPLANE SCHOOL
ARMY AIR FORCES

ELEVATOR - REMOVAL AND INSTALLATION

Tools: Midget ratchet, 7/16" socket, 7/16" deep socket, 7/16 " combination wrench, 3.8" combination wrench, 1/2" combination wrench, 5" screwdriver, wire twister, safety wire, diagonal cutters, cotter pins.

Removal:
1. Remove fairing and access plates on horizontal stabilizer, in island structure and at outboard end.
2. Detach removable pieces over elevator torque tube in island structure ribs.
3. Disconnect bonding wire, at points affected by elevator removal.
4. Disconnect tab horn from tab push-pull rod and remove push-pull rod by screwing it out of rod-end (bearing head) near elevator hinge line.
5. Remove bolt which connects elevator push-pull rod to elevator horn.
6. Remove bolts attaching torque tube to elevator stop-arm at center-line of stabilizer.
7. Remove bolts at hinge points, detaching entire hinges from elevator spar. (Avoid skin damage at outboard end by manuvering elevator, up or down, to allow proper application of socket and ratchet.)
8. Lift elevator until free.

Installation:
1. Reverse steps of removal with following precautions: Check alignment bolt and be sure holes of elevator stop-arm at centerline are properly aligned with the holes in the torque tube flange so that the elevator surface will be in neutral when the controls lock is locked. Also, be sure no bolts are exposed across elevator stop-arm so that they will prevent full elevator throw.
2. If tab is out of neutral when control at pedestal reads zero and elevator is locked, align to neutral by adjusting rod-end (bearing head) on aft end of elevator tab push-pull rod.
3. Safety all bolts with cotter pins or safety wire, as required.

RIGGING ELEVATORS ON THE B-24-E

To Rig the Elevator System: See that all installations are made and cables properly strung and the system in order.

Pull elevator down to full throw and set the push-pull tubes between elevator horns and the bellcranks so that top pulley has 1/4 inch clearance from the forward edge of bellcrank support, Figure II - (1). Tighten locknuts on push-pull tubes, Figure II - (2). Adjust turnbuckles in the tunnel between Station 3.0 and Station 4.0 so that threads are flush with the ends of the turnbuckles. See Figure I - (1).

Lock elevator with the controls lock at the tail and set the chain on the torque shaft on the left hand side. Figure I - (2), and draw the cables up to a low tension of 30 or 35 lbs. Them put the right hand chain on the sprocket and jump it until cables in the bomb bay will come together. Bring its tension up to the cables on the left hand side and then set the control columns.

To set the control columns, pull them out until they both read 7¼ inches or as near as possible. This measurement is taken from the cover plate at the aft end of the control columns to the aft end of the sliding tube. Figure IV - (1). When the control columns are pulled out to this measurement, put the run around chain on the torque shaft sprocket and apply tension to it, see Figure IV - (2). After this is completed, set the cushion.

To do this push the column all the way in and see if it springs back when it is turned loose. Pull it all the way out and observe the same thing.

This cushion comes from the stops hitting in the tail, Figure III - (1), before the stops hit in the control columns. See Figure IV - (3).

When the stop hits in the tail and the column is forced down against its stop, it causes a slight stretching of the system, and it causes the column to spring back as soon as it is released.

There will probably be more cushion one way than the other. This can be served by adjustment of the turnbuckles in the bomb bay or the turnbuckles in the run around chain.

If there is more cushion in a down position than in an up position, loosen the top cables in the bomb bay on both sides the same amount and tighten the bottom cables the same amount as you loosened the top cables. If there is more cushion in an up position, reverse the operation. After the cushion is adjusted, bring up the tension to 75 lbs. (plus or minus 5 lbs.), being careful not to spoil the tension. Tighten the same amount on each cable. Then test cushion again, and if necessary, reset it. After the cushion and tension is completed to your satisfaction, safety wire it at once.

Then check all clearances and make sure bonding is installed.

Both extra flexible 3/16 (7 x 19) and non-flexible 3/16 (1 x 19) cable is used.

Color Code: Ship up - Yellow
Ship down - Yellow and black.

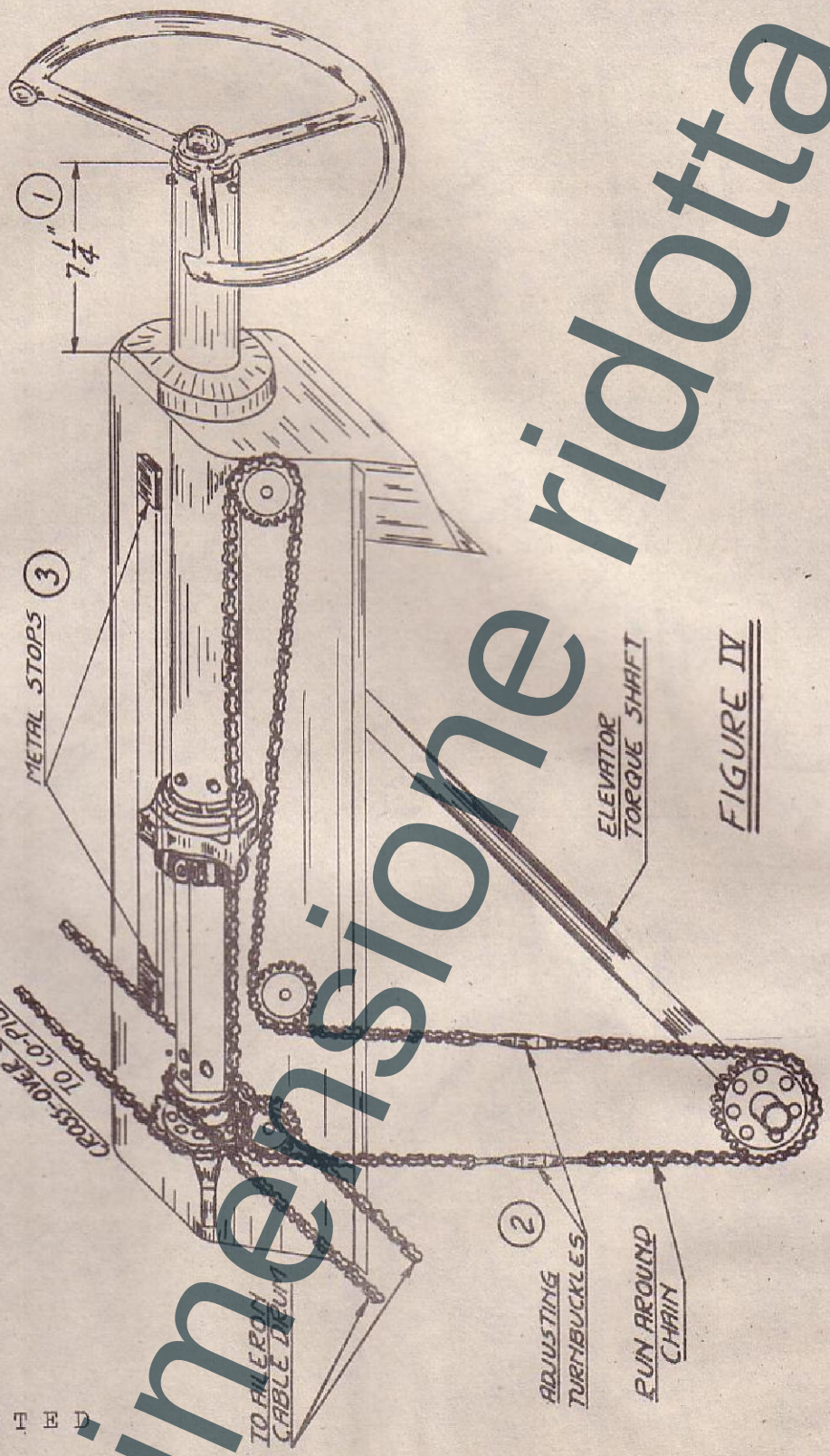
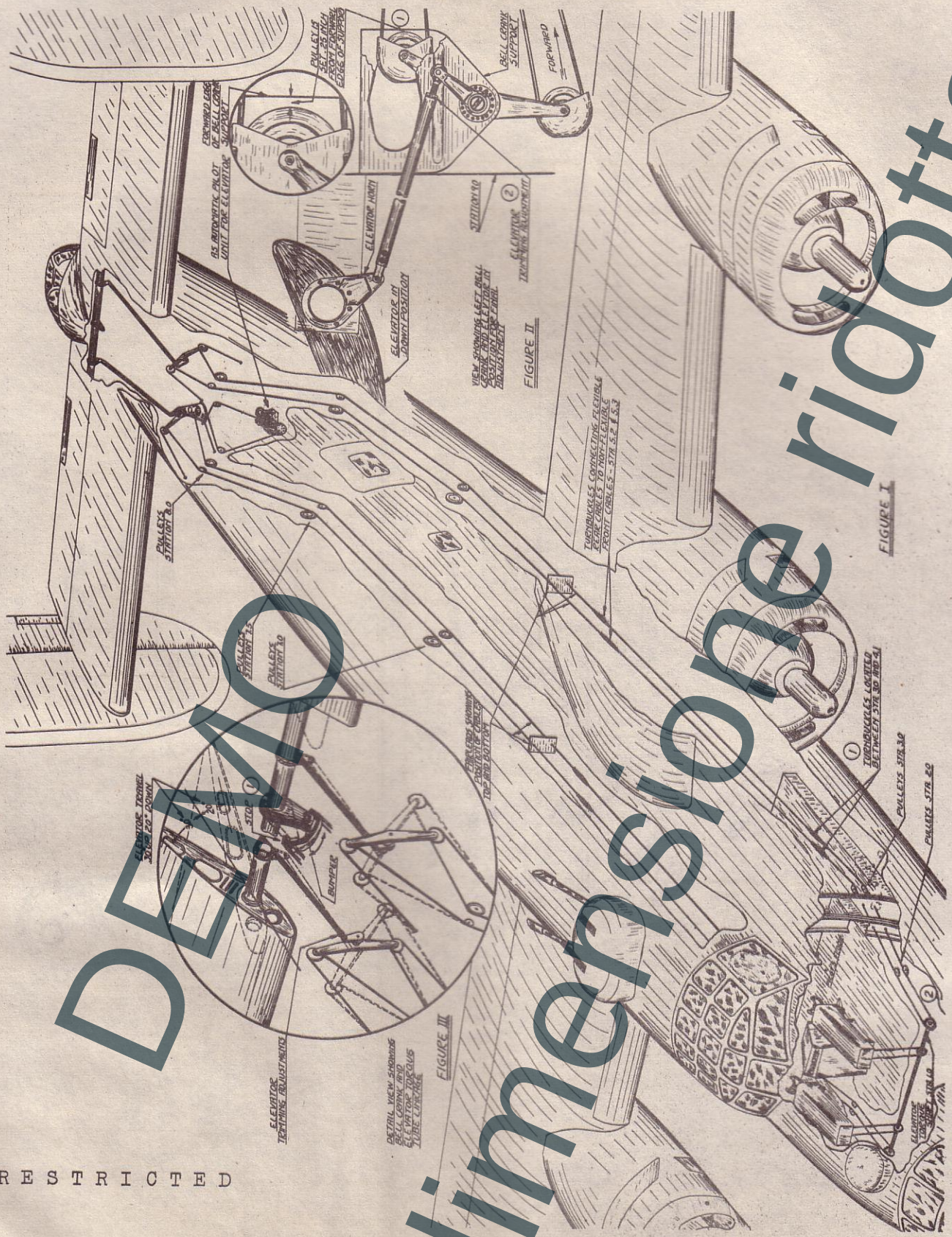


FIGURE IV



ELEVATOR QUESTIONS

1. How are the right and left parts of the elevator linked together?

2. What two features of the elevator aid the pilot in moving this surface?

3. Why can't the elevators be interchanged?

4. Is it necessary to disconnect any cables or turnbuckles when removing an elevator?

5. Why must the elevator tab push-pull rod be removed before removing an elevator?

6. In regards to removing the hinges, is the same procedure followed as in the case of the rudder? (Are they left with the fixed or movable surface?)

7. When aligning an elevator to its proper neutral position, is it necessary to use a tramming bar (or straight edge)? Why?

8. What causes elevator control columns to move together?

9. What is the position of the elevator control columns when the elevator system is properly locked in neutral?

ELEVATOR QUESTIONS CONT'D

10. How can we adjust an elevator control column if it is not properly aligned to neutral, or if the cushion is not the same for full up and down throw?

11. What clearance is obtained by using the adjustable forward end of the elevator push-pull rods?

12. Briefly, trace the elevator cables from torque shaft to bellcrank. Where are the bellcranks and what do they do?

AILERON - REMOVAL AND INSTALLATION

Tools: 3/8" socket, ratchet, 7/16" combination wrench, 3/8" combination wrench, thin lip offset screwdriver, 5" screwdriver, 7/16" deep socket diagonal cutters.

Removal:
1. Disconnect bonding wire.
2. On right aileron only, remove bolt attaching tab push-pull tube to horn.
3. Detach connecting link of gear box lever arms from aileron, one at each arm.
4. Remove hinge access plates on bottom side of aileron.
5. Loosen all hinge bolts.
6. Remove center hinge bolts FIRST, then inboard and outboard hinge holts LAST and together.
7. Slide aft until clear of brackets.

Installation:
1. Reverse steps of removal, starting inboard and outboard hinge bolts FIRST.

   Caution: Do not tighten any of the hinge bolts until all have been inserted.

2. If tab is out of neutral when control at pedestal reads zero, make adjustments as given under TAB INSTALLATION.
3. Safety all bolts with cotter pins.

RIGGING AILERONS ON B-24E.

Control Column - Figure II. With arrow on Right and Left control wheels (1) pointing downward, set stop blocks on cross-over chain exactly in the middle of the stop box (2).

Lock the aileron control drum, Figure I - (1) on the center section spar with the controls lock.

With the drum locked connect cables from drum to control chain, leading from left control unit, and adjust turnbuckles, Figure I - (2), located between Station 3 and 4 so that arrows on the control wheels point exactly vertically downward with cable tension as per table below.

Connect cables (3) between inner (4) and outer (5) gear boxes. With the lower cable loose, take up the back lash with the upper cable (6). Snug lower cable (7). This adjustment is important. If BACK LASH is not taken out ailerons will flutter. If cables are TOO TIGHT, gear boxes will be distorted and ailerons will bind. The upper cable should be slightly tighter than the lower.

With the drum still locked, clamp ailerons so that there is 1/2 inch droop in the ailerons measured between trailing edge of aileron and wing. See Figure III. Connect cables, Figure I - (8), between inboard gear boxes and main up operating drum on center section. Adjust evenly until tension of all four cables reaches that prescribed in the table below.

It is important, for proper adjustment, of the controls that ailerons be rigged to the following tensions at 70° F., 21.1° C. temperature:

Main Cables in Fuselage	60 lbs. minus 0 plus 10
Main Cables in Each Wing	60 lbs. minus 0 plus 10
Gear Box Connection Cable	No play
Cross-over Chains at Control Unit	No play

Aileron stops Figure II are set for 20° Aileron Throw.

Both extra flexible 3/16 (7 x 19) and non-flexible 3/16 (1 x 19) are used.

Color Code: Right wing up - White.
Right wing down - White and black.

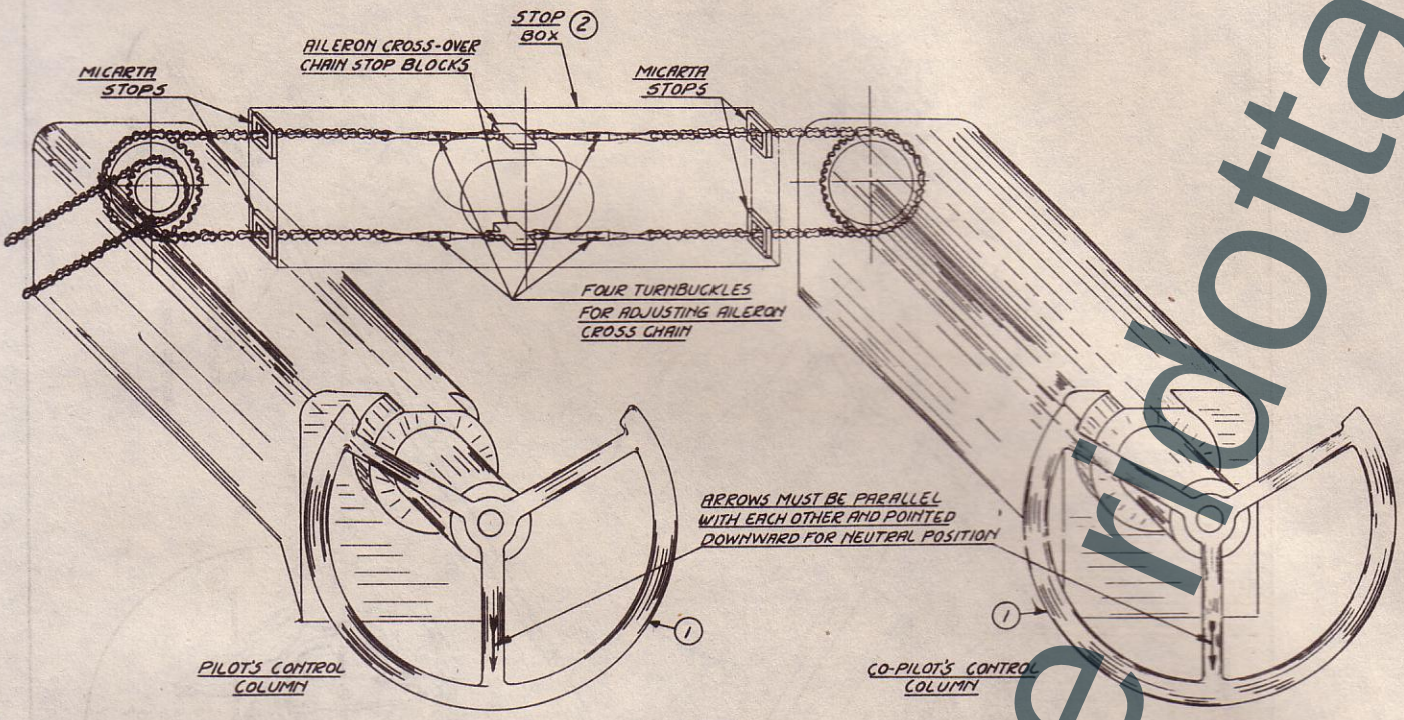
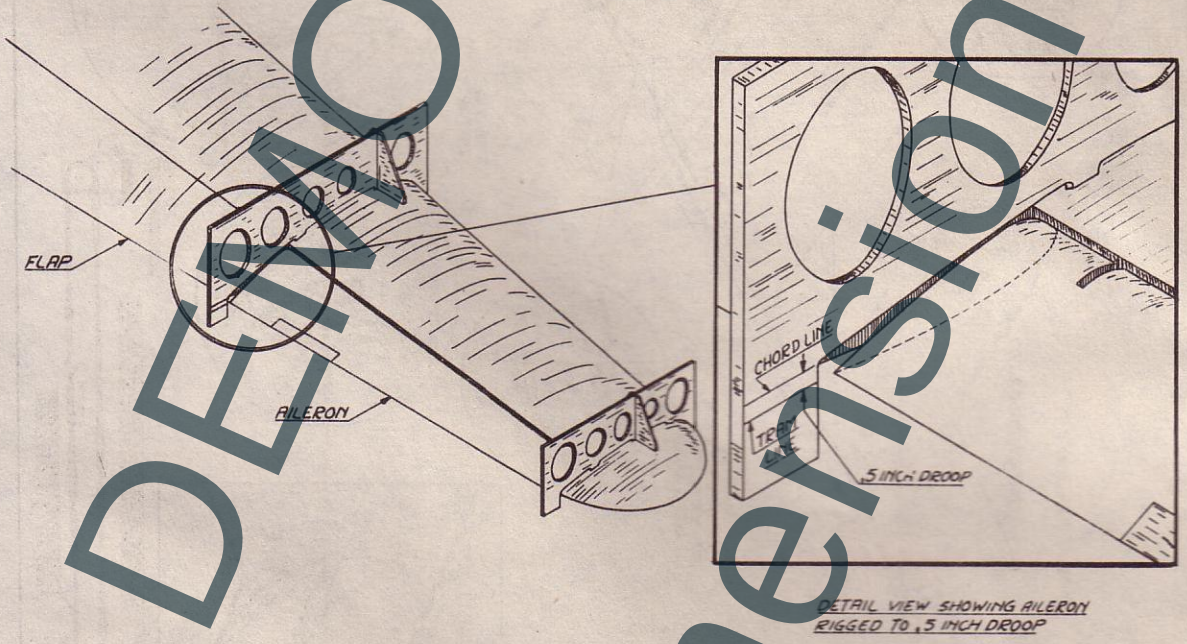


FIGURE 2



DETAIL VIEW SHOWING AILERON RIGGED TO .5 INCH DROOP

FIGURE 3

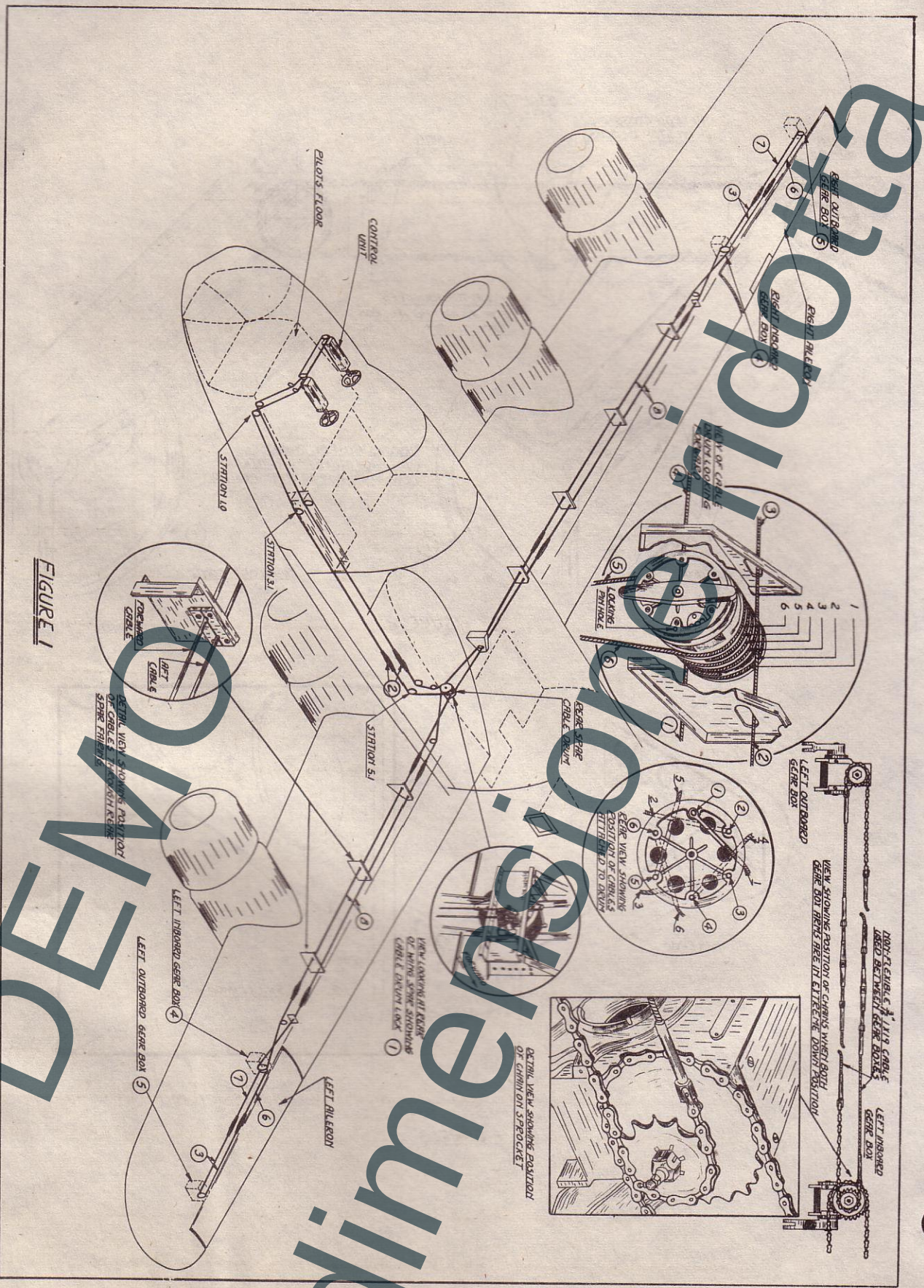


FIGURE 1

STRUCTURE

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AILERON QUESTIONS

1. How does one gain access to the aileron gear boxes and crossover turnbuckles?

2. What is inspected through the access doors on the bottom surface of the aileron?

3. Why can't the ailerons be interchanged?

4. List, briefly, the main steps in removing an aileron.

5. Before installing an aileron, how can we check to make certain that the hinge brackets are properly aligned?

6. Should the aileron be streamlined with the wing when the drum is locked and the plane is on the ground? Why?

7. If an aileron is not in its proper position when the drum is locked, how can we make the necessary adjustment?

8. What is the maximum aileron tab trim adjustment allowed for the Army acceptance flight inspection (at the factory)? Where can we look for trouble if this is exceeded?

AILERON QUESTIONS CONT'D.

9. What causes aileron control wheels to move together? How far do they turn each way?

10. What is the position of the aileron control wheels when the aileron control system is properly locked in neutral? What is the correct position of the stops at this neutral position?

11. How can we adjust an aileron control wheel if it is not properly aligned to neutral, or if the stops do not hit simultaneously?

12. What prevents the cables from slipping on the aileron cable drum?

13. How do we remove backlash from the aileron gear boxes?

14. Briefly, trace the aileron cables from control columns to gear boxes. What causes one aileron to go up when the other goes down?

WING FLAPS - REMOVAL AND INSTALLATION

Tools: 7/16" combination wrench, 3/8" combination wrench, 5" screwdriver, 9/16" combination wrench.

Removal:

1. Lower the flaps until they are fully extended.
2. Loosen turnbuckles on all extending cables.
3. Disconnect extending cables and tape them to the ribs of trailing edge of wing.
4. Disconnect retracting cables and also tape to ribs.
5. Remove pulleys.
6. Remove stops at aft end of each track. Be sure to remove the extreme outboard and inboard stops last.
7. Slide flap aft and down until free of tracks.

Installation:

1. If installing a new flap which has not previously been lined up to the tracks on the ship, each track should be removed and lined up to the carriage station which it supports. All these tracks can be removed with bolts.
2. Bolt the tracks back to the track supports.
3. Adjust the inboard and outboard track top brace so that these tracks will be flush with the trailing edge of the wing.
4. Set up a guide wire between the inboard and outboard track at the aft lower edge of the tracks, then adjust the three remaining tracks so that they will coincide with this guide wire. Lock this adjustment on the track braces. Remove the guide wire.
5. Insert the flap.
6. Adjust the position of the center track, centering it to the flap vertical and horizontal rollers in the up and down position.
7. Adjust remaining tracks to center at this position and attach them to trailing edge of wing.
8. Attach extension stops at aft end of tracks.
9. Install pulleys.
10. Attach extending and retracting cables to flap.
11. By tightening a turnbuckle on a retracting cable and loosening a turnbuckle on the corresponding extending cable, or vice versa, adjust the extreme retracted or extended position of the flap to give proper cushion and clearance fore and aft with the corresponding proper position of the hydraulic jack.
12. Adjust tension on cables (50 to 175.) safety turnbuckles and safety bolts with cotter pins.

RIGGING THE FLAPS ON THE B-24E LIBERATOR

Tighten all turnbuckles evenly until approximate operating tension is obtained.

Check all pulleys for alignment with cables and check to see that cables are not fouled or crossed at rear spar.

Extend the flaps fully so the back rollers touch the "down" stops. Then retract them 1/8" (see Figure IV - (1)), by letting out on the extending cables and taking up on the retracting cables.

A metal "horseshoe" gage. (.064, approximately 1/16") is placed on the shaft of the hydraulic jack. See Figure III - (1). This is the safety for the jack at "in" position. See Figure III - (2).

Then bring the flaps to a full retracted position. Check the four rubber "up" stops by inserting a .025" feeler gage between them and the forward flap rollers. See Figure V - (1). For the correct measurement the gage should remain there firmly.

If the flap roller is against the "up" stop and preventing the insertion of the feeler gage, loosen the retracting cables and tighten the extending cables affecting that stop.

If the feeler gage falls out when inserted, the extending cables should be loosened and the retracting cables tightened affecting that stop. This operation is repeated until a drag is felt on feeler gage when it is pulled out.

After tension and operation of the entire system is satisfactory, operate flaps and check closely for scratches and clearances. Check clearances of jack head to trailing edge over hydraulic cylinder as to clearance of turnbuckles.

Safety wire all turnbuckles with .041 stainless steel safety wire. Tighten and check nuts on cable fittings and jack shaft head. Tighten and check all fairlead bolts.

Operating tensions of cables are approximately 50 to 175 lbs. This is the lowest tension that can be held and keep the flaps in proper position on the flap tracks.

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Job Sheet #63A — Structure

Wing Flap Roller Adjustment

OBJECTIVE: To make serrated bushing adjustment so that flap will move freely but snugly on track.

TOOLS:
1 small offset screwdriver
2 9/16" combination wrenches
1 ½" combination wrench
1 feeler guage

EXPLANATION:

Mock-up

The mock-up is used to teach the preliminary roller adjustments that are made before the flap is installed. By these adjustments a near correct roller position is obtained prior to the placing of the flap in its position. Both top and center rollers of the carriage are adjusted with an .008-.015 clearance between the roller and track. In neutral position the top bushings are so adjusted that the shallow-walled side points aft, whereas the bottom roller bushings have the shallow wall pointing fore.

Procedure

A. Insert a master track in the carriage and use a feeler guage to determine which rollers need adjustment. (.008-.015 clearance)

B. If either of the top rollers needs adjustment proceed as follows:
   1. Remove cotter key, nut, and washer from one bolt and push bolt and roller assembly toward center.
   2. Mark position of bushing on housing.
   3. Cause bolt to bind bushing and push outward. (This will cause bushing to protrude sufficiently from housing so that it may be removed.)
   4. Turn bushing until you believe proper adjustment is made. (one serration will make a difference of approximately .003-.004.)
   5. Replace bushing, washer, and nut.
   6. Test with feeler guage for proper clearance and if necessary continue to adjust.

C. Should the center rollers need adjustment the following procedure should be followed. Keep in mind that both bushings are to be adjusted as a unit or the bolt will bind.
   1. Remove cotter key, nut, and washer.
   2. Insert the same size bolt in the roller assembly and push the original bolt out, thus keeping roller assembly complete.
   3. Mark position of the bushing nearest threaded end of bolt.
   4. Remove and adjust bushing.
   5. Replace original bolt and adjust other bushing. (Both bushings to be aligned same.)
   6. Replace washer and nut.
   7. Test with feeler guage for proper clearance and if necessary continut to adjust.

On Ship

The chief point to observe in adjusting flap rollers on ship is that the flap must move freely yet without excessive play. The rollers are tested and adjusted after the flap is properly rigged and in full down position. In most cases the bottom rollers will take care of any necessary adjustment after the flap is on the ship.

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B-24 Airplane School

FLAP QUESTIONS

1. What type of flap is used on the B-24? How does the movement of this type of flap differ from the movement of the three primary movable surfaces?

2. What type of system moves the flaps? Where is the actuating cylinder?

3. What two main disconnections must be made before we can remove a flap? What else should be removed to prevent unnecessary damage?

4. How can we check to see whether the flap tracks are properly aligned with each other before installing a new flap?

5. If one track is lower or higher than the rest, how can it be aligned with the rest? Must the flap be removed to make the adjustment?

6. How are the rollers of each carriage assembly adjusted so that the flap will roll freely, yet firmly, over the tracks? What tolerances should these adjustable rollers satisfy?

7. What keeps the flaps from swaying laterally? What adjustment could be made if there were too much side play?

FLAP QUESTIONS CONT.

8. How can we set the flap in "down" position so that it will be approximately right when it is moved to "up" position?

9. When setting the clearance at the forward stops, why do we use a "horseshoe" gage on the piston?

10. What should be the clearance at the forward stops when the flap is in "up" position and properly rigged? How is this measured?

11. If the clearance at the forward stops is not correct, where do we make the adjustment? Should this adjustment be made when the flaps are in the "up" position?

TABS - REMOVAL AND INSTALLATION

Tools: 3/8" combination wrench, 5" screwdriver, 7/16" combination wrench, diagonal cutters, and cotter pins.

Removal:
1. Disconnect bonding wire (if present on tab).
2. Remove bolt which attaches tab push-pull tube to tab horn.
3. Remove screws attaching tab hinge to tab spar.

Note: Do not remove hinge pin from tab hinge.

Installation:
1. Lock primary surface (rudder, elevator, or aileron) in neutral. This prevents servo action.
2. Insert screws attaching tab hinge to tab spar.
3. Line up tab in neutral position to primary surface and attach bolt between tab push-pull tube and tab horn. If necessary, align to neutral by screwing bearing head (rod end) in or out of push-pull tube, adjusting the length.
4. Connect bonding wire (if present tab).
5. Safety bolt at tab horn with cotter pin.

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RIGGING TABS ON B-24E

To Rig Aileron Tab at Aileron:

1. Set tab in neutral with joint of push-pull tube even with the aileron hinge line. See Figure II (1).
2. With aileron tab neutral, see that the tab chain ends are even. See Figure II (2).
3. Check all tab connections and see that the bolts are tight and keyed.
4. See that the push-pull tube, both ends are "in safe" and that all lock-nuts are tight.
5. Check tab sprocket bearing for end play. End play must be removed from this unit as it will cause the tab to flutter in flight.

To Rig Aileron System After Rigging Tab at Aileron:

1. With aileron tab in neutral, the following positions must be held:
   a. Turnbuckle barrels even between station 3.0 and 4.1 (See Figure I (1)).
   b. Retaining screw in drum at pedestal - on top - dead center.
   c. Indicator at pedestal reading zero.
2. See that cable stops at Station 4.1 are set and tightened to 10 degrees of travel both ways to tab on aileron. See Figure III (1).
3. Disregard the reading for full travel on the dial at the pedestal.
4. See that all turnbuckles are safetied with 1035 stainless steel safety wire not less than five wraps and not more than eight wraps.
5. See that all pulleys are aligned.
6. See that all pulley axle bolts are tight and keyed.
7. See that all cables are clear and safe.
8. The cable tension is to be approximately 35 pounds at 70 degrees.

To Rig Rudder Tab at Rudders:

1. The joint of the tab push-pull tube must be even with the hinge line of the rudder. Then the tab surface trailing edge is set even with the trailing edge or rudder for neutral position. Adjustment of tab is made at the push-pull tube attached to the tab. See Figure V (1).
2. Rudder tabs are to be "in safe" at both ends and lock nuts tight. See Figure V (2).
3. See that all rudder tab torque shaft connection bolts are tight and cotter keyed.
4. See that all clearances to push-pull tubes and torque shaft are clear and safe.
5. All clearances to push-pull tubes and torque shaft should be 1/8 inch through all webs.

To Rig Rudder System After Rigging Tabs at Rudders:

1. With rudder tab surface trailing edge even with rudder trailing edge for neutral position, the following positions must be held:
   a. Tab chain in stabilizer with ends even. See Figure V (3).
   b. Turnbuckles even between Station 3.0 and 4.1. See Figure IV (1).
   c. Cable retaining screw on drum in pedestal straight forward.
   d. Indicator at pedestal reading zero.

RIGGING TABS CONT'D

To Rig Rudder System After Rigging Tabs at Rudder: (Cont.)

2. See that pulley axle bolts are tight and keyed.
3. See that all pulleys are aligned.
4. See that all pulley anchor bolts are tight and keyed.
5. Set cable stops and tighten at Station 4.1 to 10 degrees of travel both ways of tab at tail. See Figure III (1).
6. Disregard readings of indicator dial at pedestal for full travel as the readings on indicator dial are not correct.
7. Cable tension is taken at approximately 35 pounds at 70 degrees.
8. All turnbuckles are to be safetied with .035 stainless steel safety wire, not less than five wraps and not more than eight wraps.
9. All turnbuckle barrels are to be adjusted evenly at both ends.

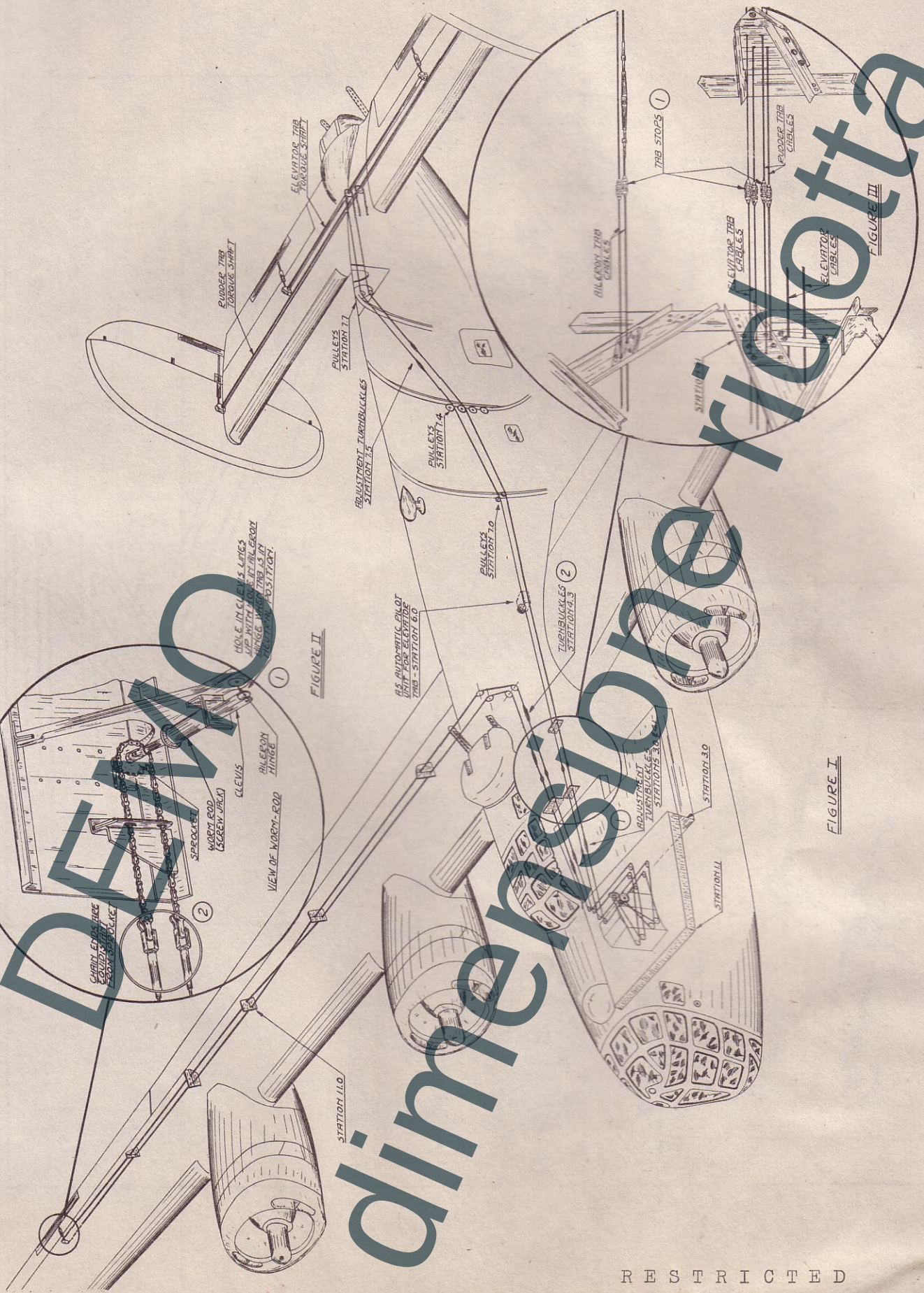
To Rig Elevator Tab at Elevators:

1. With joint of tab push-pull tab even with elevator hinge line "right and left", the tabs are to be set with the elevator trailing-edge for neutral, by adjusting the push-pull tube connected to the tab. See Figure V.
2. After adjustment, see that both ends of the push-pull tube are "in safe".
3. See that lock nuts at both ends of push-pull tube are tight. See Figure V (2).
4. All bolt connections of elevator torque shafts are to be tight and keyed with the exception of the torque shaft connecting to the gear boxes, right and left, which are to be just snug - to allow for flexibility in flight.

To Rig Elevator System After Rigging Tabs at Elevators:

1. With elevator tab surfaces trailing edge even with elevator trailing edge for neutral position, the following positions must be held:
   a. Tab chain in stabilizing with ends even. See Figure V (3).
   b. Turnbuckle barrels even between Station 3.0 and 4.1 See Figure I (1).
   c. Cable retaining screw in drum at pedestal - on top - dead center.
   d. Indicator at pedestal reading zero.
2. Set cable stops and tighten at Station 4.1 for 10 degrees travel each way to tab at elevators. See Figure III (1).
3. Disregard readings on indicator at pedestal for full travel.
4. Cable tension is to be approximately 35 pounds at 70 degress.
5. All turnbuckles are to be safetied with .035 stainless steel safety wire. All turnbuckle barrels are to be adjusted evenly at both ends.
6. See that all pulley bolts are tight and keyed.
7. See that all pulleys are aligned.
8. See that all pulley brackets and bolts are tight and keyed.

Only 3/32 (7 x 7) flexible cable used.



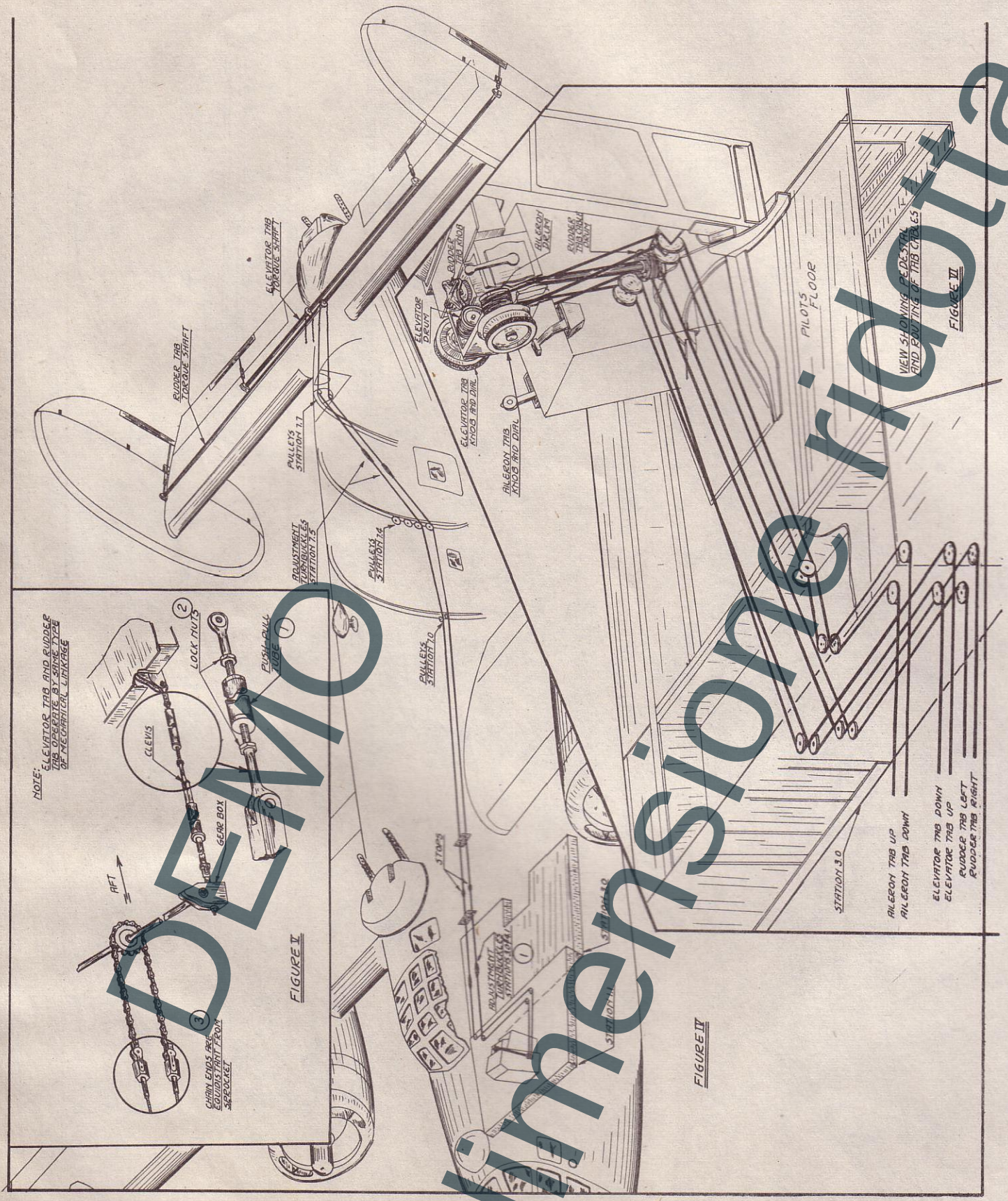


FIGURE I

FIGURE II

FIGURE III

VIEW SHOWING PEDESTAL AND ROUTING OF TAB CABLES

FIGURE III