PAN AMERICAN WORLD AIRWAYS SYSTEM

FLIGHT INSTRUCTOR'S GUIDE

Revised July 3l, l952

FLIGHT INSTRUCTORS GUIDE

INDEX
(Revised July 3l, l952)

NOTE: This DC-3A Flight Instructor's Guide was excerpted from a larger manual that included similar information on the DC-4, CV-240, and C-46F aircraft, as well as some general information on the ILS, ATC Clearance Symbols, and the procedure for tuning the ADF.

The original Flight Instructor's Guide is a manually-typed manuscript which you will quickly notice was prepared by five different typists, for the format of no two of the sections are similar, and even the two different type sizes of the day, l0 and l2 characters per inch, were used. It is as faithful of a reproduction as I could create with a scanner, missing only the type-overs of letters that resulted when the original Pan-Am document was proofed. Even the lower-case "L" is used for "ones" since typewriters of that era had no "one" key on them.

This manual was first released on December l5, l947 under the signature of W. T. Turso, Pan American's Chief Flight Instructor. All instruction was in the Miami, Florida area.

DC-3A QUESTION & ANSWER SET

(Revised 8-l-52)

INDEX

A FUEL SYSTEM

l. Q. Enumerate the fuel system drains which should be inspected for water and sediment.

A. Four fuel tank sump drains. Two fuel line strainers. Two carburetor screens.

2. Q. When should this inspection be made?
A. Fuel tank sumps shall be drained immediately prior to each departure after the final refueling operation is completed (MM DC-3A 40-2). Fuel line strainers shall be drained at terminal (50 hrs.) and base services (225 hrs.) (MM DC-3A 40-2). Carburetor screens are a service item on base service.

3. Q. What is the capacity of each fuel tank?
A. LM-2l0, LA-20l, RM-2l0, RA-20l.

4. Q. Which tanks can be dumped? How many gallons can be dumped?
A. LA and RM 4ll gallons.

5. Q. What is the dumping rate? When should fuel be dumped?
A. About 50 GPM. CAR. 6l.763 - NO FUEL SHALL BE DUMPFD IN EFFECTING A LANDING EXCEPT IN ACCORDANCE WITH 6l.78ll, AND THEN ONLY IF THE PILOT DEEMS IT SAFER THAN LANDING AT A WEIGHT IN EXCESS OF STANDARD. CAR. 6l.78ll - requires that the proper control station be kept fully informed regarding the progress of the flight and that a written report be submitted the Operations Manager.

6. Q. What is the maximum amount to be dumped to reduce the load to normal gross?
A. $\frac{25200 \text{ minus } 24400}{6}$ equals l33 gallons.

7. Q. Where are the dump valve controls located?
A. Dump valves are located under the small door on the floor between the Pilot's and Co-pilot's seat.

8. Q. Does the dump chute nozzle return to normal position when the dump valves are pulled to the closed position?
A. No. Dump chute nozzle must be returned manually to normal position when the plane is on the ground.

9. Q. Where is the cross-feed control located?
A. The cross-feed control is located on the lower right corner of the pedestal.

l0. Q. Assume a failure of the right fuel pump and fuel in the right main tank only. How should the fuel valves be set?
A. Set left engine selector valve to RIGHT MAIN tank, cross-feed valve ON, and right engine selector OFF.

ll. Q. Under what conditions are passengers permitted to remain aboard during refueling?
A. CAR. 6l.35l47 WHEN PASSENGERS ARE PERMITTED TO REMAIN IN THE CABIN WHILE REFUELING IS BEING ACCOMPLISHED A RESPONSIBLE CABIN ATTENDANT SHALL REMAIN IN THE CABIN AT OR NEAR THE DOOR.

l2. Q. How should the plane be flown to get the greatest amount of fuel out of the tanks?
A. Wing slightly high on the side of the tank being emptied.

l3. Q. If fuel pressure failed on one engine immediately after take-off what should the co-pilot do?

A. Work the wobble pump or boost pumps and be prepared to change the fuel valves as ordered by the captain.

l4. Q. What is the normal fuel pressure? (a) Wobble pump for starting? (b) Engine Pump?
A. (a) PAA Manual, 5-6 psi. (b) l4-l6 psi. Desired l5-l5.5 psi.

l5. Q. In what order should the tanks be emptied?
A. Continue using main tanks after take-off until l75 gallons remain in each, then use the auxiliary tanks. Always shift to the main tanks for landing and take-off.

l6. Q. What is the formula for fuel distribution shown on the placard near the left engine selector valve?
A. FILL FRONT TANKS FIRST. USE REAR TANK AFTER FUEL IN EACH MAIN DOWN TO l75 gallons. Minimum total main tank fuel: l4l plus $\frac{\text{AUX. FUEL}}{2}$ or 200 gallons minimum.

l7. Q. What is the minimum fuel for take-off?
A. Minimum fuel for take-off is 200 gallons. l00 in each main tank.

l8. Q. Where is the fuel measuring stick carried?
A. Fuel measuring stick is carried on the galley bulkhead at the rear of the cabin near the door.

l9. Q. What provision is made for carrying fuel samples?
A. Fuel samples when carried must be in regulation cans provided for that purpose, and must be placed in the rack in the rear baggage compartment. (Space for two cans).

B. ENGINES

l. Q. Why should the engines be turned over by hand after standing for two hours before attempting to start?

A. To determine whether oil has drained from the crankcase past the piston rings into the bottom cylinders during the time the engine is standing idle. If the compression space becomes sufficiently filled there is a possibility of damaging the engine on starting unless the oil is drained out of the exhaust port (or spark-plug hole) as the propeller is turned by hand.

2. Q. What manifold pressure is permitted for checking magnetos (a) on ground run-up (b) in flight?
   A. AMB pressure. If not satisfactory, increase to 33 inches and then return to AMB pressure for individual magneto check (b) from 25 to 30 inches with mixture in take-off and climb position.

3. Q. Itemize the cowl flap positions. When is each used?
   A. OPEN - starting, warm-up, taxiing, parking at terminals. OFF - not to be used on the ground as thermal expansion will build up intense pressures. This position is used in flight when necessary to maintain cowls wider than trail. To prevent engine overheating. TRAIL – Take-off and climb. CLOSED - Cruising, after cylinder heads have dropped to normal cruising temperatures.

4. Q. What is the minimum head temperature for run-up on the ground?
   A. l20^{o} centigrade.

5. Q. What is the minimum head temperature for take-off? Maximum before starting take-off?
   A. l50^{o} centigrade. 205^{o} C., during take-off and climb – l50 - 260^{o} centigrade.

6. Q. What ground RPM is normal at 30" on both magnetos? On one magneto?
   A. 2325 R.P.M. From 50 to 75 R.P.M. Less.

7. Q. What are the normal cruising pressures and temperatures of the oil?
   A. 75 - 95 psi @ 2050 RPM plus or minus 5 psi/5^{o} variation from 70^{o} C. Temp. 60^{o} to 85^{o}.

8. Q. At what RPM should the engines be warmed up?
   A. 600 - 800 RPM for about 30 seconds or until oil pressure starts increasing and then to l000 RPM.

9. Q. How much manifold pressure should be used for take-off?
   A. 47 inches at 2750 RPM.

l0. Q. Outline the procedure for reducing power after take-off.
   A. (a) Maintain take-off power until indicated airspeed is l08 MPH and gear is coming up.
   (b) Reduce MP to 35 inches.
   (c) Reduce RPM to 2450. (Avoid 2450 to 2700 RPM for protracted periods because of undesirable vibration frequency).

(d) Let airspeed increase to l20 MPH.
(e) Reduce MP to 30-32 inches, at 300 ft. day, or 500 ft. night.
(f) Reduce RPM to 2050.
(g) Climb at l30 MPH, 30-32 inches MP, 2050 RPM to 5000 ft.

ll. Q. If the head temperatures are too hot while climbing what may be done to make them run cooler?
A. (a) Open cowl flaps slightly wider than TRAIL. (If opened too wide buffeting will be induced, which reduces performance.)
(b) Increase airspeed by reducing rate of climb.
(c) Reduce manifold pressure.
(d) Use richer mixture.

l2. Q. Describe the procedure for stopping hot engines.
A. (a) If the heads are below 205° C. set throttles for l000 RPM and move mixture controls to IDLE CUT-OFF.
(b) When engines have stopped, cut ignition switches. CAUTION - Do Not Open Throttles Until Engine Has Stopped.

l3. Q. If the engines do not stop, what should be done?
A. At l000 RPM turn ignition switches OFF.

l4. Q. What is the propeller speed when the tachometer reads l600 RPM?
A. Propeller turns 900 RPM.

l5. Q. What is the supercharger speed when the tachometer reads l000 RPM? What does this suggest regarding changes in RPM?
A. Impeller turns 7l50 RPM. Move throttles slowly so that engine speed changes are gradual.

l6. Q. Fill in the necessary data for SlC3G engines.
TAKE-OFF HP_____,_____"MP,_____RPM, for_____minutes
METO HP_____,_____"MP,_____RPM, for_____minutes

Normal 550, 2050 RPM, _____BMEP
600, 2050 RPM, _____BMEP
650, 2050 RPM, _____BMEP

A. TAKE-OFF HP l200, 47" MP 2750 RPM for l minute
METO HP l050 4l.5" (sea level 2550 RPM for indefinite time.)

Normal 550 28.2" 2050 RPM ll6.2 BMEP
600 29.9" 2050 RPM l27 BMEP
650 3l.7" 2050 RPM l37.3 BMEP

l7. Q. What octane fuel is used?
A. 9l octane when available. Otherwise, l00 octane is used and MAP set l" hg lbs.

l8. Q. Will the DC-3A induction system collect ice? How may it be detected? How may it be removed?
A. Records show that the DC-3A induction system has collected ice when flying between cloud layers at l9^{O}C, free air temperature.

When icing occurs, the engines do not remain well synchronized, manifold pressures drop, and a considerable difference in throttle position may be required for equal manifold pressures.

Ice may be removed by application of carburetor heat. In emergency cases, when carburetor heater is not working, leaning the mixture to induce back-firing may be necessary to get heat into the induction system.

l9. Q. If the engines are underprimed in starting, does moving the throttles repeatedly back and forth correct this condition? Why?
A. No. The acceleration pump on the fuel injection carburetor is operated by pressure changes caused by venturi action, not by throttle.

20. Q. Will the SlC3G engine start if the ignition booster fails?
A. Yes, in warm temperature with starting batteries well charged, but F/A ratio must be carefully controlled. The engine should be slightly overprimed and then allowed to clear out with mixture in cut-off as the starter turns the engine.

2l. Q. What are the four positions of the carburetor manual control? When is each used?
A. IDLE CUT-OFF - For stopping engines, for clearing when overprimed.
CRUISE - For cruise or descent within normal cruising HP limits and for taxiing and idling.
TAKE-OFF & CLIMB - For take-off climb, single engine operation, approach and landing.
EMERGENCY - To by-pass the automatic mixture control unit and to provide full rich sea level mixtures. Used when the automatic unit is malfunctioning.

22. Q. What is the maximum RPM permitted on the approach for landing?
A. 2325 RPM. This P & W RPM limitation with low manifold pressure.

23. Q. (a) What is the maximum permissable cruising BMEP? (b) What is the corresponding HP at 2050 RPM at this BMEP?
    A. (a) l40 BMEP (b) 663 HP.

24. Q. (a) What is the approximate difference in HP per inch of manifold pressure? (b) What is the corresponding difference in BMEP?
    A. (a) About 25 HP. (b) about 6 psi BMEP. (If cruising at 500 HP and it is desired to use 550 HP the manifold pressure should be increased approximately two inches).

25. Q. What is the take-off BMEP? The METO BMEP?
    A. Take-off BMEP = $\frac{433}{2550} \times l200 = l89.3$ psi.

    Meto BMEP = $\frac{433 \times l050}{2550} = l78.4$ psi.

26. Q. What is detonation? How may it be induced? How may it be reduced?
    A. Detonation is an inefficient type of combustion which causes extremely high peak pressures, increases specific fuel consumption, induces overheating of the cylinder heads and pistons and may cause engine failures. Factors contributing toward detonation are:
    (a) Low octane fuel
    (b) Overheated cylinder heads. This starts a vicious circle since detonation in turn causes more over-heating of the heads.
    (c) Excessively high manifold pressure with low RPM which causes BMEP limits to be exceeded.

    Detonation may be reduced by the following:
    (a) Use high octane fuel.
    (b) If plane is climbing, increase the airspeed by reducing the rate of climb.
    (c) Reduce power (and BMEP) by reducing manifold pressure without reducing RPM.
    (d) Use richer mixture.

C. LANDING GEAR

l. Q. What signals indicate correct GEAR DOWN position?
    A. Signals indicating correct GEAR DOWN position:
    (a) Pressure on the forward gauge (minimum 500 psi)
    (b) Green light.
    (c) Visual inspection to confirm that wheels are in normal position.
    (d) Warning horn NOT sounding when throttles are pulled back.

2. Q. At what minimum pressure may the valve be closed when lowering the wheels?
   A. 500 psi. Full regulator is not excessive.

3. Q. The instructions require the landing gear handle and the flap handle to be spread apart (gear lever DOWN, flap lever UP) when the plane is left standing. Why?
   A. When the plane is parked in the sun or engines are being warmed, temperature rise causes excessively high pressures to build up in the extension and retraction lines of the landing gear and flap. Putting the landing gear lever down and the flap lever up opens the hydraulic lines to the reservoir and the accumulator where the hydraulic expansion is absorbed.

4. Q. What are the three positions of the landing gear latch? When is each position used?
   A. POSITIVE LOCK is used to complete locking the landing gear DOWN and it is left in this position when the plane is on the ground. POSITIVF LOCKED position must be used prior and during take-off. After the wheels have been raised and the retraction handle returned to NEUTRAL, the latch automatically returns to spring locked position. The latch must be left in the spring locked position while the wheels are up. The latch is left SPRING LOCKED while lowering wheels. LATCH RAISED position is used only when the wheels are to be raised.

5. Q. If the landing gear latch is moved to the LATCH RAISED position the wheels may be lowered but the locks will not engage. How may this condition be remedied?
   A. The latch is held in the LATCH RAISED position by a dog located at the side of the valve. By pulling forward on knob attached to it the dog may be tripped allowing the latch to return to the SPRING LOCKED position. The latch may then be pushed to the POSITIVE LOCKED position.

6. Q. How would you know when the safety pins are being used on the landing gear?
   A. By visual inspection. Connected to the safety pin is a red tag which is clamped on to the landing gear strut. It is visible from the pilots' compartment.

7. Q. When should the safety pins be removed?

7. A. Safety pins are always removed before engines are started. The pins must not be pulled unless pressure on the extension strut is 500 psi and the retraction lever is set to NEUTRAL, the latch in POSITIVE LOCKED position, green light burning, and confirmation received from a responsible person in the cockpit.

8. Q. When operating the landing gear why should the handle be placed in full DOWN or full UP position?
   A. Full DOWN or full UP position of the retraction handle must be used fully open the valves to permit fastest operation.

9. Q. Can the wheels be lowered with the latch in the horizontal position?
   A. With the latch POSITIVE LOCKED the wheels may be lowered but the latches will prevent the wheels from going to full down position and the locks will not engage.

l0. Q. List in correct sequence the movements you would make in raising the wheels on take-off?
   A. (a) Raise safety latch to the LATCH RAISED position.
   (b) Retraction handle out and UP.
   (c) After wheels are up and pressure built up to 500 psi or above, return retraction handle to neutral.

ll. Q. List in correct sequence the movements you would make in lowering the wheels before landing.
   A. At the command DOWN GEAR the movements are as follows:
   (a) Check latch handle for SPRING LOCKED position.
   (b) Landing gear handle DOWN.
   (c) When the pressure in the forward hydraulic gauge reaches at least 500 psi. return the handle to neutral.
   (d) Push the safety latch to the POSITIVE LOCKED position.
   (e) Verify that green light is on.
   (f) Look at the wheels to see that they are in the normal DOWN position.

l2. Q. What is the purpose of the warning horn?
   A. The warning horn sounds when the throttles are pulled back if the wheels are not properly locked down for landing.

l3. Q. Can the plane be landed safely with both latches broken? What precaution should be exercised in handling the brakes?
   A. The plane can be landed safely with both safety latches broken if normal pressure is available.

With the retraction handle in NEUTRAL the use of

brakes will cause an increase in the indicated strut pressure if the latches are broken. APPLY BRAKES LIGHTLY SO THAT HYDRAULIC PRESSURE DOES NOT EXCEED l500 psi.

l4. Q. Can the landing gear be lowered if a line fails between the supply tank and the engine hydraulic pumps?
A. Emergency extension may be accomplished by use of the hand pump.

l5. Q. Can the landing gear be lowered without oil in the system?
A. In the event of complete loss of hydraulic oil put the retraction handle DOWN and zoom the plane to snap the wheels down and engage the latches. Return the handle to NEUTRAL and if the warning light is green the landing gear is secured by the latches. If light remains red, raise latch to LATCH RAISED position, lower retraction handle and work hand pump. Continue pumping while putting retraction handle back in neutral, trip latch dog so that the latch returns to SPRING LATCHED position. If light changes to green gear is safe for landing.

D. FLAPS

l. Q. Where is the flap position indicator?
A. The wing flap indicator is on the left side at the lower edge of the instrument panel.

2. Q. What would be the result of leaving the flap handle down on the ground with engines stopped?
A. System pressure will remain the same.

3. Q. What safety feature prevents lowering the flap at too high airspeed?
A. The pressure relief valve is used to prevent lowering and damaging of the flaps at more than ll2 MPH.

4. Q. Why do the flaps go up slowly?
A. A restriction has been placed in the "flap up" line to prevent the sudden reduction in lift and subsequent high rate of descent which would occur if the flap were retracted quickly.

5. Q. At what airspeed is lowering of the flaps permitted?
A. ll2 MPH is the maximum indicated airspeed for lowering flaps.

6. Q. What is the difference in angle of attack of the wing for equal lift coefficient between flap up and flap down?

   A. About 7 degrees.

E. BRAKES

1. Q. What is the minimum hydraulic pressure for satisfactory braking?
   A. Minimum hydraulic pressure for satisfactory braking is 450 psi.

2. Q. What should be the position of the foot on the rudder pedal during take-off? Why?
   A. Lower the toes from the brake pedal to the rudder bar (bottom of pedal) and have the heels on the floor and sufficiently far back so that only the toes are on the bottom of the pedal in order to avoid all UNCONSCIOUS use of the brakes.

3. Q. If the hydraulic pressure pump on the left engine fails while taxiing how would pressure for the brakes be obtained?
   A. Move the hydraulic engine selector valve so as to use the right engine hydraulic pump.

4. Q. Can the brake lock be set or released from the pilot's side? Co-pilot's side?
   A. The brake lock can be set and released on a properly rigged DC-3A from the pilot's side only.

5. Q. How is the brake lock set? What is minimum system pressure to satisfactorily park the brakes?
   A. To set the parking brakes depress the toe pedals and pull out the knob located on the pedestal. Hold the knob until the toe pressure has been released. 500 psi system pressure is necessary.

6. Q. Should the brake lock be set in flight?
   A. The parking brake lock should never be set in flight

7. Q. What prevents the wheels from being turned by the slipstream in flight?
   A. A small loop of belting material presses against the tire and acts as a brake to prevent turning of the wheels by the slipstream in flight.

8. Q. When must the hydraulic hand pump be used for brakes?
   A. The hydraulic hand pump must be used for brakes under the following conditions:
      (a) When brakes are used repeatedly and engines are not running.
      (b) When hydraulic pumps fail.
      (c) When line from supply tank to engines is broken.

(d) At any time the pressure drops too low for satisfactory operation of the brakes with the engines inoperative.

F. PROPELLERS

l. Q. What is the propeller low pitch setting? Normal cruising angle?
A. Low pitch l8°. Normal cruising pitch 29°.

2. Q. Is engine oil used in constant speed governing? What is the pressure at the propeller?
A. Engine oil is used in constant speed governing. Engine oil pressure is boosted in the ratio of 75 to 200 for governing purposes.

3. Q. To what part of the constant speed propeller mechanism is the control in the cockpit connected and what does it do when moved?
A. The propeller control in the cockpit is connected by flexible cables to a pulley at the side of the governor housing. The pulley is on a shaft with a pinion gear which operates through a rack to vary the spring force on the flyball governor.

4. Q. At overnight stops should the propellers be left in low pitch or high pitch?
A. Propellers should be left in low pitch at all stops including overnight stops.

5. Q. Assume landing made with engines synchronized at 2050 RPM. Without moving propeller controls, plane is parked and engines stopped. In what pitch should blades be found? Low? Intermediate? High?
A. Low.

6. Q. If the governor cable breaks, at what RPM will the engine be governed?
A. l900 to 2200 RPM.

G. HYDRAULIC SYSTEM

l. Q. What pressure is registered on the front gauge? The rear gauge?
A. The forward hydraulic gauge indicates the pressure on the landing gear extension strut. The rear gauge indicates the amount of pressure in the accumulator.

2. Q. What is the normal tolerance range for the un-loading setting of the hydraulic pressure regulator? What is the desired setting?

A. Normal pressure range is between a cut-in pressure of 650 psi and cut-out pressure of 850 psi with l050 psi system pressure relief.

3. Q. When should the hydraulic globe valve be opened?
A. The hydraulic globe valve located above the flap control valve should be opened only when it is desired to build up pressure in the accumulator with the hand pump.

4. Q. When maintenance work requires the hydraulic pressure to be reduced to zero, how is it accomplished?
A. Hydraulic pressure may conveniently be reduced to zero by repeated operation of the flaps with the engines inoperative.

5. Q. Are the hydraulic engine driven pumps working constantly against the pressure in the hydraulic system when no use is being made of the system? Why?
A. No. When not required to pressurize the accumulator the discharge from the engine pumps is by-passed at negligible pressure to the hydraulic reservoir.

``6. Q. By what means is it determined if sufficient hydraulic oil is aboard?
A. The quantity of hydraulic oil is indicated by the sight gauge at the side of the reservoir.

7. Q. Does the pump which operates the automatic pilot also supply pressure to the hydraulic system? Where is the placard which explains this?
A. When the pump on one engine operates the automatic pilot, the pump on the other engine operates the hydraulic system. This may be reversed by changing the position of the engine hydraulic pump selector valve, The placard is located above the engine pump selector valve on the hydraulic panel.

H. IGNITION

l. Q. Which sparkplugs are fired by the left magneto?
A. Rear sparkplugs are fired by the left magneto,

2. Q. How many lobes has the magneto cam? Are the lobes equally spaced? Why?
A. The magneto cam has l4 lobes. The lobes are unevenly spaced. Uneven lobe space is necessary because of connecting rod eccentricity to insure that all cylinders fire at exactly the same point (25 degrees) before top center.

3. What is the purpose of the secondary condenser?

3. A. The secondary condenser is used to smooth out the high voltage peaks which otherwise would vary considerably because of unequal lobe spacing.

4. Q. Will the engine run with ignition switches off?
   A. Yes. On the booster as long as it is held in.

I. FEATHERING

l. Q. Where are the feathering controls located? Are they labeled?
   A. Feathering controls are located in the overhead panel in the cockpit, on either side of the magneto switches. The controls are labeled.

2. Q. What would be the effect of feathering the wrong propeller?
   A. Feathering the wrong propeller would nullify the l050 HP which normally would be available for single engine flight.

3. Q. Can feathering be discontinued after the process has been started?
   A. Feathering can be discontinued by pulling out the feathering button if done before feathering has progressed too far.

4. Q. What is the source of supply for feathering oil and pressure?
   A. The engine oil tank supplies the oil for feathering.

5. Q. How much pressure is needed for unfeathering? How long should the feathering button be left in?
   A. Unfeathering requires about 600 psi, Hold feathering button engaged until engine is turning 600-800 RPM.

6. Q. In case a broken oil line to the engine occurs, how much oil is left in the tank for feathering?
   A. A standpipe in the oil tank keeps 2 gallons in the tank for feathering at all times available to the feathering pump only.

J. 0IL SYSTEM

l. Q. What is the capacity of each oil tank? How much oil is usually carried? Where is the feathering oil supply?
   A. 0il tank capacity - 32 gallons each. 0nly 29 gallons can be put in. 0il usually carried - l8 gallons in each tank. The last 2 gallons at bottom of tank are below engine oil outlet.

2. Q. How is the oil temperature controlled?

A. Oil inlet temperature is controlled between 65 – 75^{O} C, by a sylphon type thermostat. When flying through cold air it is necessary to augment this control by manually closing the oil cooler shutters.

3. Q. Under what conditions in flight could "OIL IN" temperature rise abnormally high in flight?
A. Conditions which could cause abnormally high OIL IN temperature:
(a) Obstructions, such as leaves, thrown into the oil cooler by the propeller. Most apt to occur during warm-up.
(b) Congealing of oil in radiator tubes.
(c) Faulty thermostat which fails to by-pass the oil.

4. Q. What is minimum oil temperature for ground check? Take-off? Maximum at start of take-off? At any time?
A. 40^{O}C., 50^{O}C., 85^{O}C., 95^{O}C.

K. ELECTRICAL SYSTEM

l. Q. What is normal charging rate of each generator? When does the overload switch operate? What are the three positions of the battery master switch lever?
A. The rated continuous output of the generator is 50 amps. The overload switch operates at l00 amps for 30 seconds.
Lever forward, BATTERY CART
Lever vertical, OFF
Lever aft, SHIP'S BATTERY

2. Q. What action releases the lock which holds the lever?
A. The lock is released by pressing the knob on the top of the lever.

3. Q. Two batteries are carried; where are they located?
A. One battery is in the left lower compartment, one in the companionway by the baggage loading door.

4. Q. What is the voltage of each battery. What is the voltage when the batteries are in parallel?
A. Battery potential is l2 volts. The batteries are paralleled and the potential is still l2 volts.

5. Q. Where is the charging panel located? If generator voltage indicates too low what should be done?
A. The charging panel is located on the overhead panel in the cockpit above the co-pilot. Field may be flashed.

6. Q. Why has the CABIN SIDE LIGHT switch been wired in the ON position?

A. The cabin side light solenoid is spring loaded to the ON position. Continuous current is necessary to keep the solenoid switch OFF, Electrical energy is conserved by leaving the CABIN SIDE LIGHT switch ON at the electrical panel.

7. Q. In case of a water landing, how may one battery be conserved for radio use only?
   A. In case of a water landing, turn selector to "Emergency" and leave radio on under-water battery until it is dead. Then trip radio toggle on selector panel to "Emergency radio" and continue to use radio as usual.

L. FLOTATION

l. Q. How long should the DC-3 float if landed on water?
   A. If structurally undamaged the DC-3 should float for an indefinitely long period of time.

2. Q. How many flotation tanks has the DC-3?
   A. There are three flotation tanks in each DC-3 wing that extend to the wing tip Joints. Empty fuel tanks like-wise contribute to the plane's buoyancy.

M. VENTILATION SYSTEM AND HEATING

l. Q. Where is the main ventilation air inlet valve? How is it controlled?
   A. The main ventilation air inlet valve is located in the nose of the fuselage. The control for this valve is located at the lower edge of the instrument panel in front of the co-pilot, and is safety-wired in the open position on aircraft equipped with ventilating hot air dump valves.

2. Q. How is the air heated?
   A. Cabin air is heated as it passes through a radiator in which is condensed the steam produced in a flash type boiler located in the exhaust stack of the right engine.

3. Q. How is the cabin temperature controlled?
   A. On the bulkhead at the front of the cabin is a control which operates a valve to vary the pro-portions of heated and unheated air routed into the cabin ducts thus controlling the cabin temperature.

4. Q. When the air conditioner is connected to the plane on the ground how should the air valves in the plane be set?
   A. When the air conditioner is connected set the air valves as follows:
   (a) Leave the air inlet valve on in the fuselage nose when safety wired, and turn OFF when not safetied.

(b) Air vents above the cabin seats OPEN.
(c) Cockpit cold air valve ON.

5. Q. Give the location and pressure settings for the following: (a) pressure regulating valve (b) pop-off valve (c) pressure relief valve
   A. (a) PRESSURE REGULATING VALVE - located above supply tank, l5 psi.
   (b) POP-OFF VALVE - located above supply tank, blow -off 55 psi, blow down 50 psi.
   (c) PRESSURE RELIEF VALVE - located on the steam line in right nacelle, blow off 45 psi, blow down 40 psi.

6. Q. How much water is used in the heating system? What indicates a full system?
   A. 5 quarts of water are used in the system. Open water level valve in wheel well. When water comes out the system is full, close valve.

N. INSTRUMENTS

l. Q. How much vacuum should the automatic pilot gyros have?
   A. Automatic pilot gyros normally use 4 - 5 inches Hg. vacuum.

2. Q. How much vacuum should be applied to the turn indicator?
   A. The turn indicator uses 2 inches Hg. Vacuum.

3. Q. How is the vacuum obtained for these instruments?
   A. Vacuum for these instruments is obtained from the vacuum pumps driven by the engines.

4. Q. On the instrument panel there is a valve with positions labeled "PITOT" and "VFNT". Fxplain.
   A. The valve marked PITOT opens the static pressure lines of the airspeed meter, the climb indicator and the altimeters to the atmospheric pressure holes at the side of the pitot head. When turned to VENT, the static lines are opened to the static pressure in the vicinity of the left auxiliary fuel tank.

5. Q. If the artificial horizon is uncaged immediately before take-off , what is the effect on its accuracy? When should it be uncaged?
   A. Uncaging the artificial horizon immediately before take-off introduces an error equal to the angle of the fore and aft axis above the horizon. The artificial horizon should be uncaged immediately after starting the engines and before taxiing away from loading platform.

6. Q. Describe the procedure for putting the automatic pilot into operation?
   A. To operate automatic pilot:

(a) Set speed valves (located at lower part of instrument panel on left side)
l. Rudder valve just cracked open.
2. Aileron valve open to number 3 setting.
3. Elevator valve just cracked.
(b) Trim plane to fly "hands off".
(c) Set automatic pilot shut-off valve for 60 psi. It will increase to 80 psi when autopilot is Engaged.
(d) Set follow-up indices to match gyro indications.
(e) Slowly turn ON automatic pilot control (on pedestal).
As automatic pilot is engaged the pilot should hold the controls to feel whether it is taking over and functioning properly.

7. Q. If the left engine failed how would vacuum for the gyros be obtained?
A. If either engine becomes in-operative, turn the vacuum pump selector valve to the other engine.

O. EMERGENCY EQUIPMENT

l. Q. Where are the engine fire extinguisher controls?
A. Engine fire extinguisher controls are located under the panel door in the companion-way floor between the pilots' seats.

2. Q. If fire occurred in the right engine while starting how should the planes fire extinguisher be handled? If the ground system failed?
A. To extinguish a fire in the right engine, open the door in the floor, set the selector to the right engine, and pull the CO2 release handle hard (about 20 inches for cutter type flask and 2" for valve type flask.)

3. Q. Where is the CO2 flask for the engine fire extinguishers?
A. Engine fire extinguisher CO2 flask is at right rear of co-pilot's seat.

4. Q. Where are the hand fire extinguishers?
A. One hand fire extinguisher (CO2 type) is located on the floor behind the co-pilot's seat. The other (pyrene) is on the buffet bulkhead in the cabin.

5. Q. Where are the emergency escape hatches?
A. Emergency exits are located as follows:
(a) One at top of fuselage above pilots' seats
(b) Two cabin windows l row E l row F single seat side. (right)
(c) One cabin window, row E, double seat side (left)

6. Q. Where are the following carried? (a) Machete (b) Very pistol.

A. (a} Machete is carried on rear side small door between lavatory and rear baggage compartment. (b) Very pistol and 9 shells are carried on bulk-head behind co-pilot's seat.

7. Q. Where is the First Aid Kit located?
   A. First Aid Kit is located in the cabin on the lavatory bulkhead.

8. Q. What emergency rations are carried and where are they located?
   A. Candy, chewing gum and vitamin tablets are carried in the life rafts. One tin in five man raft and four tins in each ten man raft. One tin supplies five people for one day, or five cans Army Rations in Jungle kit.

9. Q. Where are the life jackets carried? Jump seat life Jacket?
   A. Life Jackets are carried as follows:
      (a) Three in right baggage compartment.
      (b) Two in pocket on left cabin wall forward of first two seats.
      (c) One in pocket on right cabin wall forward of front seat.
      (d) Eighteen in seat backs.
      (e) Steward's - in vicinity of first aid kit.

l0. Q. Where are life rafts carried?
   A. One five man boat type raft in right forward baggage compartment. Either two ten man boat type rafts or one twenty man circular raft aft of last seat on right side.

P. FLARES

l. Q. Where are the parachute flare controls?
   A. Parachute flare controls are located near top of hydraulic panel.

2. Q. Which flare should be dropped first? Why? Are the release controls placarded?
   A. Release rear flare first. To prevent its being fouled by cable from front flare. Flare release controls are placarded FRONT and REAR and release sequence is indicated.

3. Q. What speed does the operations manual specify for dropping flares?
   A. Release flares under l20 MPH.

4. Q. From what altitude should flares be dropped?
   A. Best altitude for release of first flare is 4000 feet above ground - second at 2000 feet.

5. Q. Where are the flares carried?
   A. Flares are located on left side behind rear cargo compartment.

6. Q. What is the duration of each flare?
   A. Each flare burns 3 minutes at 200,000 candle power.

Q. FLYING

l. Q. How would you determine immediately before take-off that the automatic pilot control is OFF?
   A. As a last minute check before applying take-off power, the rudder, elevator, and aileron controls should be operated to ascertain that they are free and that automatic pilot is OFF.

2. Q. What is recommended climbing speed on two engines?
   A. Recommended climbing speed is l20 - l30 MPH on two engines.

3. Q. What is the recommended climbing speed on one engine?
   A. Best single engine climbing speed is l08 MPH. (Open cowl and enrich mixture to keep cylinder heads within operating limits.)

4. Q. What is the minimum airspeed for single engine flight?
   A. Minimum single engine airspeed is 88 MPH with the live engine developing l050 HP.

5. Q. Should the plane be flown level or with one wing high for minimum drag in single engine flight?
   A. Douglas Aircraft Manual (April 20, l94l) advises l-3 degrees wing low on side of live engi~e for zero yaw and minimum drag.

6. Q. Where are the trim tab controls located?
   A. Trim tab control locations:
   ELEVATOR - wheel at left side of propeller levers
   RUDDER - crank on pedestal near left side
   AILERON - crank on pedestal near right side

R. LOAD DISTRIBUTION

l. Q. How are the seats numbered?
   A. Investigation of seat numbering systems reveals that several systems have been printed. It is sufficient for load distribution purposes to consider only the rows of seats which are lettered from front to rear: A B C D E F G.

2. Q. For weight report purposes how are the fuel tanks numbered?
   A. Fuel tank numbering:
   l - LA; 2 - LM; 3 - RM; 4 - RA

3. Q. What is the most desirable C.G. position?
   A. C.G. position about 23%.

4. Q. What are the PAA permissible C.G. limits?
   A. Permissible PAA C.G. limits 20% to 26.5%.

5. Q. What are the permissible gross weights for take-off and landing? On short flights how should take-off weight be restricted?
   A. 25,200 T.O. 24,400 landing by adding the weight of the gas to be consumed to the standard gross (landing so that at the destination the gross will not be over 24,400 lbs.)

6. Q. Regulations prohibit shipping batteries containing acid in the baggage compartments. How would you send a spare battery to a DC-3 delayed enroute by battery failure?
   A. Put the battery in the right battery box which is normally empty.

7. Q. Where is the strong box? Where is the key carried?
   A. The strong box is located at the left side of the companionway at the rear of the fuse panel. The key is on the bulkhead above the strong box.

8. Q. Where would you look for the key for the rear baggage door?
   A. The rear baggage door key is carried on the cabin wall near the lower front corner of the passenger entrance door.

S. <u>OXYGEN EQUIPMENT</u>

l. Q. Where are the oxygen outlets for Captain, Co-pilot, Radio Operator, Passengers?
   A. Captain: Under left cockpit side light.
   Co-pilot: Under rloht cockpit side light
   Radio Operator: Above the table at the rear side of the bulkhead behind the Co-pilot.
   Passengers: Rows A and D at the left side.

2. Q. Where is the oxygen flask? Where is the low pressure regulator valve?
   A. The oxygen flask and pressure regulator are located behind the Captain's seat in the cockpit, or above the emergency battery in the companionway on the left side.

3. Q. In what position should the low pressure valve be when not in use?
   A. Unscrewed, so that there is no tension on the diaphram.

4. Q. (a) In what position should the high pressure valve be when oxygen is not being used? When oxygen is being used?
   A. (a) When not being used the oxygen flask valve must be completely closed.

(b) When oxygen is being used the valve should be screwed all the way out so that the valve is firmly seated against the outer seal. This prevents leakage around the valve stem.

5. Q. Itemize the procedure for turning on the oxygen equipment?
   A. Open the flask valve all the way. Turn regulator "T" handle to right until cruising altitude is indicated on flowmeter gauge, then plug in the oxygen mask.

6. Q. Itemize the procedure for turning off the oxygen equipment ?
   A. Turn the flask valve full OFF. Allow pressure to drop to zero. Turn regulator "T" handle to left all the way, then unplug the oxygen mask.

7. Q. Where are the oxygen masks carried?
   A. Five oxygen masks are carried in the airplane. One at each flight crew's station. two masks located in the hat rack forward left side, for the passengers.

8. Q. How does availability of oxygen affect our DC-3A operations?
   A. Planes with non-supercharged cabins are not permitted to fly at an altitude above l0,000 feet for more than 30 minutes continuously, or above l2,000 feet for any length of time unless equipped with effective oxygen apparatus and an adequate supply of oxygen for the crew.

9. Q. (a) Is there any danger in using excess oxygen?
   (b) What is the effect of insufficient oxygen?
   A. (a) Physical contact with the excess oxygen is not injurious. However, hyper-ventilation results when an oversupply of oxygen in the lungs displaces the carbon dioxide and interferes with the acid-base equilibrium. Manifestations of hyper-ventilation are dizziness, tingling of extremities, and feeling of impending suffocation. A quick cure is to breathe several times while a paper bag is held over the nose and mouth.

   (b) Insufficient oxygen causes decrease in mental alertness, impairs ability to carry out complicated operations, dims the vision, clouds the memory, and increases the fatige rate.

   The reason that anoxia is so dangerous is that the pilot does not recognize its symptoms because he becomes increasingly incapable of realizing what is happening to him.

l0. Q. When and how should the masks be sterilized?
A. After the mask assembly has been used it should be sterilized. Soap should not be applied to the sponge rubber discs because it may clog the pores. The rest of the assembly should be washed in warm water with a mild soap and then rinsed thoroughly. The parts are then boiled three minutes with particular care that the rubber parts do not touch the bottom of the container. Dry thoroughly and re-assemble before packing. Disinfectants should never be used.

ll. Q. Why should oil and grease be kept away from all parts of the oxygen system?
A. Oil and grease are very explosive in the presence of oxygen.

l2. Q. Why should full notation of oxygen use be recorded on Engineering Report?
A. Notation of oxygen used must be made so that servicing of the masks and flask will be done promptly.

l3. Q. To what maximum pressure are the flasks filled?
A. When oxygen pressures drop to l500 psi. the flasks are recharged to l800 psi.

l4. Q. In what units is the flowmeter graduated?
A. Oxygen flowmeters are graduated in thousands of feet. Keep the pressure regulator set so that the gauge on the instrmnent panel shows the same altitude as the altimeter.

l5. Q. What is the function and purpose of the rebreather bag?
A. The first part of the exhalation is rich in oxygen and thus is suitable for rebreathing and it passes down into the bag where it mixes with the incoming oxygen. The bag then becomes extended and the slight pressure thus formed causes the remaining portion of the exhalation, which is high in carbon dioxide content, to pass out through the sponge rubber discs. The advantages of the rebreather bag are as follows:

(a) Rebreathing the oxygen rich portion of each exhalation greatly increases the effective use of the oxygen available.
(b) The carbon dioxide conserved by the bag stimulates breathing.
(c) The humidity conserved by the bag prevents dryness and soreness of the throat.

l6. Q. What does the CAR state regarding use of oxygen and smoking?
A. Smoking is not permitted in compartments where oxygen is being used, because it contaminates the air and prevents the necessary amount of oxygen from passing from the lungs into the blood stream.

SYSTEM INSTRUMENT COURSE & INSTRUMENT RATING FLIGHT TRAINING SYLLABUS

AIRCRAFT

I Primary phase (Contact)

Period I (l½ Hours)

(a) Preflight and cockpit check
(b) Starting, taxiing and takeoff
(c) Airwork:
    (l) Climbing turns left and right changing direction every 90 degrees (airspeed not less than l20 mph and rate of climb not greater than 500 ft. per minute).
    (2) Level off at 4000 ft - trim ship - level flight for two minutes.
    (3) Standard rate turns left and right 360 degrees.
    (4) Steep turns left and right 360 degrees (at least 4 needle widths).
    (5) Approaches to stalls.
        (a) Gear and flaps up, l5" mp. Hold heading and altitude - note airspeed.
        (b) Gear down - flaps up, l5" mp. Hold heading and altitude - note airspeed.
        (c) Gear down - full flap - hold heading and altitude - note airspeed.
    (6) Instruction on why flap should be raised before gear in climb-outs.
    (7) Descending turns left and right changing direction every 90 degrees. Gear up and down l20 mph - 500 ft per minute - to 2000 ft. (note power settings)
    (8) Level off 2000 ft - gear down - hold l20 mph in level flight (note power settings).
    (9) Slow flight - gear down - holding altitude - 90 mph airspeed (note power settings).
   (l0) Automatic pilot operation (line operation only).
   (ll) Landing gear and flap operation.

    NOTE: On all succeeding flights, the student should set up the radio and handle the radio phone contact until at least after the first takeoff. Instructor should carefully check that concise phraseology is used during these contacts. Also that the student is familiar with the operation of the radio equipment. Student to memorize feathering procedure to point of asking for check list.

Period II (l½ Hours)

Normal takeoff - approach patterns and landing.

Period III (l½ Hours)

(l) Repeat Period II
(2) Missed approach procedure, stressing good knowledge of this procedure. The instructor will act as pilot and student as copilot. Note students reaction to Captains commands. Then student will act as pilot and instructor as copilot. Note students cockpit phraseology and commands to instructor.
(3) Instructor will feather and unfeather an engine at lest three times, giving the student instructions and commands. Note students ability to carry out orders from Captain. Students are to repeat commands when given. This point to be highly stressed.

NOTE: Copilots assigned to DC-3 operation to get this: At least one period of this training shall be scheduled late enough as to give the student a minimum of at least 3 night landings. It is felt that most of this time 4:30 (3 periods) be utilized on takeoffs and landings. Student shall be able to make unassisted landing.

II Secondary Phase (Instruments)

The following maneuvers will be stressed and given on Instrument Rating.

Climbs and Climbing Turns - Climbs and climbing turns will be made at a predetermined rate of climb to be within the performance capabilities of the airplane used. Student will be rated on the basis of his use of the proper amount of power, ability to hold a uniform air speed, his ability to hold his heading straight climbs and to hold a constant rate of turn in either direction.

Steep Turns* - l80^{o} and 360^{o} steep turns will be required on the rate instruments with the steepest bank appropriate to the airplane used. Smoothness of the controls, the ability to hold the air speed and altitude within reasonable limits will be the basis for judging performance.

Timed Turns* - Student will be required to make turns of 90^{o}, l80^{o}, and 360^{o} duration in each direction; and turns to desired headings; using the rate instruments only. Standard rate turns of 360^{o} duration should be executed with an error of less than l0^{o} in good air. Performance will be judged on the basis of accuracy of heading, ability to hold altitude and air speed, coordination and timing.

Maneuvering at Minimum Speed (Slow Flight) - Demonstration of minimum flight speed in straight and level flight and turns, and of approach speed on headings and turns to headings. The transition to and from slow flight should be smooth, prompt and without change of altitude or heading.

Stalls - Stalls will be demonstrated from straight flight and from turns, with and without power. Approaches to stalls, recovery from approaches to stalls will be instituted at the first physical indication of a stall, such as buffeting. Full stalls will not be executed in multi-engine airplanes.

Propeller Feathering - Propeller feathering will be demonstrated on all flight tests in airplane equipped with propellers which can be feathered and unfeathered in flight without damage to the engine. No flight instructor will require a student to feather an engine of a twin-engine aircraft on takeoff or other critical position where failure of the other engine would endanger safety. At altitude the student will be expected to feather an engine holding his heading and altitude during the feathering procedure and memorize feathering procedure to the point where he asks for the feathering check list.

Maneuvering With One or More Engines Out - Students will be required to demonstrate emergency procedures in operation of multi-engine airplanes with one or more engines throttled or cut off, depending on conditions.

Engines should be throttled to approximately l5 in. manifold pressure to simulate loss of an engine in conditions where the failure of another engine would endanger safety. The student will be required to maintain heading and altitude (if possible), and to make moderate turns both toward and away from the dead engine. Performance will be judged on the basis of his ability to maintain engine out air speed heading and altitude, to trim the airplane and make current power settings and to apply the appropriate check list.

Recovery from Unusual Attitudes* - The flight instructor will place the airplane in attitudes unusual to normal flight from which the student will be required to recover to straight and level flight on the rate instruments alone.

(* These items are to be practised on rate instruments only).

Such attitudes may include near stalls, diving spirals, abnormal skids and slips, and steep climbing turns or glides. Performance will be judged on the basis of the student's ability to return to normal flight smoothly, without exceeding safe air speed limits, and without placing undue stress on the airplane.

Ability to Tune Radio - The student will demonstrate his knowledge of where to find the frequency for all radio aids which may be utilized with the equipment installed in his airplane, and must be able o tune in any available radio signals. He must recognize a properly-tuned signal from a distorted one, and know the uses of automatic and manual volume controls, the CW selector, and the voice and range filter. Performance will be judged on the basis of proper frequency tuning, correct filter selection and proper use of volume control.

Orientation - Orientation may be demonstrated by any accepted method practicable for the range being used under the conditions experienced. The use of a particular system of orientation which will take the shortest time under known conditions will be graded higher, but the use of any other reliable system will be acceptable. Performance will be judged on the basis of the selection of the best orientation method, the identification of range signals, proper maneuvering of the airplane, ability to hold altitude and headings, cone identification, and coordination.

Beam Bracketing - The student will be required to fly along a given range leg after intersecting it. He must be able to align himself with the leg with a reasonable number of bracketing corrections, and should be able to promptly estimate drift and average heading required. Performance will be judged on the basis of planning, coordination and the ability to hold constant heading and altitude.

Cone identification - After orientation and beam bracketing, the student will fly directly through the cone and verify the cone by generally accepted methods. Time of passing the cone should be noted.

Approach Procedures - The student will be required to execute a standard instrument approach procedure for the airport being used. He will be allowed to use only such radio equipment as is allotted him by the flight instructor. (Instrument students should be capable of instrument approaches without the marker beacons unless the specified procedure require their use.) Performance will be based on the student's ability to obtain and follow traffic clearance, his timing, his ability to maintain specified altitude and air speed, and adherence to minimum altitudes. Any error in altitude or direction toward the more dangerous side will be disqualifying.

Missed Approach Procedure - Student must demonstrate the specified missed approach procedure for the airport being used.

Judgment - Judgment is the most difficult item to analyze and the most important factor of the flight test. The pilot's judgment adds to or detracts from his ability and contributes more than any other factor in accidents. he flight instructor must be alert to determine that each situation is analyzed and the proper action taken by the student. He should utilize to the fullest extent the maneuvers which require a display of judgment on the part of the pilot.

Judgment should not be interpreted as the ability to make correct estimates; as for example; in accuracy landings. This is actually technique. Judgment is discretion - the power of arriving at a wise decision - or aeronautically, the discernment between safe and unsafe flying.

Smoothness and Coordination - Smoothness in handling the aircraft should not be confused with sufficient motion of the controls to cause the airplane to perform in the desired manner. Abrupt, jerky, or violent action of the controls is seldom necessary, but prompt, firm actions often distinguish the pilot who is doing the flying from one who is "being flown". Smoothness is a term more correctly applied to the action of the airplane than to the movement of the controls.

Coordination involves all actions. The usual criterion is the relative movement of the hands and feet, or between the aileron or rudder controls. Other features are the coordination of elevators, power and the constant control of heading when the pilot's attention is directed elsewhere.

Performance is judged on the basis of the student's ability to fly the airplane firmly without rough or abrupt movements, to keep the ball centered, and to use all controls as is necessary for flight.

Instrument rating flight test if required. If not required the student may be reassigned to Link trainer for completion of ADF course.

Note: This DF Course is not required for instrument rating; but is required to complete System Instrument Flight Training Course.

(l) Orientation with time and distance off, manual loop. Bearings on ADF function.

(2) QDM Bracketing to and away from station, an overheads, using the ADF.

(3) QDM letdowns

(4) ADF Holding Patterns:

a. Race Track
b. Circling
c. Other methods

Note: On ADF approaches and let downs, single engine work should be stressed until satisfactory. Flight Instructors are encouraged to let the student get as much experience handling the aircraft on landing and takeoff as possible.

DC3 FLIGHT TRAINING SYLLABUS

for

ATR or TYPE RATING

I. CONTACT

A. Pre-Flight:

1. Run Check List - explain or question items as required.

2. Use of Check List as outlined in Operating Manual.

3. Starting Procedure (see Operating Manual).

B. Taxiing:

Use of brakes, tail wheel lock; power and control coordination; parking, as outlined in Operating Manual. (Stress no pivoting on one wheel or riding brakes.)

C. Airwork:

1. Climb to safe altitude. Normal turns and 30^{o} banks; picking up QDMs toward and away from station. Check for continued climb.

2. Maximum performance climb, takeoff and rated power, l and 2 engines.

3. Use of Power Chart.

4. Set cruise power and trim ship; check for proper instructions to Copilot. Auto pilot operation - level; climb; descent; turns (limits).

5. Normal turns; steep turns (l and 2 engines); timed turns.

6. Slow flight below minimum maneuvering speed, 90 mph clean, standard rate turns; note power settings.

7. Approach to stalls:

   a. Clean, 2 engines; check recovery with minimum loss of altitude.
   b. Landing configuration l5 in. mp, full flap, gear down.

8. Power settings:

   a. Clean, l20 mph, cruise rpm, one and two engines, level.
   b. Gear down, level l20 mph.
   c. Gear up, cruise rpm, l20 mph, descend 500 ft per minute - one and two engines.
   d. Gear down, cruise rpm, l20 mph, descend 500 ft per minute.

e. l and 2 engine cruise control.
f. Fuel system control.

9. a. Demonstration of minimum control speed, Vmc, one-engine operation.
b. Demonstration of minimum maneuvering speed, two-engine operation, clean, note speeds (level and turning).

l0. Enroute climb speeds and ceilings - l and 2 engines.

ll. Simulated at altitude:

a. Missed approach, l and 2 engines.
b. Execute landing pattern and missed approach, followed with a 30^{o} bank, maximum performance climb-out, and change heading $l80^{o}$.

l2. a. Feathering and unfeathering.
b. Simulate loss of engine on takeoff at altitude, gear down, cut mixture when takeoff power is reached at ll5 MPH.
c. Instruction on why flap should be raised before gear in climb-outs.

l3. Takeoffs (as outlined in Operating Manual)

a. Normal.
b. Crosswind.
c. Short field maximum performance.
d. Simulated gross weight takeoff.
e. Unbalanced power (See "Emergencies").
f. Hood takeoff.

l4. Approaches, Contact:

a. Normal
b. Crosswind
c. Various flap settings
d. 0^{o} flap
e. Unbalanced power (See "Emergencies").
f. High, close-in
g. Missed approach - refused landing

l5. Landings (as outlined in Operating Manual):

a. Normal
b. Crosswind
c. Various flap settings
d. 0^{o} flap
e. Unbalanced power (See "Emergencies").
f. Short field
g. One landing, airspeeds covered on pilot's side. Simulate airspeed out.

l6. Emergencies:

a. Takeoffs:

(l) Cut engine before, at, and after V_{MC} speed.
(2) Simulate loss of fuel pressure on takeoff.
(3) Simulate engine fire on takeoff.
(4) One takeoff when gear will not come up, due hydraulic failure.
(5) One takeoff with runaway propeller (verbal instruction only).
(6) Takeoff stressing best attitude and speed for maximum performance (no slipping or skidding).

b. Approaches:

(l) Simulate smoke evacuation - cockpit windows open.
(2) Hydraulic system failure.
(3) Unbalanced power, one engine windmilling, plus hydraulic system out.
(4) Simulate poor line-up due to poor visibility. Make correction and land; emphasize when outside limits; execute missed approach.
(5) Missed approaches - refused landing.

c. Landings (as outlined in Operating Manual).

(l) One engine windmilling, normal hydraulic system.
(2) One engine windmilling, simulate hydraulic failure, 0^{O} flap. Discuss emergency brake procedure - hand pump.
(3) One engine windmilling crosswind, hydraulic system normal.
(4) Verbally discuss landing with one or more gear retracted.

d. Hydraulics:

Feather engine, kill system pressure and demonstrate following:

(l) Loss of hydraulic system pressure. Instruct in all possible methods of returning hydraulic system to operation after failure to be done in flight.
(2) Emergency gear extension - free fall and manual.
(3) Emergency flap extension.
(4) Emergency brake procedure.
(5) Emergency cowl flap operation.

l7. Aircraft Limitations

a. Rough air
b. Maximum level flight speed
c. Maximum dive speeds
d. Gear speeds
e. Flap speeds
f. Maximum speed for unfeathering
g. Maximum speed with propeller feathered

II. INSTRUMENT: (All contact airwork and simulated pull-outs done under hood. Unusual positions should be introduced, using emergency instrument group only. Instruct on use of radio, engine instruments, and flight group.)

A. Orientation:

1. Pointer progression - aural null.
2. Distance off, ADF and manual loop.
3. Range orientation (for Check Pilots and ATR only):

   a. Fade 90)
   b. Fade perpendicular) Check
   c. On course) anyone
   d. Close-in)

4. Instruction on race track pattern flying.

B. Between orientation and first "over", (1) Advise Control of position, altitude, and ETA; (2) Run landing check; and (3) Slow to letdown speed.

C. Letdowns - Range and ADF

1. Initial "over", as specified in Route Manual, landing instructions, and altimeter.
2. Fly at 120 MPH with flap and gear up.
3. Procedure turn, as specified.
4. Final approach, 120 mph.
5. Gear should be lowered at low over, or when contact straight in. Lower gear in pattern if circling approach.
6. Minimum of one letdown working Miami Approach Control.
7. 400 and 1, low down, close-in approach and landing.

III. QUIZ ON THE FOLLOWING FROM TIME TO TIME:

A. Aircraft Operating Manual.
B. Aircraft Performance.
C. Aircraft limitations.
D. Knowledge of aircraft and engines.
E. Radio set-up and its use - Normal - Emergency, water landing.
F. Electrical system.
G. Emergency electrical system.
H. Electrical warning system.
I. Lighting system - location of switches, spare bulbs, fuses.
J. Auto pilot system - control.
K. Hydraulic system and sub-systems.
L. Emergency pump operation.
M. Type of engines and power setting and how long it can be used.
N. Rated power settings and how long it can be used.
O. Temperatures and pressures.
P. Propeller system control - Normal - Emergency.
Q. Cooling system and control, engines.

R. Fuel system and control - Normal - Emergency,
S. Oil system - capacity - limits.
T. Fluid cut-off system - control.
U. Oxygen system - control - when used.
V. CO_2 system.
W. Fire control.

1. Engine fire during starting
2. Engine fire - Zones 1, 2, & 3.
3. Cockpit fire.
4. Cabin fire.
5. Cargo fire.
6. Electrical fire.

X De-icing, carburetor, pitot.
Y. Instrumentation and power supply - engine, flight, normal, emergency.
Z. Location of flares and switches.
AA. Emergency equipment location.
BB. Emergency exits
CC. Location of Operations Specifications.
DD. Gross weights; C.G. limits.
EE. Ventilation and Heating.

FLIGHT TRAINING SYLLABUS
for
DC-3A CO-PILOT QUALIFICATION

The student will fly from the right seat during this training, which will consist of three periods of instruction·

I. CONTACT

a. Pre-flight checks and cockpit explanation.
b. Starting, taxiing and takeoff.
c. Airwork:

l. Climbing turns left and right changing direction every 90 degrees (airspeed not less than l20 m.p.h. and rate of climb not greater than 500 feet per minute)

2. Level off at 4000 ft - trim ship - level flight for two minutes.

3. Standard rate turns left and right 360 degrees.

4· Steep turns left and right 360 degrees. (at least 4 needle widths)

5· Approach stalls - l5" - gear up - holding altitude – note airspeed.
Approach stalls - no power - gear up – holding altitude - note airspeed.
Approach stalls - l5" - gear down - holding altitude – note airspeed.
Approach stalls - no power – gear down - holding altitude - note airspeed.
Approach stalls – l5" – gear down - ½ flap – holding altitude - note airspeed.

6. Instruction on why flap should be raised before gear in climb-outs.

7. Descending turns left and right changing direction every 90 degrees. Gear – l20 m.p.h. - 500 feet per minute - to 3000'. Gear down - l20 m.p.h. - 500 feet per minute - to 2000'. (note power settings)

8 Level off 2000' - gear down - holding l20 m.p.h in level flight. (note power setting)

9. Slow flight. Gear down – full flap - holding altitude- 80 m.p.h. airspeed (note power setting)

l0. Automatic pilot operation.

ll. Landing gear and flap operation.

NOTE: On all succeeding flights, the student should set up the radio And handle the radio phone contacts until at least after the first Take-off. Instructor should carefully check that concise phraseology Is used during these contacts. Also that the student is familiar With the operation of the radio equipment.

II. STANDARD TAKE-OFFS, APPROACH PATTEPNS AND LANDINGS.

a. Standard take-offs - approach patterns and landings. Wheel landings to be made with tail on low side.

b. Missed approach procedure stressing good knowledge of this procedure. The instructor will act as pilot and student as co-pilot. Note students reaction to Captain's orders. Then student will act as pilot and instructor as co-pilot. Note students cockpit phraseology and commands to instructor.

c. Instructor will feather and unfeather an engine at least three times, giving the student instructions and commands. Note students ability to carry out orders from Captain. Students are to repeat commands when given. This point to be highly stressed.

NOTE: At least one period of this training shall be scheduled late enough as to give the student a minimum of at least three (3) night landings. It is felt that most of this time, 4 hours 30 minutes, (3 periods) be utilized on takeoffs and landings. Student shall be able to make unassisted landings.

Quiz on the following from time to time:

l. Radio set up and its use.
2. Electrical system.
3. Hydraulic system and sub systems.
4. Crossfeed
5. Type of engines and power settings and how long it can be used.
6. Rated power and settings and how long it can be used.
7. Temperature and pressures.
8. Emergency equipment.
9. Emergency exits.
l0. Location of operation specifications.
ll. Gross weights.
l2. Fuel dumping.
l3. Fuel and oil capacities - ratio.

FLIGHT TECHNIQUE - DC-3

FOR ATR - TYPE RATING - PERIODIC CHECK

l. PREFLIGHT AND COCKPIT CHECK

A. Oral examination on DC-3 Question Set.

B. Preflight Check)
) Read all items and check same.
C. Cockpit Check before starting)

D. Starting Procedure

E. Pre-taxi Check - tower clearance

II. TAXIING

A. After starting engines and receiving taxi instructions, release brakes and apply 800-l000 RPM. As soon as ship starts to roll check brakes, right and left, smoothly. Check brake pressure. Unlock tailwheel. Turn aircraft with smooth application of power on appropriate engine and assist with brake if needed. Care must be exercised to avoid locking wheel on inside of turn. To slow down and stop reduce power and apply brakes evenly and smoothly. Tail wheel should be locked when practicable.

B. Accomplish taxiing check list.

C. In strong wind copilot should be instructed to assist captain to hold controls. Hold aircraft straight with power on upwind engine, using appropriate brake lightly and intermittently, copilot assisting with controls held as instructed.

D. Slow down on turns to avoid excess strain on gear,

III. TAKEOFFS AND LANDINGS

A. Complete Pre-Takeoff Check list.

B. Align aircraft carefully before locking tail wheel, use all of runway.

C. Apply full takeoff power without hesitation. If short field takeoff, hold brake until 30-35 in. Hg is applied. (All takeoffs should simulate short field work).

D. Order copilot to observe fuel, oil pressures and temperatures.

E. Let tail come up to flight attitude.

F. Off runway between 80 to 90 mph.

G. Apply brake smoothly and call for gear UP at l08 mph reduce power to 2450 RPM - 35 inches.

H. Build up speed to l20 mph.

I. Establish constant climb and avoid great changes in attitude of aircraft.

J. Check head temperatures while gear is retracting.

K. At 300 ft day or 500 ft night accelerate to l30 mph, reduce to climb power, gear handle neutral.

L. At 500 ft start l80^{O} standard rate climbing turn to lOO0 feet.

M. Reduce power to 25" mp and cruise rpm at l000 feet.

N. Call for Prelanding Check.

O. At downwind end of runway, put gear DOWN, complete Landing Check, start descent.

P. l5 seconds past downwind end of runway start standard rate descending turn into active runway, leveling off at minimum 350 ft. altitude (min. airspeed ll0 mph).

Q. Flaps as required.

R. Reduce to desired airspeed. Pilot should handle power during approach and landing.

S. Maintain normal descent and cross fence at 85 - 90 mph.

T. Start, slow constant back pressure for flare out.

U. Hold off in tail low attitude and let go on smoothly.

V. Flap up as required.

W. Ease tail down slowly.

X. Use brakes early to check pressure.

IV. NO FLAP APPROACH AND LANDING

A. Normal approach pattern.

B. ll0 IAS turning final.

C. l05 - ll0 MPH final.

D. 90 - 95 MPH over fence.

E. Land as near to approach end of runway as possible.

V. CROSSWIND TAKEOFF

A. Consult DC-3 Aircraft Operating Manual, Wind Component Diagram for Cross-wind (page 65-l-2).

B. Apply full upwind aileron, or as needed, decreasing amount with increase in airspeed.

C. Maintain directional control with throttles, rudder and aileron, and the downwind throttle to takeoff as soon as rudder directional control permits.

D. Leave tail wheel on longer than normal.

E. Let speed build up high enough so that when aircraft leaves ground, a clean break may be made with no danger of contacting ground again.

F. On leaving ground, crab into wind and hold straight down runway.

a. Maximum Performance Climb after Takeoff

l. Check clock when takeoff power applied so as not to exceed engine operating time limitations.

2. Gear UP when definitely clear of runway.

3. Maintain climb speed l05 MPH until clear of obstructions.

Check temperatures and pressures and resume normal club as soon as condition calling for maximum performance no longer exists. Assume normal climb configuration as soon as possible.

4. Repeat same under hood. - Hood Takeoff.

b. Engine Fire on Takeoff

l. Engine feathering procedures, cowls trail, pull fluid shutoff.

2. Discharge fire extinguisher on appropriate engine.

3. Advise tower of emergency, return and land.

c. Loss of Fuel Pressure on Takeoff

l. Wobble pump for pressure.

2. If engine continues to run, continue its operation on crossfeed at pilot's discretion only. Check for fire. Accomplish Check List.

VI. MISSED APPROACH PROCEDURE

(Gear DOWN – Full flaps - ll0 mph or less.)

A. Apply 33" mp, props full low pitch, full takeoff power.

B. Change attitude to avoid all obstacles.

C. At 90 mph flap UP.

D. As soon as climb established command "GEAR UP", accelerate to minimum takeoff climb speed l05 mph. Use maximum performance climb to clear obstacles.

VII. EMERGENCY CLIMB

A. Mixture Takeoff and climb, cowls trail.

B. Check flap and gear UP.

C. Rated power and maintain l22 mph until desired altitude is reached.

D. At desired altitude, reduce to cruise power.

VIII. TURNS

A. STEEP TURNS

l. Mixture Takeoff and climb; gear handle NEUTRAL.

2. Cruisc power.

3. 45^0 bank.

4. Cross reference all flight instruments holding constant degree of bank and altitude.

IX. EMERGENCY INSTRUMENT FLIGHT

A. Directional control by turn and bank indicator.

B. Cross check altimeter, rate of climb, and airspeed.

X. APPROACH TO STALLS

A. CLEAN

l. Mixture takeoff and climb.

2. Cowls trail.

3. Gear handle neutral.

4. Reduce power to l5 inches.

5. Hold altitude until the approach to stall.

6. Nose down slightly on horizon on flight indicator.

7. Apply rated power.

8. Stop descent at 95 mph and accelerate to l22 mph, then climb to original or desired altitude. When desired altitude is reached, reduce power to cruise.

E. FLAP AND GEAR DOWN

1. Mixture takeoff and climb.

2. Cowls trail.

3. Reduce Power to l5" mp.

4. Gear and flap down.

5. Hold altitude until approach to stall.

6. Nose down slightly below horizon on flight indicator.

7. Apply full takeoff power.

8. Start recovery at 90 mph, crosscheck all instruments to indicate stall is broken.

9. Call "Flap UP", then gear up.

l0. Reduce to ratted power, climb to desired altitude at l22 mph.

ll. Reduce to cruise power at l40 mph.

X. SLOW FLIGHT

A. Hold heading, altitude.

B. Mixtures takeoff and climb, cowls trail.

C. Cruise RPM, power as required.

D. As 90 mph reached, increase power to maintain airspeed and altitude.

E. 20^0 bank, $i80^0$ turns right and left.

XII. UNUSUAL POSITIONS – (HORIZON, DIRECTIONAL GYRO CAGED)

A. Firm coordinated aileron and rudder pressure to stop any turning motion.

B. If needle and ball displaced to opposite sides with relatively low airspeed (spin indication) center needle first, disregard ball until turn stopped then center normally.

C. Throttle back immediately, if airspeed building up, avoiding high G pull-outs and excessive loads from partial or wholly inverted attitudes.

D. Do not use elevators to check excessive speed until turn has been stopped. (Tight diving spiral.) Use of elevators in turn increases rate of turn, making recovery more difficult.

E. Do not jerk back on yoke. (Stalls, snap rolls may be result even at high indicated airspeed.)

F. Moderate use of elevators sufficient. (Modern aircraft have tendency to go from dive at high airspeed to dangerous nose high attitude.)

G. Forward on yoke to keep attitude constant the instant airspeed starts to decrease.

H. Hold this attitude with forward pressure, checking climb tendency until momentum lost and normal cruise airspeed reached.

I. Open throttles.

J. If in attitude of stall, rapidly losing airspeed, forward on yoke before applying power.

XIII. EMERGENCY

A. Descent between stations

1. Mixture takeoff and climb

2. Check cowls, probably closed.

3. Manifold pressure l8" to 20".

4. Establish l000 ft per minute, rate of descent.

5. Do not exceed aircraft speed limitation.

B. Emergency descent from holding (Would have l20 mph, mixture takeoff and climb.)

1. Mixture takeoff and climb

2. Check cowls, probably closed.

3. Manifold pressure l8" - 20".

4. Establish l000 ft per minute rate of descent.

5. Do not exceed aircraft speed limitation.

6. Check head temperatures.

To stop at desired altitude, start to level off l00 ft. high and allow speed to decrease to l20, then apply power to maintain l20 mph airspeed at proper altitude.

XIV. LOOP ORIENTATION - AURAL NULL. It is permissible to let Instructor, Copilot, or Check Pilot fly the airplane during orientation. Radio communication between aircraft and ground station while making orientation and letdown:

Miami Radio, this is Clipper ll8 - Over.

Clipper ll8, this is Miami Radio – Over.

Cliiper ll8 in unknown "A" or "N" quadrant in vicinity of Miami at 3000 ft. Request clearance for orientation - Over.

ATC clears Clipper ll8 to all quadrants of Miami Range at Specified altitude - Report position and ETA after orientation - Over.

Clipper ll8 repeats clearance.

A. Hold heading, altitude, at cruise H.P. (True A.S. about l60) Set gyro.

B. Tune radio to station in antenna position, checking maximum needle deflection. (See Note Below.)

C. Function switch to loop CW position, volume at comfortable level.

D. Rotate loop to obtain null (increase in volume indicates loop is turning away from null).

E. When null obtained, increase volume to narrow null to 3o and note angular distance between null and closest wing tip. If null cannot be narrowed this amount, due to distance from station, narrow as much as possible and center of null will be accurate bearing.

F. Rotate needle to closest wing tip to null.

G. Leave volume alone, turn aircraft to bring null to closest wing tip. Do not make turn too rapid.

H. Do not stop turn at first indication of null. Turn through null to get build in volume, checking null width on gyro.

I. Turn back to center of null as indicated on gyro.

J. Start clock and carefully hold this heading.

K. Rotate loop to follow null, decrease station L; increase station R.

L. Fly for one minute. If l0^{O} change in bearing not obtained in that time, fly for one more minute.

M. Compute ETA, distance, QDM, change switch to compass position.

N. Clipper ll8 SW quadrant, 3000 ft on QDM 20^{O}, ETA 07. Request clearance to Miami Range Station.

O. Clipper ll8, your clearance - ATC clears Clipper ll8 to Miami Range Station on QDM 20^{O} - Contact Miami Radio overhead range station for further clearance.

P. Clipper ll8 will repeat clearance.

Q. Turn to intercept new QDM and track to station.

R. Keep volume up to hear instructions and prevent following dead needle.

S. Aircraft will follow instructions.

NOTE: Automatic operation of radio compass depends on combination of signals from both loop antenna and sense or phasing antenna. Because of ice, accident, or malfunction, phasing antenna may be lost or inoperative. Under these conditions, Pilot must rely entirely on aural null indication.

Failure of phasing antenna is indicated by satisfactory reception in loop position, but no reception on antenna or compass. To tune station in this case, it is necessary to rotate loop to estimated maximum signal position in relation to desired radio station. This avoids tuning station with loop in null position and lack of signal.

Turn up volume to decrease null. Due to distance from station, it may be impossible to narrow null more than 15^{o} - 20^{o}. In such cases, splitting null will give accurate bearing.

Using CW switch will eliminate mistaking identification signal pause, or program pauses on commercial stations for null. CW switch will not work on loop type ranges because of absence of continuous carrier wave.

If difficulty experienced getting accurate null because of poor reception, watch tuning meter.

Tuning meter will deflect counter clockwise when null is reached.

Formula _____.

Time to station $\frac{60 \times \text{minutes run}}{\text{degrees change}}$.

Distance equals $\frac{\text{TAS} \times \text{minutes run}}{\text{degrees change}}$.

Drift Calculation _____.

Fly gyro heading toward station and no changing radio compass bearing after reasonable length of time.

Divide total time to station by time flown and multiply by degrees Drift. Answer is drift correction to be applied as indicated by needle.

XV. INSTRUMENT APPROACH - MIAMI

A. Ask for latest weather and altimeter setting.

B. When fairly close in, do pre-landing check.

C. At initial overhead, call Approach Control and report over.

D. Start turn to intercept final approach leg.

E. Reduce power to maintain l20 mph airspeed.

F. Proceed according to instructions.

G. Go out 6 miles (according to wind).

H. Do a procedure turn to south.

I. Call for active runway if you don't already have it.

J. Let down to 600 ft and maintain until over low cone.

K. Cut power to l5 - 20 in. and let down to minimum altitude.

l. If contact, make a normal approach.

2. If not contact, execute Missed Approach Procedure:

a. Apply rated power.

b. Flap up, and gear up.

c. Climb out at l30 mph on East leg to l400 feet.

d. Call tower and report a missed approach and request instructions.

XVI. ONE ENGINE OPERATION

A. Absolute ceiling DC-3, one engine inoperative, l3,500 ft., 24,000 lbs.

B. DC-3 will not hold altitude on one engine with gear and flap extended, sealevel.

C. Minimum control speed (V_{mc}) 88 mph, takeoff power, sealevel.

D. Do not lower gear until landing assured.

E. Do not put flap down all at once.

F. Carefully observe altitude and airspeed turning on final.

G. Airspeed ll0 mph on final using flaps to control descent as required.

H. Center all trim tabs before landing.

I. Cross fence as near normal as possible.

XII. LOW DOWN, CLOSE-IN - 4OO & l condition - Hood over pilot's windshield.

XVIII. MISCELLANEOUS

A. Know loop operation, plus radio set up.

B. Range letdown.

C. CAA radio procedure, clearances, length of runways, destination, alternate, radio coordination, approach control, without VHF, etc.

D. Weather minimums.

E. Hold gear until contact unless landing straight in.

F. Stress airspeed, altitudes; know power settings.

G. Increase of airspeed and altitude when on alternate source.

H. Rough air cruising speed, etc.

I. Know V_{mc}.

J. Know fire procedures.

K. Know hydraulic failure procedure.

L. Know gross weight and c.g.

M. Know stalling speeds and performance.

N. Know fuel system including crossfeed, etc.

O. Know power, temperature and pressure limitations.

P. Know electrical system.

Q. Know emergency equipment location & use (including exit locations).

R. Know location operations specification, power chart etc.

S. Know fuel & oil capacities and consumptions.

T. Know fuel dumping procedure.

U. Know auto pilot operation.