Flying the DC-3

Thanks very much to Kenny Stone for providing the Real World procedures for flying the DC-3. Kenny currently flies a DC-3 for an Air Cargo service and these are the procedures that they use. Go to http://www.dc3airways.com/n58na.html to see one of the aircraft that Kenny flies.

Kenny also provided the descent procedures that he uses with Flight-Sim. These differ from the Real-World settings because the real DC-3 slows more quickly than the Flight-Sim DC-3. And to keep it all fun I've included two short example flights for you to practice the procedures that Kenny describes below. And that includes how to calculate the point when you should begin your descent. Oh yes, and there are some winds to contend with, too, in the example flights.

Real World DC-3, Power Settings...

There are different type's of engines for the DC-3, and each has its own power settings. The information here is for the Pratt and Whitney R-1830-92 engines, rated at 1200 HP for take-off. The power settings for the military R-1830-94 engines, rated at 1350 HP for take-off, are on the R4D panel and are not repeated here.

Max Take Off--- 48" @ 2700 RPM Mixture auto rich / cowl flaps trail
#1 METO (Maximum Except Take Off)--42" @ 2550 RPM Mixture auto rich / cowl flaps trail
#2 Initial Climb--- 36" @ 2350 RPM Mixture auto rich / cowl flaps trail
En route Climb--- 34" @ 2350 RPM Mixture auto rich / cowl flaps trail As you climb the MP will drop (about one-inch per thousand feet). Let it drop to 34" and then maintain 34" during climb.
Cruise--- 28" @ 2050 RPM Mixture auto lean / cowl flaps closed and off
En route Descent--- 28" @ 2050 RPM (do not exceed 145 knots) Mixture auto rich below 3000 ft / cowl flaps closed and off
Final Approach (normal)--- 21" @ 2050 RPM Mixture auto rich / cowl flaps closed and off
Final Approach (Maximum deceleration)--- 19" @ 1900 RPM Mixture auto rich / cowl flaps closed and off
Cowl flaps open and off after landing and at all times on the ground.

Real World DC-3, Descent Procedures...

Let’s start at Cruise descent, 300 to 500 fpm. In the real world, start down without pulling the power back - maintain cruise power. A good target airspeed to trim for is 145 knots
Quick descent (more than 500 to 800 fpm) - PUT THE LANDING GEAR DOWN, if you do not your airspeed will build up rapidly, cooling the engines too quickly, which could cause the cylinders to crack.
Know your Altitude, Know your GROUND speed, and Know how far you are from the airport and you can figure out when to descend and how fast to descend. (See KBOS to KPVD and KBOS to KPVC Flights below)
In a real “3" never reduce power more than an inch or two at a time. One to two inches per minute is a good rule of thumb. There again, you need to know how many minutes you are from approach to be at 22 in. to 25 in.
Avoid simultaneously descending and reducing power unless the landing gear is down.
Use your gear and flaps to slow down as needed. Know the V-speeds. You can put the gear down at 140. This will help you slow down to flap speed.
I try to be at 95-97 knots 5 to 6 miles out at pattern altitude ready for descent to land.
Final approach -- a word goes through my head as I start my descent, **GUMPS**, this helps me remember my final check. G = Gas, fuel selectors as required. U = Undercarriage, Gear down and LOCKED. M = Mixture, auto rich below 3000 ft. P = Props, RPM 2050 (should have been there since set at cruise altitude.) S = Switches, boost pumps on, landing lights as required.
There is no rule as to "When to put the landing gear down." ... Except to have them down at touchdown!
Remember the V-speeds and use them as needed.

A good rule-of-thumb when slowing the real DC-3 is to decrease the MP only 1" to 2" per minute. Don’t ever increase or decrease the throttles quickly.

When you increase power "WALK" the throttles smoothly to the desired setting.

Decrease power slowly. When the engines were new, maybe you could have increased or decreased the throttles quickly, I don't know. (never flew a new 3)

Chopping the power should not be in the vocabulary of a DC-3 pilot. Picture this --- Hundreds of 50 year old engine parts all moving in perfect harmony in one direction, under conditions of extreme heat and pressure --- all of a sudden someone chops the power.

In an instant all those antique parts start banging against each other as they try to handle the stress of the reverse load imposed on them by the propeller which is now trying to drive them in the opposite direction! Don't let this happen.

The landing phase is where most of the DC-3 engine damage occurs. Never bring the power back below square, 21" - 22" @ 2000 RPM until the flare. That is MP should never fall below RPM until the flare.

The Flare--- the flare is when the aircraft is level, approximately 2-3 feet above the runway when the wheels are about to touch the ground. Even then the power should never ever be pulled back to idle while the aircraft is in the air.

Instead, SLOWLY walk the throttles back. Normally the wheels should touch with the MP still at least 13" to 15". Once the wheels have touched you can then a little more "briskly," but not suddenly, walk the throttles back. If you want to simulate a DC-3 move those throttles slowly.

Real World DC-3, Transition from Climb to Cruise...

The transition from Climb to Cruise is not simply a matter of leveling off at the desired altitude and then pulling the Throttles and Props back to the cruise settings. We wait until the airspeed builds up a little, but remember, you’re bringing those Throttles and Props back **slowly** and your speed is increasing as you do this.

After reducing power we leave the Mixture in Auto-Rich for 5 minutes before leaning to Auto-Lean. This lets the engine cool a bit. Cowl flaps are closed and off. After one hour switch to auxiliary tanks. One waits an hour because a vapor return line from the carburetor returns up to 10 gallons of fuel per hour back to the main tanks. One hour of flight allows adequate space in the main tank to accommodate the vapor return. The Main tanks have an overflow line leading to the rear (auxiliary) tanks.

After about 3.5 to 3.75 hours switch back to Mains (this is for normal operation). Switch Boost Pumps ON before you switch tanks, then OFF when you are done.

On Flight-Sim I just leave the fuel on ALL, it runs off the aux tanks and then the main tanks. On a real “3" you have two fuel selectors, one for the left, and one for the right side.

Real World DC-3, Maneuvering Speed...

Va-Maneuvering Speed: Abrupt control movements or turbulent air penetration above 122 kts could cause structural failure.

Flight-Sim DC-3 Procedures...

For Flight-Sim when flying the R4D I use the power settings listed on the R4D panel to simulate the R-1830-94 engines. If you want to simulate the R-1830-92 engines use the Climb and Cruise power settings in the table above. You will be about 10 Knots slower than the R4D.

Descent Power Settings:

In the real DC-3, with the 1830-92's you cruise around 120-130 knots IAS. On descent leave the power at 28" @ 2050 RPM, and let the aircraft descend at about 500 fpm. Do not exceed 145 knots.

I have never flown a DC-3 with the R-1830-94 engines. In Flight Sim I simulate (fly) the R-1830-94's because it is faster. **When I descend (in sim) to keep from going over 145 knots I bring the power back to 23''.** I don't know if this is true with the real 94 engines but it works for N1776. Do not descend more than 500 fpm with out the gear down.

As mentioned earlier, I fly with the fuel selector in the ALL position ... it runs off the aux then the main tanks.

Happy flights.
Kenny
DC3-603

When to Start Your Descent...

Controlled field, ILS approach.

The sum of three segments determine the point when you should begin your descent:

1) Be at the Glide Slope intercept altitude 5 to 6 miles out from the airport. For flight Simulation, obtain that altitude either from the approach plate, or choose 2500 ft **Above Ground Level** if you don’t have the approach plates.

2) Since we don’t simultaneously descend and slow the aircraft, allow 2 to 3 miles to slow from descent speed ... about 145 kts ... to initial approach speed ... about 95 kts.

3) Calculate the distance to descend from cruise altitude to Glide Slope intercept altitude. Calculate this for a 500 fpm rate of descent and the aircraft’s **GROUND SPEED** based on the existing wind conditions.

Here's a sample calculation for when to start your descent...

For an ILS Approach

Assumptions:

Wind: 275° @ 24 kts.

Your magnetic course:	216°
Your cruise altitude:	4500 ft
Your True Airspeed:	140 kts.
Destination Airport:	KPVD, Providence, RI
Landing Runway:	23L, ILS Approach
Ground Speed	122 kts (for 140 ktstrue airspeed and this wind)
Wind Correction Angle	7° Right, for Cruise and Descent.
(GS and WCA calculated with an E6-B Aviation Calculator)	

Note: Winds aloft are stated relative to True North, so we must convert that to Magnetic to know the affect on the aircraft. The Magnetic Variation (difference between True North and Magnetic North, where your compass points) in the vicinity of Boston and Providence is 15° West. A West variation means that our compass points farther West than True North. On this flight we will be flying into a 24 kt, 44° crosswind.

1) Although the sum of three segments determine where to begin our descent, two of those segments are fixed ... the 5 to 6 miles before airport to be at the Glide Slope intercept altitude and the 2 to 3 miles needed to slow the aircraft.

2) So, allow eight miles for the two fixed segments when descending to intercept an ILS.

3) Next, calculate the distance to allow for descent, the only variable from one flight to the next.

a) From the Approach Plate the ILS Intercept altitude for KPVD is 2100 ft. But the 25 NM Minimum Safe Altitude (MSA) is 2200 ft so let's use 2200 ft for our "pattern altitude."

b) Our Cruise altitude is 4500 ft, we descend TO 2200 ft, so we descend 2300 ft to arrive at a 2200 ft altitude.

c) At 500 fpm rate of descent, it will take 2300/500 = 4.6 minutes to lose that altitude. Note that the TIME to descend depends only on the rate of descent. The aircraft speed does not enter into the calculation for time to descend.

d) Our **GROUND SPEED** is 122 kts. How far will we travel at 122 kts Ground Speed in the 4.6 minutes it takes to descend from 4500 ft to 2200 ft? At 122 kts we will travel 2.03 NM in one minute (122/60) ... so in the 4.6 minutes needed to descend from 4500 ft to 2200 ft, we will travel 9.34 NM (4.6 x 2.03). We round that to 9 NM needed for descent

e) Thus, **start descent at 17 NM before the airport for this flight** in these wind conditions (8 NM for the two fixed segments + 9 NM for the

descent).

Descent into an uncontrolled field, 800 ft Traffic Pattern.

An uncontrolled field has no Control Tower, and all aircraft arrive and depart in a standard, rectangular traffic pattern. Left turns are implied if not specified. So, during landing, a “Left” traffic pattern requires left turns from the downwind leg to the base leg and from the base leg to the final-approach leg. The landing runway will be to your left as you fly downwind. The turns would be right-hand for a “Right” traffic pattern, and the landing runway will be to your right as you fly downwind.

Unless specified, the standard traffic pattern altitude for an uncontrolled field is 800 ft Above Ground Level (AGL).

The descent situation when arriving at an uncontrolled field with a typical 800 ft Traffic Pattern Altitude differs from the descent situation for an ILS approach.. For the ILS approach, we had reached the “approach altitude” (2200 ft in the sample calculation) about 8 NM from the field. That is much too far from an uncontrolled field to be at 800 ft to enter a standard Traffic Pattern.

For the uncontrolled field, complete your descent 2 NM from the field which allows time to reduce your speed before entry into the traffic pattern. Slow to 95 kts by lowering the gear.

Sample calculation for entry into Traffic Pattern at an uncontrolled field.

Assumptions for this flight:

Ground Speed during Descent:	165 kts.
Cruise Altitude:	3500 ft
Traffic Pattern Altitude:	800 ft.

Arrive at the 800 ft Traffic Pattern altitude 2 NM before the field to slow to 95 kts.

Time to descend from 3500 ft to 800 ft = 2700/500 fpm = 5.4 minutes.

Distance to descend from 3500 ft to 800 ft at 165 kts = (5.4 x 165/60) = 14.85 NM

Distance before field to begin descent = 14.85 NM + 2 NM = 17 NM.

The same distance calculated for the ILS approach? A coincidence, don’t count on it happening often.

Your Practice flights...

Flight No. 1 ...ILS Approach,
Boston, MA; KBOS to Providence, RI; KPVD, 44 NM, 26 minutes.

Enter the weather data into the Weather page of Flight Simulator (Alt/World/Weather ... then click the “Advanced Weather” button). **DO NOT USE** Real Weather or FS Meteo for these practice flights unless you are comfortable using an E-6B to calculate Ground Speeds and Wind Correction Angles.

Flight:	KBOS to KPVD
Winds:	275° @ 24 kts
Visibility:	20 NM
Clouds:	Scattered (3/8th coverage, 3000 ft base, 6000 ft tops)

Radios:

Tune ADF to 220, IHM NDB
Tune Nav to 115.6, PVD VOR ... This is for DME information only.

Depart from KBOS Rwy 27 with a left climbing turn direct to IHM NDB, 220. While climbing to 4500 ft at 105 kts your Wind Correction Angle (WCA) will be 9° Right. Since your magnetic course is 216° your hdg will be 225° (216° + 9° WCA). On reaching cruise altitude of 4500 ft, the WCA will decrease to 7° because of your higher speed, so change the aircraft hdg to 223° . Monitor your RMI/ADF Needle. The needle always points to the beacon, and should show your WCA. If the needle is farther to the left or right from straight ahead than the WCA, readjust your hdg to correct for the proper hdg.

At station passage of IHM NDB, turn right to AR NDB, 356. The WCA will now be 5° Right, and the aircraft hdg will be 227° + 5° or 232°. Monitor your DME because you will begin your 500 fpm descent 17 NM from PVD VOR. At 17 DME begin your 500 fpm descent. Your WCA and hdg will remain the same since you will be descending at about your cruise speed. As you slow the aircraft for your approach you must increase the WCA to the right since the wind has more affect the slower your aircraft. Manually fly the ILS to KPVD, Rwy 23L Field Elevation is 52 ft. While you are sliding down the glide slope at 85 to 95 kts, the WCA will be 8° to 9° to the right. Be wary of the strong cross wind as you flare and touch down on Rwy 23L at Green State Airport.

Flight No. 2 ... 800 ft Traffic Pattern, Uncontrolled Field.
Boston, MA; KBOS to Provincetown, MA; KPVC, 45 NM, 19 minutes plus Traffic Pattern time.

Weather:		Same weather as Flight No. 1
Cruise Altitude:		3500 ft.
Pattern Altitude:		800 ft.
Landing		Rwy 25
Leg 1:	Climb	Course 150°, WCA 13° Right, 111 kts GS for 105 kts IAS ... Yes, a tailwind ... it does happen!
	Cruise	WCA 10° Right, 147 kts GS for 140 kts IAS
Leg 2.	Cruise	Course 111°, WCA 5° Right, 161 kts GS for 140 kts IAS
	Descent	WCA 5° Right, 165 kts GS for 145 kts IAS

Radios:

ADF: IMR, 368

NAV: LFV, 114.7 ... Again, for DME information only.

Dep Rwy 27, with a climbing left turn direct to IMR NDB, 368. 163° Hdg (150° + 13° WCA) during 105 kts climb. At 3500 ft Cruise Altitude, WCA is 10° Right, turn to 160° and continue to IMR NDB. Turn left at IMR then direct to PVC NDB, 389. WCA is 5° Right for this leg. Per previous calculation, begin 500 fpm descent to 800 ft pattern altitude 17 NM from KPVC, which is 25.6 NM (DME) from LFV VOR. Slow to 90 kts on reaching the 800 ft traffic pattern altitude and enter Right traffic pattern for KPVC. Land Rwy 25. Field Elev=6 ft.

Heed Kenny's instructions on throttle settings during descent, flare and touchdown.

Thanks again to Kenny Stone for his enormous help on these procedures.

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