FLYING THE JET CITY AIRCRAFT DC-9 SERIES 20

The DC-9 Series 20 is a fairly forgiving airplane provided you understand some basic fundamentals about it. The purpose of this brief guide is to walk you through a flight in the DC-9, pointing out some key features and characteristics of the airplane that will help you to pilot it successfully.

This document is not intended for real world flight and is by no means a complete “how to fly” document, as many specific aspects of flying involve specific settings in the cockpit that we won’t cover here. Because users of this airplane could be using a variety of cockpit environments, we will do our best to keep descriptions as generic as possible and will omit panel-specific procedures where we can. Please note that the speeds and figures listed below are only for general reference only; your airplane may need slight adjustments to account for aircraft weight, engine thrust, and weather conditions, but overall the figures below will work in most situations.

Are you ready? Let’s get started!

PREPARATION

One of the most important parts of a successful flight is being prepared. Plan your flight, know your routing, and plan your fuel load accordingly.

COMPUTING MINIMUM DISPATCH FUEL

The following flight plan factors must be considered to determine the dispatch minimum fuel requirements:

- Flight plan fuel as calculated
- Alternate fuel as calculated
- Taxi fuel: 400 lbs for each stop
- Reserve: 3500 lbs
- Holding Fuel: 4400 lbs
- Instrument Approach: 500 lbs for each approach

The sum of all factors will provide the minimum fuel requirements for the flight and should not be less than 5,000 lbs.

We have provided a fuel and flight planning quick reference chart at the end of this document to assist you with your fuel planning.

Once in the cockpit, prepare the airplane for the flight as per cockpit procedure. At this time, load up the fuel you’ll need for your flight. When you’re ready to go, turn on the rotating beacons and switch to external view to do a quick visual check of the airplane to make sure your doors are all closed and ground service equipment is out of the way. Since you are outside the airplane, now is a good time to check the movement of your flight controls – rudder, elevators, stabilizer trim, ailerons, and spoilers should all move freely. Switch back to cockpit view and let’s get going.

PUSHBACK, STARTUP, and TAXI

Push back from the gate and go ahead and start your left (No. 1), or port engine. When it’s stable, you can start the right (No. 2), or starboard engine. In the DC-9, you can start engines at the gate and powerback (at certain airports), start them during the pushback process, or push back, set the parking brake, and start them at that point. Whichever way, once your engines are running and you are cleared to taxi, the fun begins.

Turn on your taxi lights, release the parking brake, and advance the throttles to approximately 45% N1. The airplane will slowly move forward. You may need slightly more or less N1 depending on winds and aircraft weight.

Keep the nose wheel centered until the aircraft starts rolling then apply pressure to the nose wheel steering to make the desired turn. Differential power or wheel braking may be used for sharp turns but do not lock the pivot wheels as this causes premature tire wear.

Keep engine RPM below 45% N1 when departing the gate where possible. Once clear of the gate area, you can increase thrust to achieve a taxi speed of between 10 and 20 knots. Taxiing at around 40-45% N1 should allow you to maintain a fairly consistent taxi speed (this is a higher N1 setting than in the real plane, but the simulator doesn't model ground handling well). After leaving the ramp, verify that your stabilizer trim and flaps are at the proper takeoff settings, and spoilers are retracted.

TAKEOFF AND CLIMBOUT

When clearance is received for takeoff, scan the annunciator panel and taxi onto the runway. Set the heading bug on the runway heading as an aid in maintaining directional control in the event an engine fails after V1.

Turn on your landing lights, and press SHIFT-W to extend them into position out of the wingtips. Turn on your strobes at this time as well.

When beginning your takeoff roll, smoothly advance throttles to around 50% N1 and allow your engines to spool up a bit. Scan your engine instruments for abnormal indications. If all is OK, continue advancing the throttles until reaching takeoff EPR (See Chart). Have your takeoff power set by 60 knots.

At VR, initiate a smooth pull back on the yoke to create a five to six second interval to rotate to approximately 15° pitch attitude.

Minimum altitude for engaging the autopilot is 600 feet AGL.

With a positive rate of climb indicated on the altimeter, retract the landing gear. Continue the climb to 1,000 feet AGL at minimum V2+10 airspeed. No turns are to be made below 300ft AGL.

STANDARD CLIMB
At 1,000 feet AGL, lower the nose to approximately ½ PA (See Chart) and set climb thrust. During adverse conditions, the power may be left at takeoff setting, but not to exceed the 5 minute limitation. Continue climbing to 3,000 feet at a minimum of V2 + 10. At VF (see chart), start retracting your flaps, with flaps fully retracted to zero by VZF (see chart).

NOISE ABATEMENT CLIMB
At 1,000 feet AGL, lower the nose to approximately ½ PA (See Chart) and and allow the airplane to accelerate to VZF (See Chart). Retract flaps and reduce thrust to QT EPR (See Chart). Continue a gradual climb to 3,000 feet at ½ PA.

Passing 3,000 feet, set climb thrust (approx 1.7 EPR) and accelerate to 250 knots at a 500 to 1,000 ft/min climb rate. Once at 250 knots, increase your climb rate to maintain 250 knots to 10,000 feet. Your climb rate should be between 1,500 and 3,500 ft/min depending on the aircraft weight, engine performance, and weather.

At 10,000 feet, turn off your landing lights and retract them by pressing SHIFT-W. Lower the climb rate to approximately 1,000 ft/min and let the airplane accelerate to a climb speed of 290 knots. At 290 knots, raise the nose again and maintain a 290 knot climbout to FL 280. You may need to increase EPR to maintain speed, but not more than an EPR of 2.0. Above 280, maintain a mach speed of .72 - .74 up cruise altitude.

If you are using the autopilot to maintain your climb rate, about 1,000 feet before capturing your cruise altitude, lower the vertical speed setting in the autopilot to 500-700 ft/min. This will enable a nice, smooth altitude capture (as the ability of the simulator to capture an altitude is less than optimal in most aircraft).

<u>NOTE:</u> Because of the design limitations of the autopilot in the simulator, many self-taught virtual pilots think that climbing up to cruise altitude is as simple as setting the autothrottle, altitude, and vertical speed, then kicking back and enjoying the ride. This is NOT a realistic way to climb in an airliner! Operating a large jet requires constant monitoring of EPR or N1 fan speed, air speed, and climb rate; it's not a "Set it and forget it" type of deal. As you are learning, it's almost easier to control the airplane's climb manually than with the autopilot vertical speed settings. What you want to do is set your climb EPR and then adjust your rate of climb higher or lower in order to maintain a certain air speed. Remember that as you get higher, it takes more power to climb and maintain that airspeed... The reaction is to give it more throttle, but you need to do avoid touching the throttles and instead reduce your rate of climb, which will in turn allow you to maintain your airspeed. You may be able to climb at 3,000 ft/min at FL100 and by the time you are at FL280, your climb rate may be as little as 500 ft/min in order to maintain 290 knots and your climb EPR setting. This is perfectly normal when flying airliners. And of course, the settings you use today may not be the same as what you need tomorrow, as aircraft weight and weather impact performance greatly. That's part of the fun of flying… it's always different!

CRUISE

Do not normally exceed .76 mach during cruise. Max cruise speed is .78 mach, normal cruise speed is .76 mach, and econo cruise is .74 mach.

DESCENT

From cruise altitude, rotate the vertical speed wheel on the AP to between –500 and –1,000 ft/min. Maintain Mach cruise speed until FL280. At FL280, set IAS to 280 knots and set the sink rate to -1,000 ft/min. Do not exceed 1000 ft/min above FL250, as the DC-9 requires this due to cabin pressure issues. As you pass FL250, adjust the descent rate to descend at idle thrust and 280 knots. Reduce your descent rate to about 1000 ft/min at 12,000 feet to start bleeding off speed as you need to be at or below 250 knots at 10,000 feet. At 10,000 feet, turn on your landing lights, and press SHIFT-W to extend them. Set your IAS for 250 knots. Maintain 250 knots for the remainder of your descent until advised by ATC to reduce speed.

APPROACH AND LANDING

Determine aircraft landing weight from the fuel totalizer gauge. If the totalizer is inoperative, subtract the fuel consumed by both engines from the ramp gross weight.

By the time you turn onto final approach, you should be at approximately 210 knots at flaps 5. As you capture the localizer, set flaps 10 and let speed bleed to maintain 190-200 knots.

Just before glidepath capture, set flaps 15 and then flaps 25 and slowly bleed off speed to maintain 160 knots to the outer marker. Lower the landing gear. Once the gear is down and locked, arm the ground spoilers. Set flaps 30.

Passing the outer marker, set flaps 40 and establish your final approach speed as listed in the speed booklet. You should be in full landing configuration at this point.

You should not have to touch the throttles much during the final approach phase of flight, as the added drag from the gear and flaps will slow the aircraft down gradually.

Minimum altitude for disengaging autopilot is approximately 60 feet AGL.

Plan to pass over the runway numbers at 50 feet AGL. At approximately 20 feet AGL, slowly reduce throttles to idle and initiate the flare.

When the main gear touches down, the spoilers will extend, but they may not immediately extend if the runway is wet or slippery because of lack of wheel spin up. Spoilers must then be extended manually.

Pull the throttle levers immediately to the idle position while gently lowering the nose to the runway. Once the nose wheel is on the ground, reverse thrust power may be used up to 80% N1.

Upon reaching 70 knots, gradually reduce reverse thrust so as to reach reverse idle detent position by 60 knots and then use manual braking to reduce to taxi speed. Leave throttles in reverse idle detent until forward thrust is needed, however, they must be stowed before turning off the runway. Delay application of the wheel brakes until below 80 knots if possible.

Vacate the runway at the first available turnoff. When clear of the active runway, turn off your landing lights and press SHIFT-W to retract them, and turn off your strobes. Turn on your taxi lights, retract your spoilers and raise flaps to 0.

Upon reaching the parking area, set the parking brake, shut down both engines, and turn off your rotating beacons.

That's the general procedure for flying the DC-9 Series 20.

Most of the settings listed in this document were taken directly from official flight/aircraft documents, and only modified where necessary to compensate for shortcomings in the simulator.

DC-9 SERIES 20 LIMITATIONS

WEIGHT LIMITATIONS:
Maximum Ramp Weight: 101,000
Maximum Takeoff Weight: 100,000
Maximum Landing Weight: 84,000
Maximum Zero Fuel Weight: 74,000

Takeoff and landing weights may be further restricted by runway lengths and performance requirements.

AIRSPEED LIMITATIONS:
Vmo: 350 KIAS
Mmo: 0.84 Mach

MANEUVERING SPEED
Do not operate aileron controls to full throw above speeds listed:
Sea Level: 220 KIAS
30,000 Ft: 260 KIAS
35,000 Ft: 248 KIAS

FLAPS EXTEND SPEEDS
Slats: 280 KIAS / 0.57 Mach
Flaps 0-10: 280 KIAS / 0.57 Mach
Flaps 10-20: 240 KIAS / 0.57 Mach
Flaps 20-25: 210 KIAS / 0.57 Mach
Flaps 25-50: 180 KIAS / 0.57 Mach

LANDING GEAR OPERATING SPEEDS
Extension: 300 KIAS
Retraction: 250 KIAS

TURBULENCE PENETRATION SPEED
265 KIAS / 0.76 Mach, whichever is lower

TIRE LIMITS
Do not exceed 195 knots ground speed

MAXIMUM OPERATIONAL ALTITUDE
35,000 feet

ENGINE REVERSERS
Reverse taxiing is prohibited
In-flight reversing is prohibited

WIND COMPONENTS
Maximum tailwind for takeoff and landing: 10 knots
Maximum crosswind for takeoff and landing: 31 knots

SPOILERS
The speed brakes must only be used in the 0° flaps configuration.
Do not extend the gear with the speed brakes deployed
Do not arm the ground spoilers prior to gear extension

FUEL REQUIREMENTS
Minimum fuel for dispatch: 5,000 lbs
FAA required reserve fuel: 3,500 lbs
Fuel Capacity (density of 6.7 ppg)
Main Tanks: 1386 gallons each (9286 lbs)
Center Tank: 907 gallons (6077 lbs)
Total: 3679 gallons (24,649 lbs)

AUTOPILOT LIMITATIONS
Do not use the autopilot ILS mode with an engine inoperative
Minimum altitude for engaging the autopilot is 600 feet AGL
Minimum altitude for disengaging the autopilot is 60 feet AGL

DC-9 SERIES 20 REFERENCE CHARTS

FUEL AND FLIGHT PLANNING REFERENCE

(Includes 400lbs taxi fuel and figures are based on an 80,000 lb cruise weight. Be sure to add in reserve, alternate, and holding fuel to the totals below when fuel planning.)

TRIP LENGTH (nm)	FUEL REQUIRED (lbs)	TRIP TIME	OPTIMAL ALTITUDE
100	2800	0:27	FL 220
150	3600	0:34	FL 260
200	4200	0:40	FL 300
250	4600	0:47	FL 310
300	5200	0:54	FL 320
350	5800	1:01	FL 340
400	6300	1:08	FL 350
500	7500	1:22	FL 350
600	8700	1:35	FL 350
700	9800	1:49	FL 350
800	11000	2:03	FL 350
900	12100	2:16	FL 350
1000	13200	2:30	FL 350
1100	14400	2:44	FL 350
1200	15500	2:57	FL 350
1300	16700	3:11	FL 350
1400	17800	3:24	FL 350
1500	18900	3:38	FL 350
1600	20100	3:51	FL 350

TAKEOFF EPR / N1 RPM

RAT °C	-40	-35	-30	-25	-20	-15	-10	-5	0	5	10	15	20	25	30	35	40
Sea Level	1.95	1.95	1.95	1.95	1.95	1.95	1.95	1.95	1.95	1.95	1.95	1.95	1.95	1.95	1.94	1.90	1.85
	84.3	85.2	86.0	86.8	87.7	88.5	89.4	90.2	91.1	92.0	92.8	93.6	94.4	95.3	95.8	94.8	94.0
1000 feet	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	1.98						
	86.0	86.9	87.8	88.6	89.5	90.4	91.2	92.1	93.0	93.9	93.8						
2000 feet	2.05	2.05	2.05	2.05	2.05	2.05	2.05	2.05	2.04	2.01							
	87.6	88.5	89.4	90.2	91.1	92.0	92.8	93.7	94.4	94.1							
5000 feet	2.22	2.22	2.20	2.18	2.15	2.12	2.10	2.07									
	94.0	95.0	95.4	95.2	95.0	95.0	94.6	94.5									
7000 feet	2.23	2.23	2.21	2.19	2.16	2.13	2.11	2.08									
	94.0	95.0	95.4	95.2	95.0	95.0	94.6	94.5									
Above 7000 feet	2.24	2.24	2.22	2.20	2.17	2.14	2.12	2.09									
	94.0	95.0	95.4	95.2	95.0	95.0	94.6	94.5									

DC-9-20 FLAP SETTINGS

0
SLATS
5
10
15
25
30
40
50

TAKEOFF SPEEDS

WEIGHT (lbs)	V1	VR	V2	VF	VZF	PA	PAF	QT EPR	OPT CL	BEOC
60,000	105	108	117	136	157	22	13	1.35	246	140
62,000	107	110	119	139	160	22	13	1.37	248	142
64,000	110	112	121	140	162	21	13	1.38	250	145
66,000	112	115	123	143	165	20	13	1.39	252	147
68,000	114	117	125	145	167	20	12	1.41	254	149
70,000	116	119	127	147	169	19	12	1.42	256	151
72,000	118	121	128	149	172	18	12	1.43	258	153
74,000	120	123	130	152	174	18	11	1.45	260	156
76,000	122	126	131	153	176	18	11	1.47	261	158
78,000	124	128	133	156	179	17	11	1.48	263	160
80,000	126	130	135	157	181	17	11	1.49	265	162
82,000	128	132	137	160	183	16	11	1.51	267	164
84,000	130	134	138	161	185	16	11	1.52	269	166
86,000	131	136	140	163	188	15	10	1.54	271	168
88,000	133	138	141	166	190	15	10	1.55	273	170
90,000	135	140	143	167	192	15	10	1.57	275	172
90,700	135	141	144	168	193	14	10	1.58	276	173

If over 100 degrees F or over 4,000 feet altitude, add +2 to V1 / VR

V1 = Take-off decision speed. Before V1, the pilot can abort take-off. After V1, the pilot MUST take off
VR = Take-off rotation speed at which the pilot pulls the flight controls to raise the nose and take off
V2 = Take-off safety speed to be reached before passing 35 ft above runway altitude
VF = Speed to begin flap retraction
VZF = Speed that flaps should be fully retracted
PA = Pitch Attitude in degrees
PAF = Pitch Attitude in degrees if single engine failure
QT EPR = EPR setting for noise abatement
OPT CL = Optimum climb speed from FL100 to FL280. Above FL280, use M.72
BEOC = Best Engine-Out Climb. Safety speed to maintain should an engine fail.

LANDING SPEEDS

WEIGHT (lbs)	FLAPS	VREF	VGA	VMA
60,000	40	119	124	136
62,000	40	121	126	139
64,000	40	123	128	140
66,000	40	125	130	143
68,000	40	127	132	145
70,000	40	128	133	147
72,000	40	130	135	149
74,000	40	132	137	152
76,000	40	133	138	153
78,000	40	136	141	156
80,000	40	137	142	157
82,000	40	138	143	160
84,000	40	139	145	161
86,000	40	142	147	163
88,000	40	143	148	166
90,000	40	145	150	167

FLAPS = Recommended flaps setting for landing
VREF = Speed at which the aircraft should cross the runway threshold during landing
VGA = Speed to maintain over the runway should a go-around be required
VMA = Maneuvering speed

DC-9 SERIES 20 CHECKLISTS

PRESTART

Master Battery Switch	On
Electrical	On
Anti-Collision Lights	On
Recognition Lights	On
Air Conditioning System	On
Radios	On

ENGINE START

Parking Brakes	Check
Fuel Quantity	Check
Beacons	On
Doors	Check
Air Conditioning Supply	Check
Fuel Boost Pumps	Check On
Ignition	Both
Pneumatic Pressure	Check
Fuel Heat	Set
Port Engine	Start
Starboard Engine	Start

AFTER START/BEFORE TAXI

Electrical Power	Check
Electrical Bus	Check
Ignition Switch	Off
Yaw Damper	On
Air Conditioning Temperature Switches	Check
Emergency Lights / Cabin Signs	Check
Hydraulic Pressure Indicators	Check

TAXI

Flight Instruments	Check
Taxi Lights	On
Fuel Heat	As Required
Flaps	Set Takeoff
Takeoff EPR	Set
Stabilizer Trim	Check
Flight Controls	Check
Brake Temperature	Check

TAKEOFF

Landing Lights	On
Strobes	On
Ignition	Both
Ice Protection	Check
Hydraulic Booster Pumps	On
Transponder	On
Radio Altimeter	Set

CLIMB AND CRUISE

Flaps	Full Up
Taxi Lights	Off
Landing Gear	Up
Ignition	Off
Boost Pumps	As Required
Air Conditioning Shutoff	Override
Hydraulic Boost Pumps	Off
Radio Altimeter	Check
Cabin Pressurization	Set
Passing 10,000ft - Landing Lights	Off

DESCENT

Cabin Pressure	Set
EPR Bug	Set
Hydraulic Boost Pumps	On
Passing 10,000ft - Landing Lights	On

APPROACH

Hydraulic Boost Pumps	Check On
Cabin Signs	On
Altimeters	Set
Navaids	Check
Flight Instruments	Check

LANDING

Landing Gear	Down / 3 Green
Ignition	Both
Spoilers	Auto
Annunciator Panel	Check
Landing Weight and Data	Check
Hydraulic Indicators	Check
Flaps	Set
Landing Lights	On

AFTER LANDING

Hydraulic Boost Pumps	Off
Flaps	Full Up
Spoilers	Retract
Landing Lights	Off
Strobes	Off
Ignition	Off
Anti-Ice Switches	Off
Taxi Lights	On

PARKING

Brakes	Release
Emergency Lights / Cabin Signs	Off
Air Conditioning Supply	As Needed
Taxi Lights	Off
Beacons	Off
Parking Brake	Set
Engines	Off
Flight Recorders	Off

SECURE

External Lighting	Off
Air Conditioning System	Off
Radios	Off
Electrical	Off
Master Battery Switch	Off