DELTA VIRTUAL AIRLINES

McDonnell Douglas MD-88/MD-90

Aircraft Operations Manual

2nd Edition
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Welcome

Welcome to the Delta Virtual Airlines' Aircraft Operating Manual (AOM) for the McDonnell-Douglas MD-88 / MD-90.

This AOM is based on the DVA Fleet Installer airplane. We are always seeking to improve the accuracy of this AOM.

Should you have questions about the specifics of this airplane, this manual or aviation in general, you should create a helpdesk issue at our website, www.deltva.org that states your question and we will do our best to answer your questions.

History and Overview

The Douglas Aircraft Company was one of the pioneers of American commercial aviation. After the successful launch of their first jet-powered airliner, the DC-8, Douglas (like its archrival Boeing) looked to build a smaller, short-range jetliner to bring jet service to the hundreds of smaller towns and cities that benefited from the Civil Aeronautics Board's extension of airline service across the United States in the years immediately following the Second World War.

The original design for the DC-9 was essentially a scaled down DC-8 – ironic, since today's MD-90 seats about as many passengers as the DC-8-11! By the launch of the DC-9 program in 1963, Douglas had moved to a twin tail-mounted engine configuration, like France's Sud-Aviation Caravelle. Delta Air Lines, in fact, was the launch customer for the DC-9-10, with the world's first DC-9 service from Memphis, Tennessee to Kansas City Missouri on December 8th, 1965.

Unlike the DC-8, whose original models used a single fuselage length, Douglas provided several early variants of the DC-9. The Series 30 was fifteen feet longer than the Series 10 (allowing for 105 passengers instead of 80) and was fitted with larger wings, engines and leading-edge devices for better short field performance. The rare Series 20 produced for SAS mated the performance enhancements of the Series 30 with the Series 10 short fuselage. The DC-9 was extended further into the Series 40, 50 and 80 models, with the latter seating 155 passengers – double that of the Series 10.

The MD-80 began in 1975 as a test where a standard DC-9 was fitted with improved and more efficient JT8D-200 series turbofans. McDonnell Douglas had originally proposed fitting the new engines to a development of the DC-9-55.

Instead, they combined the new engines with a stretched fuselage, increased wing span and other improvements into a new program. On October 20th of 1977, McDonnell Douglas announced the start of its 'Super 80' program. The MD-80 designation however is a generic designation for the series and does not apply to a certain model type. This upgraded and modernized aircraft was to be a full 40 feet longer than the DC-9-10

and include an updated cockpit.

The first flight of a prototype MD-80 was flown in October of 1979, followed by the first delivery, made to Swissair less than a year later. The MD-80 series continued, with the first MD-82 delivered in 1981 and the first MD-83 (formally called the DC-9-80 'Super 80') in 1985. Although sales of the Super 80 were sluggish initially, American Airline's order for 67 MD-82s (with options for an additional 100) in early 1984 gave the program its much needed push. The MD-88, complete with an EFIS flight deck, redesigned cabin interior and other improvements, made its first flight in August of 1987 and saw delivery to Delta Airlines on January 5th, 1988. Despite its slow start, the MD-80 program became a huge success leading to its milestone 1000th delivery in March of 1992.

On November 14th of 1989, McDonnell Douglas launched its MD-90 program, which was fitted with Rolls-Royce/BMW IAE V2500 turbofans. The MD-90 can seat over 170 passengers, with a range of approximately 2,600 miles. Delta Airlines worked very closely with McDonnell Douglas in the development and launch of this stretched version. Speaking on the subject, Ronald W. Allen (Delta President and CEO) said "The MD-90 is an aircraft designed for Delta's future. From the start, we participated in writing the specifications for this aircraft in anticipation of where our industry and our company are headed." Delta was ultimately the launch customer for the MD-90, with the first being delivered on February 24th of 1995.

The end of the MD-80 program came in 1997, after the merger of Boeing and McDonnell Douglas. Boeing announced its decision to drop the MD-80 and MD-90 once current orders were fulfilled. An April 1998 order for 24 MD-83s from TWA, would keep the MD88 in production until January 2000.

Power Plant

As is to be expected with an aircraft whose commercial service spans several decades, the MD-88 and its ancestors are powered by a variety of different turbofan engines.

The Pratt & Whitney JT8D-208 was the original engine type available on the MD-80 and MD-81. Each engine produced roughly 18,500 pounds of thrust for a combined thrust of just over 37,000 pounds. The JT8D-208 burns, on average, 1,050 gallons of jet fuel per hour on a typical flight.

The Pratt & Whitney JT8D-217 allowed greater operational capabilities including increased high altitudes and hotter weather flight. These engines produced 20,000 pounds of thrust per engine. This also increased the operational weight of the airplane. These were found on the SUPER 82 or MD-82

When the MD-83 (DC-9-83) variant was produced – the long-range version was equipped with 21,000 lb thrust **JT8D-219 engines**. They continued to be placed on the MD variants up until the MD-90 series.

The MD-90 was outfitted with the newer 26,000 pound thrust **V2500**, as well as the edition of glass cockpits. The MD-90-30 was outfitted with the newer 28,000 lb thrust **V2528-D5**

Specifications

The chart below displays technical specifications of the MD-80/90 variants in use at Delta Virtual Airlines.

TYPE	MD-88	MD-90
DIMENSIONS		
Length	147ft 8in	152ft 6in
Height	29ft 6in	30ft 6in
Wingspan	107ft 8in	107ft 8in
Wing Area	1,270 Sq Ft	1,270 Sq Ft
POWERPLANTS		
Engine Type Maximum Rated Thrust	TWO JT8D-217A 20,000 lbs each	Two V2528-D5 28,000 lbs each
WEIGHTS		
Empty Weight	77,976 lbs	88,000 LBS
Maximum Takeoff Weight	149,500 lbs	153,000 lbs
Maximum Landing Weight	128,500 lbs	136,500 lbs
Zero Fuel Weight	122,000 lbs	131,000 lbs
CAPACITY		
Maximum Fuel	5,779 US Gal	5,846 US Gal
Max Seating	172	152
Cockpit Crew	2	2
Maximum Payload	34,150	39,140
OPERAIONAL LIMITS		
Service Ceiling	FL350	FL370
Normal Cruise Speed (FL300)	M.80 472 kias	M.80 458 kias
Maximum Range	2,372 NM	2,085 NM
Takeoff Distance (Max Takeoff weight)	6,100 ft	6,100 ft
Landing Distance (Max landing Weight, Flaps 25)	4,690 ft	4,690 ft
Flaps up Stall Speed (Max landing Weight)	155 kias	149 kias
Flaps 30 Stall Speed (Max landing Weight)	118 kias	112 kias
Maximum Indicated Airspeed (FL300)	M.84 495 kias	M.84 481 kias

COCKPIT IN FS2004

Here are detailed pictures of the FS2004 MD-88 cockpit. This is an expanded cockpit layout that covers everything in the aircraft cockpit. You should refer to this for cockpit familiarization.

MAIN PANEL

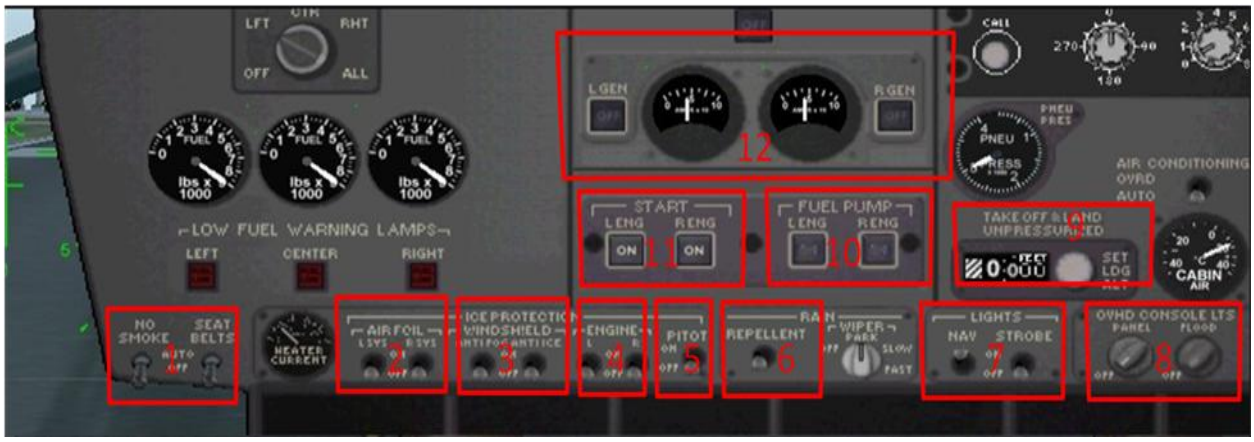
The main panel contains most of what is needed to fly the aircraft successfully.

1. Pilot's Heads-Up-Display (HUD)
2. Mode Control Panel (MCP). Manages the Autopilot system and HUD on/off
3. Altitude Indicator (V Speeds are adjustable – explained later)
4. Radio Distance Magnetic Indicator (RDMI)
5. Digital Navigational Display (HSI)
6. Attitude Indicator
7. Autopilot Information panel.
8. Altimeter
9. TCAS (Traffic Collision Avoidance System) Display (Turned on using the RADIO toggle switch below the RDMI –additionally brings up COM1/ADF1/NAV/and Transponder selections}
10. DME readout/trim degree readout
11. EGT / N1 / N2 / Fuel Flow Information
12. Fuel Temp/Oil Pressure, Temp, Quantity/Hydraulic Pressure, Quantity/Flaps/Slats

13. Fuel Quantities / Tantalizer / Gross Weight

Overhead Panel

The overhead panel contains additional controls for other aircraft systems. Again, because there is an extensive manual for this aircraft, we'll only point out key area but will not cover their operation.



1. NO Smoking and Seat Belts
2. Airfoil Anti-Ice
3. Windshield Anti-Fog and Anti-Ice
4. Engine Anti-Ice LEFT and RIGHT
5. Pitot Heat ON/OFF
6. Windshield Rain Repellent
7. LNAV and STROBE Light toggle
8. Overhead Console Lights
9. Cabin Pressure Setting
10. Left and Right Engine Fuel Pumps
11. Left and Right Engine START switches
12. Left and Right Engine GENERATOR switches

TCAS and Radio Panel

The TCAS (Traffic Collision Avoidance System) and Radio Control panel contains a few controls that the pilot needs to be familiar with.

1. TCAS Test and Transponder Mode select. When you left click, knob turns left and you will hear the TCAS SYSTEM TEST OK message. Click right, knob turns right through settings (Standby, On, Traffic Advisory, Traffic Advisory and Resolution Advisory).
2. Where you set your actual Squawk Code when given by ATC
3. TCAS scan mode and distance (6 – 40nm)
4. PRIMARY and ALTERNATE COMM 1 radios
5. Clicking on VHF1/VHF2/ADF and COM will allow you to change frequencies in the PRIMARY and ALTERNATE frequency box above

TRAFFIC COLLISION AVOIDANCE SYSTEM (TCAS)

1. Cycles the TCAS mode between the modes TEST, STBY, XPDR, TA and RA
2. Cycles the TCAS forward range between 6, 12, 18, 24, and 40nm
3. Cycles the TCAS vertical range between BLW (Below), N (Normal) and ABV (Above)
4. Toggles the TCAS between Relative (two digits), and Altitude (three digits)

HUD – Heads-up-Display

The Heads up Display provides the pilot with critical flight information without having to look down at the main panels. This system is very useful, especially during takeoffs and landings.

1. This is your KIAS (Knots Indicated Airspeed)
2. Your Artificial Horizon Line as well as your velocity vector
3. MSL Altitude (Mean Sea Level)
4. This is your Radar Altimeter (AGL – Above Ground Level)
5. This is your heading indicator and your angle of bank indicator
6. Your Mach speed, and your method of navigation (NAV/GPS)

COCKPIT IN FSX

Here are detailed pictures of the FSX MD-88 cockpit. This is an expanded cockpit layout that covers everything in the aircraft cockpit. You should refer to this for cockpit familiarization.

MAIN PANEL

The main panel contains most of what is needed to fly the aircraft successfully.

1. Airspeed Indicator
2. Standby Navigation (ADF1 and 2 / VOR1 and 2)
3. Attitude Indicator / Digital Informational Display
4. Digital Navigation Information Display (HSI)
5. TCAS Warning System Indicator
6. ACARS Status Panel
7. Altitude Indicator / Altimeter Control
8. Autopilot Display Panel
9. Flaps Position Indicator

10. Autopilot Control / Navigation Control / Default Icon Panel / Light Control
11. Flight Director Panel / Marker Indicator
12. Standby Attitude Indicator and Approach FD Bars / Chronograph
13. Transponder Control Panel
14. Engine Instrument Panel / Fuel QTY Panel
15. Fluid Pressure / Temp Panel / Flap Position Indicator
16. VOR Selection / Barometer Selection
17. Mini-Panel Throttle Quadrant / Fuel Cutoff
18. Overhead control panel (Lights / Pitot Heat / Engine start position)

Flying the aircraft – Tutorial

The purpose of this tutorial is to familiarize the pilot with the operation of the Delta Virtual Airlines fleet MD-88. The starting point will be in a 'cold and dark' cockpit parked at the gate. We will also assume fuel planning and loading is complete – see the Fuel Planning section of this manual for detailed fuel planning and loading guidance.

Because the MD-88 is a Stage 2 aircraft, we will assume a certain level of competency in the pilot and thus will not go into detail with basic procedures such as communicating with ATC, determining taxi routes or runways to use. By this time, you should be able to do these tasks.

Let's get started. Load your flight simulator with the fleet MD-88. Make sure appropriate payload and fuel loading is complete using the Flight Simulator fuel and payload menus. Please note that the Fleet MD88 does not have a "Cold and Dark" setting. If you use CTRL-SHIFT-F1 to completely turn off the engines, and then from the overhead panel, turn off the battery – that is as close to "Cold and Dark" as you will get. When the overhead panel press marks show the words OFF – that means that that function is OFF. When you press those buttons and the text darkens – that means they are ON or running.

At this point you should be in the aircraft at the Captain's "Main" panel. Before applying power to the aircraft certain safety checks must be completed.

Main Panel

1. Gear Handle DOWN
2. ALTN FLAPS OFF
3. F/D OFF
4. A/T ARM OFF
5. Autopilot Panel RESET switch PRESS
6. Field Elevation checked and SET
7. FLAPS UP
8. Throttles CLOSED

9. PARKING BRAKE SET

10. SPEED BRAKES DOWN (Closed)

Overhead

1. BATTERY ON PRESS

2. NAV Lights ON

3. LEFT/RIGHT GEN PRESS ON (the two are linked to each other)

4. RIGHT FUEL PUMP PRESS ON

If you are flying online, obtain your ATC Clearance. Now that we have our clearance and should know the departure runway and set for Pushback

Before we actually push let's make sure we are ready.

1. Verify Altimeter set

2. Verify V speeds have transferred to the PFD

3. IAS/MACH Set to 250 or lower as dictated by the departure procedure

4. Set Initial Altitude

5. Set Initial Speed

6. F/D ON

7. BEACON ON

The aircraft is now ready for pushback and engine start. If flying online with ATC, obtain push pack and engine start clearance. Now, release the parking brake and pushback using the method you prefer. When the push back is complete, set the parking brake. Once stopped and the brake is set, it is time to start engines.

1. LEFT/RIGHT GEN PRESS ON (the two are linked to each other)

2. RIGHT FUEL PUMP VERIFY ON

3. RIGHT ENG START PRESS and hold until N1 reaches 4.5% then release
4. Wait until ENG idles between 32% and 34% N1 and EGT less than 350 degrees before starting left engine.
5. LEFT FUEL PUMP PRESS ON
6. LEFT ENG START PRESS and hold until N1 reaches 4.5% then release
7. Wait until ENG idles between 32% and 34% N1 and EGT less than 350 degrees.

Overhead

1. No Smoking Sign ON
2. Seat belt Sign AUTO

When both engine indications are stable, return to the Overhead panel and complete these items:

1. Set Anti Ice as needed
2. Ensure PITOT heat is ON

Return to the main panel and set:

1. A/T ARM to ON.
2. Set flaps for takeoff (normally 10º)
3. If flying with ATC, obtain taxi clearance.
4. Turn on the taxi lights if needed.

Advance the throttles to start moving (ensure engines are synced and move as one) using only enough power to get the job done. At max. gross weight this will require about 47% N_1. Taxi the aircraft to the departure runway. Remember straight ahead taxi speeds should not exceed 30 knots ground speed and turning speeds should not exceed 10 knots ground speed. In heavy weight

situations sharp turns should be made in the 6 to 8 knot speed range or the nose wheel will become ineffective. Further, use of nose wheel steering cannot be simply "hard over" At any speed a full deflection turn will cause the nose wheel to skid. The result is the aircraft continuing straight ahead. If you get into the skid center the nose wheel and reapply the turn command but not as aggressively.

Once at the runway obtain your takeoff clearance if flying on line. Once cleared complete these tasks.

1. Strobe Lights ON
2. TAXI Lights OFF
3. LANDING Lights ON
4. Transponder set to TA/RA

Taxi onto the runway and line up on the centerline. Use as little runway as possible during line up if you are in a heavy weight condition. Once aligned, set the brakes and advance the throttles to about 60% N_1. Verify engine response and release brakes. Click the TO/GA to set takeoff power. Maintain runway alignment and monitor engine performance during takeoff roll. Monitor your speed and at Vr apply back pressure and smoothly rotate to an approximate 8 degree nose up attitude - **Tail strikes may occur at pitch angles greater than 10.5 degrees if the aircraft has not lifted off.**

Rotation rate should be about 3 degrees per second. Maintain this attitude until liftoff. Continue rotation to achieve and hold a speed of V_2+10 knots. V_2 at Max Gross takeoff weight is about 188 knots. Your target speed after liftoff will be about 170 KIAS. Once a positive rate of climb is established and the altitude has increased beyond 150' AGL, retract the gear. Once a positive rate of climb is established and the gear is up, set Autopilot to ALT and adjust the climb rate to maintain an initial climb rate speed at V_2+20. When passing 1500 feet, the "acceleration altitude", adjust the rate of climb to allow for a reasonable rate of speed increase (around 240 knots) and while maintaining good rate of climb of at least 1500 FPM.

Maintain these conditions while allowing the speed to build to what is necessary to comply with any departure restrictions. Retract the flaps prior to accelerating past 200 knots. As your speed stabilizes at the target speed, you can increase the rate of climb. Don't be too aggressive or your speed will decay. Continue your climb out complying with any departure restrictions. Upon reaching 10,000 feet MSL, turn landing lights off and accelerate to between 290 and 300 KIAS.

The landing lights will cause noise and a vibration if left extended over 250 knots. Initial acceleration should be performed through a combination of increased thrust and decreased climb rate (to approximately 1,200 fpm).

At 18,000 feet MSL (transition altitude), the altimeter should be set to standard pressure (29.92)

At approximately FL230 (23,000 feet), set Mach to .72 or .74 and continue climb to assigned altitude.

Congratulations, you are now in the cruise phase. As you progress along your route and the fuel burns off, step-climbs may become appropriate it is up to you as the pilot to account for those flight adjustments.

To execute a step-climb in the MD88 you reset your cruise altitude to your new value. The A/P *should* execute the climb to the new altitude automatically. Since the Fleet MD88 does not have VNAV, you will have to adjust your target speed.

Set cruise speed. Typical cruise speeds are between Mach 0.76 and Mach 0.80. Delta Virtual Airlines typically suggests an economy cruise speed of Mach 0.76.

Continue this process until you near your destination. When approximately 200 miles from your destination obtain the current weather and determine the landing runway. Yes, you selected a landing runway during preflight but weather does change especially on a long flight. And since the MD88 does not have an FMC, you will have to compute the descent profile manually.

When not under ATC control, descent from cruising altitude should be commenced approximately 70 nm from the destination or desired Top of Descent (TOD) point. A good rule of thumb to use is as follows: Calculate the number of feet between your cruising altitude and 10,000, divide by 1,000 and multiply by three. For example, descent from FL290 to 10,000 feet MSL is:

(19,000 / 1000) x 3 or **(19 x 3) = 57**, and will therefore take 57 miles.

When you reach your initial descent point, enter the target altitude, and the aircraft will enter an idle power descent at the current target speed (with Auto Throttle set) The aircraft will not level off at any intermediate altitudes unless you adjust your descent profile manually – the same holds true for the speed.

If you choose to use SPD and V/S to manage your descent follow the process for climb out but in reverse. Use an enroute descent speed of 300 KIAS and you can set the vertical speed a desire as long as you meet and altitude restriction.

At 12,000 feet MSL or where specified when following a STAR, reduce descent rate and decelerate to 250 KIAS. **Never exceed 250 KIAS below 10,000 feet. Violation of this rule on the MD-88 check ride is an automatic failure.** Furthermore it is company policy to turn on the landing lights when below 10,000 feet.

We will assume you are flying an ILS approach. Continue your arrival towards the Initial Approach Fix (IAF). A good rule of thumb is to deploy FLAPS 1 when slowing thru 200 KIAS. You will see a vertical line of red dots in the airspeed section of the PFD.

Short runways or heavy weight may call for a FLAPS 30 landing.

The use of speed brakes is left completely to the discretion of the pilot. The MD-80's speed can sometimes be difficult to keep under control. Always stay ahead of the aircraft.

Set the ILS approach frequency and course setting.

Extend flaps according to planned schedule. Flaps can be extended at 280 KIAS. Speed brake extension is NOT authorized with flaps or gear extended. Keep in mind that the primary functions of the flaps are for added lift at lower speeds and not to slow the aircraft.

Decelerate to about 210 KIAS on downwind leg (long final).

Decelerate to about 185 KIAS on base leg.

Once established on the localizer, set the autopilot with the missed approach heading and altitude information. Even if you are performing a visual approach, the instrument approach information should be set up, if available, as a backup.

Decelerate to about 155 KIAS and flaps 15. A note about visibility...This is a tall aircraft with a large panel. It may be necessary to make adjustments to see the runway in a landing configuration. Possible actions include

1. Resizing the panel (FS9 only)

2. Adjust your viewpoint (FS9 only) (SHIFT-DEL or SHIFT-ENT for up and down)

3. Switching to the mini panel using the "W" key.

Call for Gear Down when the glide slope indicator is a tick and a half above intercept.

Decelerate to about 140 and flaps 40.

Complete final approach check lists.

Disengage the autopilot unless performing an auto land or if conditions do not allow you to do so.

Receive landing clearance. If landing clearance is not received prior to reaching the decision height, you MUST declare a missed approach. A missed approach must also be declared if visual confirmation of the field has not been established upon reaching the decision height.

Touchdown should be at between 130 and 140 KIAS.

Smoothly move throttle levers to idle and flare for landing. Excessive airspeed can sometimes result in the aircraft "floating" above the runway.

Once the main gear contacts the ground, smoothly lower the nose, engage reverse thrust and spoilers. Note: rudder control greatly diminishes once reverse thrust is engaged. Also take care not to "slam" the nose gear down on the runway as this may cause major structural damage to the aircraft.

Disengage reverse thrust at 60 knots and continue wheel braking.

Exit the active runway at the first possible taxiway. You can conduct a high-speed taxi at no more than 25 knots (utilize the GPS for accurate speeds while taxiing). Normal taxiway speed is <15 knots.

Turn off landing lights and white strobe lights.

Squawk standby.

After off the runway:

1. Strobes OFF
2. Landing Lights OFF
3. Taxi Lights ON as needed
4. Transponder STBY
5. Flaps up

If ATC is present, obtain your taxi clearance and taxi to the gate using the same procedures you did on the way out. Once at the gate:

1. Overhead
2. GEN to ON
3. Taxi Lights OFF if used
4. Fuel Pumps OFF
5. BEACON OFF

Congratulations. You have completed a full flight in the Maddog. Yes, he is a small bird but sweet and to the point. You are now ready to handle any flight you desire, long or short...within range!

Fuel Planning and Weight and Balance

Fuel Planning is covered in the Flight Encyclopedia, 5th Edition.

Altitude	Indicated Airspeed	True Airspeed	Fuel Burn (per Engine)
Ground Operations	N/A	N/A	800 PPH
12,000'	280 KIAS	347 KTAS	1600 PPH
FL180	290 KIAS	394 KTAS	1800 PPH
FL240	290 KIAS	429 KTAS	1700 PPH
FL300	280 KIAS	448 KTAS	1500 PPH
FL360	270 KIAS	464 KTAS	1600 PPH
*9,000			

FUEL PLANNING

Delta Virtual Airlines' MD-88 and MD-90 have three fuel tanks, center, left and right. Each main tank has a capacity of 1383 gallons (18,532 lbs) of fuel, and the center tank has a capacity of 3,074 gallons or 20,596 lbs for a total of approximately 39,128 lbs (payware versions may vary from the DVA Installer version). With a full load of fuel the MD-88 is capable of flying close 2,700 nautical miles. Although the aircraft is capable of flying these distances, it is not always safe to do so.

In order to calculate the proper amount of fuel required for a trip, use the following given numbers:

Average Fuel Burn Rate Factor: **13.35 lbs/nautical mile**

Fuel Base Amount (standard): **7,500 lbs**

Taxi Fuel (standard): **450 lbs**

Contingency (standard – To cover any unexpected deviations): **650 lbs**

Final Reserve (45 minutes at 1500 feet above alternate): **Approx. 4,500 lbs**

With these standard numbers, we can begin to calculate our total fuel needed with this additional variable:

Alternate (fuel from destination to alternate): (Alt Distance * Fuel Burn Factor)

With that initial calculation complete, we can calculate our total fuel using the following formula:

(Fuel Base Amount + Taxi Fuel + Contingency + Final Reserve + Alternate + (Distance * Fuel Burn Factor))

As an example, for a 300 nautical mile flight leg with a 100 nautical mile alternate, the Fuel Loading Formula would be:

Fuel Base - **7,500 lbs**

Taxi Fuel - **440 lbs**

Route Fuel - **8,505 lbs**

Contingency - **650bs**

Alternate - **1,335 lbs**

Final Reserve - **2,000 lbs**

Total Fuel - 20,430 lbs

CAPACITIES

Left – 1,383 Gallons

Center – 3074 Gallons

Right – 1,383 Gallons

Fuel loading procedure

Follow the fuel loading procedure and keep in mind that if there is more fuel left over after loading a step in this process, proceed to the next step.

1. Load the left, left aux, right and right aux evenly.
2. Next add fuel to the center tank until total fuel required for flight is met).
3. To load fuel into your aircraft from the FS menu, select "Aircraft", then "Fuel" and place the correct fuel amounts in the correct tanks.
    a. Fuel should first be loaded into the wing tanks, with the remaining fuel loaded in the center tank.
    b. Conversely, the center tank fuel should be used first during a flight. Also note that a 1,000 lbs minimum fuel load must be loaded in the center fuel tank for all flights to prevent static ignition of fumes within the fuel tank. Some payware panels provide other refueling options as well. Feel free to utilize the method you feel most comfortable with.
4. Captains ordering fuel for Delta Virtual Airlines flights should remember that more fuel equates into a higher overall weight, requiring more power. An unnecessary overabundance of fuel will only cost the company money. Fuel should be kept as close to the trip fuel required as possible. With that said, it is always the pilot's responsibility to ensure that there is enough legal fuel for the flight. Any incident that was the result of miscalculating the fuel load will always be the fault and sole responsibility of that flights captain and crew. When in doubt, take more.

Checklist

AT GATE PARKED-BEFORE ENGINE START

- All Charts/Flight Plan — **On Board**
- Weight/Balance — **Verify** Configuration
- ACARS *(Optional)* — Connect-Flight Start (Optional)
- Battery Switch — **ON**
- Gear Lever — **VERIFY** 3 Green Down/Locked
- Clock/Stopwatch — **VERIFY** SET
- Parking Brake — **ON**
- Alternate Flaps & Gear Selector — **SET**
- NAV lights — **ON**
- Fuel Pumps (ALL) — **OFF**
- Wing Anti Ice — **OFF**
- YAW DAMPER — **ON**
- Cabin Altitude Auto Selector — **NORM**
- NAV Radios — **SET IDENT**
- ADF — **SET IDENT** (if required)
- Transponder — **SET** Code/**VERIFY** Squawk Standby
- Auto Brakes — **RTO**
- Speed Brake Lever — **DOWN**
- FLAPS — Lever and Indicator **AGREE**
- Passenger Signs — **SET**

ATC CLEARANCE - Call for IFR/VFR Departure-Push/Start Request

- Avionics Master — **OFF**
- Crew Takeoff Briefing — **Completed**
- BEACON Lights — **ON**

-BEFORE ENGINE START CHECKLIST COMPLETED

ENGINE START

ATC Clearance: Obtain pushback and engine start clearance

Execute Pushback using method/tool of your choice
When pushback complete:

- Parking Brakes — **Verify** ON
- Simulator time at start — **Document**
- Fuel Pumps (All Tanks with Fuel loaded) — **ON** Press Lights out
- Throttle Power Levers — **IDLE**

Normal Engine Start Sequence is RIGHT/LEFT
Engines may be started two at a time

○ Engine Start Switch RIGHT	**PRESS AND HOLD**
○ N1	**Monitor** Start
○ Engine indications Stable	Engine Start Lights out
○ Engine Start Switch LEFT	**PULL** Lights illuminate
○ N1	**Monitor** Start
○ Engine indications Stable	Engine Start Lights out

ENGINE START CHECKLIST COMPLETED

AFTER ENGINE START

○ Parking brakes	**Verify** ON Switch OFF then ON
○ Anti-Ice / All	**ON** as required
○ APU	**OFF**
GEN CONT switches (ALL)	Verify **ON** If Gen is in a Fault status, Cycle switch OFF then ON
○ Flap Selector Set Takeoff Flaps	**SET**
○ MCP Heading	**SET** (Runway Heading or DP)
○ MCP IAS	**SET V2+20 (SPD)**
○ Altitude	**SET (ALT)**
○ F/D	**ON**
○ A/T	**ARMED**
○ Autopilot DISENGAGE	**VERIFY OFF**
○ Flight Controls (outside)	**Demonstrate** Free and Clear

AFTER ENGINE START CHECKLIST COMPLETED

TAXI

ATC TAXI CLEARANCE – Request Taxi to Active Runway

○ Throttle Power Levers	**IDLE**
○ Parking Brakes	**Release**
○ Toe Brakes	**Verify** OPS
○ Taxi Power	45% N1 until rolling – adjust for Speed (Max 30 Straight, 10 Turn)
○ Instrument Check-Taxi	**Verify** Compass/PFD/ND move
○ Cabin Announcements	**Perform** during Taxi

BEFORE TAKEOFF/HOLD SHORT LINE

○ Parking Brakes	**ON**
○ Flight Director	**Verify** ON
○ MCP Heading	**VERIFY** Departure Heading
○ V/S	**CHECK CLIMB RATE**
○ Landing Lights	**ON**
○ Taxi Lights	**OFF**
○ Strobe Lights	**ON**
○ Takeoff time & Fuel Amount	**DOCUMENT**
○ Flap Selector & Trim	**VERIFY** Settings
○ COM's, NAV's & ADF	**VERIFY** Settings
○ Transponder	**TA/RA**

ATC Takeoff CLEARANCE – Request for Takeoff
BEFORE TAKEOFF CHECKLIST COMPLETED

TAKEOFF CLEARED OR TAXI INTO POSITION AND HOLD

○ Runway	**VERIFY** Clear
○ Toe Brakes	**ON**
○ Auto Brakes	**Verify** RTO
○ Taxi Onto Runway	**ALIGN**
○ Throttle Power Levers	**Advance** 50% N1
○ Engine Instruments	**VERIFY** stabilized
○ Toe Brakes	**Release**
○ Throttle Power Levers	**Advance** full power
○ MCP TO/GA	**SELECT**
○ Vr	**Rotate** to 8 degree pitch up
○ Landing Gear	**UP** at V2 Positive Rate & 150' AGL
○ Climb Profile	2,000-2,500 FPM at 250 KIAS
Flap Selector	**Retract on schedule**
▪ Auto Brakes	**OFF**
▪ CMD	**SELECT** (any)

TAKEOFF CHECKLIST COMPLETED

CLIMB TO ALTITUDE

○ Engine Instruments	**MONITOR**
○ Landing Gear (after flaps up)	**OFF**
○ Landing Lights (10,000 ft)	**OFF**
○ Crossing transition altitude (18,000 ft MSL in USA, other countries vary)	**Reset** Altimeter to 29.92 in.

ENROUTE

○ Flight progress, fuel flow and engine operations	**MONITOR**
○ Cruise Speed	**Mach .80** @ FL300 and above
○ Crew Approach Briefing	**Completed**

ENROUTE CHECKLIST COMPLETED

DESCENT

ATC Descent CLEARANCE or TOD (Top of Descent) - Descend

○ Weather	**OBTAIN**
○ Arrival and Landing Information	**VERIFY**
○ MCP Altitude	**RESET** within 40 NM TOD
○ Anti Ice	**ON** as needed
○ Landing Airport altimeter (below transition altitude)	**SET**
○ Airspeed 280 KIAS till 10,000 ft MSL	**VERIFY 2,500 FPM descent**
○ Airspeed 250 KIAS below 10,000 ft MSL	**VERIFY 1,500 FPM descent**
○ Flight Spoilers	**AS NEEDED**
○ Landing Lights (crossing 10,000 ft MSL)	**ON**

APPROACH

ATC Approach CLEARANCE - Approach

○ COMM Frequencies	**SET**
○ Navigation Radios	**SET** Freq/**IDENT**
○ Flap Selector	**SET** per schedule
○ MCP SPEED	**SET** per speed chart
○ DH/MDA	**SET**
○ Auto Spoilers	**ARMED**
○ Auto Brakes	**SET**
○ APP Mode (IF ILS approach)	**ARM**

FINAL APPROACH

○ MCP SPEED	**Set**
○ Flap Selector (25° or 30°)	**SET**
○ Landing Gear	**DOWN**
○ Stabilized Approach	**Established**

APPROACH CHECKLIST COMPLETED

ATC Landing CLEARANCE – to Land

○ Cross Threshold	**ON SPEED**
○ Throttle Power Levers	**50' GND IDLE**
○ FLARE (increase pitch 3 degrees)	**30' AGL**
○ SPOILERS after touchdown)	**VERIFY Extended**
○ Engine Reverse	**Reverse** > 80 KIAS (F2 Key)
○ Toe Brakes (If no auto brake)	**APPLY**

Exit high-speed taxiways at <30 knots, or 8-12 knots at any other runway turn off

LANDING CHECKLIST COMPLETED

AFTER LANDING

ATC Taxi CLEARANCE – to gate

○ Transponder/TCAS	**STANDBY**
○ Landing Lights	**OFF**
○ Strobe Lights	**OFF**
○ Taxi Lights	**ON**
○ Flap Selector	**UP**
○ Spoilers	**VERFIY Retract**
○ APU GEN	**ON**

AFTER LANDING CHECKLIST COMPLETE

GATE SHUTDOWN

○ Parking Brakes	**ON**
○ Taxi Lights	**OFF**
○ Anti Ice	**OFF**

Record the fuel in tanks and compare to fuel plan

○ SEAT BELT Signs	**OFF**
○ Doors	**OPEN**
○ Fuel Pumps (all)	**OFF**
○ Beacon	**OFF**
○ F/D	**OFF**
○ A/T	**OFF**
○ Navigation/Panel Lights	**OFF**
○ Gen – ALL	**OFF**
○ Battery	**OFF**
○ Simulator Time at Shutdown (if you are flying online, note the real world time)	Document
▪ ACARS Shutdown (optional)	End Flight, File PIREP
▪ Exit Flight Simulator	

Crew Briefing

TAKE-OFF

Captain to Co-pilot

We will be taking off on RWY (active runway), climbing to (altitude). If we encounter an engine malfunction, fire or other emergency before **V_1** (critical engine failure recognition speed) KIAS, the flying pilot will retard the throttles to flight idle and bring the aircraft to a complete stop on the runway. The non flying pilot will notify the proper ATC of our intentions and assist the flying pilot as requested or needed to operate the aircraft in a safe manner.

If the aircraft has reached **V_r** (rotate speed) KIAS, the flying pilot will fly the aircraft per company procedures and the non flying pilot will notify the appropriate ATC of our intentions and assist the flying pilot as requested or needed to operate the aircraft in a safe manner and land the aircraft as soon as possible.

Aircraft Weight is: _____ Taxi Instructions to Active: _____

V Speeds for this flight are (calculated) See prepared Flip Chart(s)

Flap Settings: Takeoff _____ Engine Failure Approach _____

Discuss the Departure Procedures for this flight (Ref Charts, SIDs)

Discuss Weather considerations (Ref ATIS, METAR, TF)

CREW APPROACH/LANDING BRIEFING

Captain to Co-pilot

Weather conditions are (obtain from ATIS, METAR and TAF).

Landing on RWY (active runway) at (airport) using the (**???**) approach (Ref STAR)

Descend at (**???**). Our Final Approach altitude will be (**???**)

V Speeds for this approach are (calculated) (See prepared Flip Chart(s))

Missed approach Procedures are (Ref Approach Plates)

Taxiway Turnoff _____ Taxi Route from Active _____

Parking at Gate (???)

CREW ANOUNCEMENTS

- Departure
    - "Ladies and gentlemen, on behalf of the flight crew, this is your (captain or first officer) (insert name), welcoming you aboard Delta Virtual Connection flight number (flight) with service to (destination). Or flight time today will be approximately (time en route) to (destination). At this time, I'd like to direct your attention to your to the monitors in the aisles for an important safety announcement. Once again, thank you for flying Delta Virtual Connection."

- Climbing above 10,000 feet MSL
    - Inform cabin crew that use of approved electronic devices is authorized.

- At Cruise Altitude
    - "Ladies and gentlemen, this is the (Captain or First Officer) speaking. We've reached our cruising altitude of (altitude). We should be approximately (time) enroute and expect to have you at the gate on time. I've turned off the fasten seatbelt sign, however, we ask that while in your seat you keep your seatbelt loosely fastened as turbulence is often unpredicted. Please let us know if there is anything we can do to make your flight more comfortable, so sit back and enjoy your flight."
- Approach
    - Inform cabin crew of approach and to discontinue use of electronic devices.

- Landing
    - "On behalf of Delta Virtual Connection and your entire flight crew we'd like to welcome you to (destination) where the local time is (time). We hope you've enjoyed your flight with us today and hope that the next time your plans call for air travel, you'll

Appendix – Operating Information

TAKEOFF AND LANDING CARD

MCDONNELL-DOUGLAS MD-88					
114,000 LBS					
Takeoff					
Flaps 11		**Flaps 15**			
V_1	120	**V_1**	118		
V_r	127	**V_r**	125		
V_2	136	**V_2**	134		
Landing					
Flaps	**0**	**11**	**15**	**28**	**40**
Maneuvering	219	150	147	137	132
V_{ref}	X	X	X	128	123
V_{app}	X	X	X	131	129

In this example, 114,000 lbs is the gross weight of the airplane – there are 2 flap settings for takeoff.

TAKEOFF SPEEDS

The chart below should serve to provide a guideline for proper takeoff speeds using Flaps 15. Slightly higher speeds should be used for Flaps 11.

TAKEOFF SPEEDS FLAPS 15								FLAPS 11	
WEIGHT (lbs)	**V1**	**VR**	**V2**	**FR**	**V1**	**VR**	**V2**	**FR**	**SR**
90,000	100	108	119	134	102	110	121	134	157
92,000	101	110	120	135	104	111	122	135	159
94,000	103	111	121	136	105	113	123	136	160
96,000	104	113	123	138	107	114	125	138	162
98,000	106	115	124	139	108	116	126	139	163
100,000	107	116	125	140	110	117	127	140	165
102,000	109	117	126	141	111	118	128	141	167
104,000	110	118	128	143	113	120	129	143	168
106,000	112	120	129	144	114	121	131	144	170
108,000	113	121	131	146	116	123	132	146	171
110,000	115	122	132	148	117	124	133	148	173
112,000	116	123	133	148	118	125	134	148	175
114,000	118	125	134	149	120	127	136	149	176
116,000	119	126	135	150	121	128	137	150	178
118,000	121	128	136	151	122	129	138	151	179
120,000	122	129	137	152	124	130	139	152	181
122,000	123	130	138	153	125	132	140	153	182
124,000	125	131	139	154	127	133	141	154	184
126,000	126	132	141	156	128	134	142	156	185
128,000	127	134	142	157	129	135	144	157	187
130,000	129	135	143	158	131	136	145	158	188
132,000	130	136	144	159	132	138	146	159	189
134,000	131	137	145	160	133	139	147	160	191
136,000	133	139	146	161	135	140	148	161	192
138,000	134	140	147	162	136	141	149	162	194
140,000	136	141	148	163	138	142	150	163	195
142,000	137	142	150	165	139	143	151	165	196
144,000	138	143	151	166	140	145	152	166	198
146,000	140	144	152	167	141	146	154	167	199
148,000	141	146	153	168	143	147	155	168	201
150,000	143	147	154	169	144	148	156	169	202

V1 – Takeoff decision. Before V1, the pilot can abort takeoff. After V1, MUST take off
VR – Rotation speed at which the pilot raises the nose and departs the runway
V2 – Takeoff safety speed to be reached before passing 35 ft above runway altitude
FR – Speed to begin flap retraction
SR – Speed that flaps and slats should be fully retracted.

MINIMUM MANEUVERING AND LANDING SPEEDS

MINIMUM MANEUVERING FLAP / SLAT							LANDING		LANDING	
WEIGHT (lbs)	**0 RET**	**0 EXT**	**11 EXT**	**15 EXT**	**28 EXT**	**40 EXT**	**FLAPS**	**VREF**	**FLAPS**	**VREF**
86,000	190	148	130	128	119	115	28	111	40	107
88,000	192	150	132	130	121	117	28	113	40	109
90,000	194	152	133	131	122	118	28	114	40	110
92,000	197	154	134	133	123	119	28	115	40	111
94,000	199	155	136	134	124	120	28	116	40	112
96,000	201	157	138	135	126	122	28	117	40	113
98,000	203	159	139	136	127	123	28	118	40	114
100,000	205	160	141	138	129	124	28	120	40	116
102,000	207	162	142	139	130	125	28	121	40	117
104,000	209	164	144	140	131	127	28	122	40	118
106,000	211	165	145	142	132	128	28	123	40	119
108,000	213	167	146	143	134	129	28	124	40	120
110,000	215	168	147	144	135	130	28	125	40	121
112,000	217	170	149	146	136	131	28	127	40	122
114,000	219	171	150	147	137	132	28	128	40	123
116,000	221	173	152	148	138	134	28	129	40	125
118,000	223	174	153	149	139	135	28	130	40	126
120,000	225	176	154	150	141	136	28	131	40	127
122,000	227	177	155	152	142	137	28	132	40	128
124,000	229	178	157	153	143	138	28	133	40	129
126,000	230	180	158	154	144	139	28	134	40	130
128,000	232	182	159	156	145	140	28	135	40	131
130,000	234	183	160	157	146	141	28	136	40	132
132,000	236	185	161	158	148	143	28	137	40	133
134,000	237	186	163	159	149	144	28	138	40	134
136,000	239	187	164	161	150	145	28	139	40	135
138,000	241	188	165	162	151	146	28	140	40	136
140,000	243	190	166	163	152	147	28	141	40	137
142,000	244	191	167	164	153	148	28	142	40	138
144,000	246	193	168	165	154	149	28	143	40	139
146,000	248	194	169	166	155	150	28	144	40	140
148,000	250	196	171	168	156	151	28	145	40	141
150,000	251	197	172	169	157	152	28	146	40	142

DVA MD-88 CAT II AIRCRAFT FUEL AND PAYLOAD

Standard Flight Setup Empty Weight	77976 lbs	Fuel	5720.5 lbs
Payload	7500 lbs	**Left (40%)**	**2143.8** lbs
Std Economy Fwd	**3000** lbs	**Center (40%)**	**1433.6** lbs
Std Economy Aft	**3000** lbs	**Right (40%)**	**2143.8** lbs
Gross Weight	44121 lbs	Max Allowable Fuel	12850 lbs
Max Gross Weight ☐51250 lbs☐☐☐☐☐ 51250 lbs			

FUEL SETTINGS

Tank	%	Pounds	Capacity
Left	**40.0**	**2143.8**	5359.4 lbs
Center	**40.0**	**1433.6**	3584.1 lbs
Right	**40.0**	**2143.8**	5359.4 lbs
Total Fuel		**5720.5**	**14302.8 lbs**
Fuel Weight Lbs/gal: 6.7			

PAYLOAD SETTINGS

Station	Pounds
Flight Crew	400
Galley	200
Std Economy Fwd	3000
Std Economy Aft	3000
Fwd Baggage	300
Center Baggage	300
Aft Baggage	300
Total	**7500**

GROUND OPERATIONS

Taxi – straight ahead between 10 and 20 knots ground speed

Taxi – turning 12 knots ground speed

DVA MD-88 CAT II Aircraft (continued)

MAXIMUM FLAP SPEED

Flap Position	Maximum Speed
8	215 KIAS
20	215 KIAS
30	185 KIAS
45	170 KIAS

CLIMB PROFILE

Speed	Altitude
V$_2$ + 10 KIAS	1,000 ft AFE
200 KIAS	2,500 ft AFE
250 KIAS	10,000 ft
290 KIAS	Cruise Alt
.74 mach	Level Cruise

STANDARD RATE CLIMB

FPM	Altitude
2500	Below 10,000 feet
1500	10,000 to15, 000 feet
1000	15,000 to FL200
500	Above FL200

DESCENT RATE

Target Speed	Descent Rate	With Flight Spoilers
310 KIAS	2300 fpm	5500 fpm
250 KIAS	1400 fpm	3600 fpm
Vref 30 + 80 KIAS	1100 fpm	2200 fpm

APPROACH/LANDING SPEEDS

Speed	Altitude	Distance from Airport
210 KIAS	Below 10,000 feet	30 nm
180-190 KIAS		24 nm
170 KIAS		15 nm
Vref + 5	Varies	Final Approach Fix
Vref + 5 @ 45 Flaps	Landing	Runway Threshold

Bold is where changes are made in Fuel/Payload Settings

FUEL SETTINGS

Tank	%	Pounds	Capacity
Left	**40.0**	**2143.8**	5359.4 lbs
Center	**40.0**	**1433.6**	3584.1 lbs
Right	**40.0**	**2143.8**	5359.4 lbs
Total Fuel		**5720.5**	**14302.8 lbs**
Fuel Weight Lbs/gal: 6.7			

Acknowledgements and Legal Stuff

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This manual was created by Tyrone Weston in 2003 and updated by and Larry Foltran.

Flight Sim Screenshots courtesy of Andrew Kaufmann.

While we strive to mirror real-world operations, this manual is not designed for use in the operation of real-world aircraft.

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