

JOINT AVIATION AUTHORITIES

OPERATIONS DIVISION

AIRCRAFT EVALUATION REPORT.

Type: Boeing 737 900.

GENERAL:

1. On request of the JAA JOINT AIRCRAFT EVALUATION BOARD, on April the 10th 2001 an evaluation flight was executed with an aircraft of the type Boeing 737-900 from Boeing Airfield in Seattle to Moses Lake Airfield in the USA. The purpose of this flight was to *determine differences in aircraft handling characteristics; operational procedures and cockpit lay out* in relation to the Boeing 737-800. The Boeing 737-900 is a variant of the Boeing 737-600; -700; -800 group. The Boeing 737-900 is a stretched version of the Boeing 737-800. Cockpit lay out, systems and maximum takeoff weight are according Boeing Test Flight Division equal to the Boeing 737-800. (See appendix 1)

The increased length of the fuselage (2.6 m) of the B 737 900 could cause slight differences in flight and handling characteristics. The length of the fuselage was extended 1.6 m in front of the wing and 1.0 m aft of the wing. The separation of the landing gear was increased 1.6m. Pitch attitude during rotation and landing flare is more critical in terms of tail strike.

DIFFERENCES:

1. Boeing Flight Test Division handed out a list of differences of the operation manual between the B737-700-800-900. See Appendix 2.
2. Cockpit lay-out: The cockpit set up is nearly equal to the cockpit of the B737 800. Optional instruments and equipment like an EFIS standby horizon and flight instruments, an angle of attack indicator in the primary flight display; a right hand side nose wheel steering tiller, weather radar operation switches and radio or navigation equipment can differ from the flown test aircraft and the final production aircraft. This is dependent from the customer ordering the different optional cockpit equipment.
3. The aircraft flown had an Experimental Certificate of Airworthiness with registration N-737X to be the first delivered model with registration N-671AS for launch customer Alaska Airlines.
4. The cabin of the aircraft was equipped with test equipment and flight data registration computers.
5. In the cockpit was a head up display (HUD) installed. This equipment was not used during the evaluation flight.

EVALUATION FLIGHT:

1. Weather conditions at Seattle Airport; rain; temperature 6 degrees Celsius; wind 100/15 kts; overcast 1500 ft; runway in use 31; wet runway.
2. Cockpit set up; T.O.W. 63 Ton. Standard B 738 procedures; take off speeds from the FMC. The FMC is certificated to calculate the speeds.
3. Take off performance: Boeing standard is full take off trust. So no assumed temperature reduction. Trim setting 5.43 units.
4. Start up; standard B738 procedures; no differences
5. Taxi; no tiller for the right hand seat pilot. This tiller is an option. Behaviour of the aircraft during taxi felt like the B 738. Before take off procedures standard.
6. Take off run; wet runway; normal B 738 behaviour.
7. Rotation; The back pressure on the yoke felt very light to rotate the aircraft at V rotate. After the flight the chief test pilot explained that this was because of the fact that during normal commercial operation an assumed temperature is used to calculate the take off trust setting. The trim setting is not changed for the lower trust setting used. The trim setting is calculated for full trust setting.
8. Initial climb and clean up; Aircraft was flown manually; aircraft felt like a B-738
9. Manual flight during climb out; no differences.
10. Auto flight; A/P and V-nav and L-nav; standard B378 procedures.
11. Air work; Steep turns; approach to stall and manual reversion; Aircraft was operated as a B 738. Standard procedures no differences.
12. Descent was flown partly with AP and partly manual. No differences were felt standard procedures.
13. Instrument approaches and circuits were flown at Mozes Lake Airfield. Weather conditions: temp 18 degrees C; wind 360/15 CAVOK. Moderate turbulence was experienced from 500ft up to 5000ft.
14. Instrument approaches; An ILS approach and a non precision approach were flown with AP and F/D off. Followed by touch and go. Normal aircraft behaviour.
15. Dual ILS approach followed by auto land and full stop landing. Normal B738 behaviour.
16. Landing, touch and go followed visual circuits flying. During landing flare normal B 737 800 pitch attitude was used. Normal aircraft behaviour. Never felt a tendency of over pitching the aircraft. During the take off run following the landing, normal pitch rates of 3 degrees a second were used. Never felt a tendency of over pitching the aircraft although the stick forces used felt light compared with the take off technique used with the B 737-800. This is because of the assumed temperature used when calculating the take off trust and no changes in trim setting are applied.
17. N-1 approaches and land; no differences
18. N-1 go around and climb out; standard procedures and aircraft control felt normal.
19. Take off followed by circling approach; no differences.
20. Return to Seattle followed by instrument approach and full stop landing wet runway with full reverse trust and auto-brakes 2. Standard B 738 aircraft behaviour.
21. Taxi to parking stand; standard.
22. Shut down according standard B 738 procedures.

CONCLUSION:

The increase of 2.60m in length of the fuselage of the B 378 had nearly no influence on aircraft behaviour during take off's, landings and other flight operations. During take off's and landings no critical pitch attitudes were experienced in terms of tail strike because of the 1.0m increased length of the fuselage aft of the wing.

Light stick forces were felt during rotation. This was explained by the trim setting based on full trust used during take off. Risk of tail strike during rotation and landing were not experienced. Standard B 738 rotation techniques and landing techniques were used. Cockpit lay-out is standard B 738 although options can make slight differences in cockpit lay-out. It can be concluded that the flight technical and flight procedures between the B-738 and the B-739 are so marginal that flying the different variants of this Boeing 737 series by standard trained pilots on the B-737 800 should not require any extra flight training and or differences training.

RECOMMANDATION:

When mixed flying of different variants of the Boeing 737 series applies, the rotation and landing flare technique of the shorter aircraft should be the same as the rotation and landing flare technique of the longer aircraft. The take off technique and the landing flare technique of the longer aircraft will prevent critical pitch attitude both for the shorter (600; 700) and the longer (800; 900) aircraft. Rotation rates of the longer aircraft should be used.

FAMILARISATION COURSE:

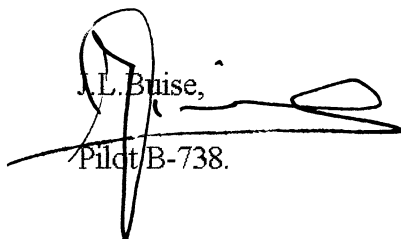
When an operator applies for an approval of a familiarisation course for the B 737 600; 700; 800; this approval also can include the B 737 900.

DIFFERENCES TRAINING:

The approved difference training course for the Boeing 737-300/400 to the Boeing 737-800 can also be approved for the Boeing 737-900.

TYPE RATING TRAINING:

The approved type rating training course for Boeing 737-800 can be approved for the Boeing 737-900.


J.L. Buise,
Pilot/B-738.

BOEING FLIGHT PLAN

INSTRUCTIONS: 1 through 16 are required for FAA domestic flight plans. If the flight plan is filed direct with the FAA, you may phone in Items 1 through 11; state that the additional information is on file at the Boeing Company.

<u>SPECIAL INSTRUCTIONS FOR DISPATCHER:</u>		AIRPLANE TYPE & EQUIPMENT PREFIX/SUFFIX GUIDE:	
		PREFIX "T" = TCAS equipped "H/" = heavy airplanes "B/" = TCAS and heavy "F/" = 757 airplanes "L/" = 757 with TCAS	SUFFIX "/A" = DME & transponder w/ altitude encoding "/E" = Dual FMS A/C & authorized crews "/F" = Single FMS A/C & authorized crews "/R" = RNP Type Certification (ICAO fit plans)
Date Of Flight: 10 Apr 01	3. Airplane Type With Equipment Prefix/Suffix: T/B738/E	EXAMPLES: T/B738/F ← or B/B773/E	
		AIRPLANE TYPE	
2. Radio Call: BOE 900		707-3, E-8-----B703 717-{X}00-----B71X 737-{X}00-----B73X 747-{X}00-----B74X 747-SP-----B74S	757-{X}00-----B75X 767-{X}00-----B76X 767 AWACS-----E767 777-{X}00-----B77X KC-135{X}-----K35X

1. IFR or VFR:	4. True Air-Speed:	5. Point Of Departure:	6. Proposed Departure Time:	7. Initial Altitude Request:	8. Route Of Flight:	9. TO: (Dest)	10. ETE: Hrs + Min
IFR	420	KBFI	1815	FL 210	SEA J12 EPH Direct EPH 010/20		+
					0+30 DELAY NORTH TRAINING AREA		+
					Direct MWH	KMWH	1+20
							+
IFR	420	KMWH	2000	FL200	Direct GLASR GLASR3	KBFI	0+30
							+
							+
							+
							+
							+

Final Destination: KBFI	Estimated Total Time: Hours Minutes 2+ 15	11. Remarks: Experimental Airplane			
12. Fuel On Board: Hours Minutes 7+ 00	13. Alternate Airport(s): KPAE	14. Pilot-in-command: Newton	15. Number Aboard:	16. Color C Airplane:	
Airplane Registration :	Airplane Tab Number: YD 501	Copilot / First Officer: Buise (JAA)		Sys Op/Flt Engineer:	

BOEING DISPATCH INFORMATION

Departure Time	Arrival Time	Total	Crew Training Flight	Support Flight	Evaluation For Development Flight
			<input checked="" type="checkbox"/> Engineering Flight	<input type="checkbox"/> Ferry Flight	Other:
			<input type="checkbox"/> Production Flight	<input type="checkbox"/> Flyaway	

WX	Existing	Destination	Dispatch:	Fss:
		Alternate		
	Forecast	Destination		
		Alternate		
Notams:				

PROPRIETARY**FAA & JAA T2 TYPE RATING FLIGHT TEST - FT**

Prep	<u>Scott A. Strandberg</u>	<u>4-2-01</u>	Conc	<u>John J. Corrigan</u>	<u>4/3/01</u>
	Analysis Engineer	Date		Lead Test Operations Engineer	Date
	Scott A. Strandberg	544-2474		J. Corrigan	662-1812
App	<u>Flash E. Parlina</u>	<u>2001-04-02</u>	App	<u>Byron R. Billingsley</u>	<u>4/2/01</u>
for	Lead Analysis Engineer	Date		Analysis Supervisor	Date
	Flash E. Parlina	655-0031		Byron R. Billingsley	655-2520

PURPOSE OF TEST

To establish same aircrew type rating with the classic 737 models through T2 Functional Equivalence testing.

RISK ASSESSMENT

All Test Conditions in the TIP Sheet are considered to be LOW Risk, except .008 which specifies a simulated engine failure during takeoff roll.

REFERENCES

- (a) Engineering Work Authorization (EWA) P3007-001, "FAA/JAA T1 Type Rating Test/Familiarization Flights"

CONFIGURATION

The test aircraft is an Alaska Airlines (ASA) Model 737-900 (Airplane YD501).

The aircraft GW and CG requirements are optional.

DATA REQUIRED

- Data Tapes - Not Required.
- Manual Data - Test Director: Record time and any pilot comments.

TEST CONDITIONS**B5.15.0118 - T2 TYPE RATING TEST****Procedure**

One JAA evaluation pilot will fly the airplane from taxi to a full stop landing through a profile that will roughly follow that described below. Pilots are free to vary from the prescribed profile so long as an excessive amount of time is not used in doing so. For record keeping purposes, if more than one profile is performed, it is requested that condition numbers be recorded as .00X.1 for the first pilot, .00X.2 for the second and so on.

PROPRIETARY
FAA & JAA T2 TYPE RATING FLIGHT TEST - FT
B5.15.0118 – T2 TYPE RATING FT

Risk	Cond No	Altitude	A/S or Mach	Operation
L	.001	GND	OPT	Taxi to the runway and perform a normal flaps 5 takeoff followed by a normal climb to a convenient working altitude, nominally 10,000 ft. Manual or Automatic control of the airplane and FMC use is pilot option.
L	.002	≥10,000	OPT	Perform any two of the following: Approach to Stall (activate stick shaker), steep bank turn or Manual Reversion of flight controls.
L	.003	OPT	OPT	Descend to an approach (mode optional) and perform a F30 approach to a touch and go.
L	.004	OPT	OPT	Perform a F40 approach to a touch and go landing. If previous approach was manual, perform a coupled approach; if not, perform a manual approach.
L	.005	OPT	OPT	Conduct a simulated engine out approach by pulling one throttle to idle (disarm the A/T). During the approach at approximately 100 ft initiate a go-around.
L	.006	OPT	OPT	Conduct a simulated engine out Flaps 15 approach by pulling one throttle to idle (disarm the A/T) to a full stop landing.
L	.007	OPT	OPT	Change flight crew and repeat conditions .001 - .006.

B5.15.0118 – T2 TYPE RATING FT
Notes

- ① Condition .008 may cause PSEU faults to set. To clear the faults, after the next landing push the throttle associated with the simulated engine out to greater than 53 deg TRA (throttle lever straight up should accomplish this). Then cycle the Master Caution to clear the remaining fault.

Risk	Cond No	Altitude	A/S or Mach	Operation
M	.008①	OPT	OPT	Perform a F1 or F15 takeoff. At V1 simulate an engine failure by pulling one throttle to idle (disarm the A/T).

RISK ALLEVIATION (B5.15.0118 – T2 TYPE RATING TEST)

Condition .008

Thorough briefing outlining pilot/copilot actions/duties during the engine pullback at V1 on takeoff.

YD501 TOL/ADVISORY SUMMARY

TOL YD501	DATE	R	TITLE
-51-T001	7/28/00	A	FUSELAGE AND CARGO BAY LOADING – DO NOT EXCEED MAIN DECK, FWD HOLD OR AFT HOLD LOAD LIMITS.
-51-T002	7/28/00		LANDING GEAR IMPACT – DO NOT EXCEED MLG SINK RATE >10 FPS AT GW UP TO 146,300 LB OR >8 FPS AT GW UP TO 174,000 LB DO NOT INITIATE MAX BRAKING EFFORT BELOW 50 KTS WHEN LANDING OVERWEIGHT DO NOT DEROTATE WITH PITCH RATE GREATER THEN 8 DEG/SEC AT NOSE GEAR IMPACT
-51-T003	11/14/00	B	LATERAL LOADING LIMITS – qB LIMITS , 16 PSI DEG For FLAPS 1 - 30 20 PSI DEG for FLAPS 40, FLAPS UP 9.5 (<M.6), 6.5 (>M.6)
-51-T004	7/28/00		MAINTAINING LOADS WITHIN DESIGN LIMITS –DO NOT EXCEED FLAP PLACARDS SHOWN IN THE AFM – V _{MO} 340 KCAS, M _{MO} .82 V _{MO} & M _{MO} MAY BE EXCEEDED WHEN TESTING LIMITS BY 10 KTS & 0.01 M V _{fe} MAY BE EXCEEDED BY 5 KTS IN CALM AIR. Nz: Fup – 1 to 2.5 g, TO FLAPS (1-25) 0 TO 2 g, LNG FFLAPS (30,40) 0 TO 2g REDUCING TO 0-1.5g @ 174,700 LBS.
-51-T005	7/28/00		NON-STANDARD FUEL LOADING/USAGE – CENTER TANK FUEL EXCEEDING 1000 LB MUST BE ADDED TO THE ZFW IF MAINS ARE NOT FULL. FLAPS UP AND DOWN G LIMITS AT ZFW => 140,300 AND > 140,300 TO 160.000
-51-T006	7/28/00		STALL BUFFET – DO NOT FLY BEYOND INITIAL BUFFET FLAPS UP OR STICK SHAKER FLAPS DOWN DO NOT PERFORM STALLS WITH NZ > 173,000 LB. MAINTENANCE INSPECTION REQD IF ENVELOPE IS EXCEEDED.
-51-T011	7/28/00		LOADING AFT OF TIP UP LIMITS – WITH LOADING AFT OF TIP UP LIMIT USE ROLLING TAKEOFF, LIMIT THRUST TO 24K RATING VALUES CROSS WINDS LESS THAN 10 KTS AND ALIGNED WITH THE RUNWAY.
-51-T012	7/28/00		HIGH SPEED LIMITATIONS FOR NON-STANDARD FUEL LOADING/USAGE – WITH LESS THAN 100% MAIN FUEL, DO NOT EXCEED V _d – 20 KCAS WHEN ZFW IS GREATER THAN 130,00 LB WITH 40% OR GREATER FUEL IN CENTER TANK.

**Operations manual Differences
between 700 - 800 - 900**

App

ITEM	737-700	737-800	737-900
Limitations			
<u>Maximum Weights</u>			
Maximum Taxi Wt.	156,000 Lb. / 70,760 Kg.	174,700 Lb. / 79,242 Kg.	174,700 Lb. / 79,242 Kg.*
Maximum Takeoff Wt.	155,500 Lb. / 70,533 Kg.	174,200 Lb. / 79,015 Kg.	174,200 Lb. / 79,015 Kg.*
Minimum Takeoff Wt.	n/a	n/a	n/a
Maximum Landing Wt.	128,000 Lb. / 58,059 Kg.	146,300 Lb. / 66,360 Kg.	146,300 Lb. / 66,360 Kg.
Maximum Zero Fuel Wt.	120,500 Lb. / 54,657 Kg.	138,300 Lb. / 62,731 Kg.	140,300 Lb. / 63,638 Kg.
Flaps 15 Maximum Landing Wt.(FAA)	n/a	n/a	144200 Lb / 65,407
Autoflight			
Minimum Use Height (MUH) JAA	135 Ft.	158 Ft.	In Test
Takeoff Crosswind Guidelines			
Dry	36 Kt.	36 Kt.	In Test
Wet	23 Kt.	27 Kt.	In Test
Standing Water/Slush	16 Kt.	19 Kt.	In Test
Snow No Melting	21 Kt.	26 Kt.	In Test
Ice No Melting	7 Kt.	8 Kt.	In Test
Engine Performance	20K, 22K, 24K	24K, 26K, 27K	24K, 26K, 27K
Dimensions (No Winglets)			
Overall Length	110' 4"/33.60m	129' 6"/39.50m	138' 2"/42.10m
Wingtip to wingtip	112' 7"/34.40m	112' 7"/34.40m	112' 7"/34.40m
Landing Gear Separation	41' 3"/12.60m	51' 1"/15.60m	56' 4"/17.20m
Emergency			
Emergency Exit Lighting	2 Over Wing Lights	4 Over Wing Lights	4 Over Wing Lights
Emergency Equipment	Varies	Varies	Varies
Emergency Routes	2 Over Wing Exits	4 Over Wing Exits	4 Over Wing Exits
Emergency Escape Straps	2 on Over Wings	4 on Over Wings	4 on Over Wings
Emergency Over Wing Exits	2 Over wing Exits	4 Over Wing Exits	4 Over Wing Exits
Air Systems			
Bleed Air Control Panel			
RECIRC Fan(s)	1	2	2
Trip Reset Switch	Bleed Trip Off, Pack Trip Off, Duct Overheat	Bleed Trip Off, Pack, Zone temp	Bleed Trip Off, Pack, Zone temp
Pack Trip Light	PACK TRIP OFF	PACK	PACK
A/C Panel			
Overheat	DUCT OVERHEAT(2)	ZONE TEMP (3)	ZONE TEMP (3)
AutoFlight			
FCC-708	as installed / Line # ??	as installed / Line # ??	production
Flap Limits			
15	195 Kt.	200 Kt.	200 Kt.
25	170 Kt.	190 Kt.	190 Kt.
30	165 Kt.	175 Kt.	175 Kt.
40	156 Kt.	162 kt.	162 Kt.

**Operations manual Differences
between 700 - 800 - 900**

Flap Retracted Stab Trim Units	4.30 – 14.5	3.95 – 14.5	4.00 – 14.5
Flap Extended Stab Trim Units	0.05 – 14.5	0.05 – 14.5	0.05 – 14.5
Tail Skid	No	Yes	Yes
OMBs			
NNC Smoke Removal (2 places)	n/a	n/a	Yes
NNC Cargo Fire	n/a	n/a	Yes
NNC Packs	n/a	n/a	Yes
CDS Flap Maneuvering Speed Discrepancy	n/a	n/a	Yes
* ASA (Launch Customer weights)			