EXPERIENCE AIMED AT THE FUTURE

ANTONOV-148/-158 FAMILY

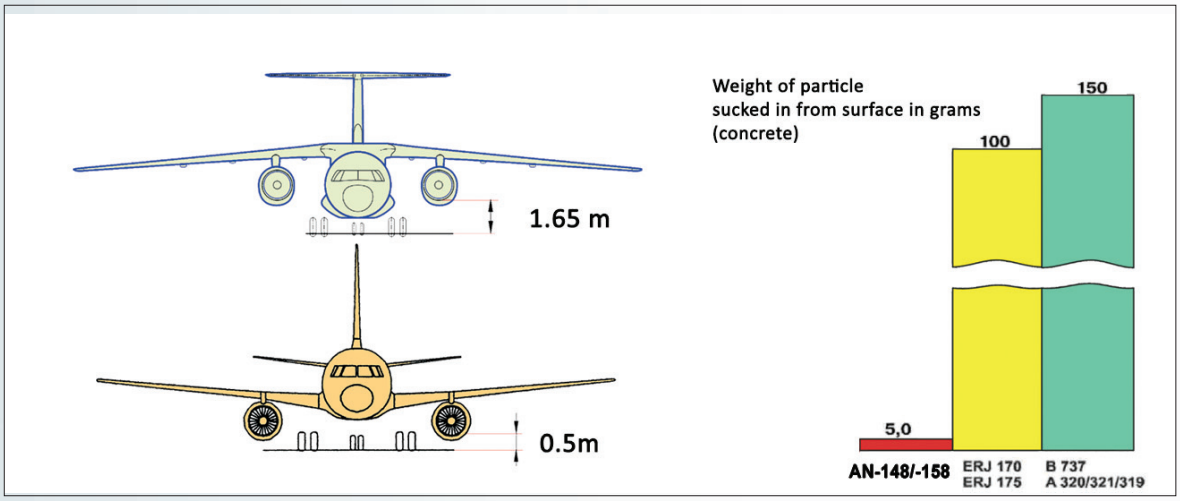
COMPARISON WITH COMPETITORS

General information about AN-148/-158 family

The family of the AN-148/-158 regional passenger aircraft is intended for transportation of 70 to 99 passengers as well as their baggage, mail and cargoes on both domestic and international routes, and possible operation at airfields with paved and unpaved runways located at the elevation of up to 4100m above the sea level. The family includes AN-148-200A, AN-148-200B, AN-148-200E and AN-158 aircraft which differ in the maximum take-off weight and passenger capacity.

The aircraft of the AN-148/-158 family are the only regional and short-range aircraft certified for take-off and landing from/to unpaved runways. The aircraft configuration (high wing) with the engine-to-runway clearance of 1.65m ensures safe operation of the aircraft at poorly prepared airfields.

Advantage of "high wing" configuration



The AN-148/-158 aircraft family is powered by the D-436-148 type engine ensuring efficient aircraft operation with the maximum take-off weight (MTOW) ranging from 38 950kg to 43 700kg. Use of one engine type for all aircraft modifications minimizes the operator's expenses for maintenance of airline fleet consisting of different aircraft models of the AN-148/-158 family.

AN-148/-158 family aircraft are equipped with fly-by-wire control system, digital avionics, digital engine control system (FADEC) which complies with the up-to-date level of regional aircraft and airliners. The AN-148/-158 family aircraft are equipped with the onboard maintenance system (OMS) similar to CFDS and CMS systems installed on the Airbus aircraft, which allows to minimize the time required for troubleshooting and ensures a higher flight safety level compared to other regional aircraft.

Making up his air fleet out of the AN-148/-158 family airplanes which are unified to the maximum extend possible allows the operator to most effectively organize the route network by selecting the best parameters of range and passenger capacity.

Main technical characteristics of AN-148/-158 aircraft family

Aircraft	AN-148-200A	AN-148-200B	AN-148-200E	AN-158
Engine	D-436-148			D-436-148
Maximum take-off weight, (MTOW), kg	38 950	41 950	43 700	43 700
Maximum landing weight (MLW), kg	37 800			38 800
Maximum payload (MPL), kg	9 000			9 800
Maximum fuel weight (MFW), kg	11900			11900
Maximum passenger capacity with seat pitch of 762 mm (30”), pax.	89			99
Operational range, km - single class layout with seat pitch of 762 mm (30”), pax.	1200 89	2600 89	3500 89	2500 99
Operational range, km - single class layout with seat pitch of 813 mm (32”), pax.	1910 79	3250 79	3950 79	3100 89
Cruising speed, km/h	780-820			780-820
Cruising altitude, m	11 600-12 200			11 600
Required RWY length (SA, H=0, concrete), m	1600	1800	1900	1900
Baggage compartments volume, m^3	12.4			14.7
Crew, flight crew + flight attendants	2 + 2			2 + 2

Comparison of AN-148-200E with competitors

Aircraft	AN-148-200E	ERJ175LR	CRJ900LR	ERJ175E2	MRJ90LR
Engine	D-436-148	CF34-8E5	CF34-8C5	PW1700G	PW1217G
Maximum take-off weight, (MTOW), kg	43 700	38 790	38 330	44 800	42 800
Maximum landing weight (MLW), kg	37 800	34 000	34 065	40 000	38 000
Maximum payload (MPL), kg	9 000	9 300	10 247	10 600	11 000
Maximum fuel weight (MFW), kg	11900	9 470	8 820	N/A	9 740
Maximum passenger capacity, pax.	89	88	90	88	88
Operational range, km - with payload, pax.	3500 89	3982 78	2876 88	3815 88	3770 88
Cruising speed, km/h	780-820	780-820	780-829	780-830	780-830
Cruising altitude, m	11 600-12 200	11 900	12 500	12 500	
Required RWY length (ISA, SL, concrete), m	1900	1910	1939	1900	1740
Crew, flight crew + attendants	2 + 2	2 + 2	2 + 2	2 + 2	2 + 2

Comparison of AN-158 with competitors

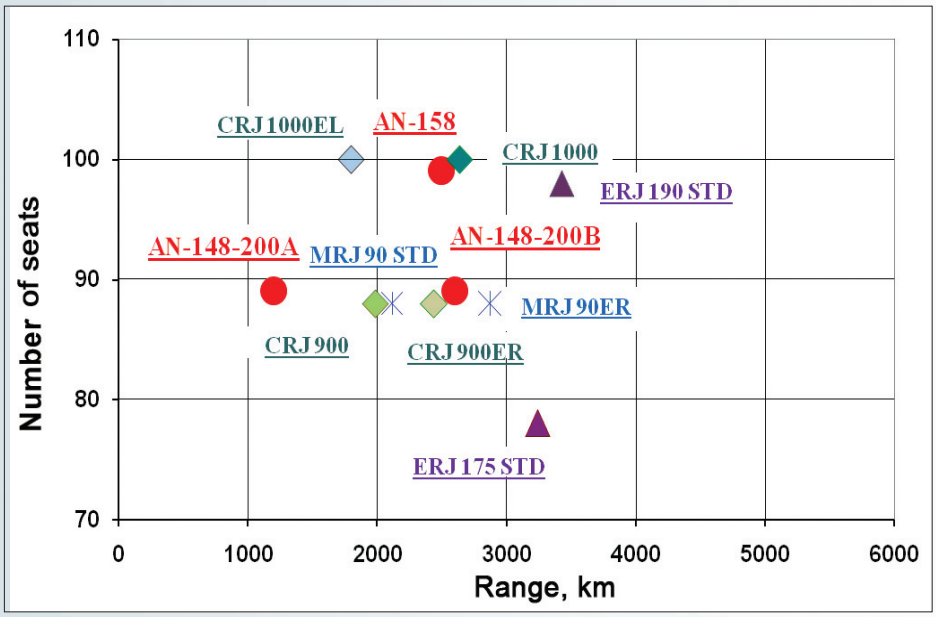
Aircraft	AN-158	ERJ190STD	CRJ1000ER	ERJ190E2
Engine	D-436-148	CF34-10	CF34-8C5	PW1970G
Maximum take-off weight, (MTOW), kg	43 700	47 790	41 640	56 400
Maximum landing weight (MLW), kg	38 800	43 000	36 968	49050
Maximum payload (MPL), kg	9 800	13 063	11 966	13080
Maximum fuel weight (MFW), kg	11900	12 970	8 990	N/A
Maximum passenger capacity, pax.	99	106	104	106
Operational range, km - with payload, pax.	2500 99	3150 98	3004 100	5186 106
Cruising speed, km/h	780-820	780-820	780-829	780-830
Cruising altitude, m	11 600	12 500	12 500	12 500
Required RWY length (ISA, SL, concrete), m	1900	1640	2120	1670
Crew, flight crew + attendants	2 + 2	2 + 2	2 + 2	2 + 2

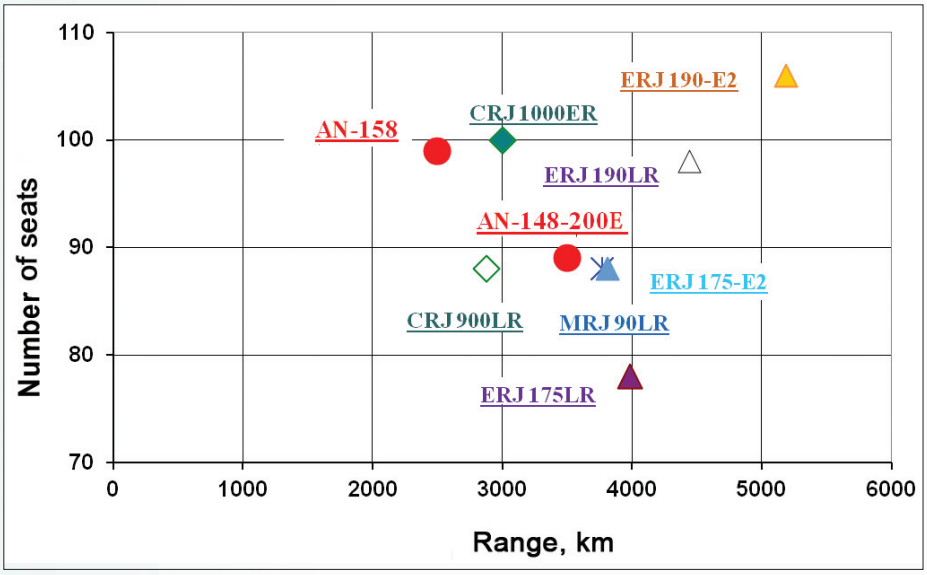
Payload range

The AN-148/-158 aircraft family is optimal for operation on air routes ranging from 800km to 3.500km:

- **AN-148-200A** – transportation of 89 passengers over range of 1200km;
- **AN-148-200B** – transportation of 89 passengers over range of 2600km;
- **AN-148-200E** – transportation of 89 passengers over range of 3500km;
- **AN-158** – transportation of 99 passengers for 2500km range.

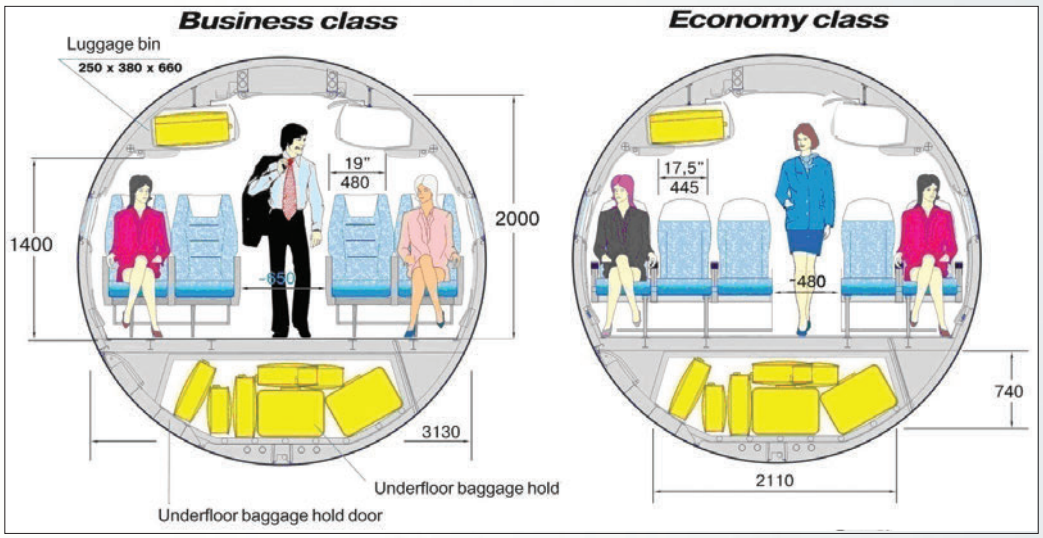
"Payload vs range" diagrams of both basic and extended-range versions of AN-148/-158 family and its competitors are given below.





Perfection of comfort

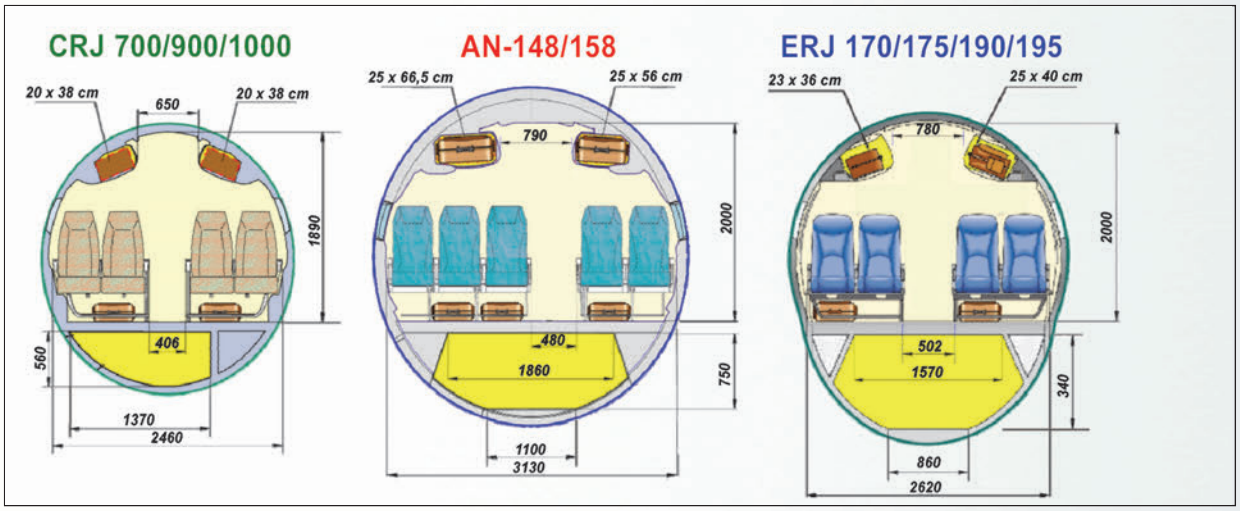
The passenger's comfort level corresponds to the average level of long-haul aircraft. It is achieved by means of efficient layout and arrangement of service compartments, profound ergonomic optimization of common and individual space in the passenger cabin.



The cabin height and width, the width of seats, the height and the width of aisles are among the biggest in the class of narrow-body aircraft of the same size.

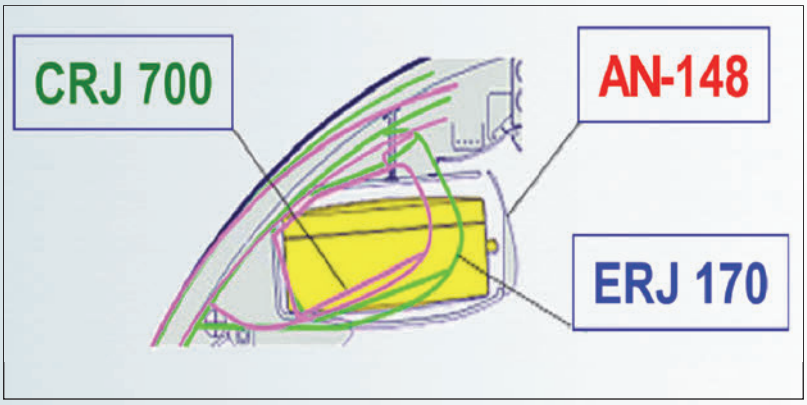
The seats are arranged in the cabin in accordance with the 3+2 layout that allows to accommodate more passengers in the aircraft with a relatively small length together with the ability to quickly embark and disembark passengers.

Such layout allows using 44cm wide seats like those used in long-haul aircraft of Boeing and Airbus.



Perfection of comfort

Specious over-head baggage racks are element to the passenger comfort too. They provide an average 0.06 cubic meters of space per one passenger for baggage accommodation. The size of the bin is no less than that in the competitors, E-Jet family aircraft, and is better then in some older modifications of Boeing and Airbus aircraft and CRJ700/900/1000, which are similar or bigger in size.



AN-148/-158: 25 x 66,5 cm;
CRJ 700/900/1000: 20 x 38 cm;
ERJ 170/175/190: 25 x 40 cm.

All AN-148/-158 aircraft family have built-in entrance stairs on the forward passenger door that provides for quick deployment of aircraft in the intermediate airport. It can help to reduce the turnaround time by five minutes minimum if compared with use of a gate or a mobile stairway. According to the calculations proved by the aircraft operation experience, the AN-148/-158 aircraft turnaround may take some 20-25 minutes.

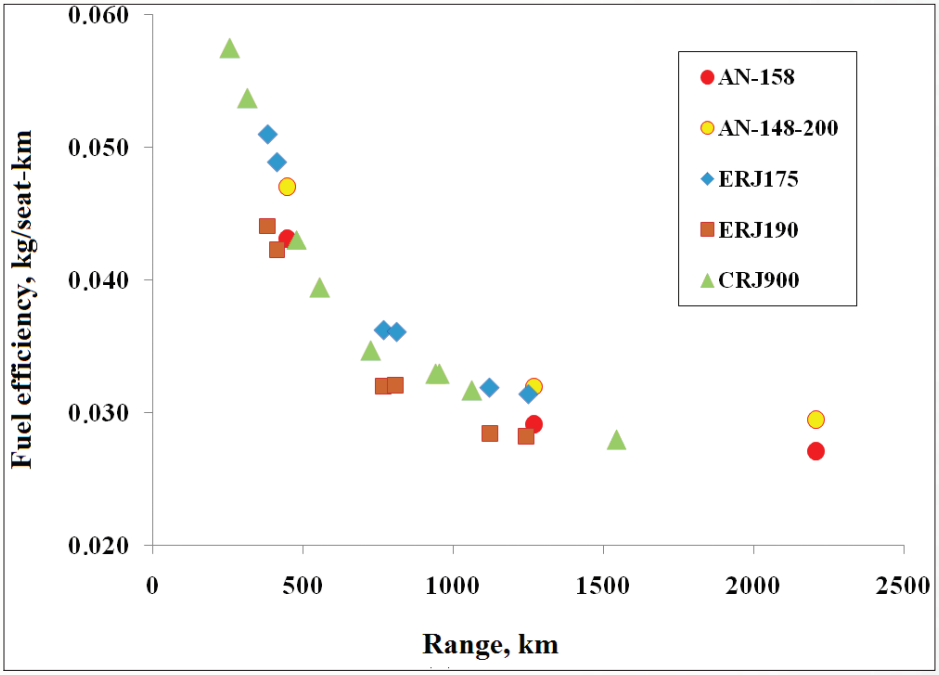
Fuel consumption of the AN-148/-158 aircraft and its competitors ERJ-175, ERJ-190 and CRJ900 were analyzed for the ranges of 260-2.200km (140-1.190nm).

The AN-148/-158 family and their competitors were evaluated in the single class layout for fully loaded flight.

The standard passenger weight with baggage was assumed 95kg.

The AN-148/-158 fuel efficiency of for the ranges of 260-2.200km (140-1.190nm) is the same when compared to the fuel efficiency of the ERJ175, ERJ190 and CRJ900 aircraft of similar passenger capacity.

The AN-148/-158 and its competitors fuel efficiency



AN-148-200: 89 passengers;
AN-158: 99 passengers;
ERJ-175: 88 passengers;
ERJ-190:114 passengers;
CRJ-900: 88 passengers.

Operation economics

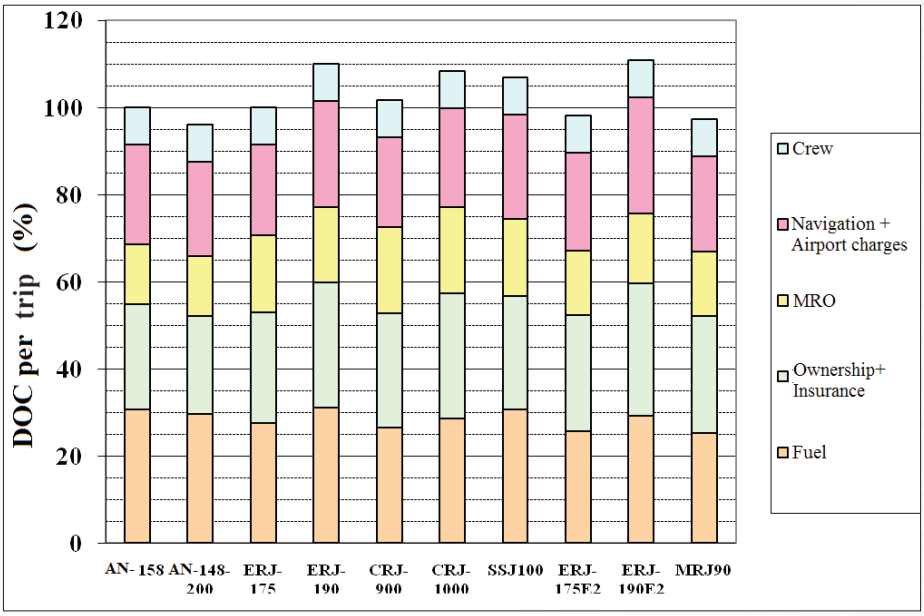
Initial data

Distance	926km (500nm)
Utilization	2500 FH/year
Seats (economy class, 2 lavatories):	
ANTONOV:	An-148-200: 87, An-158: 97
Embraer:	ERJ-175: 86, ERJ-190: 102, ERJ-175E2: 88, ERJ-190E2: 106
Bombardier:	CRJ-900: 88, CRJ-1000: 100
Mitsubishi:	MRJ90: 88
Pax Load Factor	100% (no additional cargo)
Airfield elevation	sea level
Airfield and Enroute temperature	ISA
Wind	no wind
Cruise speed	820 km/h
Fuel reserves	JAR OPS
Taxi time	20 min
Average Fuel Price (USD/tonne)	700

	Leasing rate (thousand USD/month)
ANTONOV	
An-148-200	212
An-158	230
Embraer	
ERJ-175	243
ERJ-190	274
ERJ-175E2	270
ERJ-190E2	308
Bombardier	
CRJ-900	239
CRJ-1000	253
Mitsubishi	
MRJ90	272

Assumptions	
Insurance	1% of aircraft price/year
Crew Flight crew Cabin attendants Crew cost (USD/BH)	 2 2 360
Maintenance Labor Rate (USD/FH) Unscheduled maintenance (% of scheduled)	 50 10%
Average Handling Charge (USD/seat)	6.00
Navigation Charges for Eurocontrol (USD/100km) Eurocontrol formula (USD/100 km)	 60
Average Landing Fee + Terminal Charges (USD/1000 kg of MTOW)	12
Overhead costs (% of DOC)	20%
Revenue rate (USD/pax-km)	0.140

Direct operating costs



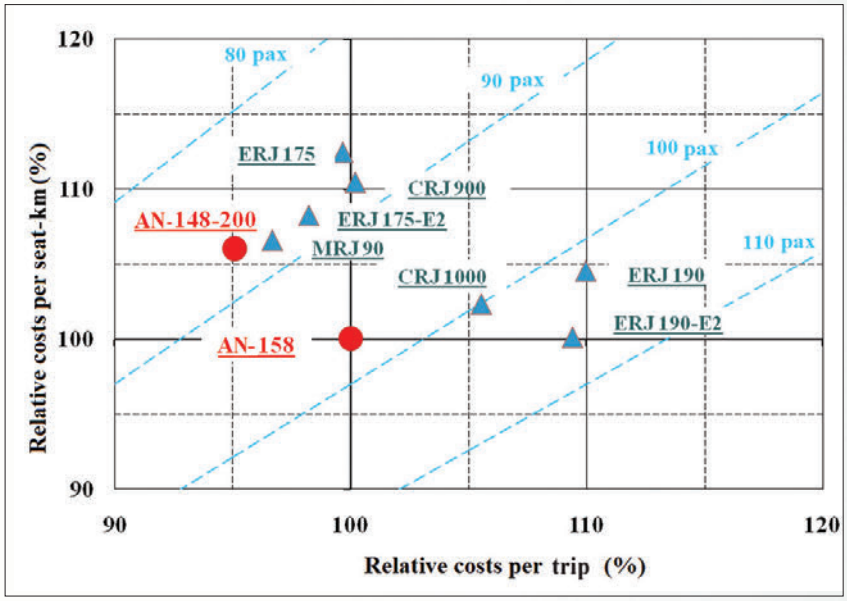
Direct operating costs (DOC) per trip of AN-148/-158 aircraft and their competitors are determined for the standard range of 926km (500nm).

Main advantages of AN-148/-158 aircraft in terms of DOC compared to their competitors:

- Low cost of ownership (leasing payments),
- Low cost of maintenance.

Relative operating costs in DOC/trip and DOC/seat-km of AN-148/-158 aircraft and their competitors are shown below.

DOC of AN-158 aircraft are used as basic value (100%).

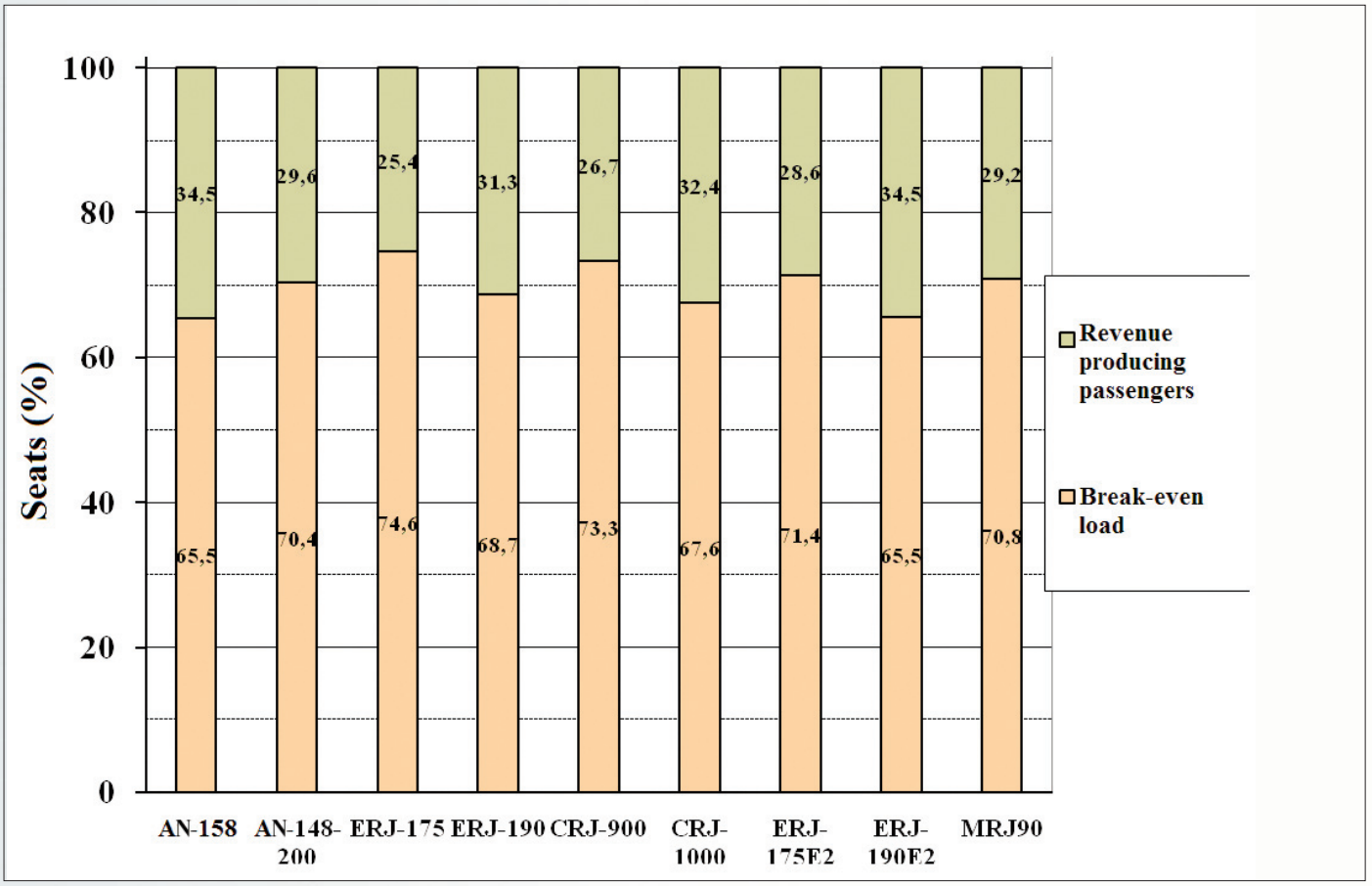


DOC/seat-km of AN-148/-158 aircraft compared to their competitors for standard flight with range of 926 km (500 nm):

- DOC of ERJ175 are by 5.5% higher than DOC of An-148-200,
- DOC of CRJ900 are by 4% higher than DOC of An-148-200,
- DOC of new generation aircraft MRJ90 and ERJ175-E2 are slightly (by 0.5% and 1% respectively) higher than DOC of AN-148-200,
- DOC of ERJ190 are by 4.5% higher than DOC of AN -158,
- DOC of CRJ1000 are by 3% higher than DOC of AN -158,
- DOC of new generation aircraft ERJ190-E2 are equal to DOC of AN-158.

Break-even load factor

Levels of seats occupation for AN-148/-158 aircraft and their competitors with respect to break-even flight



Passenger break-even load factors of AN-148/-158 aircraft (70.4% and 65.5% respectively) are the lowest in comparison with competitors of 80-100 seats class.

The AN-148/-158 maintenance program is based on the on-condition maintenance concept with no need for overhauls, being derived from the MSG-3 Transport Aircraft and Engine Scheduled Maintenance Development Document. Maintenance program development procedures have been developed in accordance with the recommendations of FAA Advisory Circular AC122-21A, with participation of the Industry Steering Committee (ISC) and Working Groups (WG), direct participation of the representatives of airlines, future operators, and industry representatives, suppliers of major components. The result of ISC work was the AN-148 Maintenance Review Board Report (MRBR). On the basis of AN-148 MRBR, the ANTONOV Company developed Maintenance Planning Document (MPD).

Maintenance Structure

Type of Check	Interval	Labor Content, man-hour
Line Maintenance		
Pre-flight Check	Before flight (done by the flight crew)	0.15
E-Check, daily	Once in 48 hours	2.16
W-Check, every two weeks	Once in two weeks	9.34
Periodic Maintenance		
A-Check	750 FH	52
SA-Check	300 cycles or 6 months	5
C-Check	7500 FH or 36 months	100
SC-Check	3000 cycles or 36 months	250

MPD provides for a possibility of introdusing the Zonal Inspection Program into the maintenance program of an airline. For this purpose, MPD contains separate section with a list of General Visual Inspections (GVI) for each specific aircraft zone. A separate appendix of MPD (Precluded Tasks) contains GVI for aircraft systems and airframe, not included into Zonal Inspection Program.

Maintenance Checks

MPD provides for two major groups of maintenance checks of aircraft systems and engine, and airframe primary structures grouped into A-checks, done every 750 FH and intervals multiple of 750 FH (2A-check, 4A-check, etc.) andC-checks (Base Checks), done every 7500 FH or 36 months, whichever occurs first, and intervals multiple to it; as well as SA-checks of airframe primary structures done every 300 FC or 6 months or intervals multiple to it (S2A-check, S4A-check , etc.) and SC-checks, done every 3000 FC or 36 months and intervals multiple to it.

A-checks

A-checks, depending on aircraft equipment, include operational checks and some functional checks of aircraft systems and equipment; the engine system checks; cabin equipment checks, service activities, etc. The check intervals selected by MSG-3, take into account the safety effect, the equipment and system reliability, and field experience of similar items operation.

Thus, the interval betwen A-checks interval may be increased or reduced by ±75FH, which increases the maximum check interval to 825FH.

A-checks

Checks	Interval, FH	Task Package	Task Total	Labor Content, MH	Access Labor Content, MH	Total Labor Content, MH
A1, A3, A5, A7	750	A	139	40	12	52
A2	1500	A+2A	171	49	12	61
A4	3000	A+2A+4A	281	89	23	112
A6	4500	A+2A+6A	172	49	12	61
A8	6000	A+2A+4A+8A	283	91	23	114

C-checks (Base checks)

In the Periodic Check package C-check tasks complement A-checks in the general packadge of aircraft service life extension.

C-check interval may be increased or reduced by ±750FH or ±3 months, which allows for easy combining of C-check with A-checks. At the same time, C-check may be distributed by A-checks.

C-checks

Base checks	Interval, FH	Task Package	Task Total	Labor Content, MH	Access Labor Content, MH	Total Labor Content, MH
C1	7500	A+2A+C	215	71	29	100
C2	15000	A+2A+4A+C+2C	334	118	29	147
C3	22500	A+2A+6A+C+3C+3C/2C	232	79	54	133

When a Task Package is being developed, A-checks and C-checks, having the same intervals are grouped together, and any convenient combination of the task package is acceptable provided that the operator follows the intervals foe each specific task.

Periodic Check Planning by FH

Interval		Flight Hours																		
Checks	FH	750	1500	2250	3000	3750	4500	5250	6000	6750	7500	8250	9000	9750	10500	11250	12000	12750	13500	14250	15000
A	750	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
2A	1500		+		+		+		+		+		+		+		+		+		+
4A	3000				+				+				+				+				+
6A	4500						+						+						+		
8A	6000								+								+				
C	7500										+										+
2C	15000																				+

Maintenance Structure

Maintenance checks of the airframe, primary structures and critical structural areas comply with the Flight Cycle (FC) or Months (Years). A-checks of the airframe primary structures consist of the Structure A-checks (SA-checks) packages. The base checks are Structure C-checks (SC-checks) packages.

Periodic Check Planning by FC

Interval		300	600	900	1200	1500	1800	2100	2400	2700	3000	3300	3600	3900	4200)	4500	4800	5100	5400
Check	FC																		
SA	300	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
S 2A	600		+		+		+		+		+		+		+		+		+
S 4A	1200				+				+				+				+		
SC	3000										+								

S A-checks

S A-check intervals may be increased or reduced by ±30 FC or ±1 month.

Accumulated aircraft operation experience, structural tests and engineering analysis allowed for substantial reduction of labor content of this type of check.

S A-checks

Checks	Interval, FH	Task Package	Task Total	Labor Content, MH	Access Labor Content, MH	Total Labor Content, MH
S A1, A3	300	S A	16	4.5	0.5	5
S A2	600	S A+S 2A	82	25.5	6.5	32
S A4	1200	S A+S 2A+S 4A	97	30	10	40

S C-checks

S C-check interval may vary by ±300 FC or ±3 months and includes 68 tasks having labor content of 45 man-hours (together with access activities labor content - 213 man-hours.

Base checks	Interval, FC	Task Package	Task Total	Labor Content, MH	Access Labor Content, MH	Removal Labor Content, MH	Total Labor Content, MH
S C1	3000	S A+S 2A+S C+ S C/S 2A	154	73	48	130	251
S C2	6000	S A+S 2A+S 4A+ S C+S C/S 2A +S 2C	172	78	54	130	262
S C3	9000	S A+S 2A+S C+ S C/S 2A+S 3C+ S3C/SC+ S 3C/S 2C	197	103	167	130	400

Cost of maintenance of AN-148/-158 and their competitors

Aircraft	AN-148/-158	CRJ900	ERJ175	ERJ190
Engine	Д-436-148	CF34-8C	CF34-8E	CF34-10E
Flight Hours : Flying Cycle	2:1	1.15:1	1.28:1	1.28:1
Line Maintenance	24	85	65	65
A-check	14	61	38	38
C-check	28	40	79	79
S A-check	2	N/A	N/A	N/A
S C-checks	5			
Interior and Exterior Renovation	10	20	21	21
Landing Gear	7	12	8	14
Wheels and Brakes	37	74	39	55
APU	42	27	18	18
Life-limited components	154	230	209	209
Airframe and Units	**323**	**549**	**477**	**499**
Powerplant	**204**	**370**	**360**	**312**
Maintenance cost, total, $/FH:	**527**	**919**	**837**	**811**

Note: Aircraft maintenance cost information contained herein as provided by the manufacturers

Summary

The AN-148/-158 family is a competitive advanced technology product, which corresponds to all modern requirements, security and ecological compatibility standarts.

In comparison with its competitors: Embraer (ERJ-175, ERJ-190, ERJ-175E2, ERJ-190E2), Bombardier 9CRJ-900, CRJ-1000) and Mitsubishi (MRJ90), the AN-148/-158 aircraft have the following advantages:

-low cost of own (leasing rates);

-optimum maintenance system with a lower cost;

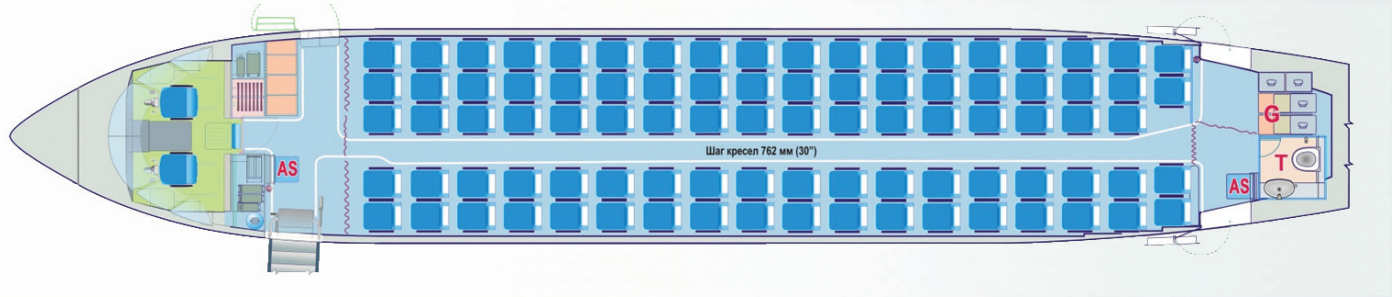
-lower direct operational costs (direct operating costs of the competitors are 5.5% higher);

-the lowest index of breakeven load with passengers.

AN-148-200 layouts

89-seat single-class layout

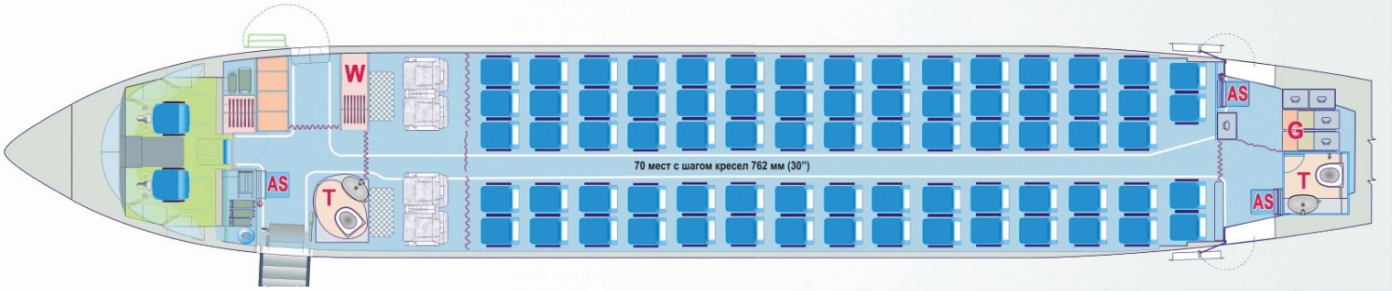
Economy-Class, seats pitch 30“(762 mm)



78-seat two-class layout

4-Business Class

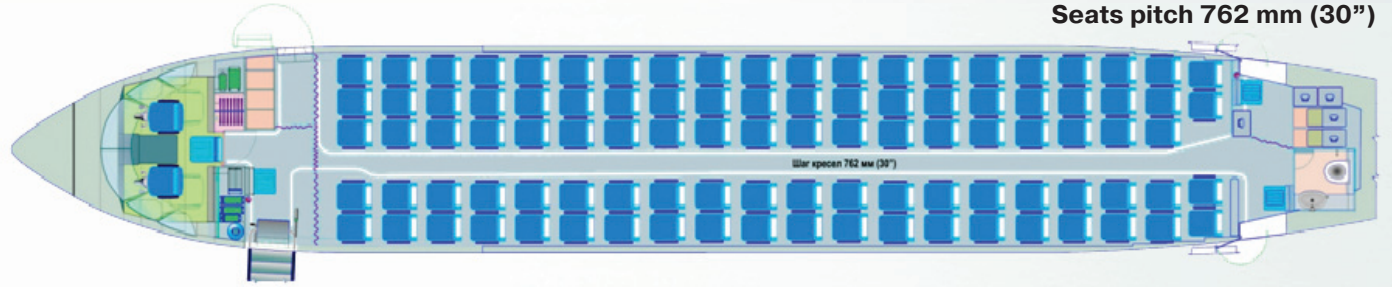
74-Economy-Class, seats pitch 30“(762 mm)



AN-158 layouts

99-seat single-class layout

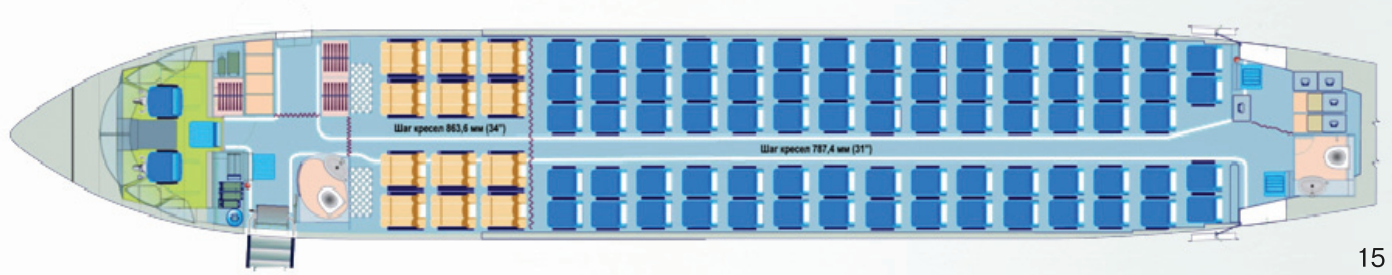
Seats pitch 762 mm (30”)



86-seat two-class cayout

12-Business Class

12 seats x 863,6 mm (34”) + 74 seats x 787,4 mm (31”)



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