POLITECNICO DI TORINO
ESAME DI STATO PER L'ABILITAZIONE ALLA PROFESSIONE DI INGEGNERE
RAMO AERONAUTICO
VECCHIO ORDINAMENTO

II SESSIONE 2011

Prova scritta del 23 novembre 2011

Si consideri un velivolo executive a getto, della classe del Bombardier Challenger 300, di cui sono riportate le caratteristiche in allegato.

Quesito n.1
Il velivolo in esame è dotato di due serbatoi integrali alari. Si assuma che:

- ogni serbatoio alare è dotato di 2 pompe combustibile azionate elettricamente
- la pressione del serbatoio è $p_{serbatoio}$ = 1.5 bar
- la pressione di ingresso motore è $p_{ingresso\ motore}$ = 0.5 bar
- il consumo specifico dei motori è SFC = 0.42 N/Nh
- il peso specifico del combustibile in condizioni operative è $\gamma = 8$ N/dm^3
- la viscosità cinematica del combustibile è ν = 1.2 E-4 m^2/s
- le tubazioni di alimentazione hanno un diametro $\phi \leq 20$ mm
- le perdite di carico concentrate sono pari alle perdite di carico distribuite

Si ipotizzi il velivolo in discesa, in condizioni di angolo di discesa massimo pari a 30°, e con una sola pompa combustibile funzionante sulle 4 presenti a bordo. Nel disegno allegato sono indicate:

- la posizione indicativa della pompa
- la posizione della valvola di cross feed
- la linea di alimentazione

Si calcolino:

a. le perdite di carico (concentrate e distribuite)
b. il punto di funzionamento sulla caratteristica della pompa (diagramma portata volumetrica-prevalenza)

Quesito n.2
Il velivolo in esame è dotato di un carrello retrattile.

c. Si stimi il peso del carrello principale, mediante la formula di derivazione statistica

$$W_{mlg} = 0.095 \times (N_l \times W_l)^{0.768} \times \left(\frac{L_m}{12}\right)^{0.409}$$

dove:

- N_l è il fattore di carico ultimo all'atterraggio, tipicamente un valore compreso tra 2.7 e 3 moltiplicato per un fattore di sicurezza
- W_l è il peso massimo del velivolo all'atterraggio [in libbre]
- L_m è la lunghezza di ciascuna gamba del carrello principale [in pollici]

Quesito n.3
La trave in figura 1 è incastrata e può rappresentare una semiala del velivolo, di cui ai punti precedenti, ipotizzata come dritta e non rastremata. I valori delle distanze L_1 e L_2 dalla radice possono essere ricavati dai disegni in scala allegati. P è un carico concentrato (in Newton) rappresentato dalla gamba del carrello principale di cui al Quesito n.2, C=10 kNm è una coppia applicata all'estremità alare, e q=10 kN/m è il carico distribuito lungo tutta l'apertura della semiala.

Data la struttura schematizzata come in figura 1:

d. si traccino i diagrammi di sollecitazione T, N, M

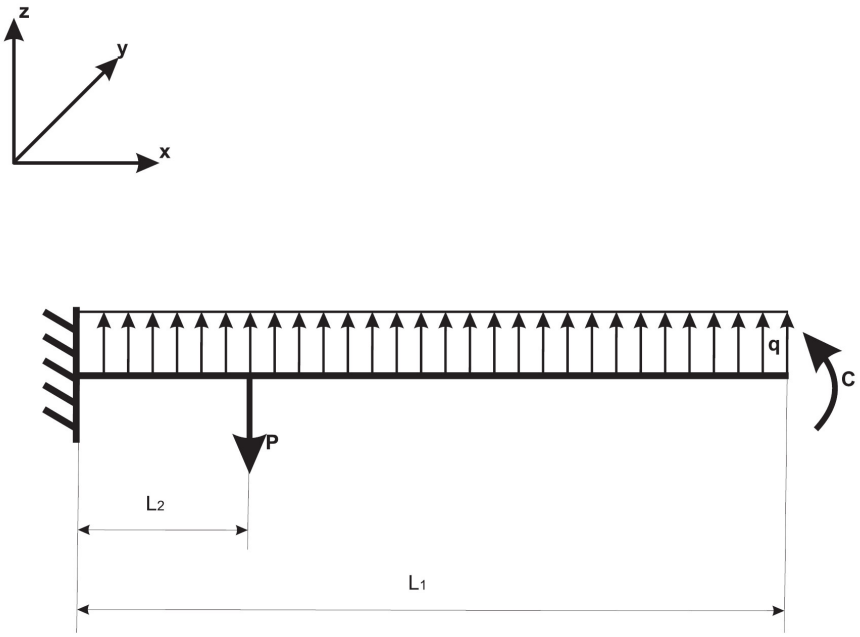


Figura 1

Quesito n.4

Si consideri quindi una sezione alare a distanza L = 8 m dalla radice e schematizzata come in figura 2. Si ipotizzi la dimensione d=400 mm e le aree dei correnti A1=A5=A3=350 mm^2 e A2=A4=700 mm^2.

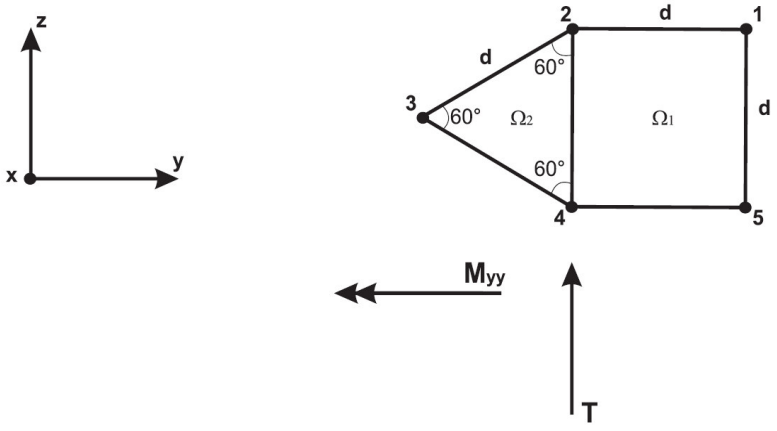


Figura 2

Con il metodo della trave a semiguscio si calcolino:

e. le tensioni nei correnti e i flussi nei pannelli
f. il gradiente di torsione
g. il centro di taglio

N.B.

Il candidato ipotizzi gli eventuali dati mancanti in modo sensato dal punto di vista ingegneristico.

ACCOMMODATION: Standard dual-class accommodation for 86 passengers in four-abreast configuration at 79 cm (31 in) seat pitch with fore and aft lavatories and forward galley; alternative configurations include high density with accommodation for 90 passengers at 79 cm (31 in) seat pitch, dual-class with 15 business class seats three-abreast at 86 cm (34 in) seat pitch in forward section and 60 economy class four-abreast at 79 cm (31 in) seat pitch at rear, and dual class with 55 business class seats in four-abreast configuration at 84 cm (33 in) seat pitch in forward section and 24 economy class at 79 cm (31 in) seat pitch at rear. Standard additional floor beam facilitates offset seat rail for three-abreast seating throughout cabin.

SYSTEMS: Honeywell RE220 APU.

Following data are provisional.

AVIONICS: As for CRJ700.

DIMENSIONS, EXTERNAL: As for CRJ700 except

Wing span	23.24 m (76 ft 3 in)
Length overall	36.19 m (118 ft 9 in)
Height overall	7.49 m (24 ft 7 in)
Wheelbase	14.73 m (48 ft 4 in)
Aft service door (stbd):	
Height	1.22 m (4 ft 0 in)
Width	0.61 m (2 ft 0 in)
Height to sill	2.39 m (7 ft 10 in)
Emergency exits (four, overwing):	
Height	0.91 m (3 ft 0 in)
Width	0.51 m (1 ft 8 in)

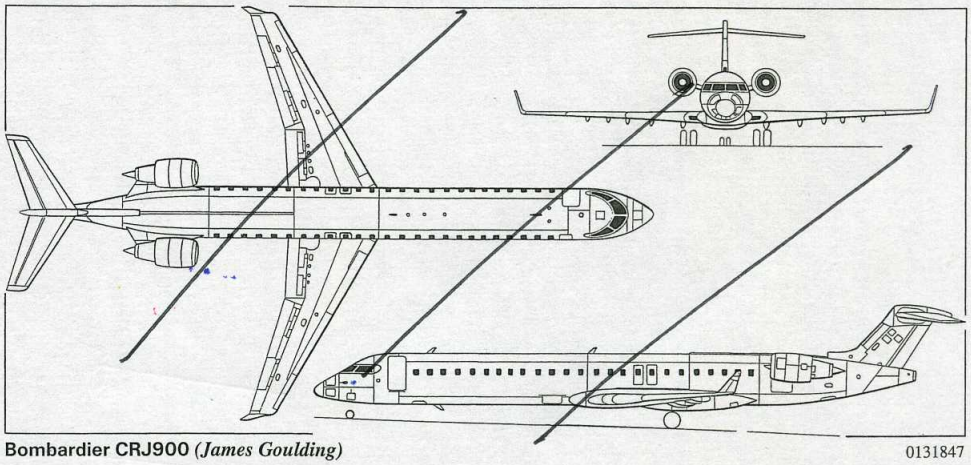
DIMENSIONS, INTERNAL:

Cabin (excl flight deck):	
Baggage volume: checked	16.81 m³ (593.5 cu ft)
total	25.57 m³ (903 cu ft)

WEIGHTS AND LOADINGS:

Operating weight empty	21,546 kg (47,500 lb)
Max payload	10,206 kg (22,500 lb)
Payload with max fuel: 900	6,178 kg (13,620 lb)
900ER	6,972 kg (15,370 lb)
Max fuel weight	8,822 kg (19,450 lb)
Max T-O weight: 900	36,514 kg (80,500 lb)
900ER	37,421 kg (82,500 lb)
900ER European	36,995 kg (81,560 lb)
900LR	38,328 kg (84,500 lb)
900LR European	39,808 kg (87,763 lb)
Max ramp weight: 900	36,627 kg (80,750 lb)
900ER	37,535 kg (82,750 lb)
900LR	38,442 kg (84,750 lb)
Max landing weight	33,339 kg (73,500 lb)
Max zero-fuel weight	31,751 kg (70,000 lb)
Max wing loading: 900	532.1 kg/m² (108.98 lb/sq ft)
900ER	545.3 kg/m² (111.68 lb/sq ft)
900ER European	539.1 kg/m² (110.41 lb/sq ft)
900LR	558.5 kg/m² (114.39 lb/sq ft)
900LR European	580.1 kg/m² (118.81 lb/sq ft)
Max power loading: 900	313 kg/kN (3.07 lb/lb st)
900ER	320 kg/kN (3.14 lb/lb st)
900ER European	317 kg/kN (3.11 lb/lb st)
900LR	328 kg/kN (3.22 lb/lb st)
900LR European	325 kg/kN (3.19 lb/lb st)

Prototype Bombardier CRJ900 wearing house colours 0130587

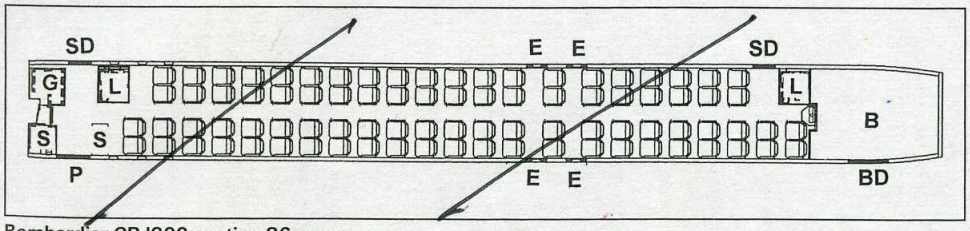


Bombardier CRJ900 ***(James Goulding)*** 0131847

PERFORMANCE:

Cruising Mach No:	
high speed	0.83 (476 kt; 882 km/h; 548 mph)
for max range	0.78 (444 kt; 822 km/h; 511 mph)
Max certified altitude: 900, 900ER	12,500 m (41,000 ft)
Service ceiling, OEI: 900	4,968 m (16,300 ft)
900ER	4,755 m (15,600 ft)
FAR T-O field length:	
900	1,871 m (6,140 ft)
900ER	1,969 m (6,460 ft)
900LR	2,068 m (6,785 ft)
FAR landing field length at S/L, ISA, at max landing weight:	
900, 900ER, 900LR	1,660 m (5,445 ft)
Range, 86 passengers, at M0.77:	
900	1,540 n miles (2,852 km; 1,772 miles)
900ER	1,777 n miles (3,291 km; 2,045 miles)
900LR	1,941 n miles (3,594 km; 2,233 miles)

UPDATED



Bombardier CRJ900 seating 86 passengers

B: baggage, BD: baggage door, E: Type III exit, G: galley, L: lavatory, P: Type I passenger door, S: Stowage, SD: Type I service door 0105026

BOMBARDIER BD-100 CHALLENGER 300

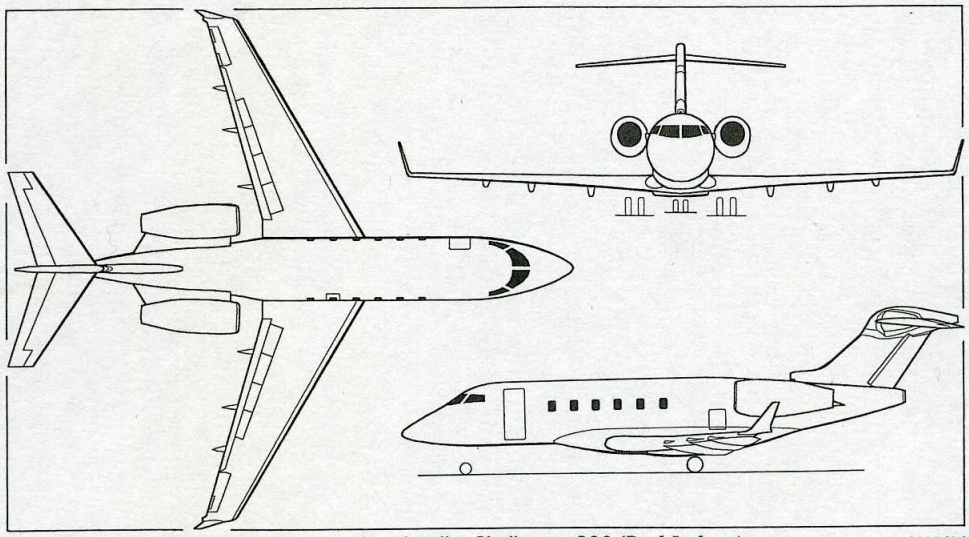
TYPE: Business jet.

PROGRAMME: Design study, then known as 'Bombardier Model 70', revealed at the Paris Air Show in June 1997; formally announced at NBAA Convention at Las Vegas 18 October 1998; launched at Paris Air Show 13 June 1999; initially named Continental; engineering designation BD-100-1A10; first metal cut 21 October 1999 following completion of joint definition phase; AS907 engine first flown 29 January 2000, engine certification achieved 25 June 2002; wing/fuselage mating of first aircraft achieved 19 November 2000; first flight (c/n 20001/C-GJCJ) from the Bombardier Flight Test Center at Wichita's Mid-Continent Airport 14 August 2001, followed by second aircraft (c/n 20002/C-GJCF) on 9 October. These and three further aircraft (c/n 20003/C-GIPX, dedicated to avionics test and flown 6 December 2001; c/n 20004/C-GJCV for systems testing and the first to be fully outfitted with standard interior, flew 5 April 2002; and c/n 20005/C-GIPZ, for function and reliability testing (including cabin systems), originally due to fly in May 2002 but delayed until 8 March 2003; is participating in the flight test and certification programme scheduled to last for more than 1,500 flight hours, culminating in Transport Canada 525 approval, FAA FAR Pt 25 and JAA JAR 25 certification, with RVSM approval, FAR Pt 36 Stage 3 noise compliance, and first customer deliveries in 2003. By 23 April 2003 the five aircraft then flying had accumulated 2,126 flight test hours in 1,039 sorties.

Public debut at NBAA Convention, New Orleans, 11 December 2001 (formal presentation 12 December). European debut (C-GJCV) at EBACE 2003 at Geneva 5 May 2003. Re-named Challenger 300 on 8 September

Bombardier Challenger 300 flight deck 0126928

Bombardier Challenger 300 cabin mockup 0126929



Provisional general arrangement of the Bombardier Challenger 300 ***(Paul Jackson)*** 0085636

2002, immediately prior to NBAA Convention at Orlando, Florida. Customer deliveries scheduled to begin in late 2002, with up to five aircraft expected to be handed over to operators by the end of the year. Target production up to 15 in 2003, rising to 40 in 2004 and the maximum planned rate of 60 per year from 2005.

CUSTOMERS: Two orders signed at time of launch, by customers in Germany and United Arab Emirates; total of 125 firm orders received by 5 May 2003, including 25 for Bombardier's Flexjet fractional ownership programme, 15 for European customers and five for its Middle East and Arab nations distributor TAG Aeronautics. Bombardier anticipates gaining 30 per cent of estimated 1,200-aircraft market in this class by 2012, with fractional ownership operations especially targeted.

COSTS: Development cost C$500 million (1998); break-even estimated at 300th aircraft. Unit cost US$16.29 million typically equipped (2002). Direct operating cost estimated at US$1,329 per hour (2002).

DESIGN FEATURES: Design goals included coast-to-coast range across USA with eight passengers in cabin with stand-up headroom and take-off field length less than 1,525 m (5,000 ft). General configuration is as shown in the accompanying illustrations; supercritical wing with winglets, sweepback 27° at quarter-chord.

FLYING CONTROLS: Conventional. Ailerons manually actuated via cables, pulleys and pushrods, each with a geared tab and fixed tab, plus trim tab on port aileron only; maximum aileron deflections +23/–19°. Horn-balanced elevators, maximum deflections +23/–18°, and single rudder panel, maximum deflection ±30°, hydraulically actuated by cables and pulleys with manual reversion, each with dual PCUs; variable incidence tailplane for pitch trim, maximum travel +2/–13°. Hydraulically actuated Fowler flaps, maximum deflection 30°; each wing has two-segment multifunction spoiler outboard, maximum deflection 45°, and two-segment ground spoiler/lift dumper inboard, maximum deflection 60°; yaw damper standard.

STRUCTURE: Primarily light alloy, with composites for some non-structural fairings; fuselage of semi-monocoque construction with frames and stringers; two-spar wing; three-spar fin. Programme suppliers include: AIDC Taiwan (rear fuselage and tail unit); Canadair (cockpit, forward fuselage and primary flight controls); DeCrane Aircraft (cabin interior) ECE (electrical system and cockpit lighting); Fischer Austria (wing-to-fuselage fairings); GKN Westland (engine nacelles); Goodrich (wheels and brakes); Hawker de Havilland Australia (tailcone and APU installation kit); Hella (lighting); Honeywell (power plant and APU); Hurel-Dubois (thrust reversers); Intertechnique (fuel system); Liebherr Aerospace-Toulouse (environmental control and anti-icing systems); Liebherr Aerospace Lindenberg (flap control system); Messier-Dowty (landing gear); Mitsubishi Heavy Industries (wing); Moog (secondary flight controls); NLX (flight training device and level C/D flight simulator); Parker Aerospace (hydraulic system); PPG Industries (cockpit windscreens and cabin windows); Rockwell Collins (avionics); Scott Aviation (oxygen system); Shorts (centre fuselage), and Walter Kidde (fire detection and suppression system). Final assembly will be at Bombardier's Learjet facility in Wichita, with interior completion in Tucson.

LANDING GEAR: Hydraulically retractable tricycle type by Messier-Dowty, with two wheels on each unit; trailing-link-type main units retract inwards, nosewheel forwards. Steerable nosewheel, maximum deflection ±65°. Mainwheel tyre size 26.5×8.0-18, nosewheel tyre size 18×5.5-10. Goodrich carbon composites multiple disc brakes. Turning radius 17.68 m (58 ft 0 in).

POWER PLANT: Two Honeywell AS907 turbofans with FADEC, each with thermodynamic rating of 35.81 kN (8,050 lb st), flat-rated to 28.91 kN (6,500 lb st) with APR at ISA+15°C. All fuel contained in two integral wing tanks, combined capacity 7,684 litres (2,030 US gallons; 1,690 Imp gallons). Gravity fuelling point in top of each wing, near leading-edge, plus single-point pressure refuelling/defuelling port in starboard wingroot near leading-edge. Target-type reversers standard.

ACCOMMODATION: Two crew flight deck; cabin, with flat floor, accommodates eight passengers in standard 'double club' arrangement on tracking, swivelling and reclining 16 *g* seats with retractable headrests, cabin management controls, cupholders and shoulder harnesses; three-seat 16 *g* take-off and landing-certified divan with extending backrest optional as interchange for two club seats. Standard cabin equipment includes fold-out work tables; one 110 V electrical outlet per club seat group; hot drinks dispensers; DVD/CD player with hi-fi grade audio speakers and two 381 mm (15 in) flat screen monitors; Airshow 400 system; Magnastar 2000 in-flight telephone with two handsets and switchable locations; extended-life LED lighting; forward galley with microwave oven; forward passenger wardrobe and crew coat closet; aft lavatory and vanity unit with hot and cold water and removable waste tank, and flight-accessible baggage compartment. Free-fall opening/power-assisted-closure, semi-plug-type airstair cabin door, on port side immediately aft of flight deck, also serves as Type I emergency exit; single plug-type overwing Type III emergency exit on starboard side, between rearmost pair of club seats. External baggage door aft of port wing trailing-edge. Cabin and baggage compartment pressurised, air-conditioned and heated.

SYSTEMS: Two independent phosphate-ester hydraulic systems with one engine-driven pump and one DC motor pump per system, pressure 207 bar (3,000 lb/sq in), plus one auxiliary system powered by an accumulator. Pressurisation system, differential 0.60 bar (8.78 lb/sq in), with auxiliary system providing pressurisation up to 10,670 m (35,000 ft). 28 V DC electrical system comprises three 400 Ah DC brushless generators (one each on the engines and one on the APU) and two 24 V 44 Ah Ni/Cd batteries which provide power for APU starting, in-flight emergency power and ground power. APU generator can carry load of a failed engine generator, and one battery can supply power for APU starting. Oxygen system, capacity to suit customer requirements, with demand-type masks for crew and drop-down masks for passengers.

Engine bleed air automatically controlled anti-icing for wing leading-edges and nacelle lips; electrically anti-iced windscreen; heated angle-of-attack vanes and pitot probes. Honeywell tailcone-mounted RE220 APU, with FADEC, will be certified for operation up to 11,280 m (37,000 ft) and in-flight starting to 9,150 m (30,000 ft).

AVIONICS: Rockwell Collins Pro Line 21 as core system.

Comms: Dual VHF com with 8.33 kHz frequency spacing capability; dual integrated radio control and display units; dual transponders, all standard. Third VHF com; dual HF com, satcom, VHF/satcom datalink capability, Selcal and ELT optional.

Radar: Dual-scan digital weather radar with optional turbulence detection.

Flight: Standard equipment includes dual ILS/VOR/markers, AHRS and air data computers; single ADF, DME, FMS/CDU, GPS sensor, EGPWS, TCAS II, EICAS, radio altimeter, CVR and flight deck aural warning system. Second ADF, DME, FMS/CDU and GPS, three-dimensional flight plan maps, FDR and lightning sensor optional.

Instrumentation: EFIS with four 305 × 254 mm (12 × 10 in) colour LCDs providing liquid PFD and MFD functions for pilot and co-pilot.

DIMENSIONS, EXTERNAL:

Wing span over winglets	19.46 m (63 ft 10 in)
Length overall	20.93 m (68 ft 8 in)
Height overall	6.17 m (20 ft 3 in)
Fuselage max diameter	2.34 m (7 ft 8 in)
Tailplane span	7.23 m (23 ft 8½ in)
Wheel track	3.20 m (10 ft 6 in)
Wheelbase	8.46 m (27 ft 9 in)
Passenger door: Height	1.89 m (6 ft 2½ in)
Width	0.76 m (2 ft 6 in)
Baggage door: Height	0.76 m (2 ft 6 in)
Width	0.61 m (2 ft 0 in)
Height to sill	1.63 m (5 ft 4 in)
Emergency exit: Height	0.91 m (3 ft 0 in)
Width	0.51 m (1 ft 8 in)

DIMENSIONS, INTERNAL:

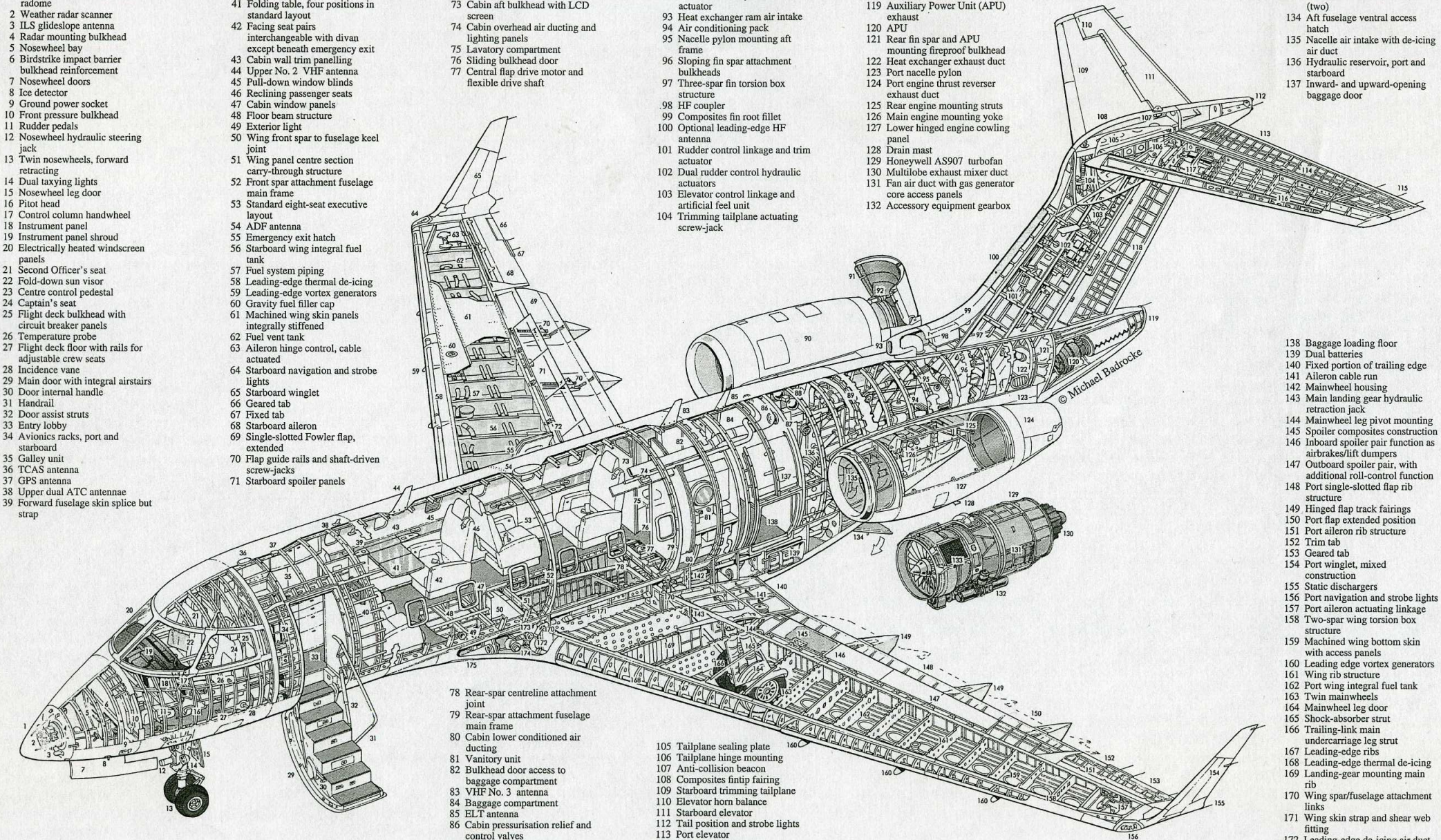
Cabin (excl cockpit):	
Length	8.71 m (28 ft 7 in)
Width: at centreline	2.18 m (7 ft 2 in)
at floor	1.55 m (5 ft 1 in)
Max height	1.85 m (6 ft 1 in)
Floor area	13.5 m² (146 sq ft)
Volume	24.35 m³ (860 cu ft)
Baggage compartment volume	2.99 m³ (105.50 cu ft)

Challenger 300 wearing its new name for the first time at NBAA Convention, Orlando, Florida, September 2002 ***(Paul Jackson)*** 0533392

Fifth Bombardier Challenger 300 taking off for the first time on 8 March 2003 ***NEW***/0547101

Bombardier Challenger 300 cutaway drawing key

1 Upward hinging composites radome
2 Weather radar scanner
3 ILS glideslope antenna
4 Radar mounting bulkhead
5 Nosewheel bay
6 Birdstrike impact barrier bulkhead reinforcement
7 Nosewheel doors
8 Ice detector
9 Ground power socket
10 Front pressure bulkhead
11 Rudder pedals
12 Nosewheel hydraulic steering jack
13 Twin nosewheels, forward retracting
14 Dual taxying lights
15 Nosewheel leg door
16 Pitot head
17 Control column handwheel
18 Instrument panel
19 Instrument panel shroud
20 Electrically heated windscreen panels
21 Second Officer's seat
22 Fold-down sun visor
23 Centre control pedestal
24 Captain's seat
25 Flight deck bulkhead with circuit breaker panels
26 Temperature probe
27 Flight deck floor with rails for adjustable crew seats
28 Incidence vane
29 Main door with integral airstairs
30 Door internal handle
31 Handrail
32 Door assist struts
33 Entry lobby
34 Avionics racks, port and starboard
35 Galley unit
36 TCAS antenna
37 GPS antenna
38 Upper dual ATC antennae
39 Forward fuselage skin splice but strap
40 Wardrobe
41 Folding table, four positions in standard layout
42 Facing seat pairs interchangeable with divan except beneath emergency exit
43 Cabin wall trim panelling
44 Upper No. 2 VHF antenna
45 Pull-down window blinds
46 Reclining passenger seats
47 Cabin window panels
48 Floor beam structure
49 Exterior light
50 Wing front spar to fuselage keel joint
51 Wing panel centre section carry-through structure
52 Front spar attachment fuselage main frame
53 Standard eight-seat executive layout
54 ADF antenna
55 Emergency exit hatch
56 Starboard wing integral fuel tank
57 Fuel system piping
58 Leading-edge thermal de-icing
59 Leading-edge vortex generators
60 Gravity fuel filler cap
61 Machined wing skin panels integrally stiffened
62 Fuel vent tank
63 Aileron hinge control, cable actuated
64 Starboard navigation and strobe lights
65 Starboard winglet
66 Geared tab
67 Fixed tab
68 Starboard aileron
69 Single-slotted Fowler flap, extended
70 Flap guide rails and shaft-driven screw-jacks
71 Starboard spoiler panels
72 Spoiler hydraulic actuators
73 Cabin aft bulkhead with LCD screen
74 Cabin overhead air ducting and lighting panels
75 Lavatory compartment
76 Sliding bulkhead door
77 Central flap drive motor and flexible drive shaft
78 Rear-spar centreline attachment joint
79 Rear-spar attachment fuselage main frame
80 Cabin lower conditioned air ducting
81 Vanitory unit
82 Bulkhead door access to baggage compartment
83 VHF No. 3 antenna
84 Baggage compartment
85 ELT antenna
86 Cabin pressurisation relief and control valves
87 Rear pressure bulkhead
88 Engine fire extinguisher bottles
89 Nacelle pylon mounting main frame
90 Starboard engine nacelle
91 Target-type thrust reverser
92 Reverser door hydraulic actuator
93 Heat exchanger ram air intake
94 Air conditioning pack
95 Nacelle pylon mounting aft frame
96 Sloping fin spar attachment bulkheads
97 Three-spar fin torsion box structure
98 HF coupler
99 Composites fin root fillet
100 Optional leading-edge HF antenna
101 Rudder control linkage and trim actuator
102 Dual rudder control hydraulic actuators
103 Elevator control linkage and artificial feel unit
104 Trimming tailplane actuating screw-jack
105 Tailplane sealing plate
106 Tailplane hinge mounting
107 Anti-collision beacon
108 Composites fintip fairing
109 Starboard trimming tailplane
110 Elevator horn balance
111 Starboard elevator
112 Tail position and strobe lights
113 Port elevator
114 Elevator rib structure
115 Static dischargers
116 Tailplane two-spar and rib torsion box structure
117 Dual elevator control hydraulic actuators
118 Rudder rib structure
119 Auxiliary Power Unit (APU) exhaust
120 APU
121 Rear fin spar and APU mounting fireproof bulkhead
122 Heat exchanger exhaust duct
123 Port nacelle pylon
124 Port engine thrust reverser exhaust duct
125 Rear engine mounting struts
126 Main engine mounting yoke
127 Lower hinged engine cowling panel
128 Drain mast
129 Honeywell AS907 turbofan
130 Multilobe exhaust mixer duct
131 Fan air duct with gas generator core access panels
132 Accessory equipment gearbox
133 Electronic fuel control unit (two)
134 Aft fuselage ventral access hatch
135 Nacelle air intake with de-icing air duct
136 Hydraulic reservoir, port and starboard
137 Inward- and upward-opening baggage door
138 Baggage loading floor
139 Dual batteries
140 Fixed portion of trailing edge
141 Aileron cable run
142 Mainwheel housing
143 Main landing gear hydraulic retraction jack
144 Mainwheel leg pivot mounting
145 Spoiler composites construction
146 Inboard spoiler pair function as airbrakes/lift dumpers
147 Outboard spoiler pair, with additional roll-control function
148 Port single-slotted flap rib structure
149 Hinged flap track fairings
150 Port flap extended position
151 Port aileron rib structure
152 Trim tab
153 Geared tab
154 Port winglet, mixed construction
155 Static dischargers
156 Port navigation and strobe lights
157 Port aileron actuating linkage
158 Two-spar wing torsion box structure
159 Machined wing bottom skin with access panels
160 Leading edge vortex generators
161 Wing rib structure
162 Port wing integral fuel tank
163 Twin mainwheels
164 Mainwheel leg door
165 Shock-absorber strut
166 Trailing-link main undercarriage leg strut
167 Leading-edge ribs
168 Leading-edge thermal de-icing
169 Landing-gear mounting main rib
170 Wing spar/fuselage attachment links
171 Wing skin strap and shear web fitting
172 Leading-edge de-icing air duct
173 Wing inspection light
174 Position of pressure refuelling connection on starboard side
175 Landing light, port and starboard



AREAS:

Wings, net	48.49 m² (522.0 sq ft)
Ailerons, total	0.93 m² (10.00 sq ft)
Trailing-edge flaps, total	7.56 m² (81.40 sq ft)
Spoilers, total	3.55 m² (38.26 sq ft)
Rudder, incl tabs	1.89 m² (20.40 sq ft)
Tailplane	11.39 m² (122.55 sq ft)
Elevators	4.22 m² (45.40 sq ft)

WEIGHTS AND LOADINGS (provisional):

Operating weight empty	10,138 kg (22,350 lb)
Outfitting allowance	1,315 kg (2,900 lb)
Payload: max	1,360 kg (3,000 lb)
with max fuel	725 kg (1,600 lb)
Max fuel weight	6,214 kg (13,700 lb)
Fuel with max payload	5,579 kg (12,300 lb)
Max T-O weight	17,010 kg (37,500 lb)
Max ramp weight	17,078 kg (37,650 lb)
Max landing weight	15,308 kg (33,750 lb)
Max zero-fuel weight	11,498 kg (25,350 lb)
Max wing loading	350.8 kg/m² (71.84 lb/sq ft)
Max power loading	294 kg/kN (2.88 lb/lb st)

PERFORMANCE (estimated):

Max level speed	476 kt (882 km/h; 548 mph)
High cruising speed	M0.82 or 470 kt (870 km/h; 541 mph)
Normal cruising speed	M0.80 or 459 kt (850 km/h; 528 mph)
Max rate of climb at S/L	1,097 m (3,600 ft)/min
Rate of climb at S/L, OEI	205 m (673 ft)/min
Initial cruising altitude	12,500 m (41,000 ft)
Max certified altitude	13,715 m (45,000 ft)
T-O balanced field length	1,509 m (4,950 ft)
Landing run at max landing weight	792 m (2,600 ft)
Range with eight passengers, NBAA IFR reserves	3,100 n miles (5,741 km; 3,567 miles)

UPDATED

BOMBARDIER CL-600 CHALLENGER 604

Canadian Forces designations: CC-144, CC-144B and CE-144A

TYPE: Business jet.

PROGRAMME: First flight of first of three prototypes (C-GCGR-X) 8 November 1978; first flight production Challenger 600 with AlliedSignal ALF 502L-2 turbofans 21 September 1979; first customer delivery 30 December 1980; first flight Challenger 601 with GE CF34s 10 April 1982; first 601-1A delivered 6 May 1983; first 601-3A 6 May 1987 and first 601-3A/ER 19 May 1989; first 601-3R 14 July 1993; first 604 25 January 1996. Challenger certified for operation in 40 countries by 1998. By 31 December 2002 the Challenger fleet had flown 2,300,000 hours, with a despatch reliability of 99.7 per cent. 500th Challenger rolled out 'green' 25 May 2000 and handed over (as N816CC) 1 September 2000; 600th was undergoing interior outfitting in March 2003.

CURRENT VERSIONS: **Challenger 600:** Total 84 built after certification in 1980 (76 since retrofitted with winglets); 12 delivered to Canadian Department of National Defence as CC-144 (three) and CE-144A (three), plus three for coastal patrol, two for general transport and one test aircraft. Production completed with final delivery on 22 June 1983.

Challenger 601-1A: First production version to have CF34 engines; first flight 17 September 1982. Deliveries (66, including four CC-144Bs) between 6 May 1983 and 29 May 1987.

Challenger 601-3A: Version with 'glass' cockpit and CF34-3A engines; first flight 28 September 1986; Canadian and US certification 21 and 30 April 1987; also certified for Cat. II and in 22 other countries; improvements include CF34-3A engines flat rated to 21°C, and fully integrated digital flight guidance and flight management systems. Total of 134 delivered between 6 May 1987 and 29 October 1993.

Challenger 601-3R: Extended-range option available on new 601-3As since 1989 (c/n 5135 and onwards) and as retrofit to 601-1As and 601-3As; range increased to 3,585 n miles (6,639 km; 4,125 miles) with NBAA IFR reserves; first flight 8 November 1988; Canadian certification 16 March 1989; tail fairing replaced with conformal tailcone fuel tank which extends fuselage length by 46 cm (1 ft 6 in) and adds 118 kg (260 lb) to operating weight empty; maximum ramp weight increased by 680 kg (1,500 lb). Optional gross weight increase of 227 kg (500 lb). Total of 92 modification kits supplied between March 1989 and October 1993. Challenger 601-3ER, incorporating extended-range modifications, CF34-3A1 engines and 20,457 kg (45,100 lb) max T-O weight, was standard production version from 14 July 1993 (first delivery); 59 new-build aircraft delivered by early 1996; no further production.

Challenger 604: Has range of 4,077 n miles (7,550 km; 4,691 miles) at M0.74 and is powered by General Electric CF34-3B engines each rated at 38.8 kN (8,729 lb st) T-O power at ISA + 15°C. Prototype (C-FTBZ) modified on the production line from a Challenger 601-3R; engineering designation CL-600-2B16; first flight (with CF34-3A engines) 18 September 1994; first flight with definitive CF34-3B engines 17 March 1995. Exploits systems developed in Regional Jet programme. Rockwell Collins Pro Line 4 EFIS; extra 1,242 litres (328 US gallons; 273 Imp gallons) of fuel in aft equipment bay, forward fuselage tank and tail tank. Automatic aft-CG control to reduce trim drag for longer range. New landing gear, carbon brakes and anti-skid system; strengthened tail unit; new wing-to-fuselage and underbelly fairings. Maximum T-O weight 21,863 kg (48,200 lb). Transport Canada certification achieved 20 September 1995; FAA certification 2 November 1995; 100th delivery to a customer was made in mid-1999.

From June 2001, Challenger 604s have been delivered with upgraded PrecisionPlus Collins Pro Line 4 avionics, intended to reduce pilot workload and make the aircraft more compatible with future air traffic environments. Standard PrecisionPlus features include automatic look-up and display of take-off, approach, landing and missed-approach speeds, eliminating the need to refer to manual charts; automatic look-up and display of thrust setting (N_1) for take-off, climb, cruise and go-around; blending of actual observed wind and entered wind to improve the prediction of flight time and fuel requirements; position reporting in non-radar environments such as the North Atlantic; improved polar navigation, enabling the crew to navigate and steer the aircraft at latitudes over 89°; full-time DME reporting on the pilot's MFD; EICAS improvements including the addition of metric fuel indication capability, logic enhancements and FMS performance enhancements; and full integration with the Flight Dynamics HUD and Safe Flight AutoPower autothrottle system. Optional features include flight plan map feature providing an intuitive, three-dimensional graphic representation of the programmed flight plan and predicted flight path for the pilot's and co-pilot's MFDs; long-range cruise feature allowing pilots to select a cruise speed computed by the FMS for either maximum range or maximum speed; search pattern feature offering automatic generation of waypoints; and expanded FDR to meet FAA FAR Pt 135.152 requirements. The PrecisionPlus avionics upgrade is also available for retrofit to earlier Challenger 604s.

Max-Viz EVS-1000 enhanced vision system received FAA certification on 13 March 2003 for installation on Challengers.

Detailed description applies to Challenger 604.

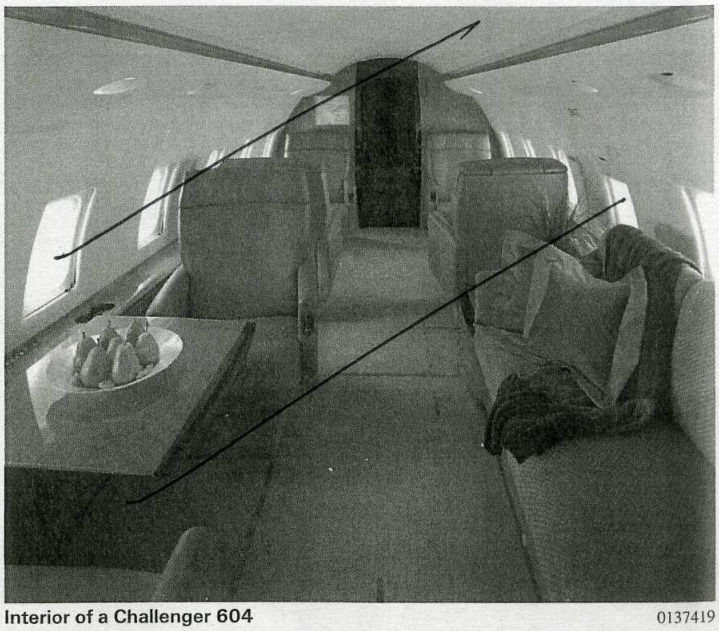
Special Missions: One Challenger 604 delivered in late 2000 to (South) Korean National Maritime Police with unspecified sensor and communications suite. First of two maritime surveillance 604s entered service with Royal Danish Air Force in late 2002.

CUSTOMERS: See under individual headings in Current Versions. More than 600 Challengers of all versions delivered (including to completion centres) by 31 December 2003, including 262 Challenger 604s. Recent customers include the Royal Jordanian Air Force, which ordered two in VIP configuration for delivery during 2000; the Australian government, which ordered three on 16 August 2000 for delivery in 2001 to Qantas Airways, which operates them on behalf of the Royal Australian Air Force for transport of senior government officials; REGA Swiss Air-Ambulance Ltd, which ordered three on 26 September 2001 for delivery in September and November 2002 in air ambulance configuration, and Shandong Airlines of China, launch operator of Bombardier's Flexjet Asia-Pacific fractional ownership programme, which has ordered four. Annual deliveries have included 33 in 1997, 36 in 1998, 40 in 1999, 38 in 2000, 41 in 2001, 31 in 2002, and five in the first three months of 2003.

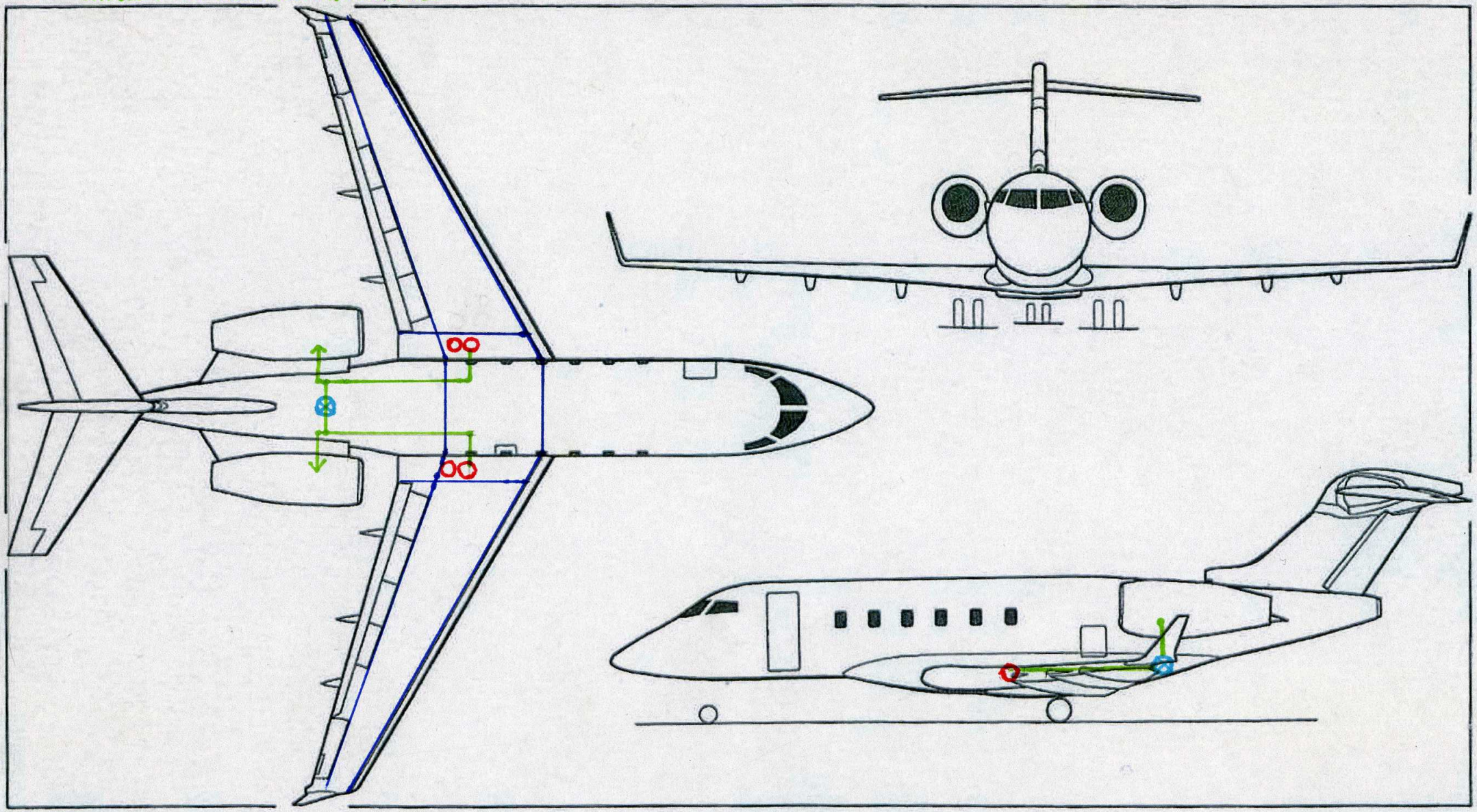
COSTS: Unit cost (604), US$4 million, typically equipped (2002).

Bombardier Challenger 604 business jet *(Paul Jackson)* ***NEW***/0546840

Bombardier Challenger 604 flight deck with PrecisionPlus upgraded Rockwell Collins Pro Line 4 integrated avionics 0126924

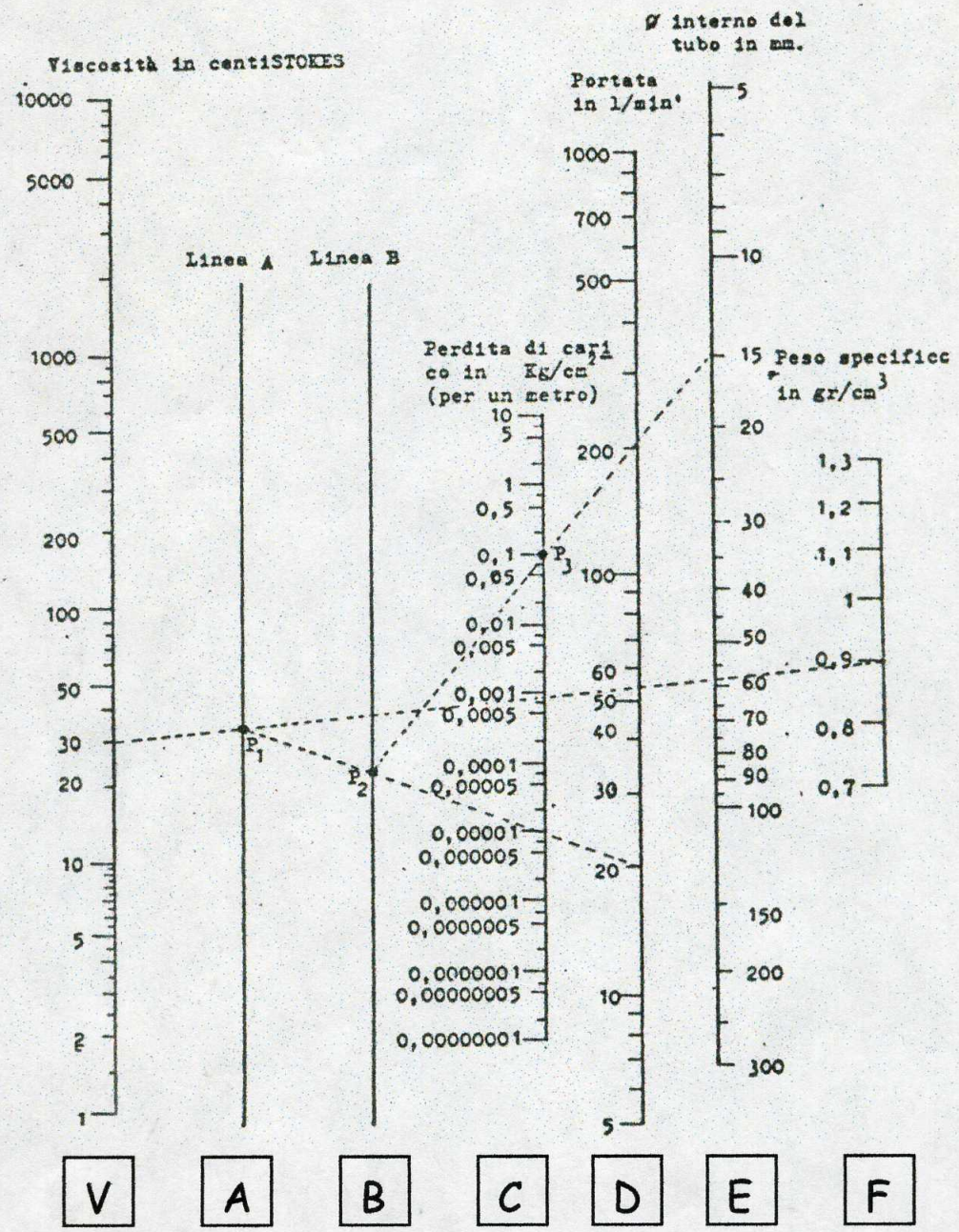


Interior of a Challenger 604 0137419



Provisional general arrangement of the Bombardier Challenger 300 ***(Paul Jackson)***

0085636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Peso specifico in gr/cm³
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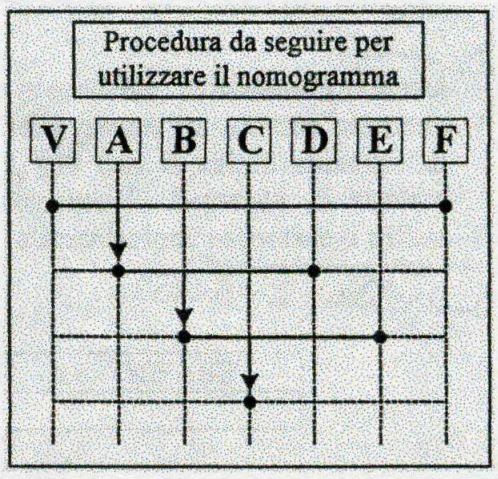
Procedura da seguire per utilizzare il nomogramma
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