F28 PROFESSIONAL

OPERATIONS MANUAL

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Just Flight™

F28 PROFESSIONAL

Operations Manual

Please note that Microsoft Flight Simulator must be correctly installed on your PC prior to the installation and use of this F28 Professional simulation.

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INTRODUCTION

This Just Flight F28 Professional expansion for Microsoft Flight Simulator features the Mk 1000, 2000, 3000 and 4000 variants of this venerable Dutch airliner.

Following on from the successful F27 Friendship turboprop regional airliner, the F28 Fellowship was the Dutch manufacturer's first venture into the turbojet-powered airliner market. Initially aiming at the 50-65 passenger seat market, the F28 Mk 1000 first took to the skies in 1968. Later fuselage extensions and other improvements would see the seating capacity increased to 85 passengers in the stretched Mk 4000 variant which first flew in 1976.

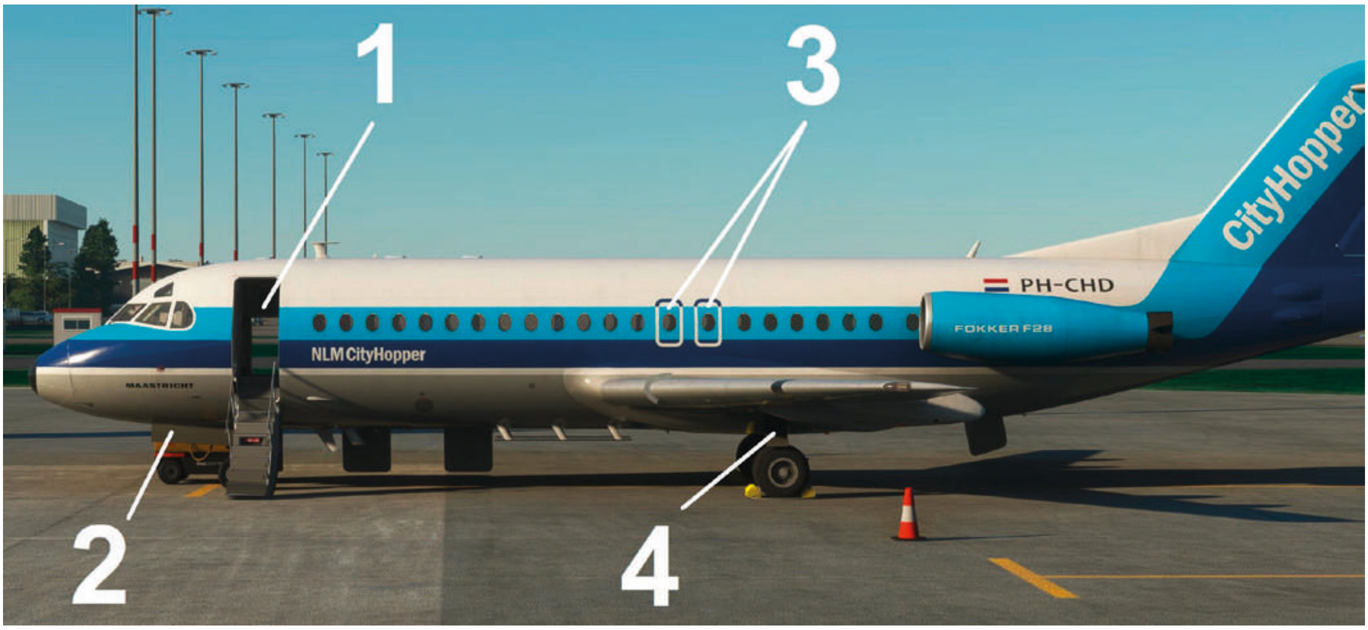
With its low wing, T-tail and rear-mounted engines, the F28 bears a strong resemblance to other regional airliners of its time, such as the BAC 1-11 and DC-9. Unlike its competitors, however, the F28 was designed and built with simplicity of operation and servicing in mind. This led to design decisions such as choosing not to install leading-edge slats on the wings or a reverse thrust mechanism on the RB.183 Mk.555-15 Spey engines; the designers favoured instead a fuselage-mounted airbrake and lift dumpers on the upper surface of the wings.

The F28 continues to serve with a small number of operators into the mid-2020s.

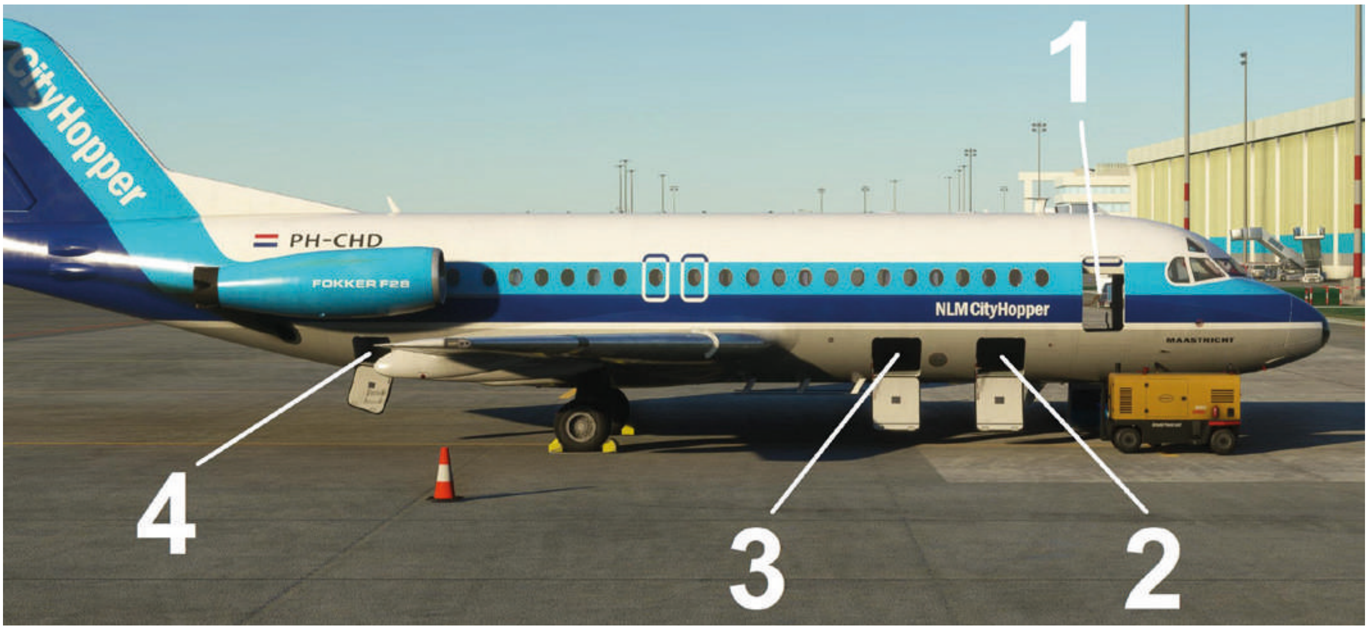
This Just Flight simulation is based on PH-CHN, an F28 Mk 4000 that was originally delivered to NLM Cityhopper in 1982 and is now preserved at the Fokker Technical College in The Netherlands.

Aircraft specifications

Doors



1. Front passenger door
2. Nose gear bay door
3. Over-wing emergency exit doors
4. Main gear bay door



1. Front service door
2. Forward cargo door
3. Centre cargo door
4. Aft cargo door

Dimensions

F28 Mk 1000

Length	27.4 m (89’ 10”)
Wingspan	23.6 m (77’ 4”)
Height	8.47 m (27’ 9.5”)
Wing area	773 m^2 (832 ft^2)

F28 Mk 2000

Length	29.6 m (97’ 2”)
Wingspan	23.6 m (77’ 4”)
Height	8.47 m (27’ 9.5”)
Wing area	773 m2 (832 ft^2)

F28 Mk 3000

Length	27.4 m (89’ 10”)
Wingspan	25.07 m (82’ 3”)
Height	8.47 m (27’ 9”)
Wing area	773 m^2 (832 ft^2)

F28 Mk 4000

Length	29.6 m (97’ 2”)
Wingspan	25.07 m (82’ 3”)
Height	8.47 m (27’ 9.5”)
Wing area	773 m^2 (832 ft^2)

Weights

F28 Mk 1000

Empty weight	35,517 lb (16,144 kg)
Maximum zero fuel weight	54,500 lb (24,720 kg)
Maximum take-off weight	65,000 lb (29,490 kg)
Maximum landing weight	59,000 lb (26,770 kg)

F28 Mk 2000

Empty weight	36.953 lb (16,707 kg)
Maximum zero fuel weight	54,500 lb (24,720 kg)
Maximum take-off weight	65,000 lb (29,490 kg)
Maximum landing weight	59,000 lb (26,770 kg)

F28 Mk 3000

Empty weight	37,139 lb (16,846 kg)
Maximum zero fuel weight	56,000 lb (25,400 kg)
Maximum take-off weight	73,000 lb (33,112 kg)
Maximum landing weight	64,000 lb (29,030 kg)

F28 Mk 4000

Empty weight	38,825 lb (17,611 kg)
Maximum zero fuel weight	62,000 lb (28,120 kg)
Maximum take-off weight	73,000 lb (33,112 kg)
Maximum landing weight	69,500 lb (31,525 kg)

Performance

F28 Mk 1000

Economical cruise	0.7 Mach / 274 IAS at 28,000 ft
Range	1,370 NM / 1,577 M / 2,210 km
Take-off to 35 ft, surface level, ISA	5,490 ft (1,673 m)
FAR landing, surface level, ISA, max. landing weight	3,545 ft (1,080 m)

F28 Mk 2000

Economical cruise	0.7 Mach / 274 IAS at 28,000 ft
Range	1,050 NM / 1,208 M / 1,694 km
Take-off to 35 ft, surface level, ISA	5,490 ft (1,673 m)
FAR landing, surface level, ISA, max. landing weight	3,545 ft (1,080 m)

F28 Mk 3000

Economical cruise	0.7 Mach / 274 IAS at 28,000 ft
Range	1,550 NM / 1,783 M / 2,872 km
Take-off to 35 ft, surface level, ISA	5,490 ft (1,673 m)
FAR landing, surface level, ISA, max. landing weight	3,545 ft (1,080 m)

F28 Mk 4000

Economical cruise	0.7 Mach / 274 IAS at 28,000 ft
Range	1,240 NM / 1,426 M / 2,000 km
Take-off to 35 ft, surface level, ISA	5,490 ft (1,673 m)
FAR landing, surface level, ISA, max. landing weight	3,545 ft (1,080 m)

Engines

Type	Two x Rolls-Royce Spey RB.183 Mk 555-15P
Thrust (sea-level, static)	9,850 lb (31 kN)
Bypass ratio	1
Length	8’ 5” (2.6 m)
Dry weight	2,222 lb (1,008 kg)

Fuel

Fuel capacity	2,869 imp gal / 3,445 US gal / 13,040 litres

Liveries

The F28 Professional is supplied in a total of 33 liveries:

- Mk 1000 – 10
- Mk 2000 – 6
- Mk 3000 – 4
- Mk 4000 – 13

F28 Mk 1000

Air France

Fokker F28-1000 F-BUTE (construction number 11031) first flew on 11 March 1971 and was delivered to the short-lived German operator Aviaction as D-AHLB. It was repossessed by Fokker in late 1973 and then leased to Touraine Air Transport (TAT) from June 1974, initially as PH-ZBE and then as F-BUTE. In April 1977 TAT merged with Air France and F-BUTE continued in service, flying short-haul routes on behalf of the French carrier all over Europe until it was returned to Fokker in April 1981. The airframe was finally withdrawn from use and scrapped at Marana in late 1997. The aircraft is depicted with the code 330 on the nose, as worn at the 1975 Paris Air Show.

Air Ontario

F28-1000 C-FONG (construction number 11070) first flew on 22 June 1973 and was delivered a month later to THY as TC-JAS. It was sold to French airline TAT in September 1987 and then leased to Air Ontario in Canada as C-FONG. Along with C-FONF, these two F28s were the first jets for Air Ontario. After C-FONF was involved in a fatal crash, C-FONG was returned to TAT in July 1989 and Air Ontario ended its jet operations. The aircraft was eventually sold to Iran Aseman Airlines as EP-PAW and written off on 12 October 1994 when it struck a mountain near Nantanz after a double engine failure, sadly killing all seven crew and 59 passengers.

Argentine Air Force

Fokker F28-1000 T-50 (construction number 11028) first flew in March 1972 and was delivered to Fairchild Hiller Corp. Two years later she was leased to Aviateca before being sold to the Argentinian government in 1976. She carried presidents and popes during service with the government before being transferred to the military in 2005.

Braathens S.A.F.E.

Construction number 11013 first flew on 30 June 1969 using test registration PH-ZAH. The aircraft was delivered to Braathens S.A.F.E. on 10 August 1969 with registration LN-SUO and named ‘Magnus Barfot’. After a short lease to MMA MacRobertson-Miller Airlines, where the aircraft was briefly re-registered as VH-MMJ, the aircraft was quickly returned to Braathens S.A.F.E. in July 1970 and it received its original registration. The aircraft continued to serve with Braathens S.A.F.E. until December 1986, at which time the aircraft was re-registered as C-GQBS and sold to the Canadian airline Quebecair which then merged into Inter-Canadien 11 months later. After a two-year stint in Canada, the aircraft returned to Europe in the June 1989, re-registered as F-GIAI, and operated with TAT, Stellair and Palair Macedonia before finally being broken up at Dinard in October 1997.

Canadian Regional

First flown on 11 April 1972, construction number 11050 was delivered that month to Germanair as D-AGAC, before being sold to TAT as F-GBBS in December 1977. In April 1998 it was sold to Canadian Regional and flew as the ‘Spirit of Prince George’ until finally being withdrawn from use at Saskatoon on 25 October 2002. That might have been the end of the aircraft, but it was eventually acquired by enthusiast Jesse Millington, who had it transported by road to his property in Alberta during October 2021, where it now resides in his care.

Demonstrator

The third F28 built (construction number 11003), PH-MOL first flew on 20 October 1967 and was kept by Fokker for demonstration flights and leases to a host of airlines until it was eventually sold to Air Mali in October 1998. It ended its days at Senou in late 2014, when it was finally withdrawn from use. The aircraft is depicted in the colour scheme it wore during late 1970 and early 1971 – the markings worn when it was displayed at the Farnborough Air Show in September 1970.

Horizon Air

Construction number 11097 first flew on 7 October 1975 and initially went to the Ivory Coast Government, was then leased to Air Ivoire in 1979 and returned to Fokker in 1984. As N801PH, the aircraft became the first of three -1000s purchased by Horizon Air in November 1984. (Subsequently seven other -1000s were used by Horizon Air at various points, mostly leased.) In April 1996 Horizon disposed of N801PH to Canadian Regional Airlines and subsequently it returned briefly to the US for storage in April 2000 before being sold in Peru, where it ended its days at Lima in 2004.

LTU

LTU (Lufttransport-Unternehmen GmbH) was the first airline to order the Fokker F28, although the second to put it into service as its first aircraft was damaged before it went into service. D-ABAX (construction number 11006) was LTU’s second aircraft and the fifth F28 built. It first flew on 19 December 1969 before being delivered to LTU in April 1969. After just four years, LTU disposed of this aircraft to the Italian airline Itavia in July 1973. The aircraft ended its days with Peruvian operator Nuevo Continente and was withdrawn from use at Lima in April 2005.

Martinair

PH-MAT was the first F28 for Dutch airline Martinair. It was the 6th F28 built, with construction number 11008; numbers 11005 and 11007 were built as static test frames and never flew. First flown on 24 July 1969, the aircraft was delivered to Martinair on 1 October that year and remained with the airline until March 1980, albeit with leases to Swedish airline Linjeflyg and French operator Air Alsace while on Martinair’s books. It was sold to Ansett Transport Industries in Australia as VH-FKF in October 1980 and flew its final service with Ansett Australia on 30 March 1995. The aircraft was scrapped at Melbourne in January 1996.

Time Air

Construction number 11106 first flew on 21 June 1976 and was delivered to Indonesian airline Garuda as PK-GVW the following month. It returned to Fokker in September 1984 and then went to Piedmont Airlines in August 1985. It was acquired by Time Air (at one point one of the largest F28 operators) in 1991 and registered as C-FTAV. (It became the second -1000 to wear these marks, as construction number 11033 was also registered as C-FTAV from 1972 until 1979 while with Transair Canada.) Time Air merged into Canadian Regional Airlines in April 1993, which in turn merged into Air Canada Jazz in 2000, and C-FTAV continued flying until it was withdrawn from use at Saskatoon in August 2002. It is now in the safe hands of the Time Air Historical Society, which acquired it in September 2020 and intends to preserve it. There are plans to move it to Lethbridge in Alberta but currently it remains on site at Saskatoon.

F28 Mk 2000

Air France (TAT)

Construction number 11108 was ordered by Nigeria Airways in February 1975, first flew on 7 July 1976 and was delivered to the airline as 5N-ANI in August 1976. It was sold to TAT (Transport Aerien Transregional) as F-GDUU in July 1985 and then in May 1992 the airline was renamed TAT European before being merged into Air Liberté in October 1997. F-GDUU was sold as XT-TIB to Air Burkina in March 2001 and withdrawn from use at Ouagadougou in the summer that year before finally being broken up in October 2006. It wore Air France colours from late 1987 until 1992; in July 1989 Air France acquired a 35% stake in the airline before British Airways in turn took a 49.9% stake and it was then repainted in the latter's markings.

British Airways (TAT)

F28-2000 F-GDUV (construction number 11109) first flew on 7 September 1976 and was delivered to Nigeria Airways as 5N-ANJ in October that year. It was sold to French airline TAT (Transport Aerien Transregional) as F-GDUV in August 1985. In May 1992 the airline was renamed TAT European and in January 1993 British Airways acquired a 49.9% stake, with the consequence that F-GDUV flew in British Airways colours, as depicted, from 1993 until 1999, by which time British Airways had ownership of the whole company. In October 1997 TAT was merged into Air Liberté. F-GDUV was eventually scrapped at Paris (Orly) Airport in January 2021.

Ghana Airways

9G-ABZ (construction number 11062) was one of five F28s operated by Ghana Airways. It was ordered in December 1971, first flew on 29 December 1972 and was initially used by Fokker as PH-ZBE. Finally delivered to Ghana Airways (as 9G-ABZ), it spent its whole active career with the airline before being sold to East West Helicopter Inc as N103EW in May 1996. The aircraft was not actually painted in those markings but remained stored at Dinard in France until finally being broken up in 1999.

Nigeria Airways

5N-ANB (construction number 11053) was the first of six -2000 series aircraft ordered by Nigeria Airways in February 1971 after its first F28, a -1000 series (5N-ANA) had crashed in December 1970. 5N-ANB was delivered on lease from Fokker in October 1972, having first flown on 2 June 1972, and was the first of just ten -2000 series aircraft built. It was bought outright by Nigeria Airways in January 1973 and sold to TAT (Transport Aerien Transregional) as F-GDUS in August 1985. F-GDUS was retired from service and scrapped at Paris (Orly) Airport in July 2008.

TAT European

Construction number 11108 was ordered by Nigeria Airways in February 1975, first flew on 7 July 1976 and was delivered to the airline as 5N-ANI in August 1976. It was sold to TAT (Transport Aerien Transregional) as F-GDUU in July 1985. In May 1992 the airline was renamed TAT European and it was then merged into Air Liberté in October 1997. F-GDUU was sold as XT-TIB to Air Burkina in March 2001 and withdrawn from use at Ouagadougou in summer of that year before finally being broken up in October 2006. It is depicted in the colourful TAT European colours that it wore from mid-1992 before being painted in a British Airways scheme the year after.

TAT yellow

The first -2000 series aircraft built, F-GDUS (construction number 11053) was ordered by Nigeria Airways in February 1971 and first flew on 2 June 1972 before being delivered as 5N-ANB in October 1972. It was then sold to TAT (Transport Aerien Transregional) as F-GDUS in August 1985. In May 1992 the airline was renamed TAT European and in October 1997 TAT was merged into Air Liberté. F-GDUS was retired from service and scrapped at Paris (Orly) Airport in July 2008. F-GDUS wore this yellow colour scheme until 1990, when it was repainted in Air France colours.

F28 Mk 3000

Ansett Australia Airlines

Ansett Australia VH-EWF (construction number 11143) began life as an aircraft ordered by Danish airline Cimber Air in May 1978. It first flew on 7 March 1979 and joined Cimber as OY-BRM in April that year. In April 1987 the aircraft was sold to East-West Airlines of Australia as VH-EWF and it then passed to Ansett NSW in October 1990. In November 1990 the airline became Ansett Express and then in October 1993 VH-EWF was transferred to Ansett Australia Airlines. It flew with Ansett Australia until July 1995, when it was withdrawn from service and stored at Perth. After a sale to Namibian airline Kalahari Express Airlines as V5-KEX in October 1998, the aircraft flew in Africa until eventually being withdrawn from use at Lanseria in South Africa during 2007 after service with AirQuarius Aviation as ZS-JAP. The aircraft is depicted in the 'Starmark' livery worn from 1994 until it went out of service.

Ansett Express

VH-EWF (construction number 11143) began life as an aircraft ordered by Danish airline Cimber Air in May 1978. It first flew on 7th March 1979 and then joined Cimber as OY-BRM in April that year. In April 1987 the aircraft was sold to East-West Airlines of Australia as VH-EWF and it then passed to Ansett NSW in October 1990. In November 1990 the airline became Ansett Express and then in October 1993 VH-EWF was transferred to Ansett Australia Airlines. It flew with Ansett Australia until July 1995, when it was withdrawn from service and stored at Perth. After a sale to Namibian airline Kalahari Express Airlines as V5-KEX in October 1998, the aircraft flew in Africa until eventually being withdrawn from use at Lanseria in South Africa during 2007 after service with AirQuarius Aviation as ZS-JAP. The aircraft is depicted in the Ansett Express 'Union Jack' livery worn from 1990 to 1993.

Garuda

Indonesian airline Garuda operated five F28-3000Rs, which were -3000 series aircraft with the weight and performance limitations of the -1000 series. PK-GFT (construction number 11129) was the fifth and final Garuda 3000R and first flew as PH-EXS on 6 March 1978. It was delivered to Garuda in April 1978 and flew with the airline until September 1989, when it was leased to another Indonesian airline, Merpati, until returning to Garuda in December 1997. In January 2003, PK-GFT was transferred to Garuda's low-cost airline, Citilink, where it remained in service until July 2005, when it was sold to another Indonesian airline, Gatari Air Services, as PK-HNK. The aircraft was finally withdrawn from use at Jakarta in October 2006.

Saudia

OY-BRM (construction number 11143) was ordered by Danish Airline Cimber Air in May 1978. It first flew on 7 March 1979 and was delivered to Cimber the following month. In May 1979 it was leased out to French airline Touraine Air Transport (TAT), returning in August that year. From 1 July 1980 until 16 December 1986, the aircraft was wet leased to Saudia Saudi Arabian Airlines and it is depicted in these colours. (A wet lease is where the aircraft is provided by the supplying airline complete with crew, maintenance and insurance.) The aircraft was sold to East-West Airlines of Australia as VH-EWF in April 1987 and ended its days at Lanseria in South Africa in 2007.

F28 Mk 4000

Air France

This aircraft (construction number 11142) was ordered by Nigeria Airways in August 1978 and first flew on 9 July 1979; it was then delivered to Nigeria Airways as 5N-ANU in the same month. In August 1985 the aircraft became F-GDUY with TAT (Transport Aerien Transregional). F-GDUY wore Air France colours from late 1987 until 1992 and in July 1992 Air France acquired a 35% stake in the airline which had been renamed TAT European in May of that year. Subsequently the aircraft was leased to a number of different operators before being stored at Dinard in April 1997. It was then sold in Indonesia to Manunggal Air Services as PK-VFA on October 1997 and ended its life as a canvas for a graffiti spraying competition at Bandung in March 2019.

Air Anglia

PH-ZBT (construction number 11135) was the first of two F28s ordered by UK airline Air Anglia in April 1978. It first flew as PH-EXR on 10 October 1978 and then, unusually, took up another Dutch registration, PH-ZBT on 19 May 1979. Thus it flew with this Dutch registration but in Air Anglia colours for a few months before it was placed on the British register as G-JCWW. Air Anglia merged with Air UK in January 1980 and the aircraft was leased out to French airline Air Alsace shortly afterwards before being sold to the same airline in May 1981. The aircraft was eventually withdrawn from use by Iran Aseman Airlines in 2006 and is still believed to be preserved at Tehran Mehrabad Airport.

Air Niugini

P2-AND (construction number 11118) performed its first flight in July 1977 as PH-EXN before then being delivered to the Ivory Coast Government in December 1977 as TU-VAH. The aircraft was then transferred to the country's national airline Air Ivoire in April 1979, becoming TU-TIJ. After flying with the country's flag carrier for 13 years, the aircraft was sold in December 1992 to the Papua New Guinea airline Air Niugini and was re-registered as P2-AND, a registration that would come to be reused by the airline's future F28s' replacement, the F100. The aircraft served with Air Niugini for 14 years, a period of time that included a left landing gear collapse during a landing mishap at Goroka in April 1999. The aircraft was repaired and returned to service, eventually being sold to Interlink Airliners Pty of South Africa in May 2006 and re-registered 3D-DAW. The aircraft was withdrawn from service in early 2009 and stored in Lanseria, South Africa, where it was eventually broken up for parts.

Air UK

UK airline Air Anglia briefly operated four F28s as its first jet aircraft. Two were leased and two were ordered direct from Fokker, including G-JCWW (construction number 11135), ordered in April 1978. The aircraft first flew in October 1978 and was delivered in May 1979. After a period flying with a Dutch registration, the aircraft was registered as G-JCWW while the second aircraft was registered as G-WWJC. The significance of the registrations was that they were the initials of the joint Managing Directors, Wilbur Wright and Jim Crampton. Air Anglia merged with Air UK in January 1980, with the aircraft carrying the Air UK logo on the tail, as depicted. In August 1980 the aircraft was leased out to French airline Air Alsace before being sold to the same airline in May 1981. The aircraft was eventually withdrawn from use by Iran Aseman Airlines in 2006 and is still believed to be preserved at Tehran Mehrabad Airport.

Empire

American regional airline Empire Airlines served the Northeastern USA and ordered this aircraft, construction number 11222, in 1984. It first flew on 25 February 1985 and was delivered as N117UR the following month. It flew for just over a year in these markings before Empire merged with Piedmont Airlines in May 1986; the aircraft was subsequently re-registered as N475AU by 1989 when Piedmont itself merged with US Air. The aircraft was eventually sold to Ecuadorian airline ICARO Express and crashed at Quito in September 2008. The remains were saved and the aircraft was last known to be preserved in a park in the town of Salcedo in Ecuador.

KLM Cityhopper

KLM Cityhopper PH-CHD (construction number 11139) was ordered by the Dutch operator NLM in December 1977. It first flew on 17th November 1978 and was then delivered to NLM as PH-CHD in January 1979. It then flew for more than 17 years with the airline, operating short-haul services around Europe. NLM became NLM Cityhopper in April 1988 and was then merged into KLM Cityhopper in April 1991, as seen in this version. The aircraft was finally sold to Indonesian operator Merpati in December 1997 and ended its days at Tripoli in Libya, where it was withdrawn from use in the summer of 2009.

Korean Air

Construction number 11203 was ordered by Korean in February 1982 and first flew from Fokker's facility at Amsterdam/Schiphol Airport as N2703Y in March 1985. In July 1985 the aircraft became N282MP and it was delivered to Mid Pacific airlines. After two years the aircraft was sold to Korean Airlines as HL7284. It was then sold onwards to Air Niugini in December 1994, where it would remain for the rest of its flying days.

Linjeflyg

First flown on 5 April 1977 with test registration PH-EXP, the aircraft was delivered just 17 days later to Swedish airline Linjeflyg with the registration SE-DGI. The aircraft operated for Linjeflyg for 16 years until the airline merged with SAS Scandinavian Airlines System in January 1993. It operated for SAS until July 1999, when it was flown to Woensdrecht Air Base to be withdrawn from use and sold for spares. The aircraft was eventually broken up in July 2005.

NLM Cityhopper

PH-CHD (construction number 11139) was ordered by the Dutch operator NLM in December 1977. It first flew on 17 November 1978 and was then delivered to NLM as PH-CHD in January 1979. It then flew for more than 17 years with the airline, operating short-haul services around Europe. NLM became NLM Cityhopper in April 1988, as seen in this version, and was then merged into KLM Cityhopper in April 1991. The aircraft was finally sold to Indonesian operator Merpati in December 1997 and ended its days at Tripoli in Libya, where it was withdrawn from use in the summer of 2009.

Piedmont

Originally ordered by Altair Airlines in early 1978, this aircraft (construction number 11156) first flew on 22 February 1980 before entering service with Altair as N505. The aircraft was sold on to American regional airline Empire Airlines in December 1983 before that airline merged with Piedmont Airlines in May 1986, with the livery shown. In April 1989 the aircraft became N491US as Piedmont merged with US Air. The aircraft was eventually sold in South Africa and then employed in Equatorial Guinea before being scrapped at Abidjan in 2013.

Sabena

This aircraft (construction number 11142) was ordered by Nigeria Airways in August 1978 and first flew on 9 July 1979; it was then delivered to Nigeria Airways as 5N-ANU in the same month. In August 1985 the aircraft became F-GDUY with TAT (Transport Aerien Transregional). After leases to Air Burkina and Palair European, in March 1994 the aircraft was leased by TAT to Delta Air Transport which in turn flew services for the Belgian national airline, Sabena until November 1996, wearing the markings depicted. Subsequently the aircraft was stored at Dinard in April 1997 and then sold in Indonesia to Manunggal Air Services as PK-VFA in October 1997. It ended its life as a canvas for a graffiti spraying competition at Bandung in March 2019.

Scandinavian Airlines

SE-DGN (construction number 11130) was ordered by Swedish airline Linjeflyg in August 1976. It first flew on 3 January 1978 and was then delivered to Linjeflyg as SE-DGN in April of that year. In January 1993 Linjeflyg merged with Scandinavian Airlines System (SAS) and the aircraft was then painted in the scheme depicted. The aircraft flew with SAS until September 1999, when it was withdrawn from use and stored before being sold in South Africa. It was eventually withdrawn from use at Lanseria in 2011.

US Air

N499US (construction number 11182) was originally ordered by Empire Airlines in June 1980 and first flew on 31 March 1983. It was subsequently delivered to Empire in April 1982 as N110UR. Empire Airlines merged with Piedmont Airlines on 1 May 1986 and Piedmont Airlines merged with US Air in August 1989 when the aircraft was also re-registered as N499US, as seen here. The aircraft flew with US Air until October 1995, when it was put into storage before being sold in February 1996. The aircraft was eventually scrapped at Moses Lake in December 2013.

INSTALLATION, UPDATES AND SUPPORT

You can install this Fokker F28 Professional software as often as you like on the same computer system:

1. Log in to your Account on the Just Flight website.
2. Select the 'Your Orders' button.
3. A list of your purchases will appear and you can then download the software you require.

Accessing the aircraft

To access the aircraft:

1. Click on 'World Map'.
2. Open the aircraft selection menu by clicking on the aircraft thumbnail in the top left.
3. Use the Search feature or scroll through the available aircraft to find the 'Just Flight Fokker F28'.
4. After selecting the aircraft, use the 'Liveries' menu to choose your livery.

Uninstalling

To uninstall this product from your system, use one of the Windows App management features:

Control Panel > Programs and Features

or

Settings > Apps > Apps & features

Select the product you want to uninstall, choose the 'Uninstall' option and follow the on-screen instructions.

Uninstalling or deleting this product in any other way may cause problems when using this product in the future or with your Windows set-up.

Updates and Technical Support

For technical support (in English) please visit the Support pages on the Just Flight website.

As a Just Flight customer, you can get free technical support for any Just Flight product.

If an update becomes available for this aircraft, we will post details on the Support page and we will also send a notification email about the update to all buyers who are currently subscribed to Just Flight emails.

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SYSTEMS OVERVIEW

The Fokker F28 Fellowship is a short-range subsonic transport aircraft, powered by two Rolls-Royce Spey Mk 555-15 turbojet engines mounted either side of the rear fuselage. The tail is comprised of a single vertical stabilizer and a high-mounted horizontal stabilizer, commonly referred to a ‘T-tail’ due to its appearance.

The flight deck has seating positions for a Captain, a First Officer and an observer, whilst the passenger cabin has a seating layout that varies depending on an airline’s preference. Passenger seat numbers can range from 50 in a low-density Mk 1000 variant to as high as 85 in a high-density Mk 4000 variant.

The aircraft is electrically powered using 115/200V AC from the two engine-driven generators, with each taking half of the total load. An Auxiliary Power Unit (APU) houses an additional generator to supplement the system. Constant Speed Drives (CSD) are fitted to both engine generators to maintain a 400Hz constant frequency across the entire engine RPM range. DC power is obtained from two Transformer Rectifier Units (TRUs) or from the aircraft’s battery.

Two completely independent hydraulic systems are supplied via two engine-driven pumps, one on each engine. The pumps supply 3,000 PSI to both the UTILITY system (System No. 1) and the FLIGHT CONTROL system (System No. 2). An electrically driven pump powered by the AC busbars also supplies pressure to the UTILITY system.

The tricycle landing gear is short and sturdy, allowing for operations from remote dirt airstrips, and is hydraulically operated by the pressure of the UTILITY system. In the event of a hydraulic system failure, an alternative landing gear extension is installed in the form of a cable system to unlock the nose and main gear door uplocks, and a dump valve to depressurise the landing gear pressure lines. The landing gear can be manually retracted using a hand crank to operate the cable system.

All flying controls are duplicated across both pilot stations and are mechanically-hydraulically connected to the respective control surfaces. In the case of a control lock or a runaway flight control condition caused by a stuck servo valve, the hydraulic system can be manually depressurised via controls in the cockpit.

Four semi-Fowler flaps (two per wing) are operated by ball-screw-type mechanical actuators linked to the flap lever on the centre pedestal. The flaps can be extended to a maximum of 42°. A hydraulically operated speedbrake is located on the rear of the fuselage, controlled via a single hydraulically controlled actuator, which in turn is mechanically linked to the control lever on the centre pedestal. The speedbrake is limited in movement above 190 knots.

Lift dumpers on the top side of both wings spoil lift and increase drag after touchdown. These are hydraulically controlled via the UTILITY system and can only be operated when the aircraft is on the ground.

Two completely independent fuel systems in each wing operate in isolation from each other. A cross-feed system allows both engines to be fed from either tank. The transfer of fuel between left and right tanks is not possible.

The air conditioning and pressurisation systems maintain the air in the pressurised compartments at the desired level of pressure, temperature and freshness. Bleed air is tapped directly from the 7th and/or 12th stages of the high-pressure compressor of either engine and is then cooled, conditioned and distributed to the individual compartments and then discharged overboard.

Ice and rain protection is provided for the engines, horizontal stabilizer and wings in the form of hot bleed air from the engines. The pitot tubes, stall warning vanes and windshields are electrically heated. Variable-speed windshield wipers, a rain repellent system and ice detection systems are also fitted.

An automatic flight guidance system is fitted with independent autopilot and flight directors. Attitude and directional data are provided by on-board systems, using gyroscopic, inertial and magnetic forces. Radar and radio guidance is provided using on-board systems (radar) or a combination of on-board and off-board systems (ADF, VOR/ILS, DME).

AUTO-FLIGHT

System overview

The electro-mechanical S.E.P. 6 autopilot provides flight stabilisation and manoeuvring controls about all three-control axes (pitch, roll and yaw).

Operating in conjunction with navigational radio and flight instrument systems, it provides the following facilities as standard:

- Full stabilisation in pitch, roll and yaw
- Pitch attitude control and fully coordinated turns via manual pitch and roll controls on a central control panel
- Automatic acquisition and holding of selected VOR radials
- Automatic acquisition and holding of ILS localiser and glidepath
- Speed and altitude hold
- Preselected heading

The autopilot maintains straight and level flight by sensing a deviation in aircraft attitude from the appropriate attitude-sensing device. Demand is then applied to the control surfaces equal to the amount of mean attitude error signal, to return the aircraft to the original attitude.

Attitude rate sensors are also fitted which detect a disturbance in a much shorter time scale and provide a strong response to a disturbance before any appreciable angular displacement has appeared.

All autopilot-commanded functions are achieved by the pitch and roll channels, meaning that direction control is maintained by aileron steering throughout all flight manoeuvres. The rudder channel is used for yaw damping only.

The yaw damper can be engaged either as the yaw damper channel of the autopilot or separately when the aircraft is under manual control. The yaw damper should be switched ON whenever the aircraft is flying above 25,000 ft.

The cockpit controls consist of an autopilot controller and a mode selector. The controller is located on the pedestal and includes the roll, pitch and yaw channel engage switches. The mode selector is located on the glareshield and features push-buttons with which the pilot can select a particular autopilot mode. These buttons illuminate to indicate when a particular autopilot mode is engaged.

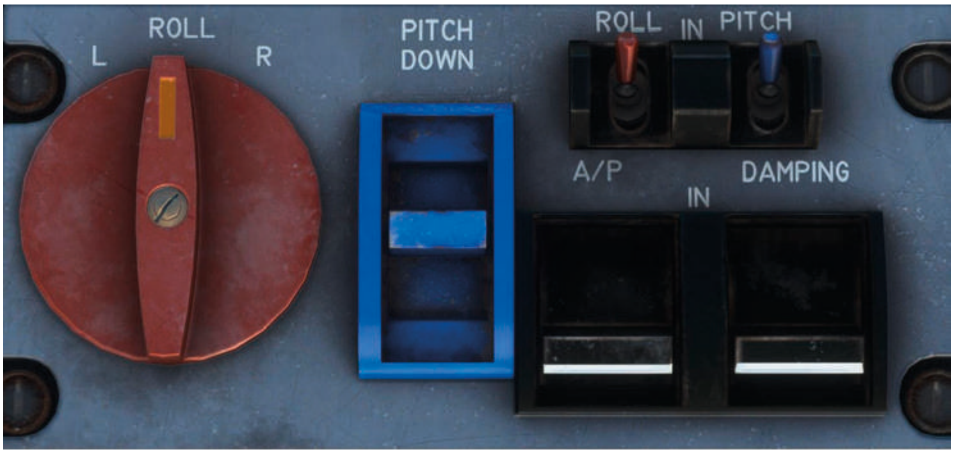
Controls and indicators

Master radio

The MASTER RADIO panel is mounted on the First Officer's side of the aft pedestal. The autopilot supplies are obtained by setting the No. 2 MASTER RADIO switch ON. The autopilot can then be engaged after a 60-second gyro run-up period.

The autopilot is powered by 115V 400 Hz from Bus 2.

Autopilot controller



The autopilot controller is located on the Captain's side of the aft pedestal. The panel includes all the switches and controls required for basic autopilot operation. All controls relating to the PITCH channel are coloured blue and all controls relating to the ROLL channel are coloured brown.

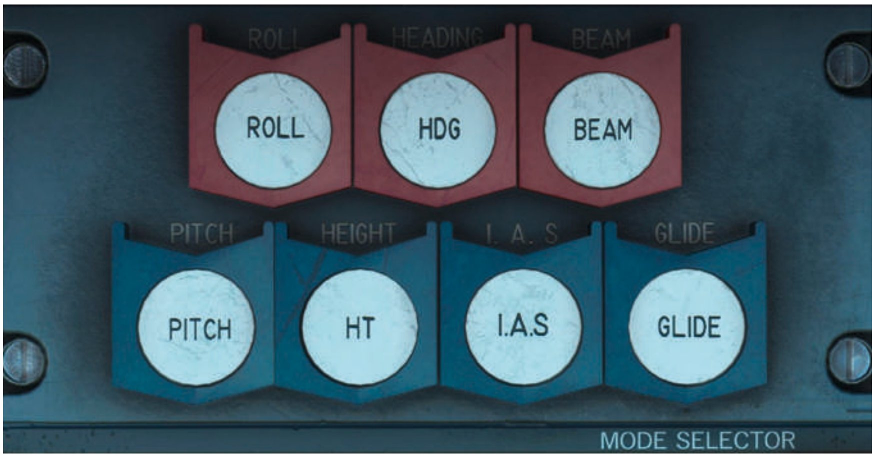
A two-position A/P engage switch engages/disengages the autopilot. The switch is held in the IN (forward) position electromagnetically and returns to the OFF position under spring pressure.

A DAMPING hold-on switch engages/disengages the autopilot yaw channel, providing automatic yaw damping when engaged.

PITCH and ROLL channel switches activate the respective PITCH and ROLL autopilot channels. Both switches must be in the IN (forward) position to allow the A/P engage switch to hold in the engaged position.

PITCH and ROLL controls allow for manual inputs to the autopilot and become operative when the respective autopilot channel is engaged. The PITCH control allows for altering of the aircraft's datum pitch attitude at a rate of between 0-2° per second depending on how far away from the detent the switch is moved. The ROLL control is spring-loaded to the mid position and provides a fully coordinated turning manoeuvre at a rate that depends on the control setting. A maximum of 30° of bank can be achieved in this manner.

Mode selector



The mode selector is located on the glareshield and is used to select the main autopilot modes that are not covered on the autopilot controller. The selector is split into two colour-coded banks. The PITCH bank is protected by a blue guard and the ROLL bank is protected by a brown guard.

PITCH and ROLL modes allow the aircraft's pitch and roll to be adjusted using the PITCH and ROLL controls on the autopilot controller (see above). These buttons are mechanically biased 'in' and remain in this position until another mode is selected. When another mode is selected which involves the same aircraft control axis, the PITCH and/or ROLL mode is automatically disengaged.

HT and I.A.S modes are used to maintain the height or indicated air speed existing at the time of selection of the mode. When selecting HT mode, the aircraft will maintain the current pressure altitude. When selecting I.A.S mode, the aircraft will adjust vertical speed to climb or descend at the current indicated airspeed.

GLIDE mode arms the system for an automatic capture of an ILS glidepath beam. Until automatic capture occurs, any other pitch mode can be selected. Upon capturing the glidepath, all other pitch modes are inhibited.

HDG mode adjusts the aircraft's heading to match the position of the heading bug on the HSI. The heading bug can be adjusted using the HEADING knob on the remote datum selector.

BEAM mode arms the system for an automatic capture of a VOR radial or an ILS localiser beam. Until automatic capture occurs, any other ROLL mode can be selected. Upon capturing the glidepath, all other ROLL modes are inhibited. The required radial to a VOR or ILS localiser beam can be selected using the COURSE 1 or COURSE 2 controls on the remote datum selector.

Engage and trim indicator

Located on the main instrument panel, the engage and trim indicator indicates the current trim of the aircraft relative to its roll, pitch and yaw axes, as well as the engagement status of each autopilot channel.

Three bar-type meters on the upper section of the dial move in the appropriate plane to show the amount and direction of the applied trim.

Three flag-type mechanical indicators on the lower section of the indicator will show 'IN' when their respective autopilot channels are engaged.

Altitude preselector

An altitude preselector is fitted to the Captain's main instrument panel. When used in combination with the vertical autopilot modes, it offers the automatic requisition of a preselected altitude as set by the altitude selector knob and as displayed on the altitude display.

Altitude can be set in 100-foot increments with the altitude selector knob.

Progress annunciators

Two PROGRESS ANNUNCIATOR panels are fitted, one for each pilot, and are used to display the current status of the autopilot modes.

VOR LOC – illuminates amber when the autopilot is in BEAM mode and the received signal is armed for capture, until capture of the VOR radial or LOC course (or with less than one dot deviation of a VOR course, or with less than two dot deviation of a LOC beam), at which time it illuminates green.

GLIDE SLOPE – illuminates amber when the autopilot is in GLIDE mode and the received signal is armed for capture, until capture of the glideslope has occurred at approximately one dot deviation, at which time it illuminates green.

SPEED COMMAND – illuminates green after activation of the palm-operated Go-Around switches on the throttles. (This mode is simulated as not fitted in the aircraft).

GPS – illuminates green when a GPS path has been captured.

A progress annunciator BRIGHT/DIM switch is fitted to the left of each panel, providing control of the annunciator light brightness.

Two press-to-test buttons are located on either side of the panel to test the illumination of the annunciator lights.

Safety features

Pilots' cut-out button

An autopilot cut-out button is fitted to the top of the outboard vertical grip of each control wheel. Pushing this button will disengage the entire autopilot system, except the yaw damper.

Engage switching circuit

In order for the autopilot engage and yaw damper switches to hold in the IN position, the presence of certain operating voltages and currents in the relevant computers and circuits is established by means of the engage switching circuit.

If the voltage or current disappears during operation, automatic disengagement of the autopilot will occur. Autopilot disengagement will be indicated by means of a 900-1,100 Hz wailing tone playing through the cockpit speakers, an amber flashing light on the main instrument panel and the engage indication on the engage trim indicator showing 'black'.

Pitch monitor computer

A pitch monitor computer is provided to increase the reliability required for CAT 2 operation.

At 250 ft above terrain (as sensed by the radio altimeter), glideslope deviation, pitch attitude and pitch attitude-derived pitch rate signals coming from autopilot-independent sources are monitored.

When the derived signal is above a predetermined level, the pitch channel will be automatically disengaged.

If the aircraft is not yet established on the glidepath, the 20° roll attitude cut-out will become operative as well at 250 ft.

Slip clutches

Slip clutches are fitted between each flying control surface servomotor and the control system. If the torque delivered by the motor exceeds a predetermined level, the clutch will slip and limit the control surface load. The operation of a slip clutch will not disengage the autopilot and the autopilot will continue to operate normally after the torque reduces.

Roll attitude cut-out

If the aircraft's roll exceeds a 45° angle of bank during normal flight operations, or a 20° angle of bank when flying an ILS approach, the roll channel will be automatically disengaged by means of interruption of the roll servomotor clutch supply.

When these conditions are met, the autopilot failure warnings will operate.

Trim failure cut-out

In the event of an autopilot stabilizer trim failure. as detected by signals from the pitch computer, the pitch channel will be automatically disengaged.

Stall cut-out

In the event of a stick shaker operation during a stall condition, the autopilot pitch channel will automatically disengage.

The pitch channel can be re-engaged by toggling the pitch switch on the A/P controller to the OFF and ON positions.

Vertical gyro unit failure

In the event of the vertical gyro unit failing to supply the autopilot with attitude information, all three autopilot channels will be automatically disengaged.

AUXILIARY POWER UNIT (APU)

The auxiliary power unit (APU) is a small gas turbine engine housed in the aircraft's tail cone. The APU drives a generator which can be used to supply electrical power and bleed air to the aircraft for air conditioning and engine starting, allowing the aircraft to operate completely independently of ground services.

Although primarily used on the ground, the APU can also be used in the air up to an altitude of 30,000 ft, serving as an alternative source of power (Generator 3) in the event of a generator failure on one or both of the engines.

Fuel is supplied to the APU from the left-hand wing collector tank.

The APU is controlled and monitored via the APU panel on the overhead panel.

Fuel control system

The fuel control unit regulates the fuel flow, engine shaft speed and exhaust gas temperature (EGT).

If during starting the turbine gas temperature (TGT) exceeds 650°C, a signal will be sent by the thermostat to the fuel control unit to reduce fuel flow.

Bleed air system

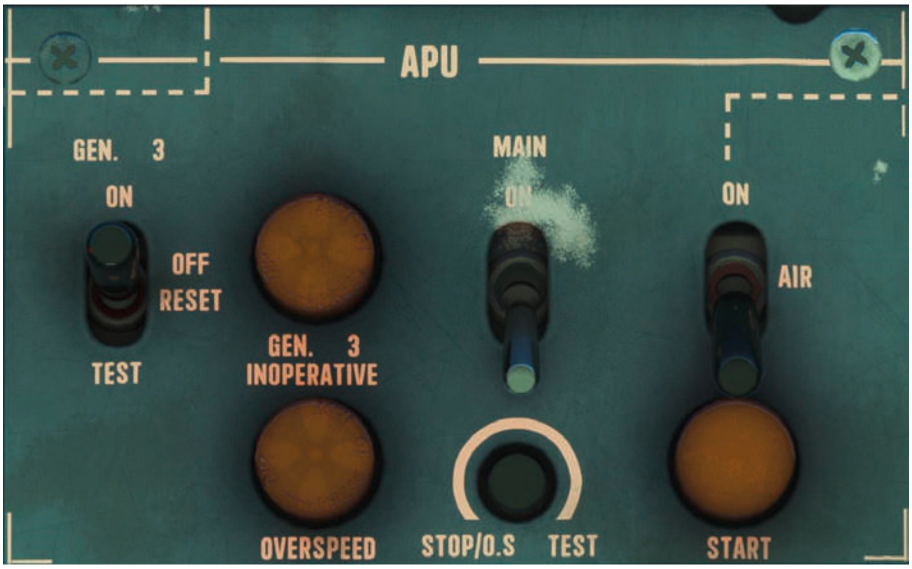
An AIR switch on the APU's overhead panel operates an electrically controlled, pneumatically operated load control valve and controls the passage of air to the aircraft's bleed air system.

Air can only be delivered to the bleed air system via this method on the ground, and when the APU is operating at more than 95% RPM.

An anti-surge valve prevents the APU from surging.

Operation

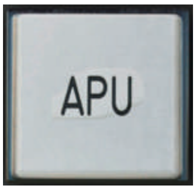
Controls



The APU is controlled via the APU panel on the overhead panel, which has the following controls:

- ON/OFF main switch
- START push-button with START ON light
- STOP/O.S TEST push-button
- ON/OFF bleed air switch
- ON/OFF RESET/TEST switch for Generator 3

Indications



The panel includes the following indicators:

- TGT indicator
- RPM indicator
- Overspeed caution light
- Generator 3 inoperative light
- Starter ON light
- APU ON light

Starting

Electrical power can be supplied to the APU either via external DC power or via the aircraft's batteries. When the BATTERY switch on the ELECTRICAL POWER panel is switched ON, power from the essential DC bus will be supplied to the APU. Selecting the MAIN switch on the APU panel to ON will then supply power to the start control circuit, to the APU light on the main instrument panel, and to open the air ventilation valve and compressor air intake door.

Pressing the START push-button completes the start control circuit to the starter motor and opens the solenoid valve in the fuel supply line from the left-wing collector tank.

At 10% RPM, the APU fuel valve opens.

At 45% RPM, the starter disengages from the gear train.

At 95% RPM, combustion is self-sustaining and the ignition is automatically cut off.

APU acceleration continues until 102% RPM (no load speed).

APU RPM will drop to 100% as soon as a load is applied.

Stopping

The correct procedure to stop the APU is to depress the STOP/O.S TEST button. This procedure tests the overspeed protection circuit by increasing the APU RPM indication above the overspeed protection threshold (110% RPM).

After depressing the STOP/O.S TEST button, the APU will begin to shut down and RPM will begin to decrease. The MAIN switch is then to be set to OFF, which cuts all electrical power to the APU and also closes the air intake door and ventilation valve.

If this procedure fails to shut down the APU, shutdown can be achieved by moving the MAIN switch to OFF.

Automatic shutdown

The APU will shut down automatically in the following circumstances:

On the ground in case of:	**In flight in case of:**
Generator 3 failure	
Overspeeding (110% RPM)	Overspeeding (110% RPM)
Low oil pressure	Low oil pressure
Fire	Fire

Fire protection

An automatic fire detection and extinguishing system is fitted to detect and extinguish an APU fire.

If an APU fire is detected:

- The fire warning light on the glareshield will illuminate.
- The extinguisher test light on the secondary instrument panel will illuminate.
- APU will shut down.
- Air intake door and ventilation valves will close.
- Extinguisher bottle will discharge after five seconds.

BLEED AIR, AIR CONDITIONING AND PRESSURISATION

This chapter is divided into three parts, each covering a separate section of the pneumatic systems:

1. Bleed air supply system – supplies compressed air from the engines at a sufficient pressure for operating sub-systems.
2. Air conditioning supply system – controls cockpit and cabin temperature and ventilation.
3. Pressurisation system – maintains cabin pressure when the aircraft is flying at high altitudes.

Bleed air supply system

Air is tapped directly from the 7th and 12th stages of the HP compressor of each engine, depending on the current engine RPM setting. Under normal operating conditions, and when the engines are running above 80% RPM, air tapped from the 7th stage compressor is sufficient to supply all sub-systems. If the engine RPM is less than 80%, air will be tapped from the 12th stage automatically. Air will also be tapped from the 12th stage compressor to supplement the air supply if the airfoil anti-icing or engine anti-icing systems are operating.

System pressure at idle engine power ranges between 15 PSI and 25 PSI. A main valve located downstream of the 7th and 12th stage ducts limits the system pressure to 55 PSI, with an additional back-up valve regulating the pressure at approximately 65 PSI.

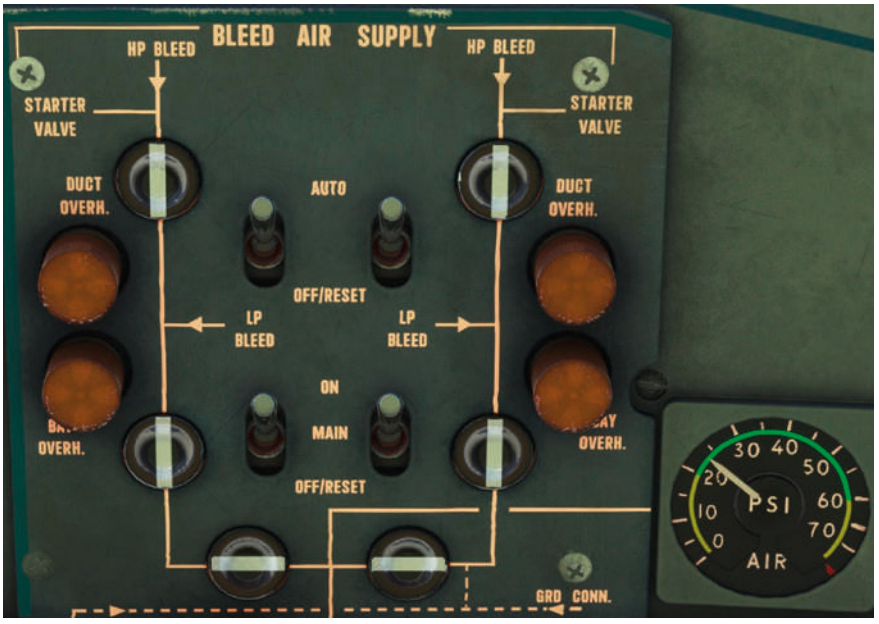
In the event of an engine failure, the supply of air from one engine is sufficient to supply all sub-systems.

If the engines are not operating, air can be supplied via the APU or external means.

Cross-bleed engine starting is possible.

Controls and indicators

A BLEED AIR SUPPLY panel is located on the overhead panel. A schematic outline of the bleed air system is provided, with mechanical indicators representing the position of the various valves in the system.



Two MAIN switches labelled ON and OFF/RESET control the position of the relevant main valves and back-up valves.

Two HP switches labelled AUTO and OFF/RESET control the supply of air from the 7th and 12th stage compressors. In the AUTO position, the system will automatically tap air from the 12th stage compressor to supplement the 7th stage compressor when the system demand requires it.

A bleed air pressure indicator is installed to the right of the BLEED AIR SUPPLY panel; this dial provides a visual indication of bleed air system pressure. The dial is marked in increments of 5 PSI from 0 PSI to 75 PSI.

A green band indicates the normal operating range between 20 PSI and 60 PSI. Yellow bands indicate the abnormal operating ranges between 0-20 PSI and 60-75 PSI. A red mark indicates 75 PSI.

Safeties and warnings – bleed air duct overheat and leakage

Duct overheat

Safety against overheat conditions is provided at various temperature levels depending on the ambient temperature.

At high ambient temperature, an overheat condition is triggered as high as 350°C. When the wing or tail anti-icing is switched on, 300°C is considered an overheat condition.

When an overheat condition is detected, a DUCT OVERHEAT caution light will illuminate on the overhead panel. After corrective action has been taken, the overheat warning can be cleared by moving the respective system switch to the OFF/RESET position, and then back to ON.

Bay overheat

Overheat switches, located in each stub wing and in the shroud around the supply duct in the APU, detect air leakage from the supply duct.

When a leak is detected, automatic closure of the three valves will take place and a BAY OVERHEAT caution light will illuminate on the overhead panel.

Duct leak

If a pressure differential is detected between the walls of the double-walled duct and the cabin, a DUCT LEAK caution light will illuminate on the overhead panel.

Air conditioning supply system

Bleed air is routed through the aircraft via two paths in the air conditioning supply system. The left-hand path supplies air to the cockpit and the right-hand path supplies air to the cabin via an air conditioning unit. In the case of a failure, a single air conditioning unit is capable of supplying air to both the cockpit and the cabin.

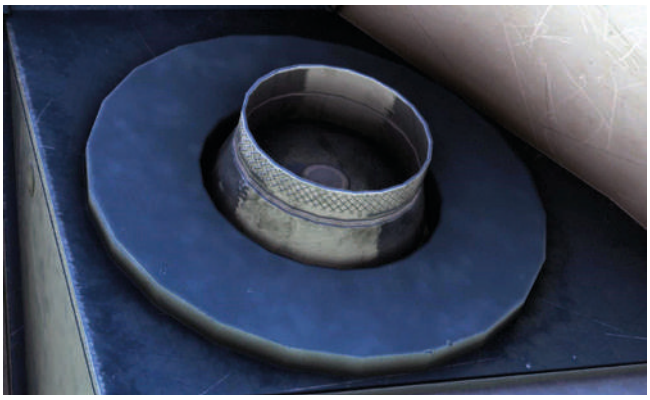
An AIR CONDITIONING sub-panel is located under the BLEED AIR SUPPLY panel on the overhead and provides controls and indications of the various air conditioning systems in the cockpit and cabin.

An AUTHORITY switch on the overhead panel allows for the cabin air conditioning to be controlled by the cabin crew from controls in the galley.

Cockpit

Air is distributed in the cockpit by:

- Louvres on the forward part of each side panel
- Two constantly open outlets on the pedestal
- Two footwarmers, controlled by levers above the side panels
- Two side wall outlets, also controlled by levers above the side panels



Cabin

Air is distributed in the cabin by:

- Hatrack ducts with opening and louvres for each passenger
- Hatrack ducts in the cabin windows used for demisting
- Side wall outlets and floor openings to the area around the cargo compartments and to the outflow valves

Radio rack

An electrically operated fan controlled by the radio master switches provides ventilation to the radio rack.

Cooling system

A heat exchanger in each path utilises ram air to cool the flow of hot air from the engine in the air conditioning system. To provide sufficient ram air flow when on the ground, a fan in the ram air duct driven by the cooling turbine is used.

A minimum air pressure of 30 PSI is required to maintain normal cooling turbine operation within the heat exchanger, necessitating the use of the APU when on the ground.

A water separator in each path also removes any excess moisture from the system and discards it overboard via a constant drain flow at the ram air outlet.

Auto shut-off system

Under normal operating conditions, bleed air is automatically shut off to the cockpit and cabin when additional air is required by the engines, either during engine starting, during high power settings or during single-engine operations:

Engine Cond.	Engine Start	2x < 97% RPM	2x > 97% RPM	1x < 95% RPM 1x OFF	1x > 95% RPM 1x OFF
Cabin Air Cond.	OFF	ON	ON	ON	OFF <10,000 ft ON >10,000 ft
Cockpit Air Cond.	OFF	ON	OFF	ON	OFF

An override switch is fitted to the AIR CONDITIONING panel which overrides the automatic shut-off system. With the switch set to the OVERRIDE position, manual operation of the relevant bleed air valves is required during all phases of flight.

Controls and indicators

An AIR CONDITIONING panel is located on the overhead panel. A schematic outline of the air conditioning system is provided, with mechanical indicators representing the position of the various valves in the system.

Two MAIN switches labelled ON and OFF/RESET control the position of the relevant main valves.

Two temperature control knobs allow for temperature control of the airflow to the cockpit and cabin when the temperature control switch is in the AUTO position. These knobs control the temperature within a range of 15°C to 27°C.

Two four-position temperature control switches labelled AUTO/OFF/COLD/HOT provide alternate means of temperature control to both the cockpit and cabin:

- **AUTO** – allows for control of the cockpit and cabin temperature via the rotary selector knobs above the temperature control switches.
- **OFF** – the temperature control system is deactivated and the airflow to the cockpit/cabin will continue at the present settings. When using the COLD and HOT switch position, the switch is spring-loaded to the OFF position.
- **COLD** – decreases the temperature of the airflow to the cockpit/cabin by providing direct control of the refrigeration unit bypass valve.
- **HOT** – increases the temperature of the airflow to the cockpit/cabin by providing direct control of the refrigeration unit bypass valve.

Two refrigeration unit bypass valve position indicators display the position of the valves. The dials are marked with COLD and HOT, indicating what effect the position of the valve has on the temperature of the airflow.

Two outlet duct temperature indicators display the temperature in the ducts. The dials are marked in increments of 5°C between 0°C and 60°C. A green band indicates the normal operating range between 0°C and 50°C. A yellow band indicates the abnormal operating range between 50°C and 60°C.

A guarded AUTHORITY switch labelled COCKPIT/STEW controls whether the cockpit or cabin crew has control over the cabin air conditioning system:

- **COCKPIT** – the pilots have control over the cabin temperature, using the controls on the AIR CONDITIONING panel on the overhead panel.
- **STEW** – the cabin crew have control over the cabin temperature, using the controls in the cabin. The switch should be in this position under normal operating conditions.

A guarded auto shut-off system switch labelled OVER RIDE/AUTO SHUT OFF provides the option to override the air conditioning auto shut-off system. This switch should be in the AUTO SHUT OFF position with guard closed prior to take-off.

A guarded RAM AIR switch at the lower centre of the overhead panel, labelled ON/STOP/OFF, allows for direct control of the right-hand ram air valve to provide ventilation to the cockpit and cabin:

- **ON** – electrically opens the right-hand ram air valve.
- **STOP** – allows the valve to be stopped at an intermediate position.
- **OFF** – electrically closes the right-hand ram air valve.

Two OVERHEAT caution lights will illuminate if an overheat condition is detected in the supply duct of a turbine inlet, that bay of an air conditioning unit, or in the supply duct to the cockpit or the cabin. The respective main valve will also close automatically. Moving the respective MAIN switch to the OFF/RESET position and then back to ON will reset the caution lights and re-open the main valve.

Pressurisation system

To provide a comfortable atmosphere for the passengers, the aircraft is pressurised to maintain a cabin pressure differential of 7.45 PSI and cabin altitude of 8,000 ft when the aircraft is cruising at 35,000 ft. During climb, it is recommended that the cabin is pressurised at a maximum rate of 500 ft/min and that, during descent, the cabin is de-pressurised at a maximum rate of 300 ft/min.

The cabin pressure is controlled via two pneumatically controlled outflow valves. These outflow valves are operated by a diaphragm in a chamber with a spring which, when the diaphragm is subjected to a differential in pressure, allows the outflow valves to open and close to maintain the correct pressure.

The pressurisation system can be controlled via two methods:

1. An automatic control system, by means of a pressure controller.
2. A manual control system, by means of a needle valve.

Automatic control system

A pressure controller is located on the lower centre of the overhead panel.

The CABIN ALT selector knob can be used to set the required cabin pressure between 0 and 10,000 ft. A window at the top centre of the controller indicates the maximum altitude the aircraft can fly at to maintain the set cabin pressure.

With a cabin altitude selected on the controller, a spring force is applied to the valve in the upper chamber of the diaphragm, which will allow pressurised cabin air to flow into the upper chamber. The difference in the pressure of air in the upper chamber compared to the ambient air in the lower chamber operates the diaphragm, which then operates the outflow valve, maintaining cabin pressure at the required setting.

A differential pressure limiter valve is operated automatically should the pressure differential in the cabin exceed 7.45 PSI.

The BAR.CORR knob is used to set the current QNH pressure, to allow for the smooth pressurisation and depressurisation of the cabin. The current selected QNH is displayed by a pointer on the scale in the window at the top right of the controller.

The RATE knob is used to adjust the rate of cabin pressure change. With the arrow pointing directly up, cabin altitude will be adjusted at approximately 400 ft/min. Rotating the knob anti-clockwise will reduce the rate to 50 ft/min and rotating the knob clockwise will increase the rate to 2,000 ft/min.

Manual control system

A red needle valve on the lower left overhead panel labelled MANUAL CONTROL provides an override of the automatic pressure controller.

To decrease cabin pressure, rotating the valve in an anti-clockwise direction will open the needle valve by the required amount. Rotating the valve in a clockwise direction will close the needle valve by the required amount, slowing down the pressure decrease or maintaining the current pressure level.

The valve controller is wire-locked to the closed position. Opening the valve will break the wire lock, indicating that the valve has been operated.

Safeties

If cabin differential pressure reaches 7.7 PSI, an outflow valve relief safety valve will automatically operate.

A red-guarded DUMP switch on the lower overhead panel serves as an emergency means of depressurising the cabin in the shortest amount of time. Once the switch is operated, the cabin will become fully depressurised within 10 seconds if flying at maximum cabin differential pressure.

The dump control valves will open automatically when the aircraft is on the ground, thus it is not possible to pressurise the aircraft whilst on the ground.

A cabin altitude limiter is fitted which limits the maximum cabin altitude to 12,000 ft.

Indicators

A cabin altitude and pressure differential indicator is located on the lower overhead panel. This provides a visual indication of:

- Cabin altitude on the outer scale. This scale is marked in increments of 1,000 ft between 0 ft and 40,000 ft, and in increments of 2,000 ft between 40,000 ft and 50,000 ft.
- Cabin pressure differential on the inner scale. This scale is marked in increments of 2 PSI between 0 PSI and 10 PSI. A yellow band indicates the abnormal operating range between 7.5 PSI and 8 PSI. A red mark indicates 8 PSI.

Warnings

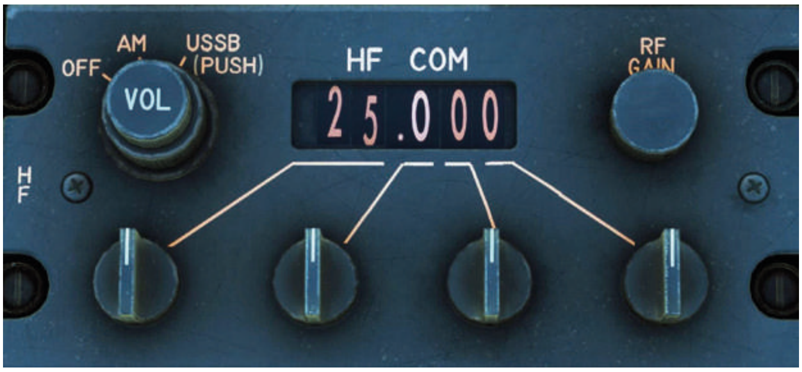
Two CABIN PRESS caution lights will illuminate when the cabin altitude exceeds 10,000 ft. One caution light is fitted to the lower overhead panel and one is fitted to the Captain's glareshield.

COMMUNICATION

Communication equipment is supplied via electrical power from various AC and DC buses and the supply is controlled via two Master Radio switches on the aft pedestal. The Master Radio No. 1 switch controls the No. 1 systems and the Master Radio No. 2 switch controls the No. 2 systems.

HF (High Frequency)

HF radios may be fitted to aircraft flying long-distance flights, but as the F28 is a short-haul aircraft, many airlines chose not to have HF radios installed and instead relied upon VHF transceivers.



The HF equipment consists of a transceiver, the control/selector panel and the tuner/antenna coupler. The HF control/selector panel is fitted to the aft pedestal and allows the pilots to select a frequency range between 2 and 30 MHz in 1 kHz increments, providing a total of 28,000 channels.

A dual rotary control on the left side of the panel allows for mode changing via the outer rotary control and volume control via the inner rotary control. An RF GAIN switch on the right side of the unit controls gain.

Once a frequency has been set and the pilot's microphone button pressed, the tuner will match the antenna impedance within six seconds. The receiver output is routed through the audio accessory unit to the audio selector panel, where the audio output can be selected individually by each pilot.

The HF antennas can be equipped from the Aircraft page of the EFB (Electronic Flight Bag).

VHF (Very High Frequency)

Two VHF transceivers can operate between 116,000 MHz and 151,975 MHz in 25 kHz or 50 kHz increments.

The VHF communication control panel is located on the pedestal and includes the following controls:

- Frequency control
- Combined volume and ON/OFF controls
- Squelch controls
- Test buttons

Note: *In this simulation of the F28, the radios feature 8.33 kHz spacing to be fully compatible with modern ATC systems. To see the frequency selected to three decimal places, enable tooltips in MSFS Options > General Options > Accessibility > Instrument Name Tooltips > INSTANT, and then hover your mouse over the frequency controls.*

The pilot's headset and microphone are connected to the VHF transceiver via jack boxes on the cockpit side panels. The audio selector panel allows for the audio output to be selected individually by each pilot.

For redundancy purposes, and to ensure a clear uninterrupted signal is detected during all aircraft attitudes, each VHF antenna is mounted in a different location on the exterior of the aircraft. The VHF1 antenna is mounted on the belly of the aircraft just aft of the nose landing gear. The VHF2 antenna is mounted on top of the cockpit.

Audio integrating system

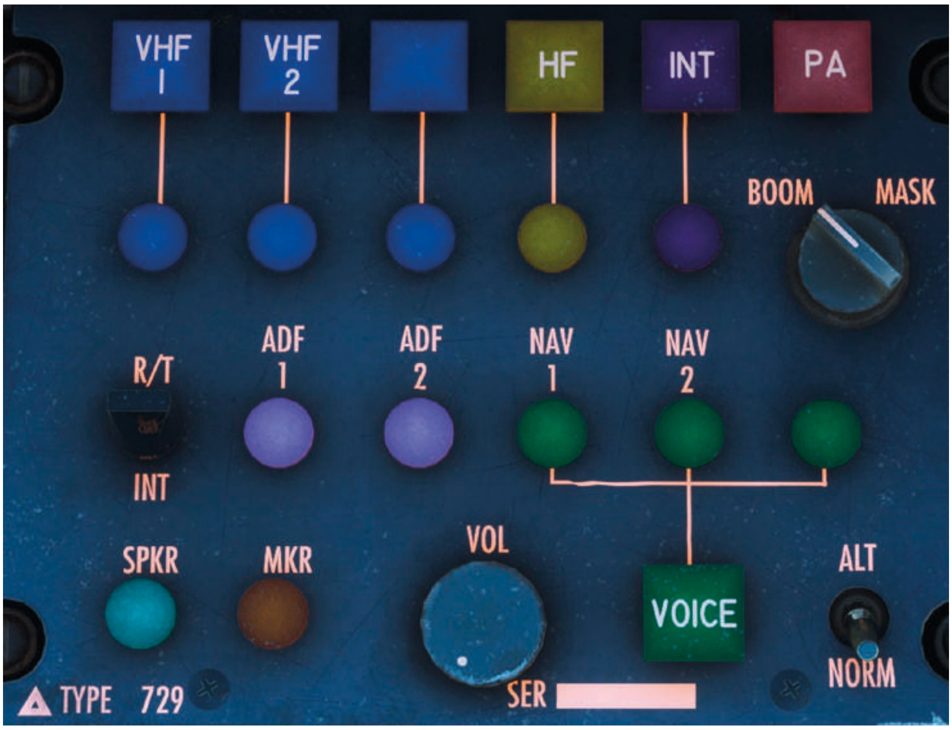
The audio integrating system consists of the following components:

- Jack boxes in the cockpit
- Jack boxes in the maintenance areas
- Audio selector panels (one at each crew member station)
- Audio accessory unit (in the radio stack)
- Cockpit ceiling speakers
- Headsets and microphones

Jack boxes

Jack boxes are located at each crew member's station and allow for the electrical connection of microphones and headsets to the audio integrating system.

Audio selector panels



Push-buttons on the audio selector panels allow each crew member to select the audio output of a specific communication or navigation source to their headset and/or speakers. The panels also allow each crew member to connect the output of their microphone to a specific transmitter.

Square push-buttons along the top of the audio selector panels allow each crew member to enable the selection of voice or range information – or both – when the output of the ADF or VHF NAV receivers has been selected.

A volume knob on each panel controls the audio output to the respective crew member's headset.

A SPKR button allows a crew member to play the selected audio through the cockpit speakers on their side of the cockpit.

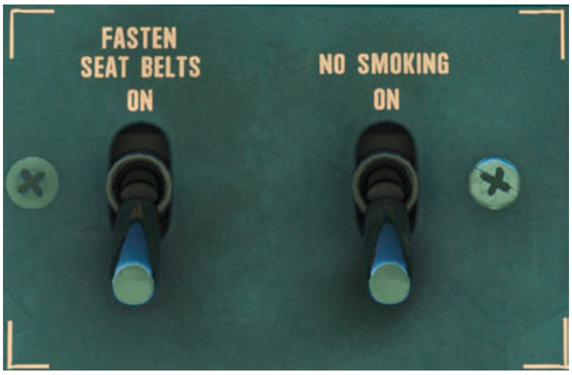
Crew member microphones can also be connected to the Passenger Address (PA) and intercom (INT) systems.

Passenger Address system

A Passenger Address (PA) system is provided and can be used with priority from the flight interphone stations when PA is selected on the respective audio selector panel, overriding transmissions from any other station.

Two high/low chime tones are activated by corresponding signals when received from passenger and toilet call, cabin crew call, ‘fasten seat belts’ and ‘no smoking’ signs. All chime tones are fed to the flight attendant panels, passenger cabin and toilet speakers.

A cabin announcement will also be made when the ‘fasten seat belts’ switch is used.



The stewardess call and passenger lights can be controlled via the stewardess (STEW’DESS) panel located on the forward wall of the cabin.

Cockpit voice recorder system

A cockpit voice recorder system is fitted to the lower overhead panel, consisting of a microphone and a monitor panel. Its purpose is to monitor and record the flight crew's communications. From the time of recording, the system stores the information for 30 minutes. The recording is constantly erased, allowing for endless recording.

Power is supplied to the voice recorder system from the 115V AC essential bus.

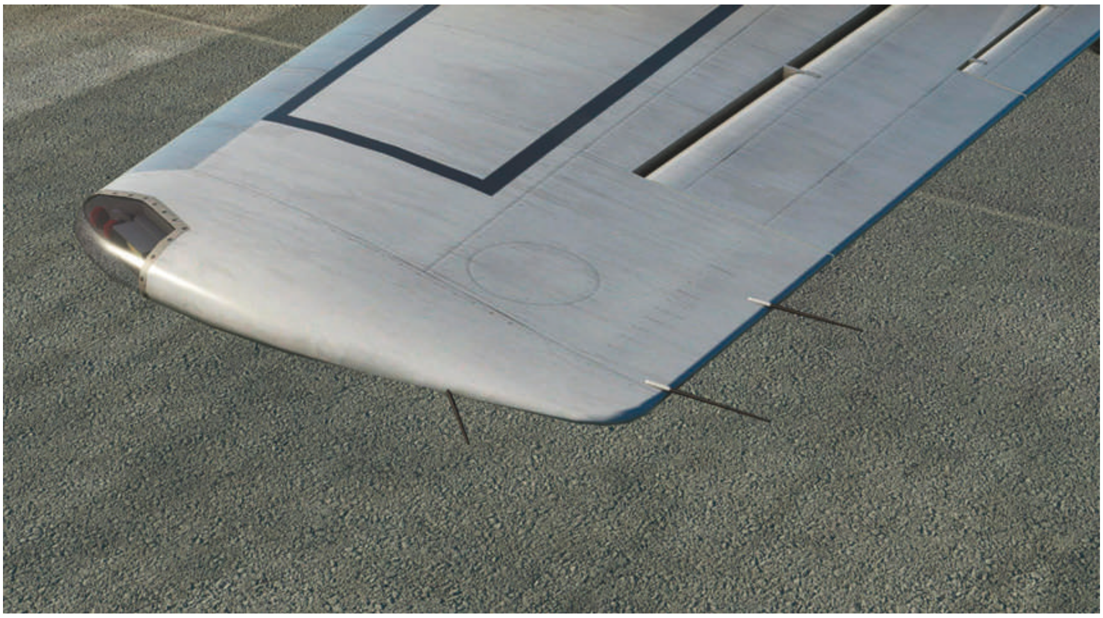
A green TEST button sends a signal to all recording heads and provides two indications on the monitor meter, the first after one second and the second after 2.6 seconds.

A red ERASE button allows the crew to erase the recording at the completion of a flight, to avoid any unauthorised use of the information on the tape.

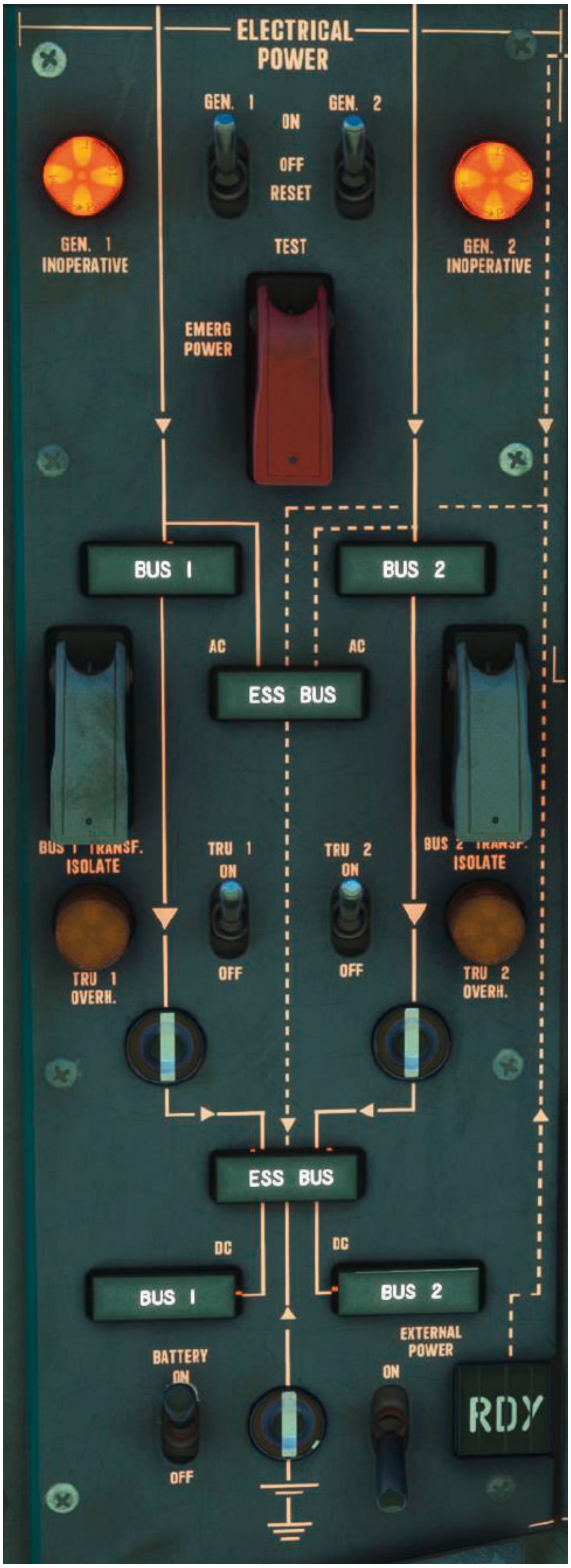
Static dischargers

Static dischargers (also known as static wicks) are fitted on the trailing edge of the wing at the wing tip, as well as on the trailing edge of the horizontal stabilizer.

The purpose of these static dischargers is to dissipate any static charge that has built up on the aircraft during flight, preventing any radio interference.



ELECTRICAL POWER



The electrical power system has both AC (Alternating Current) and DC (Direct Current) power services.

AC power is supplied by two engine-driven generators, an APU-driven generator or by external sources.

DC power is provided by transformer-rectifiers (TRUs) which convert the AC from the engine and APU generators to DC. Limited DC power can also be provided via the aircraft's internal batteries or via an external source.

AC power supply and distribution

Each of the two engine-driven generators feeds its own busbar via a three-phase bus contractor producing 115/200V 400 Hz. As each generator feeds its own busbar, each busbar only manages approximately half of the total electrical load.

The APU generator (Gen 3) can supply both pneumatic and electrical power when the engines are not running. When the APU is supplying power, both AC busbars will be interconnected. The APU generator can also serve as an alternate source of power, allowing for the aircraft to be dispatched when either of the engine-driven generators are inoperative. An external AC power source can also be connected to power both AC busbars.

An automatic bus transfer system automatically connects the distribution buses to the appropriate sources, keeping system management to a minimum. This allows the busbars to automatically detect and draw power from the optimum power source, without any doubling up of the system sources. During normal operation, this provides a seamless transition of power when changing between external ground power and APU generator, or between the APU generator and the engine generators.

If the system exceeds the maximum continuous generator rating, an automatic load-shedding circuit becomes active to limit or switch off the load to non-critical systems.

An essential AC bus provides power to a select number of systems that are considered to be critical to the aircraft's operation. The essential AC bus can be supplied via any AC source by means of a supplementary independent transfer system. This system connects the bus directly to one of the generators bypassing the main transfer system. This will ensure that the bus always has a power supply if at least one AC power source is operational. Systems connected to the essential AC bus include fuel booster pumps, pitot heating elements and two further sub-buses carrying electronic loads for the compass system, voice recorder and flight data recorder.

DC power supply and distribution

Other than the aircraft's battery, there are no direct sources of DC power on the aircraft, therefore DC power is derived from the AC system via two transformer-rectifier units (TRUs). The TRUs receive their input via AC bus 1 and AC bus 2, and then output it to DC bus 1, DC bus 2 and the essential DC bus. Although each TRU can be operated independently via ON/OFF switches in the cockpit, in normal operation the TRUs are automatic in their operation and will begin operation as soon as the associated AC bus is energised.

An essential DC bus can be supplied either via the TRUs or by the aircraft's battery. Like the essential AC bus, the essential DC bus carries only the most essential loads. Some essential DC systems include VHF 1 radio, engine fire warnings and extinguishing, engine indication, emergency lighting, APU starting control, standby gyro horizon and engine anti-icing control.

A 24V 25Ah nickel-cadmium battery is used as a standby source of DC supply and is kept in a charged state via the TRUs. In the case of a total AC and DC power failure, the aircraft's battery will feed the DC essential bus for approximately 30 minutes. Under normal operation, the main load carried by the battery is the operation of the passenger and crew doors.

During APU starting, a DC ground service bus can either be supplied by the battery or, when an external AC source is connected, by a 6-amp transformer-rectifier which is part of the external power control unit. The DC ground service bus is always automatically energised and can also be fed via an external DC source via a receptacle on the exterior of the aircraft. This supplies enough power for APU starting and refuelling using the refuelling control system.

Constant speed drive

Two constant speed drive (CSD) transmissions are installed on the aircraft, one on each engine. The CSDs take the rotational speed of their respective engine and, via a series of hydraulically controlled gears, output it to the AC generator at a constant 8,000 RPM, providing the aircraft with a constant supply of AC power over the whole RPM range of the engine.

Should a fault occur with one of the CSDs, a CONSTANT SPEED DRIVE warning light will illuminate in the cockpit. The pilots can then disconnect the CSD by operating the red-guarded CONSTANT SPEED DRIVE DISCONNECT control on the overhead panel. Once a CSD has been disconnected, it can only be reconnected when the aircraft is on the ground and the engine has come to a complete stop.

AC generator system

Each of three AC generators consists of three main parts: the permanent magnet generator, the exciter generator and the main generator.

DC power suppled via the TRUs connected to the permanent magnet generator is fed via the voltage regulator to the exciter wiring. The magnetic field of the exciter field winding induces a voltage in the three-phase rotor winding. The AC output voltage of the three-phase winding is then rectified by a set of six rectifiers inside the rotor. The DC output of these rectifiers is now fed to a field winding inside the rotor. The rotating magnetic field of this winding induces 115/200V AC in the main generator stator winding. The generator is cooled by ram air during flight and by an internal fan on the ground.

An AC generator control unit regulates the output voltage of the generator by controlling the amount of power delivered from the regulator to the generator exciter field winding. The regulator then compares the system voltage against its reference voltage and uses that information to control generator excitation.

A generator protection system protects the generator from over-voltage, under-voltage, differential protection (feeder fault), over-current (bus fault) and under-frequency. With the exception of under-frequency, if one of the protective functions becomes inoperative, a LOCK OUT RELAY energises and switches off the generator, remaining energised on its own to hold contact. The LOCK OUT RELAY can be reset by switching the generator control switch to OFF/RESET on the overhead panel.

The LOCK OUT RELAY switches off the generator by de-energising a GENERATOR CONTROL RELAY. This relay then connects the voltage regular to the exciter field winding of the generator, energising a POWER READ RELAY. This relay controls the GENERATOR CONTRACTOR that connects the generator to its appropriate bus bar and controls the amber GENERATOR INOPERATIVE light on the overhead panel.

If an under-frequency condition occurs, the LOCK OUT RELAY does not operate. This protective function only de-energises the POWER READY RELAY for as long as the under-frequency is present.

In an over-current condition (bus fault), both the LOCK OUT RELAY and BUS FAULT RELAY operate. With the latter energised, it inhibits the automatic bus transfer between AC bus 1 and AC bus 2.

If the generator control switch is placed in the TEST position, the generator will operate as normal, but the GENERATOR BUS CONTACTOR does not energise, meaning the generator is not connected to its busbar.

An external AC power control unit prevents the connection of an external power source with an incorrect phase sequence. An expanded external power control unit could be installed at the operator’s request.

The following table lists all possible controls and indications on the overhead panel, and warnings on the annunciator panels:

CSD oil temperature gauges	Normally presenting the difference between inlet and outlet temperature of the CSD oil. After pressing the button, the oil inlet temperature is presented.
AC load meters	Giving a percentage of the generator load, i.e. 10 KVA = 0.5
Gen. 1 and Gen. 2 'ON' position	Generator control. Can be left in the ON position when engine is started.
Gen. 3 'ON' position	Generator control. Must be in the OFF/RESET position prior to APU start.
Position 'OFF-Reset'	To switch off the generator, reset the lock-out relay in case of over-voltage, under-voltage, over-current or differential protection.
Position 'TEST'	Generator operative but not connected to the bus.
'GEN INOPERATIVE' light	Illuminated when the generator is not operative or not connected to the bus except in TEST.
'EMERG POWER' switch	De-energises all main AC and DC buses.
'BUS' indicators	Bus indicator illuminates whenever there is power to the bus.
'BUS 1 (2) TRANSFER ISOLATE' switches	Prevents power transfer to appropriate bus.
'TRU 1 (2)' switches	Controls TRU; can be left in the ON position.
'TRU 1 (2) OVRH.' lights	Illuminates when TRU temperature is above a predetermined value.
Magnetic indicator	Shows 'in line' when appropriate TRU is operative.
'BATTERY' switch	ON – battery charged when TRUs are operative. Discharged, feeding DC essential bus when TRUs are inoperative. OFF – normal position on the ground. Battery not charged and not discharged expect for passenger and crew door operation.
Magnetic indicator	Shows 'in line' whenever the battery is connected with the 'control tie point', to be charged or discharged.
'EXTERNAL POWER' switch	Controls external power. Should normally be kept in the OFF position unless external power is ready and required.
'EXTERNAL POWER' magnetic indicator shows	OFF whenever no power or incorrect power is connected to the aircraft. RDY whenever AC external power is ready for use. ON whenever AC external power is used by at least one AC bus.
'CONSTANT SPEED DRIVE DISCONNECT' switch	To disconnect the CSD drive from the engine in case of a failure (overhead, under-speed or low oil pressure) as indicated by the CSD warning lights on the annunciator panels.
DC ammeter, voltmeter and selector switch	Allows you to check the current to the battery and from the TRUs and battery, and the voltages as marked by the selector switch.
AC freq. and voltmeter and selector switch	Allows you to check the frequency and voltage of the generators and external power connected or not connected to the bus and various points as marked by the selector switch.
'AC SUPPLY' warning light	Illuminates in case both AC bus 1 and 2 are de-energised.
'DC SUPPLY' warning light	Illuminates in case both DC bus 1 and 2 are de-energised.
'No. 1 (2) CONSTANT SPEED DRIVE' warning light	Illuminates in case of overheat, under-speed or low oil pressure.

Central Warning System

The Central Warning System (CWS) informs the flight crew of the state of the aircraft's systems by illuminating legends on the annunciator panels located to the side of either pilot. The system has two main parts:

1. The warning system (red system).
2. The flight guidance caution system (amber system).

Illumination of one of the annunciators will cause a simultaneous illumination of one of the master warning/ caution lights. These lights can be extinguished by depressing the respective light, but the legend on the annunciator panel will remain illuminated until the fault has been rectified.

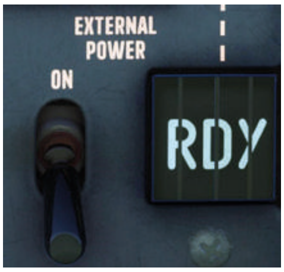
Each annunciator panel has a two-position BRIGHT/DIM switch, which provides control over the annunciator brightness of the respective panel. The panel's TEST switch illuminates all legends on both annunciator panels and all master lights.

Note: *The purpose of the BRIGHT/DIM switch on the annunciator panel is only to adjust the brightness of the legends on that panel. To adjust the brightness of the master lights and other annunciators in the cockpit, use the BRIGHT/DIM switch on the main instrument panel.*

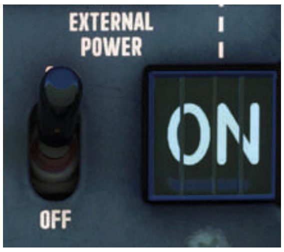
All caution lights on the overhead panel can be manually dimmed by twisting the respective light.

External power

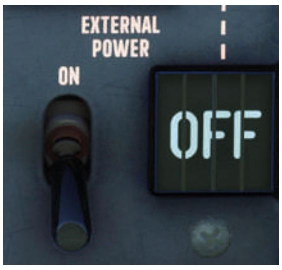
Both AC and DC power can be obtained from an external AC power source. Power is supplied to the aircraft's AC busbars for AC power and is then converted to DC via the TRUs.



When an external power source is connected, a RDY indicator will be shown on the overhead panel, indicating that the external power switch can then be selected to ON.



With external power supplying the aircraft, the indicator will then change to display ON.



When no external power source is connected, the indicator will display OFF.

Note: *With the aircraft connected to an external AC power source and DC power being supplied via the TRUs, APU starting cannot be performed. However, the battery can be charged if the battery switch is in the ON position.*

In this simulation of the F28, external power can be connected by clicking the GND PWR tab on the EFB.

Malfunction of automatic transfer system

When generators 1 and 2 are operating normally, generator 1 will feed AC bus 1 and generator 2 will feed AC bus 2, and an automatic transfer will occur if a generator becomes inoperative.

The automatic transfer system will become inoperative automatically if a bus fault occurs and the buses will be separated. The buses can also be manually separated via the bus transfer isolate switches.

To isolate bus 1 from generator 2 or 3:

Bus 1 transfer isolate switch – ISOLATE

To isolate bus 2 from generator 1 or 3:

Bus 2 transfer isolate switch – ISOLATE

If both switches are in the ISOLATE position, generator 3 is isolated from the buses.

If a GENERATOR INOPERATIVE light (amber) is illuminated:

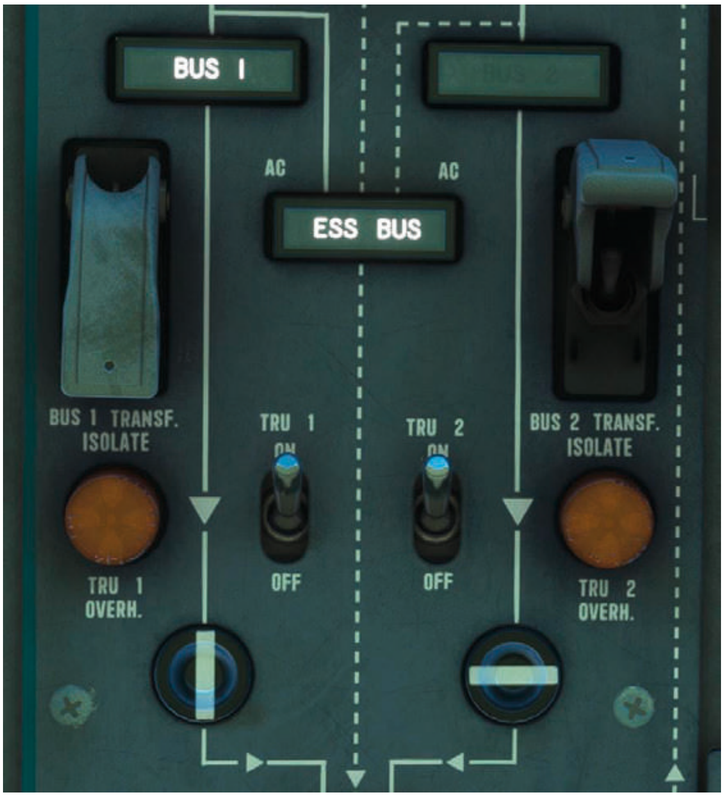
Generator switch – OFF/RESET

The generator's light, voltage and frequency can be checked by holding the generator switch in the TEST position for at least five seconds.

A reset may be attempted if nominal indications are confirmed by switching the generator switch back to ON.

If the oil temperature in the CSD is greater than expected, or a mechanical failure is suspected:

CSD – DISCONNECT



FIRE PROTECTION

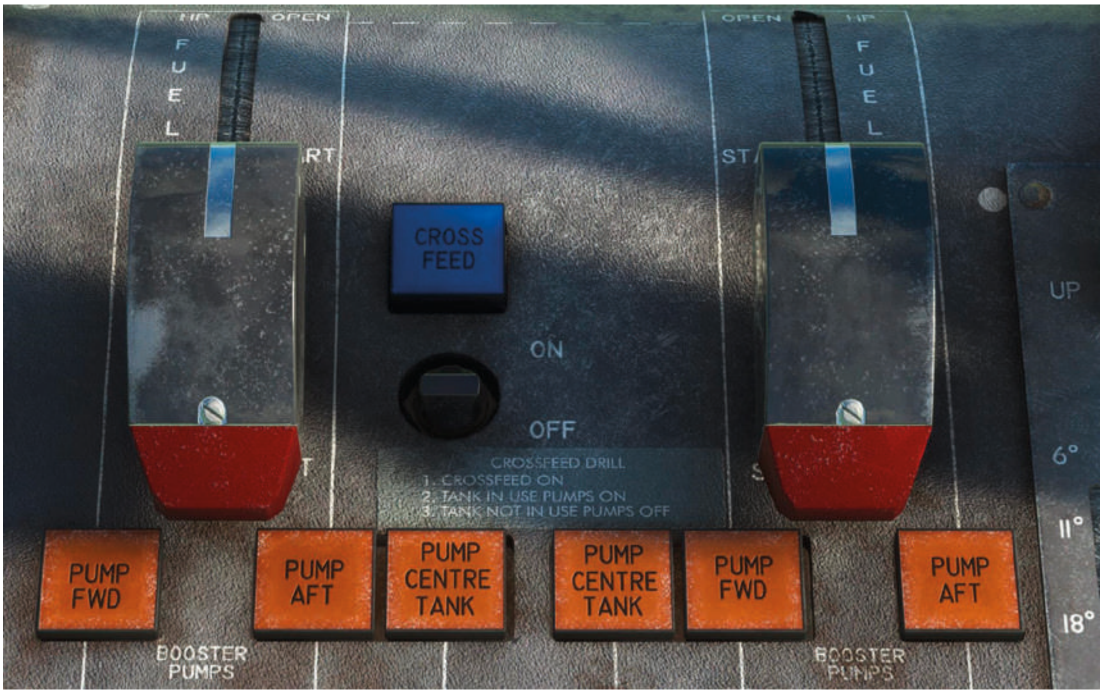
The fire protection system consists of two systems:

1. The detection system, which provides the means to detect a fire.
2. The extinguishing system, which provides the means of extinguishing a fire.

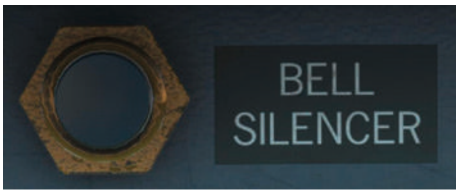
Both systems are supplied from the 28V DC essential bus.

Engine fire detection system

Sensing elements fitted in zone 1 of each engine activate the warning circuit when a fire is sensed, resulting in the respective ENGINE FIRE warning light illuminating on the glareshield panel, a light on the respective engine's HP fuel valve and a fire warning bell.



A BELL SILENCER button on the glareshield provides the means of silencing the fire warning bell.



Both engine fire detection systems can be tested by means of two test buttons located on the secondary instrument panel – one for each system.

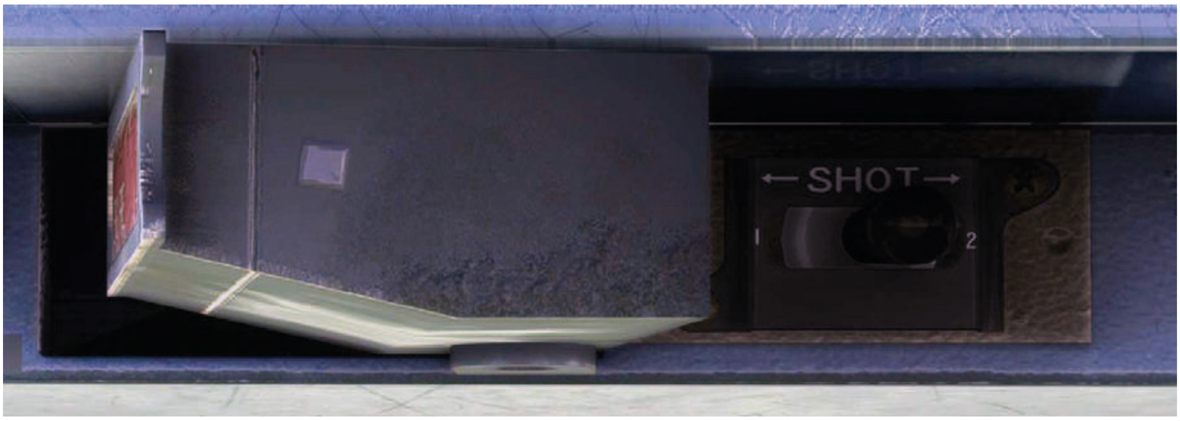
Engine fire extinguishing system

Two fire extinguisher bottles are installed just aft of the rear pressure bulkhead and can be discharged using the three-position toggle switches under the fire warning guard on the glareshield.

The switches are each covered with a guard. When a guard is raised, fuel and hydraulic shut-off valves cut off the flow of fuel and hydraulic fluid to the respective engine.

If the fire is not extinguished, the extinguisher switch can then be toggled to the left (1) or right (2) position to discharge the relevant extinguisher bottle.

Each fire extinguisher bottle can only be discharged once, although the contents of each bottle can be used on either engine.

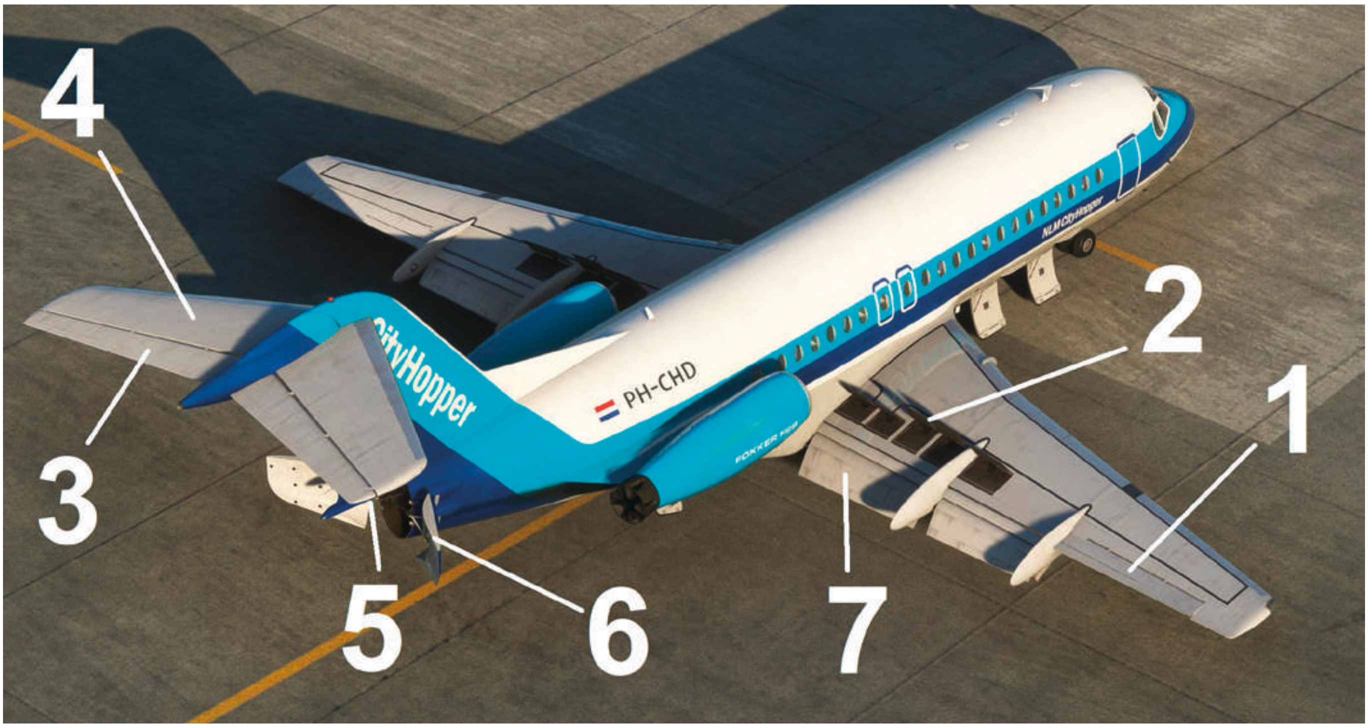


FLIGHT CONTROLS

Conventional flying controls are provided for each pilot to control the aircraft during flight and on the ground. Each pilot has a floor-mounted control column and rudder pedals allowing for control over the primary flight control surfaces.

Trim systems are provided for the ailerons, rudder and horizontal stabilizer.

Secondary flying controls are provided by means of wing flaps, tail-mounted speedbrakes and wing-mounted lift dumpers which are controlled via various controls on the pedestal.



1. Ailerons
2. Lift dumpers
3. Elevators
4. Horizontal stabilizer
5. Rudder
6. Speedbrake
7. Wing flaps

Powered flight controls

Control of the primary flying controls is achieved by means of a control column for the ailerons (roll) and elevator (pitch), and rudder pedals for the rudder (yaw). The controls are duplicated for both pilot stations and are mechanically-hydraulically connected to their respective control surfaces.

Each flying control has a duplicated set of hydraulic actuators; one is supplied with hydraulic pressure from the UTILITY system, whilst the other is supplied from the FLIGHT CONTROL system. This duplication ensures that powered operation of the flying controls is not affected by a single hydraulic system failure.

In normal operation all master switches on the flight control panel at the rear of the pedestal are set in the ON position, but in the event of a flight control failure the system can be manually depressurised using these master switches.

Indicators

Low hydraulic pressure in an actuator is indicated by the illumination of the respective caution light on the flight control panel. As this panel is not directly in the pilot's normal line of sight, a FLIGHT CONTROL central caution light is fitted to the secondary instrument panel, which serves as a repeater light. This light will illuminate if there is a caution light illuminated on the flight control panel and the respective master switch is in the ON position. Moving the switch to the OFF position will extinguish the central caution light, but the flight control panel light will remain illuminated.

Hydraulic operation

When the cockpit controls are operated, servo valves inside the hydraulic actuators are mechanically displaced in order to admit hydraulic pressure into the desired cylinder chambers, resulting in the deflection of the control surface.

Safety

Special protection devices (detent assemblies) are fitted to protect against a locked or runaway flight control condition. If an opposite force is applied on the controls by either the pilot or autopilot, hydraulic pressure will quickly be dumped in the hydraulic actuator, thus freeing the flying control surface.

Feel and trim

The ailerons and rudder are fully hydraulically controlled and therefore, when operated, they lack any true feel through the control column. An artificial feel system consisting of springs is fitted to the aileron and rudder controls.

Trimming of the flying control surfaces is performed mechanically, by adjusting the respective trim knob on the pedestal. This action moves the neutral position datum of the artificial feel spring, thus altering the 'no load' position of the system.

No artificial trim system is fitted to the elevator controls or stabilizer trim controls. Elevator control directly acts on the control surface, meaning that air loads are felt naturally through the control column when operated, alleviating the need for an artificial feel system. The stabilizer is only used for trim and so an artificial spring system is not required.

Flight control modes

There are three flight control modes, depending on the serviceability of the flying controls and hydraulic systems:

First mode – the normal mode of operation. Each flying control is operating with both actuators functional, and all flight control caution lights are extinguished.

Second mode – active in the event of a single actuator failure on one of the flight controls, and with one flight control system caution light illuminated. In this mode there is no apparent deterioration of the aircraft's response and feel.

Third mode – active in the event of a complete hydraulic failure of both UTILITY and FLIGHT CONTROL systems, and where both flight control system caution lights are illuminated. In this mode the ailerons, rudder and elevator are all operated manually, and the stabilizer is operated electrically. A summary of how each flying control surface is controlled in third mode is listed below:

Ailerons – controlled using control tabs. Sloppy control expected below 150 knots. Trim remains available.

Elevator – direct manual control. Control forces up to 4x higher than first or second mode operation.

Rudder – direct manual control. Control forces become very high at speeds greater than 200 knots. Artificial feel system disabled due to high control forces. No trim possible.

Stabilizer – controlled by electric motor using the ALTERNATE STABILIZER CONTROL on the pedestal labelled NOSE UP – NOSE DOWN. Electric mode is non-variable, and slow operation.

Reset push-button

The reset push-button can be used to extinguish any remaining caution lights on the flight control panel after a depressurisation of the system has been performed. The use of this push-button may be required:

- After testing or training third mode operation.
- After engine start.

Aileron control system

The ailerons are mechanically interconnected and each is provided with its own hydraulic actuator, allowing for normal operation of the system in the event of one actuator or hydraulic system failure.

A summary of the aileron control system:

- Fully hydraulic-powered, with artificial feel.
- Trimmable via trim knob and position indicator on pedestal.
- In third mode operation, controlled using control tabs on the control surface.
- Autopilot operates control column and is operative in third mode operation.
- Automatic depressurisation of the failing actuator in the event of a runaway or locked control surface.

Rudder control system

The rudder is hydraulically controlled and is fitted with two hydraulic actuators, allowing for normal operation of the system in the event of one actuator or hydraulic system failure.

A summary of the rudder control system:

- Fully hydraulic-powered, with artificial feel.
- Trimmable via trim knob and position indicator on pedestal.
- In third mode operation, manually controlled using rudder pedals.
- Autopilot operates only the rudder, not the pedals, and is operative in third mode operation.
- Automatic depressurisation of the failing actuator in the event of a runaway or locked control surface.

Elevator control system

The elevator is manually controlled and hydraulically boosted and is fitted with two hydraulic actuators, allowing for normal operation of the system in the event of one actuator or hydraulic system failure.

A summary of the elevator control system:

- Manually controlled, hydraulically boosted at a ratio of 4:1.
- In third mode operation, controlled directly using the control column.
- Autopilot operates control column and is operative in third mode operation.
- Automatic depressurisation of the failing actuator in the event of a runaway or locked control surface.

Stabilizer control system

The stabilizer is hydraulically controlled and is fitted with two hydraulic actuators, allowing for normal operation of the system in the event of one actuator or hydraulic system failure.

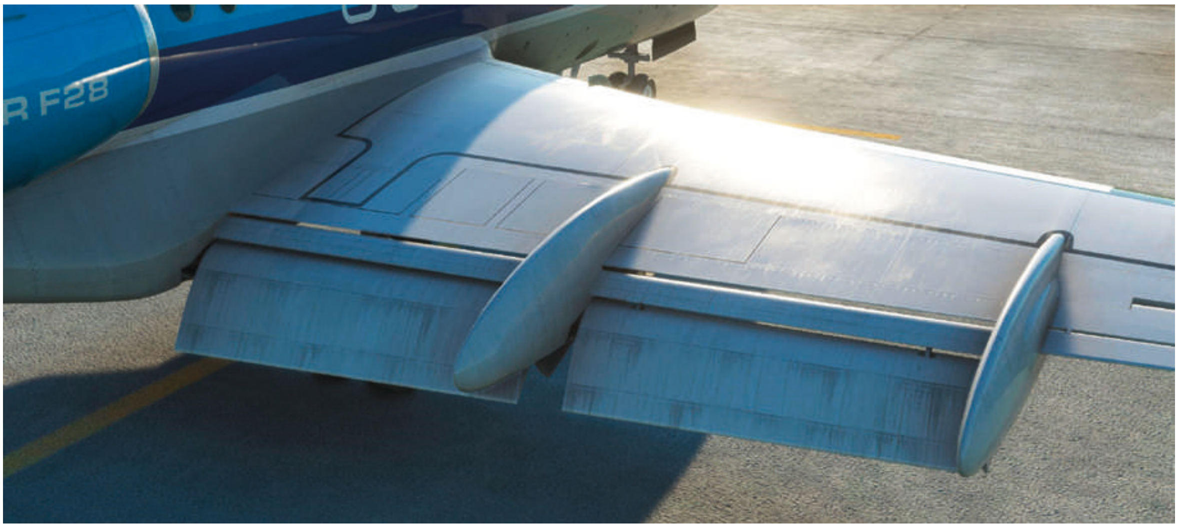
A summary of the stabilizer control system:

- Fully hydraulic-powered, with an operating range of 8°20’ up, 2°40’ down.
- Trimmable via trim wheels and position indicators on the side of the pedestal. An electrical position indicator is also fitted to the main instrument panel.
- In third mode operation, controlled using the ‘alternate stabilizer control’ toggle switch on the pedestal. Operation is achieved using a low-speed electric motor.
- Autopilot operates trim wheels but is inoperative in third mode operation.
- Automatic depressurisation of the failing actuator in the event of a runaway or locked control surface, up to a maximum of 15’ runaway.

Wing flap control system

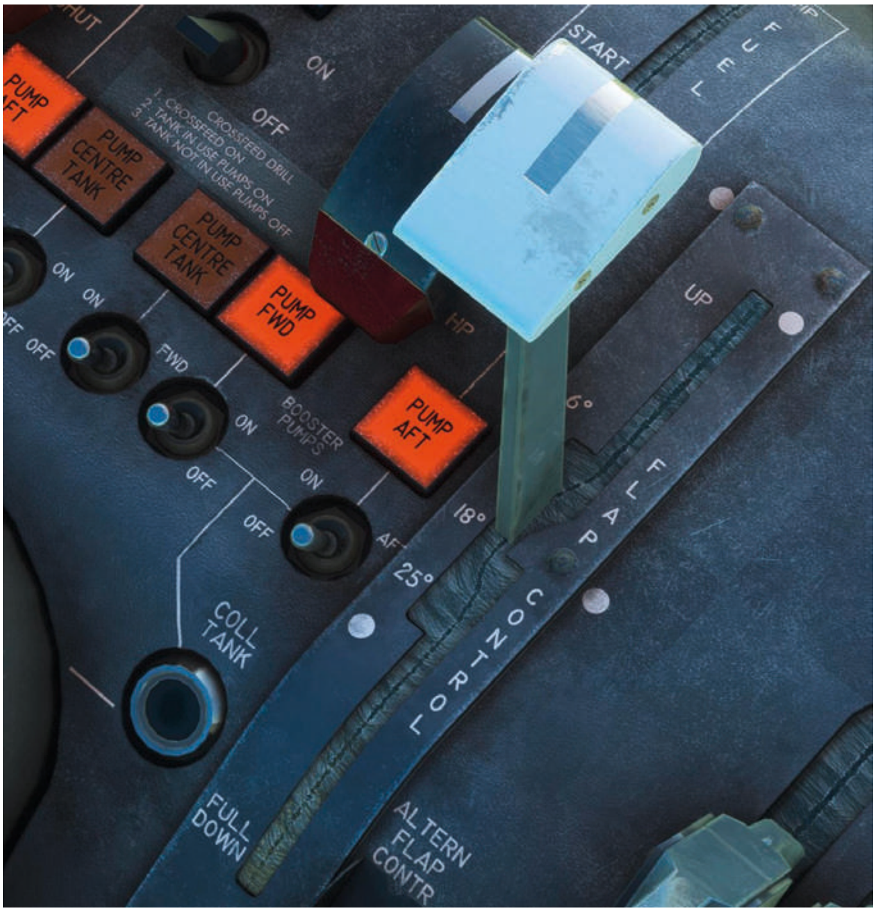
Four semi-Fowler flap sections are fitted to the trailing edge of each wing. The flaps are hydraulically operated by means of six ballscrew-type mechanical actuators and driven via drive shafts through a main gearbox. In normal operation, a hydraulic motor is used to drive the shafts and an electric motor is provided in the event of a hydraulic failure. Flap tracks covered with aerodynamic fairings support the flaps and allow them to be extended up to a maximum of 42°.

For the first 20° of travel, the flaps travel in a single slotted configuration. When extending through 20°, flap vanes are pushed forwards away from the main flap surfaces, transforming the flaps to a double-slotted configuration.



Normal selection

The flaps may be selected to any of the six gated positions (UP, 6, 11, 18, 25 and FULL DOWN) using the flap control lever on the pedestal.



The flap control lever is connected to a hydraulic control valve via a cable loop and a gear transmission. When a selection is made with the flap control lever the control valve is opened, allowing hydraulic pressure from the UTILITY system to the hydraulic motor, thus operating the flaps via the drive system.

A flap position indicator is located on the main instrument panel.

Note: *This indicator is not linear with the actual flap movement. Flap positions are painted on each of the centre flap track fairings visible from the cabin windows, providing a visual reference of the flap position in the event of an electrical system failure.*

Alternate operating and resetting

Alternate operation of the wing flaps can be achieved by operation of the ALTERN FLAP CONTR switch on the pedestal. Operation of the switch will depressurise the flap hydraulic system, allowing the electric motor to drive the system.

Following alternate operation, the flap control system can be reset by operating the reset switch located on the test panel behind the co-pilot's seat. To regain normal operation, the flap lever must then be moved to a new position.

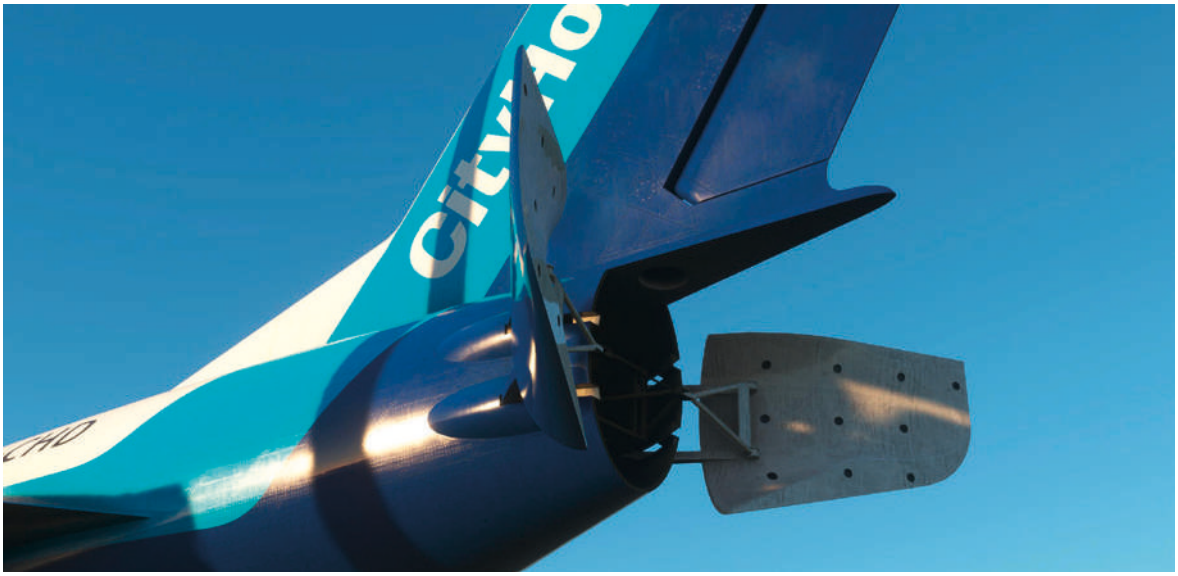
Asymmetry protection

During normal hydraulic system operation an automatic asymmetry protection system is fitted to the aircraft; this automatically stops the flaps if a difference in flap angle is detected and will also illuminate a WING FLAP ASYMMETRY warning light.

If a difference in flap angle is detected when the flaps are operating using their electric motors, only the warning lights will illuminate. In this case, flap operation must be manually stopped by releasing the alternate flap control switch.

Speedbrake control system

Located on the rear of the fuselage, the speedbrakes provide the primary drag control of the aircraft when in flight and are controlled with the speedbrake control lever on the pedestal. The speedbrakes can be extended symmetrically up to a maximum angle of 60° and are infinitely variable.



A speedbrake position indicator is fitted to the main instrument panel and will indicate the position of the speedbrake between 0° and 60°.

A blue SPEED BRAKE indication light is also fitted to the main instrument panel. It is illuminated whenever the speedbrakes are not fully retracted.

Selection

The speedbrake can be selected to any position between 0° and 60° by using the speedbrake control lever on the pedestal. When the speedbrake control lever is operated, a servo valve is mechanically operated, which in turn issues hydraulic pressure from the UTILITY system to the single actuator that controls both speedbrake surfaces. This system ensures that an asymmetric extension of the speedbrake surfaces is not possible.

In the event of a UTILITY system failure, accumulator power is sufficient for either one retraction or one extension of the speedbrakes.

Blowback

At airspeeds greater than 190 knots, hydraulic pressure is not sufficient to overcome the pressure of the air acting on the speedbrake surfaces. At airspeeds greater than 190 knots, the speedbrakes will only extend as far as to provide 0.1G of deceleration. Once the airspeed is below 190 knots, the speedbrakes will extend directly related to the speedbrake control lever.

Automatic retraction

An automatic retraction system is fitted which automatically retracts the speedbrakes when either throttle is advanced to, or over, the throttle detent position. In this condition the speedbrake control lever will also be automatically retracted to the IN position, meaning that further speedbrake movement will not be possible until both throttles are retarded below the throttle detent position.

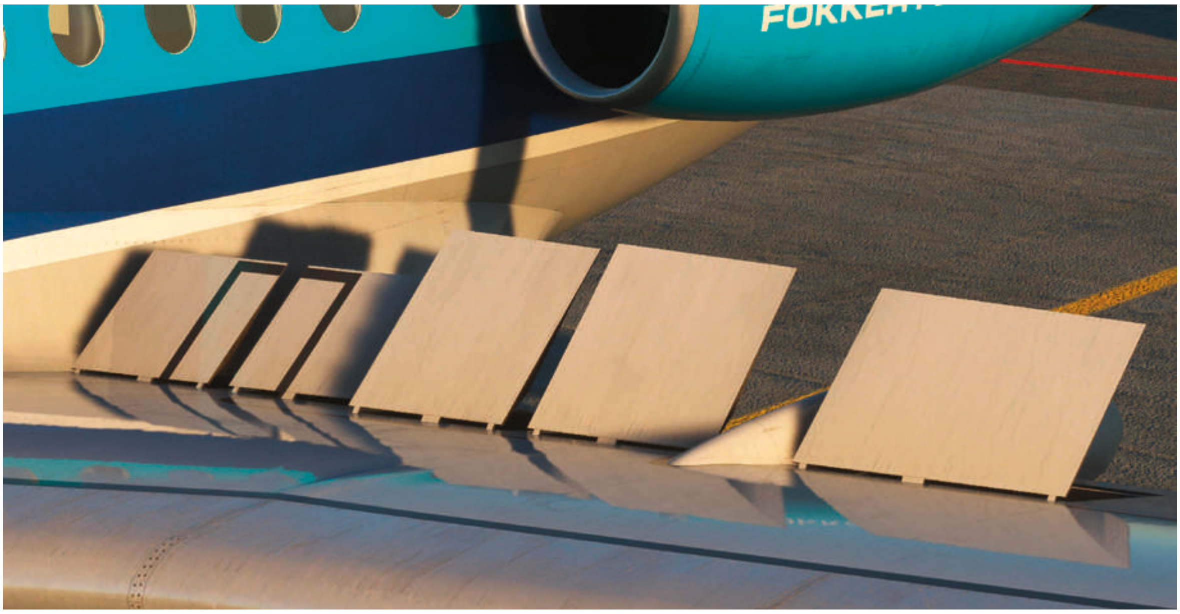
Operational use

Some typical examples of when speedbrakes may be used:

- If a rapid descent from cruise altitude at the maximum allowed rate of pressure change in the cabin is desirable, speedbrakes may be deployed to maintain the best possible vertical speed. In the interest of flight economy, the engines will be kept as close to idle as possible during this type of descent.
- If rapid changes in altitude are required either by airport procedures or Air Traffic Control (ATC) instruction.
- If high airspeed is required up until glideslope intercept, extension of the speedbrakes allow for the rapid bleeding off of airspeed.
- Allows for glidepath interception without the need to adjust throttle settings.
- Can be used during final approach to maintain a constant aircraft configuration with high drag (flaps full, gear down, speedbrakes extended) or can be used as a standby drag device when in the retracted position, for use around noise-restricted airports. In the latter situation, the speedbrake will typically be deployed prior to touchdown in order to minimise the landing distance.

Lift dumper control system

The purpose of the lift dumpers, which are located on the upper surface of each wing, is to spoil lift and increase drag. Their effectiveness in these areas means their use is limited to when the aircraft is on the ground. During normal operation they are deployed automatically after touchdown or during an aborted take-off.



The lift dumpers can be armed by pushing in the lift dumper arming switch on the pedestal. The button will be held in the in the ARMED position and will be illuminated red when the system is armed.

Two solenoid-operated valves mounted in a manifold control the flow of hydraulic pressure from the UTILITY system to the lift dumper actuators. The two valves operate in series, ensuring that the malfunction of one valve cannot cause accidental lift dumper extension. The valves are retracted with hydraulic pressure derived directly from the UTILITY system.

When retracted, the lift dumpers are mechanically locked in place.

Two magnetic indicators are fitted to the glareshield, one for each pilot, which indicate the position of the lift dumpers:

IN – lift dumpers locked. System not armed.

RDY – lift dumpers locked. System armed.

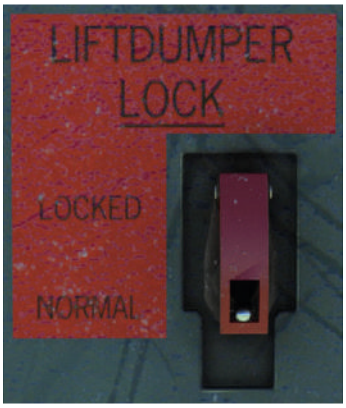
OUT – lift dumpers extended.

Prolonged barber pole – malfunction in the automatic extension system.

Lock switch

A lift dumper lock switch is located on the left-hand aft side of the pedestal. With the switch set to the LOCKED position, the lift dumpers will be secured in the retracted position both hydraulically and electrically. This switch should only be required in the event of a LIFTDUMPER warning light displaying on the annunciator panel. The LIFTDUMPER warning light will illuminate:

1. In the case of an unlocked lift dumper.
2. In an unsafe condition of the valve manifold that could lead to accidental lift dumper operation.



Automatic lift dumper operation

In order for the lift dumpers to extend automatically on touchdown or during an aborted take-off, the system must first be armed by pushing in the lift dumper arming switch on the pedestal prior to take-off or landing. The switch will illuminate red when the system is armed.

The switch will be held in the ARMED position if the following conditions are met:

1. The aircraft is on the ground.
2. Both throttles are below the 95% throttle detent when in flight.

The system will be disarmed and the switch will be released to the DISARMED position in the following conditions:

1. After take-off.
2. One or both throttles are advanced above the 95% throttle detent when in flight.

Conditions for automatic extension

Automatic extension of the lift dumpers will occur if the following condition are met:

1. The system is ARMED and indicating RDY.
2. Both throttles are below 75% HP RPM.
3. The wheel speed of at least both left-hand or both right-hand main wheels is above the equivalent of 50 knots aircraft speed.

Retraction of the lift dumpers after an automatic extension will occur if:

1. The lift dumper handle is brought back to NORMAL and the system is disarmed (indicating 'IN').
2. The lift dumper handle is brought back to NORMAL and the throttles are advanced above 75% HP RPM in the event of a touch-and-go.

Manual lift dumper operation

A manual lift dumper handle is fitted to the Captain's right-hand throttle. The handle can only be operated when the throttle is in the idle position and manual extension will only take place when the aircraft is on the ground.

With the throttle at idle, and the manual lift dumper handle operated, the arming switches and wheel spin-up speed systems will be overridden and the lift dumpers will be extended.

The lift dumper handle will not override the lift dumper lock switch and no extension will take place with this switch in the LOCK position.

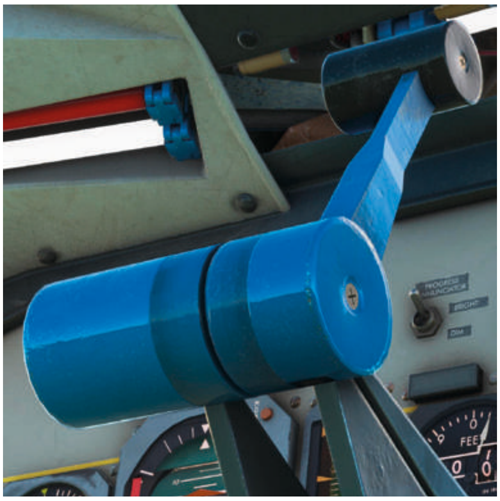
Automatic selection should always be backed up by the selection of the manual lift dumper handle to ensure lift dumper extension under all circumstances. If the lift dumper handle is used to back up automatic extension, retraction will then take place when:

- The manual lift dumper handle is moved back to normal and the system is DISARMED

  OR

- The manual lift dumper handle is moved back to normal and the throttles are advanced above 75% HP RPM (system remaining ARMED).

If a manual extension of the lift dumpers is performed when the system is not ARMED, retraction will take place when the manual lift dumper handle is returned to the NORMAL position.



Gust lock system

A gust lock system is provided for the ailerons, elevator and rudder. A blue handle on the left-hand aft side of the pedestal mechanically locks the control surfaces when moved to the locked (up) position.

With the gust lock engaged, a mechanical link prevents the throttles from advancing beyond 80% HP RPM, thus preventing take-off.

When there is no electrical external power supplying the aircraft, a microswitch in the gust lock mechanism activates the flight data recorder when the handle is moved to the unlocked (down) position.

FUEL SYSTEM

Two fuel systems on either side of the aircraft operate as completely independent and isolated systems under normal conditions. The systems are used to automatically supply fuel in sufficient quantity to match the requirements of both the engines and the APU under all operational conditions.

Fuel flow is controlled by the position of throttle levers and the mass flow of air through the engine.

A cross-feed system allows fuel to be fed from either tank to either engine, but the transfer of fuel between left-hand and right-hand systems is not possible. Fuel dumping is also not possible.

Fuel supply and distribution

Storage

Fuel is stored in fuel tanks built as an integral part of the outer wing structure as standard. These tanks have a total capacity of 16,982 lb (7,703 kg) and can be supplemented by the fitment of bag tanks which can be installed in the centre wing.

To prevent fuel sloshing during manoeuvre and causing an interrupted fuel flow to the engines, as well as causing unwanted changes to the aircraft's centre of gravity, collector tanks are installed on the inboard section of each wing tank. The collector tanks are kept full of fuel by the automatic transfer of fuel from the outer sections of the wing tank by a jet pump system which receives flow from the fuel booster pumps. A flapper valve allows fuel to enter the collector tank by gravity in the event of a failure with the transfer system.

When the collector tank is full, fuel is transferred back to the outer wing section via four top hat section stringers on the topskin. A ventilation outlet is also fitted to the lower side of the outer flap track fairing.

Refuelling and defuelling

A single refuelling/defuelling adapter is fitted to the lower side of the right-hand wing to allow for pressure refuelling. An additional over-wing filling point is also provided in the topskin of each wing.

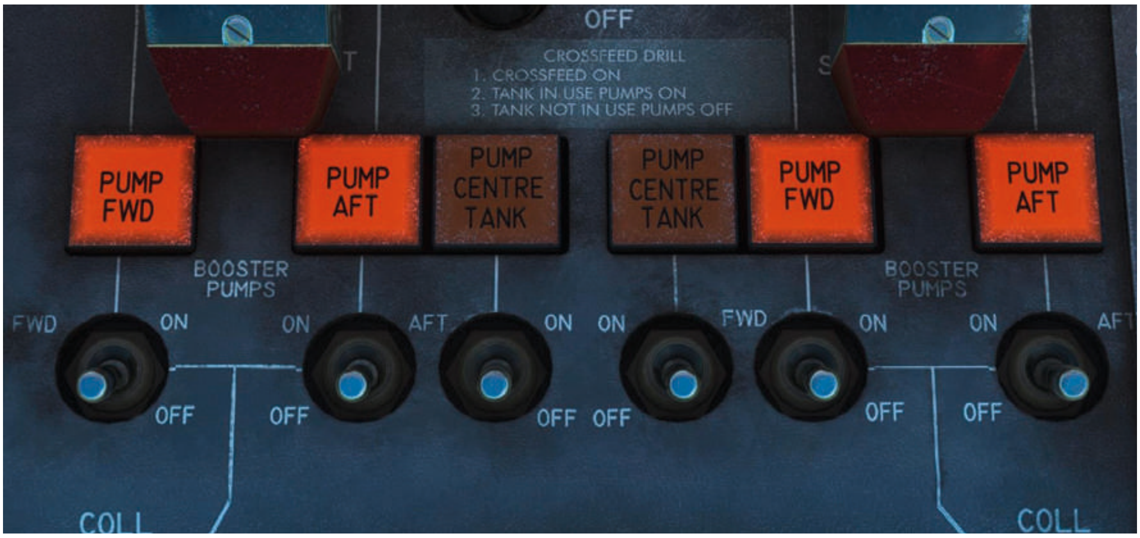
A fuel control panel for pressure refuelling/defuelling is located behind a service door on the centre wing body.

Booster pumps

Two AC-driven fuel booster pumps in each collector tank supply fuel under pressure to the engine-driven pumps and provide the driving flow for the jet pumps.

Two-position ON/OFF switches on the pedestal in the cockpit control the operation of the booster pumps.

There is a low-pressure amber caution light adjacent to each switch. The caution lights are arranged so that when one of the two booster pumps in a collector tank is switched ON and the pressure supply is normal, both lights will be extinguished. A low-pressure light will only illuminate if both pumps are switched OFF, or if one or both pumps are switched ON and a pressure decrease is sensed by the pressure switch in the system.



In the case of an emergency, the engines may be operated without booster pumps up to 30,000 ft when using kerosene (JP-1), or up to 15,000 ft when wide-cut gasoline (JP-4) is used.

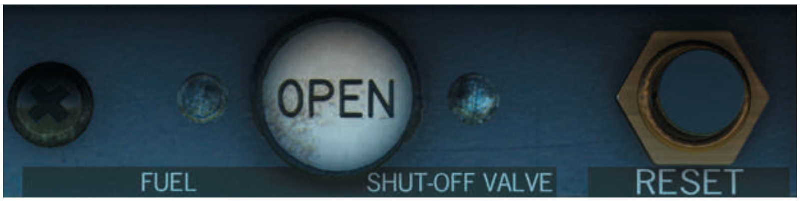
Cross-feed

Cross-feed valves in the interconnected fuel supply lines allow fuel to be supplied to either engine from either wing tank. This procedure may be used as a method to solve a fuel imbalance between wing tanks.

A two-position ON/OFF switch is located on the pedestal to electrically control these valves. A blue light illuminates whenever the cross-feed valves are open.

Fire shut-off valves

Electrically operated fuel shut-off valves are fitted in the fuel supply lines to each engine. Normally in the open position, these valves will close and shut off the fuel to the engine whenever the respective fire warning guard on the engine is lifted. A valve position indicator is fitted to the glareshield indicating whether the valve is OPEN or SHUT.



Once a valve has been shut, it can be re-opened by closing the fire warning guard and pressing the RESET button on the glareshield.

A shut-off valve is also fitted in the APU supply line which is controlled by the APU main switch on the overhead panel. When this switch is in the ON position and the start button is depressed, the valve will open. The valve will remain open until the APU is stopped.

Distribution (engine fuel system)

From the fire shut-off valves, fuel is routed to the engine-driven LP fuel pump before passing through the engine and CSD oil coolers, filter and flow meter, then arriving at a variable-output HP pump.

From the HP pump, a flow regulator meters and divides the fuel into two separate flows to the spray nozzles in the engine's combustion chamber. The main flow passes through the LP shaft governor to the HP fuel valve, whilst the primary flow passes directly to the HP fuel valve. Both flows are distributed to the primary and main spray nozzles respectively.

Controls for the HP fuel valves are located on the pedestal and have three positions: SHUT, START and OPEN.

SHUT – the HP fuel valves are closed and no fuel can be supplied to the engines. This position is used when the engines are being shut down or when they are already shut down.

START – supplementary fuel flow is added to the main fuel flow. This position is used during engine starting.

OPEN – the supplementary flow ceases. This position is used for normal flight operations.

Fuel heating

At temperatures below 0°C water can freeze and block the LP fuel filter, preventing a continuous flow of fuel to the engine. To prevent this, heat is supplied to the fuel as it is used to cool the engine and CSD oil coolers.

Cockpit indicators

Fuel quantity

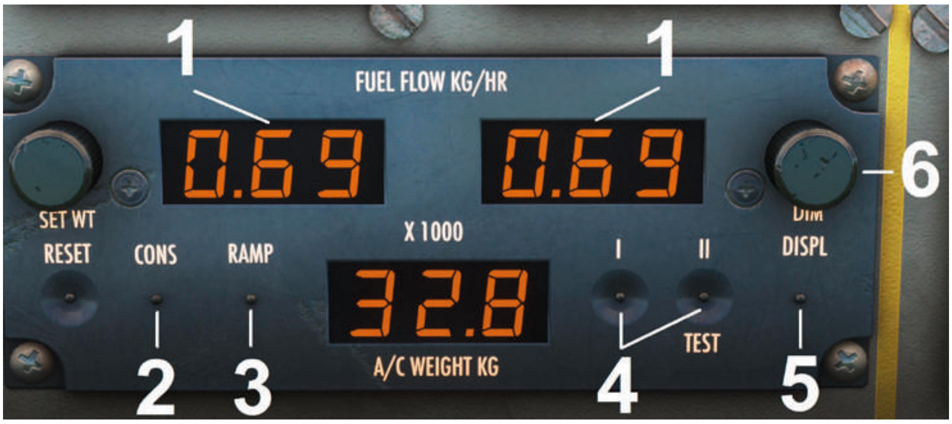
The fuel tank quantity indicating system is of a capacitive type, with the fuel tank quantity for each tank displayed on respective indicators on the secondary instrument panel.

A three-position switch under each indicator labelled COLL/TOT/TEST allows for the displaying of fuel quantity either in the collector tank (COLL), total fuel in that wing (TOT) or testing of the indicator (TEST). The switch is spring-loaded to the TOT position.

A float switch in each collector tank is connected to a mechanical indicator on the pedestal. The mechanical indicator will show black when the fuel in the respective collector tank is greater than 1,300 lb. If the fuel quantity in a collector tank drops below 1,200 lb, the indicator will show a barber pole.

Fuel flow/consumption/weight

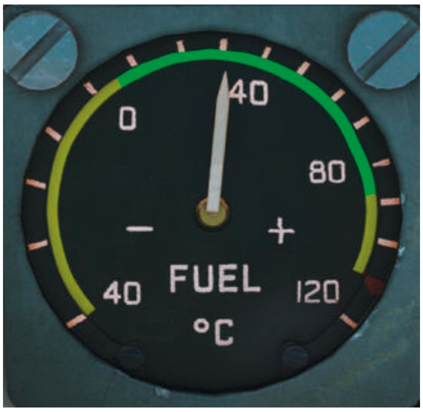
A digital fuel flow/consumption/weight indicator is fitted to the main instrument panel and is supplied with 155V AC from AC bus 2.



1. The two digital displays at the top of the unit indicate fuel flow in kg/hr x 1,000 to each respective engine. The digital display at the bottom of the until displays the aircraft's weight in kg x 1,000 and can be manually adjusted using the SET WT rotary knob on the left side of the unit.
2. Fuel consumption can be displayed by pushing the CONS push-button. This will display the total fuel consumed by each engine on the upper two digital displays. The total fuel consumed counter can be reset by pressing the RESET button.
3. The RAMP push-button displays the ramp weight of the aircraft on the lower digital display.
4. The TEST I push-button begins a test of the indicator simulating a fuel flow of 3,000 kg/hr. The TEST II push-button begins a test of the indicator simulating a fuel consumption of 2,000 kg/S.
5. The DISPL push-button tests the display's filaments and displays an '888' pattern on all displays.
6. The DIM rotary knob on the right side of the unit is used to adjust the brightness of the digital displays.

Fuel temperature

Two fuel temperature indicators are fitted to the main instrument panel and indicate fuel temperature over a range of -40°C to +120°C. This system is supplied with 28V DC bus 1.



Filter icing

An amber FILTER ICED caution light is fitted to the secondary instrument panel and illuminates if ice crystals form and clog the low-pressure fuel filter, resulting in the fuel pressure differential switch closing. This system is supplied with 26V AC dim bus 1.

Low fuel pressure

An amber FUEL PRESS caution light is fitted to the secondary instrument panel and illuminates when fuel pressure downstream of the LP pump falls below a set pressure. This system is supplied with 26V AC dim bus 1.

Centre wing tank

A centre wing tank fuel system can be installed in the centre wing torsion bar to increase the fuel capacity and range of the aircraft. Seven interconnected bag tanks increase the usable fuel capacity by 5,755 lb (2,610 kg).

Each bag is connected via a fuel line and two electrically operated shut-off valves with a refuelling/defuelling system and a ventilation and overflow system.

Refuelling and defuelling

Refuelling and defuelling of the centre wing tank is controlled via the same control panel as the wing tank fuelling system. A maximum-level thermistor mounted in the centre bag tank gives the refuelling operator an indication of when the tank is full and two motor-operated shut-off valves will automatically close.

Fuel transfer

Fuel can be transferred from the centre wing tank to the wing tanks by means of two transfer pumps, centre wing shut-off valves and fuel shut-off valves in the collector tanks. The transfer pumps and centre wing shut-off valves are controlled via switches on the pedestal.

Amber warning lights on the panel illuminate if the respective fuel pump fails. In the event of a failure, turning the pump OFF will automatically open the transfer control valve, allowing the remaining operational pump to supply fuel to both collector tanks.

Fuel transfer should not be initiated until the wing tanks are reading less than 6,500 lb (2,948 kg).

Indicators

A centre wing tank indicator is fitted to the secondary instrument panel.

A TEST switch located to the right of the indicator allows for testing.

HYDRAULIC POWER SYSTEMS

The hydraulic power systems are comprised of two completely independent systems, the UTILITY system (System No. 1) and the FLIGHT CONTROL system (System No. 2). Being independent systems, they can both be operating at the same time, and in the case of a failure with one of the systems, the other system will remain operative.

Both systems operate at a pressure of 3,000 PSI. Pressure is generated by two engine-driven hydraulic pumps, two in each engine. This level of redundancy means a single engine failure will have no effect on the operation of the hydraulic power system.

Each hydraulic power system supplies pressure to the following services:

UTILITY SYSTEM (System No. 1)

Left aileron

Rudder

Elevator

Horizontal stabilizer

Flaps

Lift dumpers

Speedbrakes

Landing gear

Nose-wheel steering

Brakes

Alternate brakes

FLIGHT CONTROL SYSTEM (System No. 2)

Right aileron

Rudder

Elevator

Horizontal stabilizer

Hydraulic power system indication is provided via various indicators and caution lights on the secondary instrument panel. A yellow line on this panel separates the two systems: the upper section for the FLIGHT CONTROL system and the lower section for the UTILITY system.

Reservoirs

A pressurised reservoir on each system stores hydraulic fluid. The reservoirs are pressurised to 40 PSI by air tapped from the engine bleed air system, to supply hydraulic fluid under pressure to the engine-driven hydraulic pumps to reduce the risk of a pump inlet cavitation.

Pressure regulators with integral relief valves control the reservoir pressures. If the pressure drops below 15 PSI, a LOW TANK PRESSURE caution light illuminates in the cockpit.

A temperature switch in each reservoir triggers an OVERHEAT caution light in the cockpit if the temperature of the hydraulic fluid exceeds 90°C.

Two quantity indicators in the cockpit indicate the level of hydraulic fluid in the respective system. This is sensed by a level transmitter in each reservoir.

Pressure supply system

Four engine-driven hydraulic pumps ensure a continuous, non-pulsating flow of hydraulic fluid. Each hydraulic system has two engine-driven pumps, one on each engine, for added redundancy in case of an engine failure. This means that if one engine fails, there will be no impact on the hydraulic system or any of its services as the whole system can function on one engine. The normal hydraulic pressure in the system is 3,000 PSI.

The two engine-driven pumps are controlled by two-position off-loader switches on the secondary instrument panel in the cockpit. These switches have two positions: NORMAL and OFF-LOAD. When in the NORMAL position, the hydraulic system operates as normal, with a pressure of 3,000 PSI. In the OFF-LOAD position, the relevant pump output is reduced to between 400-500 PSI.

If the pressure output of one of the hydraulic pumps in a system drops below 2,500 PSI, a pressure switch will activate and the relevant PUMP caution light will illuminate in the cockpit. If both hydraulic pumps in a system are producing a low-pressure output, the PUMP light will be accompanied by a HYDR. SYSTEM UTILITY or HYDR. SYSTEM FLIGHT CONTROLS light.

Hydraulic pumps on the UTILITY system are automatically off-loaded during engine start to reduce engine starting load.

All hydraulic controls and indicators are located on the secondary instrument panel in the cockpit.

Fire shut-off valves

In the case of an engine fire, electrically controlled dual fire shut-off valves are fitted to both suction lines of each engine. When activated, the shut-off valves halt the supply of hydraulic fluid to the engine.

The shut-off valves are controlled by microswitches located behind the glareshield panel. When one of the fire warning light assemblies is opened, the relevant switch is activated and the shut-off valve will be closed. The valve can be re-opened by closing the fire warning light assembly and then depressing the RESET switch on the side of the fire warning light assembly.

The fire shut-off valves are supplied by the essential DC bus.

System relief valves

In the case of an increase in system pressure due to a pump pressure regulator malfunction, a system relief valve will automatically open when the system pressure is between 3,450 PSI and 3,750 PSI.

Electrically driven pump(s)

When the aircraft is on the ground with no engines running, hydraulic system pressure in the UTILITY system can be obtained by means of an electrically driven pump. This pump can be controlled via a switch on the secondary instrument panel and is supplied by AC bus 1.

On some aircraft an identical pump may be installed for the FLIGHT CONTROL system. If fitted, this pump is supplied by AC bus 2.

Failures

In the case of a failure, the hydraulic pumps should be off-loaded in the following conditions:

- When the OVERHEAT caution light illuminates
  (faulty pump of the relevant system)
- In the case of fluctuating system pressure
  (faulty pump only)
- In the case of decreasing quantity indication
  (both pumps of the relevant system)
- When a PUMP pressure caution light illuminates
  (faulty pump only)
- When annunciator panel red warning lights illuminate
  (both pumps of relevant system)

ICE AND RAIN PROTECTION

The aircraft is certificated for flight in icing conditions. Ice and rain protection systems are provided to detect and prevent ice accumulation on the exterior of the aircraft and to warn the crew.

Ice and rain protection can be broken down into five systems:

1. Airfoil anti-icing
2. Pitot heating
3. Windshield anti-icing
4. Windshield wipers
5. Ice detection

It is important to emphasise that anti-icing systems are used to prevent the accumulation of ice whilst you are airborne and are NOT intended to de-ice the aircraft on the ground.

Airfoil anti-icing system

The airfoil anti-icing system is split into two sub-systems: wing anti-icing and tail anti-icing. Both systems utilise hot bleed air from the bleed air supply system and pass the hot air through ducts in the leading edges of the wing and tail.

System control and indicators

The airfoil anti-icing controls are located on the anti-icing panel, on the right-side of the overhead panel. A schematic layout of the system is depicted on the panel, with mechanical indicators representing the various shut-off and modulating valves.

Two OVERRIDE switches labelled SHUT/STOP/AUTO are kept in the AUTO position (guard closed) during normal operating conditions.

When in the AUTO position, the two MAIN switches labelled ON-MAIN-OFF/RESET control the relevant shut-off valve positions.

When the OVERRIDE switch is moved to the STOP position, this halts any current movement in the shut-off valves. The valves can then only be closed further by operation of the primary overheat protection circuit. When the OVERRIDE switch is moved to the SHUT position, the shut-off and modulating valves will close.

Two ANTI-ICING temperature indicators at the bottom of the panel provide a visual indication of the temperature in the wings and tail. The left indicator indicates the temperature of the left-hand or right-hand wing (toggled by means of a two-position switch below the indicator labelled LH-RH NORMAL) and the right indicator indicates the temperature of the tail. The indicator is marked in increments of 10°C between 0°C and 120°C.
A green band indicates the normal operating range between 35°C and 70°C. A yellow band indicates the abnormal operating ranges between 20°C and 35°C, and between 70°C and 85°C.
A red mark indicates 85°C.

System overheat protection and warning

Two overheat protection systems are fitted: primary and secondary.

The primary overheat protection system will automatically close the shut-off valves and illuminate the L.E. PRIM OVERHEAT caution light if a temperature of 65°C is detected in the leading edges of the wing or stabilizer. Once the temperature has reduced below 65°C, the caution light will extinguish and the valves will automatically re-open.

The secondary overheat protection system is provided as a redundancy to the primary system. The secondary system will automatically close the shut-off valves and illuminate the L.E. SEC OVERHEAT caution light if a temperature of 93°C is detected in the leading edges of the wing or stabilizer. Once the temperature has cooled down to normal levels, the MAIN switch must be moved to the OFF/RESET position and then back to ON in order for the valves to re-open.

The BAY OVERH. caution lights will illuminate if a temperature of 90°C is detected in the belly fairing for the wing anti-icing system, or in the tail and the vertical stabilizer tip for the tail anti-icing system. In this situation, all shut-off and modulating valves will be automatically closed. Once the temperature has cooled down to normal levels, the MAIN switch must be moved to the OFF/RESET position and then back to ON in order for the valves to re-open.

System testing

A VALVE TEST switch is fitted at the top of the airfoil anti-icing panel. The switch is spring-loaded to the centre position. The switch can be used to test the shut-off and modulating valves as long as the OVERRIDE switch is in the AUTO position and the DC buses are powered.

When the switch is moved and held in the SHUT OFF position, both shut-off valves will open.

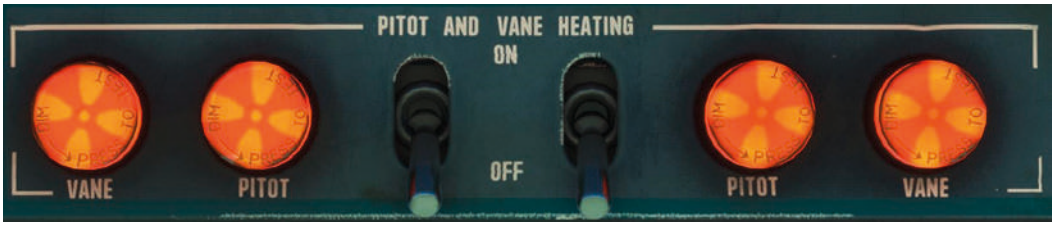
When it is moved and held in the MODUL position, both modulating valves will open if there is also bleed air supply pressure available.

Pitot heating system

Pitot tubes, stall warning vanes and static openings are electrically heated with 115V AC. The left-hand pitot heater and left-hand static opening heater are both powered by the essential AC bus.

Two PITOT HEATING switches on the lower overhead panel directly control the supply of electricity to the heaters.

Four amber caution lights labelled PITOT and VANE will illuminate if the respective pitot or vane is not heated. It is recommended that both PITOT HEATING switches are left in the ON position to ensure that the caution lights will only illuminate in the event of a failure.



Windshield anti-icing system

All windshields are of the electrically heated laminated type and heating is controlled by two switches labelled HIGH/OFF/LOW on the WINDSHIELD HEATING panel on the lower overhead panel. The left switch controls the Captain's windshield heating and the right switch the First Officer's windshield heating.

When the respective switch is in the OFF position, no electrical power is supplied to the windshield. When in the LOW position, electrical power is supplied to the windshield and the voltage is transformed to 240V AC. When in the HIGH position, the voltage is transformed to 323V AC.

Electrical power is supplied to the left-hand system by AC bus 1, and to the right-hand system by AC bus 2.

In the event of icing conditions, it is necessary to move the switches to the HIGH position. The windshield then selected by the PRIORITY switch will be fully heated, whilst the other windshield will only be heated during the cooling off period of the primary windshield.

Windshield wiper system

Each windshield is provided with an electrically operated, two-speed windshield wiper. Each wiper is independently operated with the four-position WINDSHIELD WIPER rotary switches labelled PARK/OFF/LOW/HIGH on the lower instrument panel.

In the LOW position the wiper moves at half speed. In the HIGH position it moves at full speed. When the switch is moved to the OFF position, the windshield wiper will stop at its current position and you have to move and hold the switch at the PARK position to return the wiper to its original position. The windshield wiper moves at half speed when PARK is selected.

Electrical power is supplied to the left-hand wiper motor by AC bus 1 and to the right-hand wiper motor by AC bus 2.

Ice detection system

Ice can be detected on the exterior of the aircraft by means of an ice detector probe fitted to the right-hand side of the aircraft's nose cone.

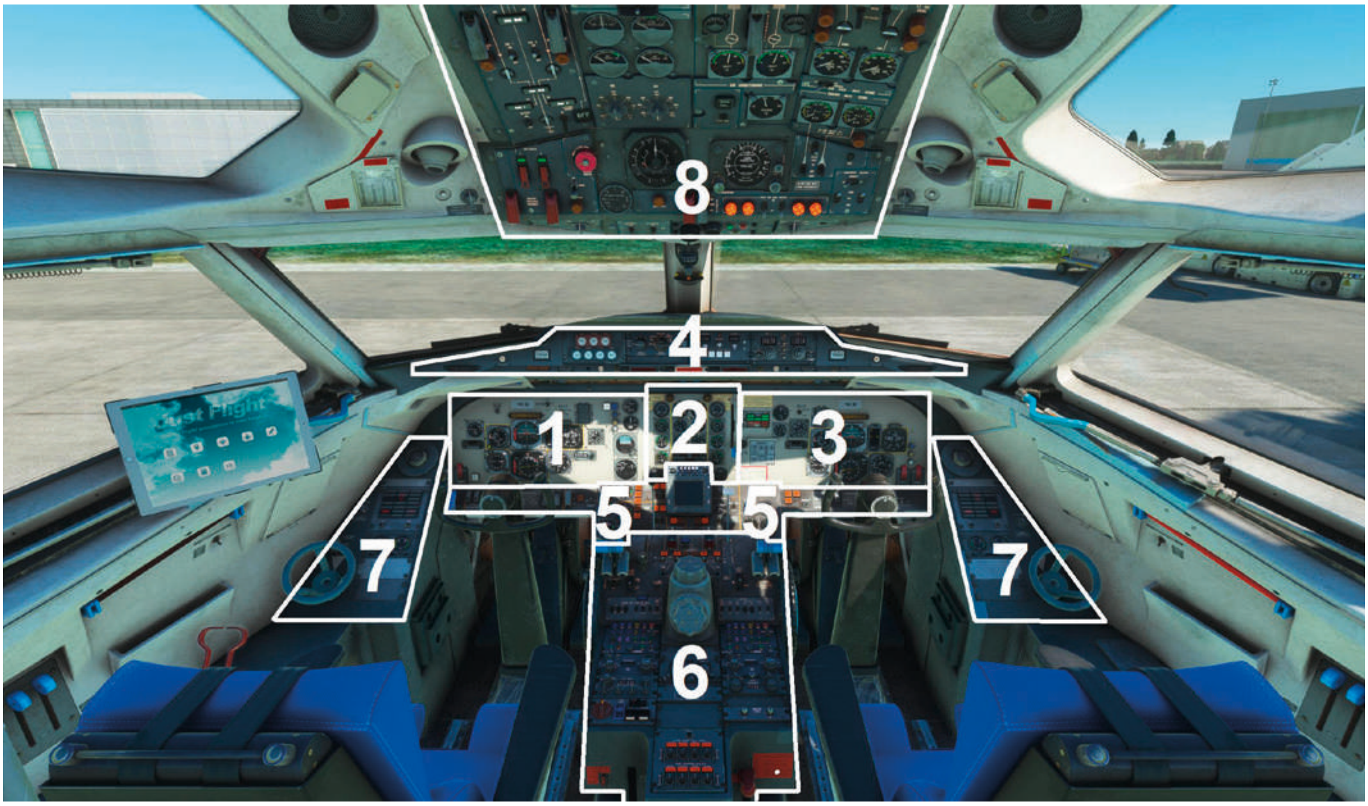
When ice is detected:

- Both ICE DETECT caution lights will illuminate (one on the Captain's glareshield and one on the overhead panel).
- The engine anti-icing system will be automatically switched on.
- Heat will be applied to the ice detector probe, melting the ice and allowing the detection system to start again.

INSTRUMENTS

Instrument panels

The location of the instrument panels on the flight deck are shown below.



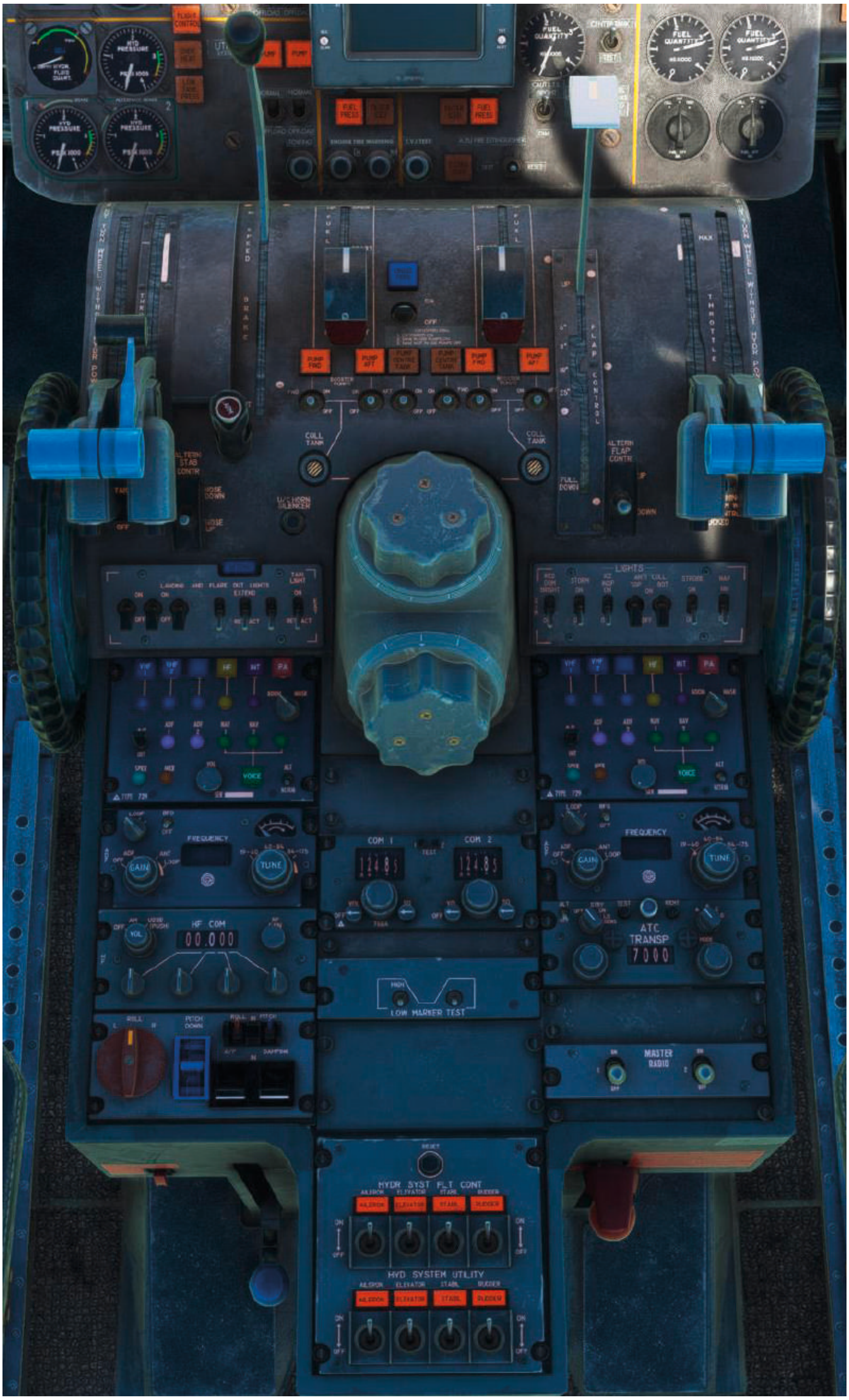
1. Captain's panel
2. Centre panel
3. First Officer's panel
4. Glareshield
5. Secondary instrument panel
6. Pedestal
7. Side consoles
8. Overhead panel

Captain’s panel and First Officer’s panel

Centre panel

Secondary instrument panel

Pedestal



FUEL QUANTITY
HYD PRESSURE
LIGHTS
FREQUENCY
GAIN
TUNE
COM 1
COM 2
HF COM
00.000
ATC TRANSP
7000
LOW MARKER TEST
MASTER RADIO
HYDR SYST FLT CONT
AILERON
ELEVATOR
STAB.
RUDDER
HYD SYSTEM UTILITY

Side consoles


BLEED AIR SUPPLY
HP BLEED
STARTER VALVE
DUCT OVERH.
OFF/RESET
LP BLEED
MAIN
GEN DRIVE OIL TEMP °C
GEN DRIVE OIL TEMP °C
AC LOAD 1.25
x100 TGT
R.P.M. %
PSI AIR
ELECTRICAL POWER
GEN. 1 INOPERATIVE
GEN. 2 INOPERATIVE
EMERG POWER
BUS 1
BUS 2
ESS BUS
APU
ENGINES
STARTER VALVE
STARTER MASTER
RELIGHT IGNITION
DC AMPS
AC CPS
AC VOLTS
DC
AC
BATTERY
EXTERNAL POWER
OFF
COCKPIT
CABIN
DUCT °C
ANTI ICING °C
AIR FOIL ANTI ICING
ENGINE ANTI ICING
AIR CONDITIONING
STEW CALL
CABIN °C
PSI AIR
CABIN PRESSURE CONTROL
MANUAL CONTROL
CONSTANT SPEED DRIVE DISCONNECT
EMERG. LIGHT
CABIN PRESS
PRESSURIZATION
PITOT AND VANE HEATING
VANE
PITOT
WINDSHIELD HEATING PRIORITY
DO NOT LAND WITH CABIN PRESSURIZED
INOP
FASTEN SEAT BELTS
NO SMOKING
TEST
ERASE
HEADSET
COCKPIT VOICE RECORDER

Pitot-static system

Pitot-static systems rely on the ability to measure the static pressure of the undisturbed air, and the pitot or total pressure of the air at a point where the airstream is brought to a rest on a surface.

Two electrically heated pitot tubes (one on either side of the nose) and four electrically heated static ports (two on either side of the fuselage) are used to provide information to the Mach-airspeed indicator, altimeter and vertical speed indicator. This system is called the normal static system.

A non-heated static port on the left-hand side of the fuselage can be used instead of the normal static system via NORMAL/ALTERNATE selector valves on the main instrument panel.

An electrically heated auxiliary static port on the left-hand side of the fuselage provides information for the following:

- Thrust switches of the air conditioning automatic shut-off system
- The 10,000 ft altitude switch of the air conditioning automatic shut-off system
- Engine thrust indicators
- Cabin altitude and pressure differential indicator
- Height sensor of the autopilot system
- Height sensor of the flight director system
- Flight data recorder system
- Airspeed sensor of the autopilot system

The latter two systems are also connected to the co-pilot's pitot system via the NORMAL/ISOLATE valve.

Air data instruments

Mach speed indicator

The Mach speed indicator can be divided into two parts: an airspeed indicator and a Mach number indicator.

The airspeed indicator shows Indicated Air Speed (IAS) by subtracting the static pressure from the pitot pressure.

An additional Mach scale is included on the instrument.

A VMO/MMO barber pole indicates maximum indicated IAS (330 knots or 0.75 Mach, whichever comes first).

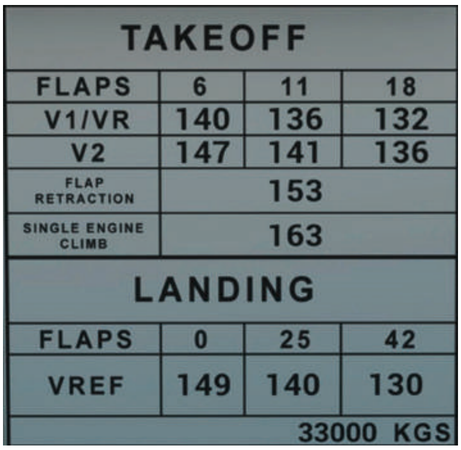
An adjustable command speed pointer can be operated by rotating the knob on the lower left of the bezel. Its position is also sent to a fast/slow indicator on the ADI.

The speed pointer can be automatically configured by left-clicking on the speeds flipchart located to the right of the landing gear lever.

There are cards for each 1,000 kg of aircraft gross weight and the correct card will be automatically selected based on the current gross weight. Each card displays take-off, climb and approach speeds, based on the selected flap setting:

- **V1/VR** – rotation speed
- **V2** – take-off safety speed
- **FLAP RETRACTION** – flap retraction speed
- **SINGLE ENGINE CLIMB** – optimum single-engine climb-out speed
- **VREF** – landing speed based on flap setting

The first officer will also call out these speeds if the ‘Pilot Callouts’ option is enabled in the EFB.



TAKEOFF			
FLAPS	6	11	18
V1/VR	140	136	132
V2	147	141	136
FLAP RETRACTION	153		
SINGLE ENGINE CLIMB	163		
LANDING			
FLAPS	0	25	42
VREF	149	140	130
			33000 KGS

Altimeter

The altimeter indicates the aircraft's current pressure altitude in feet, sensed by the static pressure port.

The altitude indicated is in relation to a set pressure on the subscale in the instrument for QNH or QFE settings:

- **QNH** – altimeter will display the true altitude of the airport above mean sea level upon landing.
- **QFE** – altimeter reads zero upon landing.

The set pressure can be adjusted by means of a knob on the lower right bezel of the instrument and the current set pressure is indicated on the instrument in both mb and inHg.

One full rotation of the instrument pointer indicates 1,000 ft in altitude, and with current altitude in 100s, 1,000s and 10,000s of feet showing on a mechanical roller display in the middle of the instrument.

Vertical speed indicator (VSI)

The vertical speed indicator (VSI) provides indication of the aircraft's rate of ascent or descent. The indication of vertical speed is shown by a pointer moving over a calibrated dial.

TCAS vertical speed indicator (TCAS VSI)

The analogue VSI can be converted to a digital TCAS VSI by toggling the option on the Aircraft page on the EFB. The indicator provides the same vertical speed indication as the analogue indicator with the addition of TCAS advisory and resolution indications for any other aircraft in the vicinity.

A test of the TCAS VSI can be performed by pressing the TEST button on the transponder panel and the range displayed by the TCAS VSI can be adjusted by rotating the cross-headed control immediately to the right of the transponder code.

Overspeed warning system

An overspeed warning system provides an audible, interrupted 300Hz tone via the cockpit speakers whenever the following speeds at the given altitudes are exceeded:

- **Sea level** – 333 knots (or 0.75 Mach)
- **10,000 ft** – 337 knots (or 0.75 Mach)
- **20,000 ft** – 344 knots (or 0.75 Mach)
- **35,000 ft** – 255 knots (or 0.75 Mach)

These speeds are indicated on the Mach speed indicator by means of a barber pole.

Outside air temperature indicator

An outside air temperature (OAT) indicator is fitted to the co-pilot’s main instrument panel. Temperature is sensed by an outside thermometer element and is indicated on the indicator in degrees Celsius.

Stall warning system

Two independent stall warning systems provide unmistakable visual and audible warnings which indicate that the aircraft is approaching a dangerously high angle of attack. The system consists of two stick shakers, aural warnings and a TAA indicator on the main instrument panel.

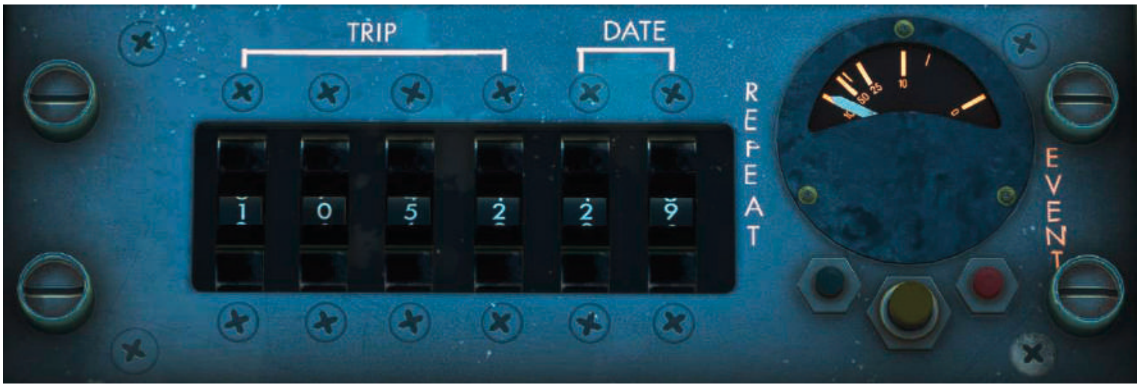
The stick shakers on both control columns will activate whenever the angle of attack is sensed to be 11 degrees or more by one of the two angle of attack vanes on either side of the fuselage. The autopilot will be automatically disengaged if a stall condition is sensed when the autopilot is engaged. The appropriate recovery action should be initiated at the onset of the stick shaker warning.

If no recovery action is taken in response to the stick shaker warning, a 1,000Hz stall identification signal will play through the cockpit speakers once angle of attack exceeds 15°, indicating that the angle for maximum lift coefficient has been exceeded.

Flight data recorder

A flight data recorder is fitted in the rear cargo compartment. Scribers engrave various flight data on a strip of stainless steel which is fire, water and shock resistant.

A trip and date encoder is fitted to the right-hand side panel in the cockpit.



Mechanical thumb-wheels allow the pilot to input up to a four-digit flight number and a two-digit date.

A REPEAT button is used to manually start the engraving cycle of the trip and date figures.

An indication light will illuminate when the 15-minute engraving cycle of the trip and date figures is in progress.

An EVENT button inserts a marker in the recording to call attention to any particular flight event.

An HOURS REMAINING indicator displays the time remaining on the tape.

An amber F.D. REC caution light illuminates any time the tape in the recorder is not moving.

Electrical power is supplied from the essential 115V AC bus and the essential 26V AC bus, with power connecting automatically to the recorder when external power is switched OFF and the gust lock handle is moved to the OFF position.

LANDING GEAR

This section covers the aircraft's landing gear in three parts:

Landing gear system

The landing gear is hydraulically operated using pressure from the UTILITY system. The main gear retracts inwards and the nose gear in a forward direction. Retraction time from selecting gear up to doors closed is five seconds. However, extension time from selecting gear down to gear being locked is approximately 25 seconds due to pressure in the system being reduced to 500 PSI.

Wheel brake system

Two wheel brake systems are provided: NORMAL and ALTERNATE, both supplied with pressure from the UTILITY system. The NORMAL brake system is operated using the brake pedals and is provided with a skid control system and parking brake. The ALTERNATE brake system is operated using the brake handles on the left-hand side panel in the cockpit. The ALTERNATE system is only to be used in the case of a failure with the NORMAL system, as it is not provided with a skid control system.

Nose-wheel steering system

A hydraulically operated nose-wheel steering system is supplied with pressure from the UTILITY system. The nose-wheel is controlled with two control wheels located on either side of the cockpit. The maximum steering angle is 76° either side.

Landing gear system

Landing gear control system

The landing gear can be extended and retracted by moving the landing gear selector handle, located on the main instrument panel between the two pilots. The landing gear selector handle is mechanically connected to the landing gear selector value, which directs fluid to the ‘up’ or ‘down’ hydraulic lines.

The sequencing of the landing gear and its doors is achieved through mechanically operated sequencing valves.

As the landing gear is hydraulically operated and mechanically controlled, electrical failures have no effect on its operation.

Main landing gear and doors

The main gear strut is pivot-connected to the airframe main gear brackets and consists of a main fitting and a sliding member (oleo strut). The wheel axle is fitted to the lower end of the sliding member. A ground/flight switch is provided by means of torque links which connect the sliding member to the main fitting.

When in the extended position, the main gear is supported by a two-member side stay. Two toggles between the strut and the side stay provide the means of locking the gear in position. The toggles are held in an overcentred position by the spring load of a down-lock actuator, acting on the lower toggle.

When the landing gear selector is moved to the UP position, hydraulic pressure is fed to the download actuator to release the overcentre lock, which then allows the side stay to fold during retraction. Once unlocked, the main gear itself can then be retracted by means of a main gear actuator and held in the up position by hydraulic pressure in this actuator. The final ‘up’ movement of the retraction sequence is dampened and stopped by a damper unit.

Once in the retracted position, the main gear is held in position by hydraulic pressure. Two doors on each main gear ensure the main gear strut and wheel bays are completely closed once the gear is fully retracted. A mechanically operated outboard door is directly connected to the main gear strut and a hydraulically operated inboard door is used to close the wheel bay. The latter is also closed when the gear is in an extended position. Mechanical door uplocks are provided on both inboard doors which are hydraulically released upon an UP or DOWN selection of the landing gear selector handle. The doors themselves are controlled by two actuators on each door.

When the landing gear selector is moved to the DOWN position, hydraulic pressure is fed to the door uplocks and the door actuators open the inboard doors. Once the doors are fully open, the main gear is allowed to extend by applying pressure to the main gear actuator. Down-locking is achieved mechanically by the spring in the down-lock actuators. Once the gear is fully extended, the door actuators close the inboard doors.

Nose landing gear and doors

The nose gear strut is pivot-connected to the airframe by brackets on each side of the nose-wheel bay. The strut consists of a main fitting, a turning tube and a sliding member (oleo strut). Torque links connect the turning tube and sliding member.

In the extended position, the main fitting houses a spring-loaded down-lock plunger which is snapped in an airframe down-lock bracket in order to lock to nose gear.

When the landing gear selector is moved to the UP position, hydraulic pressure is fed to the nose gear actuator. The hydraulic pressure actuates the piston which allows a pin to travel in a slotted opening, allowing the down-lock plunger to be withdrawn. With the down-lock plunger withdrawn, the nose gear is unlocked and will begin retracting.

In the retracted position, the nose gear is held in position by hydraulic pressure. Two hydraulic actuators, one on each nose-wheel bay door, close the doors after gear retraction. A mechanical door uplock holds the doors closed.

When the landing gear selector is moved to the DOWN position, hydraulic pressure is fed to the door uplock and door actuator opening the nose-wheel bay doors, and the nose gear will extend simultaneously by applying hydraulic pressure to the nose gear actuator. Down-locking is performed mechanically by the spring load on the down-lock plunger.

Unlike the main gear doors, the nose-wheel bay doors remain open when the gear is extended.

Alternate landing gear extension system

In the event of a failure of the UTILITY system, the landing gear will be prevented from extending by the mechanical locks on the landing gear doors.

Alternate landing gear extension can be performed by means of a red-coloured two-position lever on the right-hand aft side of the centre pedestal. The lever is spring-loaded to either position. Moving the lever downwards will actuate:

- A cable system to mechanically unlock the nose and main gear door uplocks.
- A dump valve to depressurise the landing gear hydraulic lines, which allows the gear to extend using gravity.

Once an alternate extension has been actioned, there will not be sufficient hydraulic pressure to close the main gear inboard doors. These doors can be partially closed manually by means of a winch. A hand-crank used for operating the winch is stowed on the left-hand side wall of the cockpit and this can be inserted via an access panel in the floor of the aft cockpit.

To manually retract the inboard doors, remove the access panel on the floor of the cockpit and insert the hand-crank. Rotate the hand-crank clockwise approximately 10 turns until the landing gear position indicator lights are extinguished.

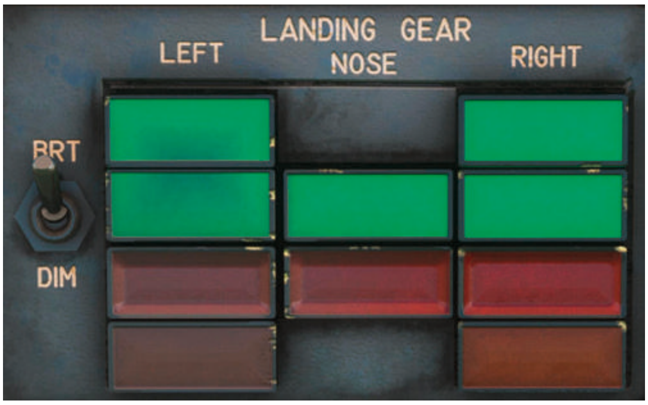
The winch must never be used before an alternate gear extension or when any hydraulic pressure is present in the system, as this could lead to overstressing and breakage of the cables.

Landing gear selector handle lock mechanism

A locking mechanism on the landing gear selector handle locks the handle in the DOWN position if the aircraft's weight is on the wheels, preventing inadvertent landing gear extension while the aircraft is on the ground. The locking mechanism is disengaged by energising a solenoid after take-off when both shock struts on the main landing gear are extended.

A lock override switch is located to the right of the landing gear handle and allows for gear extension in the event of an electrical failure.

Landing gear position indicators



The position of the landing gear and doors is indicated in the cockpit by means of a landing gear indicator located to the right of the landing gear lever on the main instrument panel. The indicator is fitted with green, red and amber lights which, when illuminated, provide various indications:

Three green lights	Gear down and locked, inboard doors closed, nose gear doors open.
Three green lights and two amber lights	Gear down and locked, inboard doors open.
Three red lights	All doors open, gear is in transit.
No lights	Gear up, all doors closed and locked.

A BRT/DIM switch on the left side of the panel controls the brightness of the indicator lights.

Landing gear visual indicators

In the event of a DC supply failure or a faulty microswitch in the electrical indication system, the 'down and locked' condition of the landing gear can be checked by means of a mechanical system:

For the main gear, this is by means of a blue indicator pin protruding from the upper surface of the wing, visible through the cabin windows.

For the nose gear, a mechanical pointer is visible after opening the same access panel as used to operate the inboard door winch.

Landing gear warning system

A landing gear warning system is fitted to warn the flight crew when the landing gear is in an unsafe condition for landing. This warning is communicated by means of an uninterrupted tone through the cockpit speakers. The system can be divided into two categories:

- Primary warning – can be silenced using a push-button on the centre pedestal.
- Secondary warning – cannot be silenced unless corrective action is taken.

The primary warning will sound when one or more landing gears are not in the down and locked position and either throttle is retarded below 75% HP RPM. Pressing the silencing button on the centre pedestal silences the warning until the relevant throttle has been advanced above the 75% HP RPM threshold.

The secondary warning will sound if the landing gear handle is still in the UP position and the flaps are selected beyond the 'Approach' position (flaps 25° or 11°). In accordance with normal operating procedures, flaps are to be selected to the 'Landing' position after the landing gear has been selected DOWN and the 'down and locked' indication is obtained. The warning will be automatically delayed if the flaps are selected before the landing gear 'down and locked' indication is obtained.

In the event of a DC supply failure, both landing gear warning systems will be inoperative.

Wheel brake system

The aircraft is equipped with six wheels: two on the nose gear and two on each of the main landing gears. All wheels are fitted with tubeless tyres which include thermal relief plugs; these melt and deflate the tyre if the brake temperature exceeds a predetermined limit.

The brakes can be operated by two separate systems: the Normal brake system which includes a skid control system and a parking brake, and the Alternate brake system.

Normal brake system

The normal brake system is operated by the brake pedals on both the Captain's and the First Officer's side. When depressed, the pedals actuate a mechanical linkage to the brake control valves, starting the flow of hydraulic fluid to the brake units via the skid control valves. Hydraulic pressure on the brake pistons then forces the stationary discs against the rotating discs, slowing the aircraft down.

Alternate brake system

The alternate brake system is operated via two red-coloured handles on the left-hand side panel of the cockpit. These handles act in the same way as the brake pedals in the normal brake system, except with the alternate brake system hydraulic pressure is supplied directly to the brake units, bypassing the skid control system.

Both handles are spring-loaded to the ‘brake off’ position.

Brake accumulators

Both brake systems are fitted with brake accumulators which supply enough hydraulic pressure to operate the brakes in the event of a utility system failure.

The NORMAL brake accumulator can supply pressure to the brakes from 3,000 PSI down to 1,600 PSI, whereas the ALTERNATE brake accumulator can supply pressure to the brakes from 3,000 PSI down to 1,000 PSI. No braking force is available below these limits.

Indicators

Two indicators on the secondary instrument panel display the system pressure for the respective system. In the event of a utility system failure, the indicators will display the available accumulator pressure for the respective system.

Parking brake

The parking brake is controlled by a blue-coloured T-handle located below and to the left of the main instrument panel. To set the parking brake, both brake pedals must be depressed before pulling the parking brake handle out. The parking brake can be released by depressing both brake pedals and the handle will return to its 'off' position automatically.

All four main wheels are braked automatically when the landing gear is retracted.

Skid control system

The best braking action is always achieved when the brake pressure is just above the skid threshold. To prevent this threshold from being exceeded, a skid control system is installed between the brake control valve and the brake units.

The system functions by means of a wheel speed generator fitted to each wheel which senses the wheel rotation speed and feeds the signal to an electronic box. The box reacts to the rate of deceleration of each individual wheel, and if the rate of deceleration is too high for the existing runway conditions, a signal will be sent to the relevant skid control valve, which reduces the applied brake pressure proportional to the signal received. The system allows for the most efficient braking during all runway conditions.

During braking, the skid control system can also detect an impending locked wheel. If this is detected, brake pressure is dumped for that wheel to allow it to continue rotating. This works by comparing the outputs of the generators on the two inboard wheels against the outputs of the generators on the outboard wheels. If one wheel is slowing down too fast, while the other wheel is still rotating at a speed above 19 knots, the pressure in the locked wheel is completely dumped.

As the system requires two generators between which to compare speeds, the signal sent to the skid control valve to dump the applied brake pressure can only occur if the aircraft's speed is above 19 knots. Below 19 knots, full brake pressure is always available to all wheels.

When landing under adverse runway conditions on runways covered with slush or standing water, high landing speeds and smooth touchdowns may trigger aquaplaning. It is imperative that, when landing in these conditions, correct landing speeds are used and a positive touchdown is executed. Should aquaplaning occur, lift dumpers may fail to operate automatically. In this situation it is recommended that you use the manual override and apply brakes manually until it is assured that wheel spin-up has been achieved.

Test system

A test switch and an amber skid control light for the locked wheel prevention system is located on the secondary instrument panel. Testing of the system must be carried out prior to touchdown and take-off as the amber light will not illuminate during the braked run if a fault occurs.

To test the system on the ground:

1. Ensure the aircraft speed is below 11 knots.
2. Alternate the test switch between the INBOARD and OUTBOARD positions. Illumination of the amber light in both positions indicates proper functioning of the system. A small drop in NORMAL BRAKE pressure may be noted during the skid control system test.

To test the system in flight:

1. Ensure the landing gear is in the DOWN position.
2. Alternate the test switch between the INBOARD and OUTBOARD positions. Illumination of the amber light in both positions indicates proper functioning of the system.

If the light does not illuminate during this test, the system should be considered inoperative. Avoid the use of full brake pressure during the braked run to prevent a locked wheel.

Skid control master switch

The skid control master switch is located on the secondary instrument panel and is supplied by 28V DC bus 1. As this is one switch for four individual systems, it is advisable to leave the switch in the ON position during all phases of flight, even in the case of failures.

The skid control system will be operative when:

- Supplied power is from the 28V DC bus 1.
- The skid control master switch is set to ON.
- The wheel speed is above 19 knots.
- No faults are indicated during a system test.

Touchdown protection system

The touchdown protection system prevents the wheel brakes from being applied accidentally before touchdown. If the system detects that the brakes are applied before touchdown, the skid control valves will be signalled to release the applied brake pressure. After touchdown the signal will be interrupted by the ground/flight relays.

Nose-wheel steering system

The aircraft features a mechanically controlled, hydraulically actuated nose-wheel steering system. Steering can be achieved on the ground using a combination of the pilot's steering wheel and an ON/OFF steering switch, both located on the left and right side panels in the cockpit.

The nose-wheel steering has a range of 76° either side of centre. Hydraulic pressure is supplied by the UTILITY system.

Automatic centring of the nose gear is ensured upon selecting landing gear UP. When the landing gear is retracted, it is kept locked in the centred position as long as the UTILITY system is pressurised.

When landing gear is selected DOWN, or in the event of a UTILITY system failure, the steering mechanism is unlocked by spring load.

Nose-wheel steering should be switched OFF during towing or when a system fault is apparent.

As the nose-wheel steering is mechanically controlled and hydraulically actuated, electrical failures will have no effect on its operation, except that it cannot be switched off.

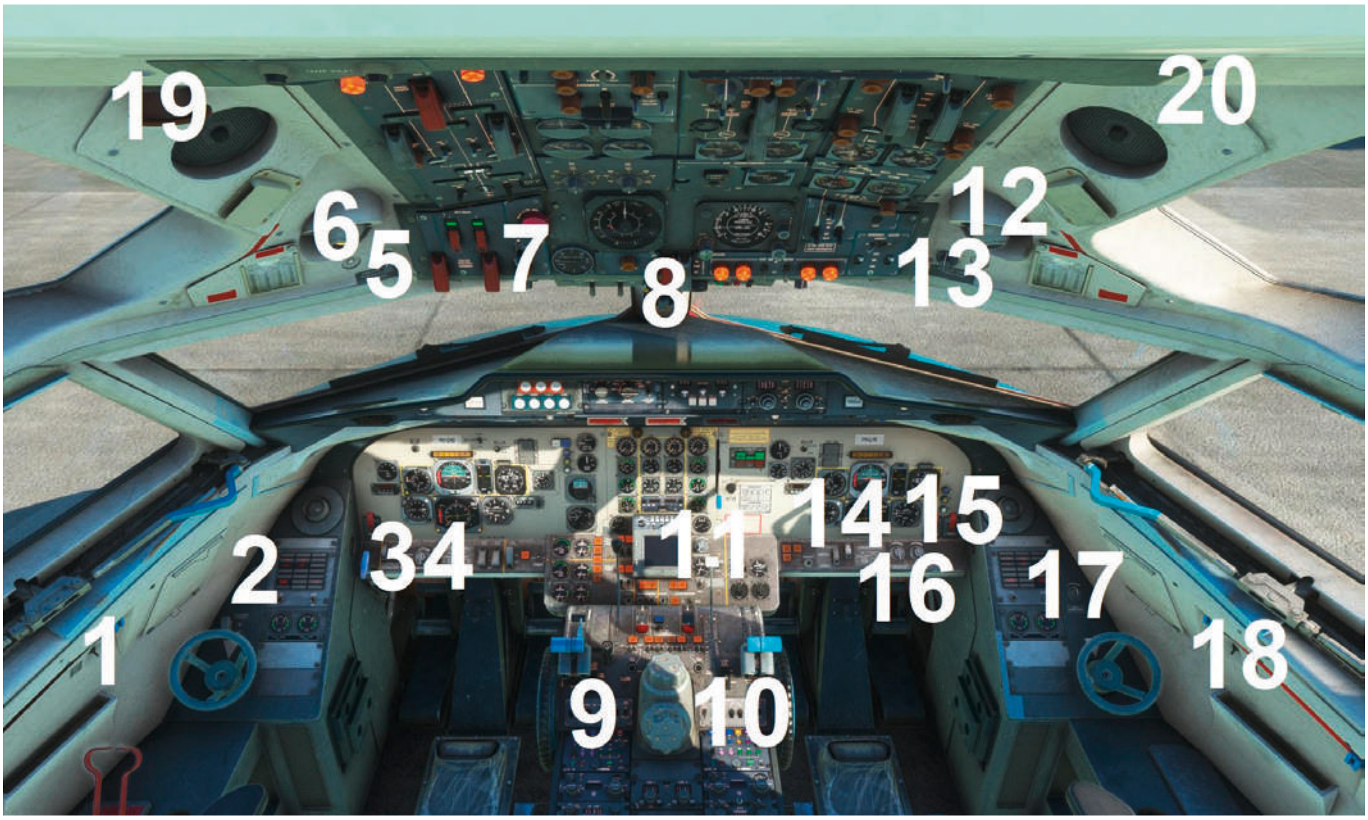
LIGHTS AND NOTICES

Cockpit lights

Roof-mounted filament units provide overall illumination of the flight deck in the form of both red and white dome light, as well as adjustable reading lights above each of the pilot's seats.

All the instruments are integrally lit, as are the panels on which they are mounted, with additional lighting mounted under the glareshield for the instrument panels. All cockpit switch labelling is backlit to ensure ease of operation at night.

The control switches for the cockpit lights can be found in various locations around the cockpit, including near their respective lights on the overhead and side panels, as well as on the lower instrument panel.



1. Side panel lighting (Captain)
2. White flood light (Captain)
3. Red flood light (Captain)
4. Instrument lights (Captain)
5. Panel instrument lighting (glareshield, pedestal and left-hand side panel)
6. Left reading light
7. Emergency light
8. Compass light
9. Landing and flare out lights
10. Exterior lights
11. Engine instrument lights
12. Right reading light
13. Panel instrument lighting (overhead panel)
14. Right-hand side panel and OBS panel lighting
15. Instrument lights (First Officer)
16. Red flood light (First Officer)
17. White flood light (First Officer)
18. Side panel lighting (First Officer)
19. Red dome light
20. White dome light

Cabin lights

Cabin, vestibule, toilet and galley lighting is provided by fluorescent tubes in the ceiling of the aircraft. The cabin lights are controlled by the cabin crew panel in the forward galley.

The integral airstairs house eight lights on each step; these are automatically turned on/off as the door is opened and closed.

Call systems permit signalling between the ground crew and the flight crew, and between the flight crew and cabin crew. Illuminating signs indicate 'fasten seatbelts', 'no smoking' and 'toilet engaged' with a 'return to seat' sign in each toilet.

Three door warning system lights are fitted to the First Officer's secondary instrument panel and provide indication of an open door. Testing of the lights is done by means of a LAMP TEST push-button.

External operational lights

The aircraft's exterior lights can be controlled by the lighting controls on either side of the centre pedestal, just aft of the throttles.

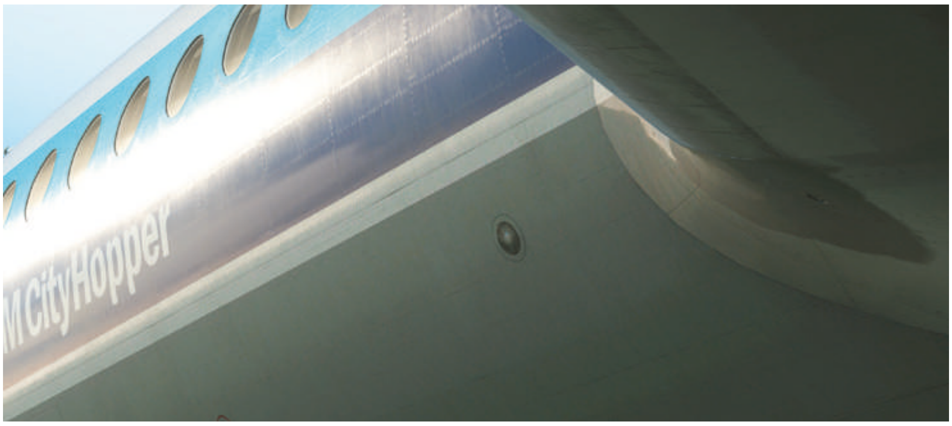
Landing lights are installed in each wing with extend/retract functionality.

A flare-out light and taxi light are fitted in the nose.

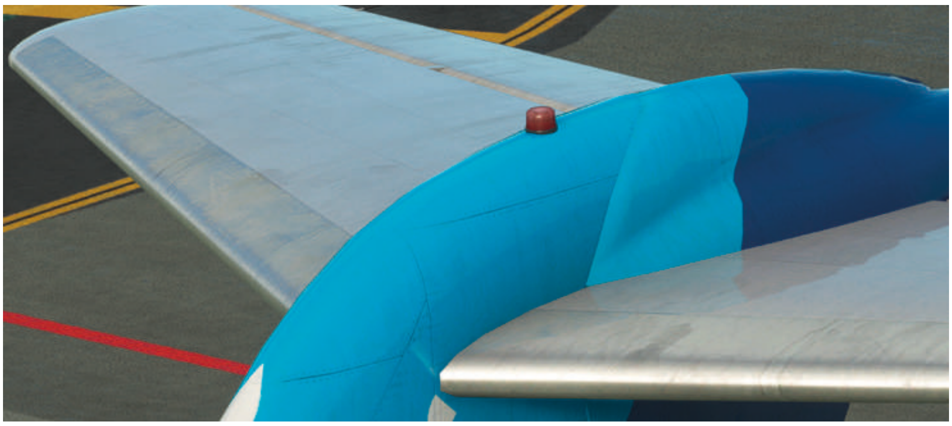
A blue indication light on the pedestal will illuminate when any of these lights are not fully retracted.

Navigation lights are fitted in pairs: two on each wing tip and two on the vertical stabilizer. One set of NAV lights is powered by the AC bus 1, whereas the other is powered by the AC/DC ground service bus. The aircraft can be dispatched even with only one set of these operational. A strobe light is also fitted in the wing tip housing.

Two ice inspection lights are installed on the sides of the fuselage, facing the leading edge of the wing. These lights are controlled independently.



Two anti-collision lights are installed: one at the top of the vertical stabilizer and one on the bottom of the fuselage. These lights are controlled independently.



Logo lights are fitted on the inward-facing side of the outer flap track fairings. If the logo lights are enabled on the Aircraft page of the EFB, these lights can be illuminated using the NAV lights switch in the cockpit.

Emergency lights

Emergency lighting on the underside of the glareshield, as well as lights on the main circuit to light the overhead panel, will be switched ON automatically in the event of an AC or DC supply failure. A warning of this will be given on the annunciator panels.

In the cabin, emergency/night lights are installed in the passenger entrance, toilet and rear ceiling compartment. These are supplied from the essential DC bus. Evacuation lights installed at various points throughout the cabin are supplied by 2.5V DC from small nickel-cadmium batteries inside the battery power supply.

A three-position emergency lights switch is located on the lower instrument panel and labelled OFF/ARM/ON. The switch should be in the ARM position whenever the aircraft is operating.

NAVIGATION

Navigational services include the equipment used for the transmission, reception and presentation of air data, attitude, heading and navigational information required by the flight crew during all phases of flight. The audio output of the navigation aids is fed into the audio integrating system.

Aircraft speed, altitude, attitude and direction are provided by on-board systems using gyroscopic, inertial and magnetic forces, and are displayed symbolically on attitude director indicators (ADI) and horizontal situation indicators (HSI) fitted to each side of the main instrument panel.

Radar and radio guidance for navigation is provided through a mixture of on-board systems (radar) and ground systems (ADF, VOR/ILS, DME).

Instrument displays

Altimeters

The altitude system consists of two primary altimeters, one on the Captain's panel and the other on the First Officer's panel.

The altimeter is a barometric instrument with a servo-driven presentation. Altitude information is presented by a single pointer reading against a dial and by a four-drum counter. The pointer turns through one revolution for every 1,000 feet of altitude and the dial and first drum counter are calibrated in 100-foot increments. The selected barometric pressure setting in mb and inHg is shown along the lower portion of the altimeter. The setting is controlled by a knob on the bottom right corner of the bezel.

The operating range of the altimeter is from minus zero to 50,000 feet. The 10,000 ft counter drum presents red lines below zero altitude and black and white lines from zero to 10,000 ft.

Static source error signal failure is indicated by a red flag marked SSC (Static Source Correction) in the centre of the gauge.

Electrical or servo malfunction is indicated by a red and black striped warning bar which obscures the altitude read-out.

A hidden clickspot on the screwhead at the top left of both the primary Captain's and co-pilot's altimeter will automatically set the standard barometric setting (29.92 inHg / 1013.2 mb) on all altimeters.

A ‘Sync Altimeters’ option on the EFB tablet enables the automatic synchronising of the standby and Co-pilot/Captain altimeter barometric settings. The ‘master setting’, which is sync’d to the other altimeters, is based on your current camera selection.

Vertical speed indicator (VSI)

The vertical speed indicator (VSI) provides indication of the aircraft’s rate of ascent or descent. The indication of vertical speed is shown by a pointer moving over a calibrated dial.

Mach airspeed indicator (ASI)

The Mach speed indicator can be divided into two parts: an airspeed indicator and a Mach number indicator.

The airspeed indicator shows indicated air speed (IAS) by subtracting the static pressure from the pitot pressure.

An additional Mach scale is included on the instrument.

A VMO/MMO barber pole indicates maximum indicated IAS (330 knots or 0.75 Mach, whichever comes first).

An adjustable command speed pointer can be operated by rotating the knob on the lower left of the bezel. Its position is also sent to a fast/slow indicator on the ADI.

The speed pointer can be automatically configured by left-clicking on the speeds flipchart, which is located to the right of the landing gear lever.

There are cards for each 1,000 kg of aircraft gross weight and the correct card will be automatically selected based on the current gross weight. Each card displays take-off, climb and approach speeds, based on the selected flap setting:

- **V1/VR** – rotation speed
- **V2** – take-off safety speed
- **FLAP RETRACTION** – flap retraction speed
- **SINGLE ENGINE CLIMB** – optimum single-engine climb-out speed
- **VREF** – landing speed based on flap setting

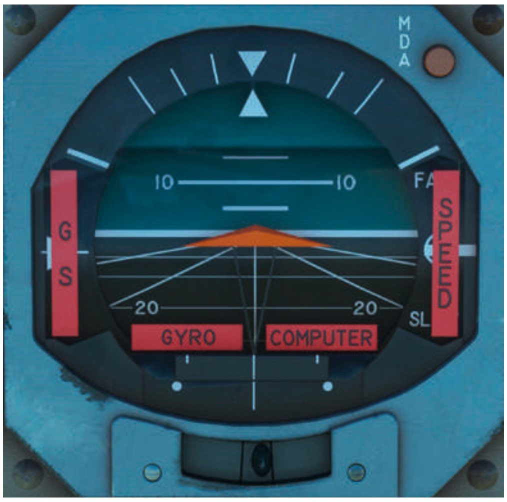
The first officer will also call out these speeds if the ‘Pilot Callouts’ option is enabled on the EFB.

TAKEOFF			
FLAPS	6	11	18
V1/VR	140	136	132
V2	147	141	136
FLAP RETRACTION	153		
SINGLE ENGINE CLIMB	163		
LANDING			
FLAPS	0	25	42
VREF	149	140	130
			33000 KGS

Outside air temperature indicator

The outside air temperature (OAT) indicator fitted to the First Officer’s main instrument panel provides the flight crew with a continuous display of the outside air temperature over a range of -60°C to +60°C.

Attitude director indicator (ADI)

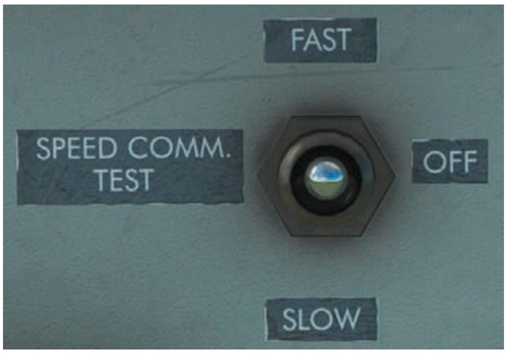


Two ADIs are fitted, one on each pilot's main instrument panel.

The ADIs provide a visual presentation of the pitch and roll attitude of the aircraft by means of a three-dimensional forward view display. The side scale shows glideslope, and localiser deviation is presented on the lower horizontal scale. An inclinometer is mounted on the lower front face of the instrument.

A 'V-bars' flight director system consists of two pointers flanking a Delta-shaped aircraft symbol. The flight director bars provide a 'fly-to' command and direct the pilot to fly into the 'V'. When the aircraft symbol and flight director bars are aligned, this indicates that the aircraft is on course. The bars are hidden from view when the flight director system is switched off.

A FAST/SLOW speed display is on the right side of the ADI. The datum for the display is the yellow internal bug on the Mach airspeed indicator (ASI). The scale is composed of white FAST and SLOW text at the upper and lower limits, a white dash indicates the datum position, and a white circular pointer indicates the aircraft's current speed compared to the datum. The fast/slow indicator can be tested by a three-position SPEED COMM. TEST switch on the Captain's main instrument panel. Holding the switch to the FAST or SLOW position will move the indicator to the respective position. Releasing the switch back to OFF will return the indicator to its correct position with respect to the datum.



When the ASI pointer is against the ASI internal bug, the fast/slow pointer is over the centre of the scale. As speed increases above the ASI bug speed, the circle moves up the scale. As speed decreases below the ASI bug speed, the circle moves down the scale. A red SPEED flag will show if a fault is detected in the system.

GS, GYRO, COMPUTER and SPEED warning flags are incorporated and appear due to electrical power failure or loss of a valid signal. A TEST switch causes the sphere to indicate a preset right bank and climb, while the flight director bars should indicate pitch up and roll right command. Both the FD and ATT flags should be visible.

Pitch and roll information is supplied to each ADI from a Vertical Gyro Unit (VGU), the signals from which are then amplified via an instrument amplifier. The power supplies to the VGU and each instrument amplifier are arranged so that a failure of an AC bus will only render one ADI inoperative.

Standby attitude indicator

The standby attitude indicator displays pitch and bank attitude with horizon reference on a forward-view display against a fixed aircraft symbol. The upper part of the sphere is blue, representing the sky, and the lower part is black, representing the earth. A white line dividing the two colours represents the horizon.

The horizon can be manually caged and the aircraft symbol adjusted by means of a control on the lower-right bezel on the indicator.

Should electrical power fail to the indicator, an ‘X’ warning flag is displayed.

Horizontal situation indicator (HSI)

Two horizontal situation indicators (HSI) are fitted, one on each pilot’s main instrument panel.

These provide a visual representation of aircraft heading, direction to next waypoint, glideslope deviation, course deviation, selected course, reciprocal heading, to-from station indication and selected heading.

Distance to the next waypoint as well as the selected course are displayed in the upper windows.

A glideslope pointer and scale on the left-hand side give a conventional display and an invalid signal will cause a GS failure flag to obscure the display. The glideslope pointer will display indications for both an ILS glideslope and RNAV/GPS pseudo-glideslope.

Selected heading is displayed by an orange square-shaped heading marker and is remotely controlled by means of the HDG selector on the centre of the glareshield panel.

Selected course is displayed on the azimuth card by a yellow course arrow. This is remotely set by the associated COURSE knob on the glareshield panel.

A HEADING failure flag will cover the heading index at the 12 o’clock position if the associated compass fails or if there is a power failure.

Radio magnetic indicator (RMI)

Two radio magnetic indicators (RMIs) are fitted, one on either side of the main instrument panel; they are provided with continuous heading information from their respective compass indicators.

Radio bearing information is displayed by two selectable radio pointers, either of which may indicate ADF or VOR bearings.

A fast erect function is provided by means of a rotary control on the lower right bezel of the indicator.

An OFF failure flag will be visible if the associated compass fails or if there is a power failure.

Angle of attack indicator

The angle of attack (AoA) indicator fitted to the Captain's main instrument panel provides the flight crew with a continuous display of the aircraft's current angle of attack over a range of -2° to +32°.

Standby compass system

As back-up heading information, a standby magnetic compass is provided on the centre strut of the front windscreens.

A light switch is provided on the underside of the overhead panel.

Master beacon system

Three master beacon lights on the Captain's main instrument panel provide a visual indication of the aircraft's position with respect to three beacons located on the approach to an airport's runway. An aural alert system also plays aural alerts at different frequencies, depending on which beacon is being flown over:

Outer beacon – blue light illuminates, 400Hz aural alert.

Middle beacon – yellow light illuminates, 1,300Hz aural alert.

Inner beacon – white light illuminates, 3,000Hz aural alert.

Radio altimeter system

The radio altimeter provides an accurate indication of the aircraft's altitude when within 2,500 ft of terrain. Altitude is detected by pointing radio frequency energy directly downwards and measuring the time it takes from the signal's transmission and reception.

The radio altimeter indicator is fitted immediately to the left of both pilots' ADI and has three modes of operation:

Mode I – at altitudes below 2,500 ft the system will generate a normal return signal and a proper operation and indication.

Mode II – at altitudes above 2,500 ft the system will generate signals for self-monitoring.

Mode III – test mode. When the TEST button is pressed, a warning flag will appear and 100 ft will be indicated.

Minimum decision height can also be inserted, using the rotary control on the lower-right bezel of the indicator. The selected decision height is displayed on the three digits immediately to the left of the rotary control. When the decision height is reached, a warning light will illuminate.

Comparator Warning Monitor (CWM) system

The CWM system monitors the navigation systems by comparing the indication of the instruments against the output signal of the navigation systems. If a discrepancy exists which is larger than a pre-defined value, the respective indicator light will illuminate:

MON PWR – monitor power. Illuminates to indicate failure of the power supply to the CWM.

HDG – heading. Illuminates to indicate a discrepancy between headings indicated by HSI 1 and HSI 2.

ATT – attitude. Illuminates to indicate a discrepancy between attitudes indicated on ADI 1 and ADI 2.

GS – glideslope. If an ILS frequency is selected, illuminates to indicate a discrepancy between GS deviation signals from NAV 1 and NAV 2 receivers.

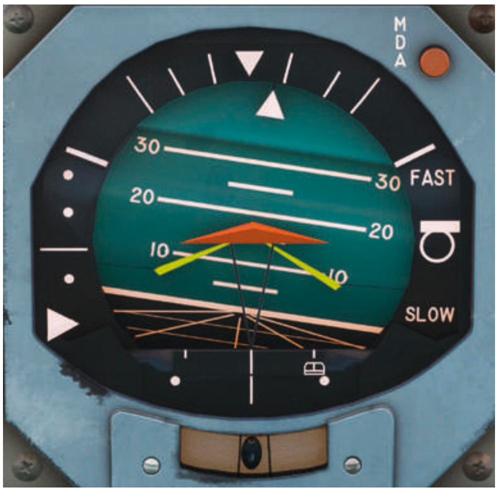
LOC – localiser. If an ILS frequency is selected, illuminates to indicate a discrepancy between LOC deviation signals from NAV 1 and NAV 2 receivers.

The indicator lights can be dimmed by pushing in the glass protective cover.

Testing of the comparator lights can be achieved by means of a test button labelled COMPAR TEST on the Captain's main instrument panel.

Flight director system

The flight director system takes information from the selected heading and navigation aids and displays the difference between the aircraft's current position and attitude with respect to the selected heading and navigation aids. The necessary instrument indications are shown by the flight director bars on the ADI and the course indicator on the HSI.



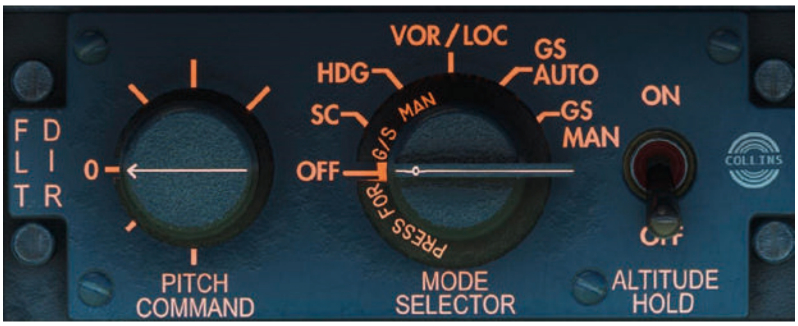
The ADI and flight director bars show the following information:

- Aircraft attitude on the ADI
- Steering commands from the flight director bars
- Localiser and glidepath deviation indicators
- Slip indication
- Speed control indication
- Various system failure flags
- Minimum Decision Altitude (MDA) light

The HSI and course indicator show the following information:

- Aircraft heading
- Selected heading
- Selected course or track
- VOR/LOC beam track deviation
- Glideslope deviation
- VOR TO-FROM indicator
- Distance to or from a DME station
- Various system failure flags

Flight director mode selector



Control of the flight director is achieved by means of PITCH COMMAND and MODE SELECTOR controls located at the centre of the glareshield panel.

A PITCH COMMAND knob controls the pitch attitude of the flight director bars in certain modes of operation. The flight direction bars can be adjusted between 15° nose up and 5° nose down.

A MODE SELECTOR switch is used to select the operating mode of the system, and thus the type of guidance the flight director will provide:

OFF – flight director not used. V-bars out of view.

SC – Speed Control mode, intended for use during an overshoot. When selected, the flight directors will indicate the optimum climb-out pitch guidance and also indicate a wings level command. (This mode is simulated as not fitted to the aircraft and will display a COMPUTER failure flag in the ADI when selected).

HDG – the V-bars will indicate the roll required to achieve the preselected heading. In this mode the pitch attitude indicated by the V-bars will be commanded either by the ALTITUDE HOLD or by the preselected pitch on the PITCH COMMAND knob.

VOR/LOC – the V-bars will indicate the roll required to guide the aircraft onto the beam of the tuned VOR or localiser. Once the aircraft is captured on the beam, V-bars will indicate the roll required to maintain the aircraft on its current course. In this mode the pitch attitude indicated by the V-bars will be commanded either by the ALTITUDE HOLD or by the preselected pitch on the PITCH COMMAND knob.

GS AUTO – when first selected, and before glideslope intercept, pitch steering commands will be generated from ALTITUDE HOLD or the PITCH COMMAND knob. After glideslope intercept, the ALTITUDE HOLD switch jumps to OFF and the V-bars will then indicate the required pitch to maintain the glideslope. In this mode the roll attitude indicated by the V-bars will show exactly the same sequence of operation as VOR/LOC mode.

GS MAN – to select this mode, the MODE selector must first be pressed in, before being rotated to the GS MAN position. In this mode no intercept facilities are used and glideslope and localiser deviation signals will immediately start to drive the V-bars. PITCH COMMAND and ALTITUDE HOLD cannot be used in this mode.

Progress annunciators

Two progress annunciator panels are fitted, one for each pilot, and are used to display the current status of the flight director and autopilot modes:

VOR LOC – illuminates amber when the flight director is in VOR/LOC mode until capture of the VOR radial or LOC course, at which time it illuminates green.

GLIDE SLOPE – illuminates amber when the flight director is in G/S AUTO mode until capture of the glideslope has occurred, at which time it illuminates green. The annunciator illuminates green whenever the flight director is in G/S MAN mode, as glide slope capture is ‘forced’.

SPEED COMMAND – illuminates green after activation of the palm operated Go-Around switches on the throttles. (This mode is simulated as not fitted in the aircraft).

GPS – illuminates green when a GPS path has been captured.

A progress annunciator BRIGHT/DIM switch is fitted to the left of each panel, providing control of the annunciator light brightness.

Two press-to-test buttons are located on either side of the panel to test the illumination of the annunciator lights.

Radio navigation

Automatic direction-finding system (ADF)

The ADF is a long-range navigational aid that provides bearing information to/from an LW or MW radio station with respect to the aircraft's current position.

The system is comprised of two ADF receivers, two antennas and two controllers located on the aft pedestal. The frequency range is 190 to 1749.5 kHz.

ADF bearing displays are presented to each pilot on a radio magnetic indicator (RMI). The aural ident of the selected non-directional beacon (NDB) is distributed via the audio selector panels.

The ADF system can operate in either of two modes, selected on the controller:

ANT mode – system operates as a non-directional MF receiver. Pointers will park in the 3 o'clock position.

ADF mode – system operates as an ADF.

There is a two-position switch labelled BFO/OFF:

BFO – a beat frequency oscillator allows the identification of NDBs which employ interrupted carrier idents.

The bearing pointer switches on the RMI must be selected to ADF in order to obtain ADF bearings. If the ADF is operating but no useable signal is being received, the pointer moves to the 3 o'clock park position.

Air Traffic Control transponder

The aircraft's transponder is an integral part of the Air Traffic Control radar beacon system and provides identification of the aircraft to the air traffic controller.

The ATC TRANSP panel is located on the aft pedestal.

An ALT/OFF switch allows for altitude reporting. With this switch set to ALT, the aircraft's current altitude will be sent to ATC during each interrogation. With this switch set to OFF, no altitude information will be sent to Air Traffic Control.

A selector switch on the left side of the panel labelled OFF/STBY/ON/LO SENS controls the transponder's current state.

A TEST button illuminates the monitor light.

A blue light at the top centre of the panel illuminates whenever the transponder is interrogated in the correct mode. The transponder will then generate a coding according to the selected four-digit code and return the signal to the ground station.

The IDENT button can be pressed at the request of Air Traffic Control to positively identify the aircraft on their radar screen.

A MODE selector switch on the right side of the panel allows for the selection of various transponder modes (Mode A, Mode B, Mode C, Mode D).

Two rotary controls on either side of the panel allow for the setting of a 'Squawk' code as requested by ATC. The controls on the left side of the panel control the first two digits and the controls on the right side of the panel control the last two digits.

Distance measuring equipment (DME)

Tuning the VHF NAV receiver to an active VORTAC or DME/VOR facility will also automatically tune the DME transceiver to the correct DME channel.

The DME displays on the HSIs will indicate the distance to the navaid tuned into whichever VHF NAV radio is selected on the remote datum selector panel, with the DME distance to the navaid tuned into the other VHF NAV radio displayed on the IND-40 digital DME display.

If the NAV transfer switches on the remote datum selector panel are set to NAV-1 or APPR, the DME distance to the navaid tuned into the VHF NAV 1 radio will be displayed on each HSI, with the DME distance to the navaid tuned into the VHF NAV 2 radio displayed on the two IND-40 digital DME displays on the main instrument panel. If NAV-2 is selected on the remote datum selector panel, the location of the DME distances will be reversed.

The unit has four modes of operation plus a dimmer switch for the DME display:

NM – the distance to the navaid in nautical miles.

MIN – the distance to the navaid in minutes, based on the aircraft's current distance and speed.

KTS – the aircraft's current ground speed.

TEST – displays '888.8' to test the digital display.

A DME 1 / DME 2 annunciator located at the bottom left of the Captain's instrument panel illuminates the respective DME light when an active DME signal is received by the DME transceiver.

VHF NAV receivers and switching

The VHF NAV panel is located on the right side of the glareshield.

Two identical VHF NAV receivers are fitted and can be tuned with the rotary controls on the VHF NAV control panel. The outer control adjusts the NAV frequency in 1 MHz increments, whereas the middle control adjusts the NAV frequency in 50 kHz increments. Each VHF NAV receiver can be tuned in a range of 108.05 MHz to 117.95 MHz.

The innermost rotary control adjusts the volume of the Morse code emitted from the ground station.

Two rotary switches labelled OFF/STBY/DME control the operational state of the respective DME transmitter/receiver.

OFF – both the DME transmitter and receiver are inoperative.

STBY – only the DME receiver is operational, allowing time for the DME transmitter to warm up.

DME – both the DME transmitter and receiver are operational.

The NAV 1 VOR bearing is displayed by the single pointer on both RMIs. The NAV 2 VOR bearing is displayed by the double pointer on both RMIs.

The VOR/ILS deviation will also be displayed on the HSIs, should a relevant course be selected on the remote datum selector panel.

Various VOR, ILS and DME test switches are located between the NAV 1 and NAV 2 controls.

Remote datum selector

The remote datum selector panel is located on the centre of the glareshield and provides heading selection, course selection and NAV transfer controls.

The remote HEADING selector knob in the centre of the unit directly controls the heading bug on both HSIs. With the heading bug set to a desired heading, and the MODE SELECTOR set to HDG mode on the flight director mode selector panel, the path the aircraft needs to take to achieve the desired heading will be shown by the flight director’s V-bars on the ADIs. If the autopilot is then engaged, and autopilot HDG mode engaged, the aircraft would then turn onto and maintain the selected heading.

The remote COURSE selector knobs control the course indicators on the HSIs, depending on the position of the NAV transfer switches:

NAV-1 – the left-hand course knob controls the course indicators on both HSIs and the deviation to the tuned VHF NAV 1 frequency will be displayed on both HSIs. VHF NAV 1 DME will be displayed on both HSIs, and VHF NAV 2 DME will be displayed on both IND-40 digital DME displays.

NAV-2 – the right-hand course knob controls the course indicators on both HSIs and the deviation to the tuned VHF NAV 2 frequency will be displayed on both HSIs. VHF NAV 2 DME will be displayed on both HSIs, and VHF NAV 1 DME will be displayed on both IND-40 digital DME displays.

APPR – this mode is similar to the NAV-1 setting but is used during final approach. With an active ILS frequency tuned into the VHF NAV 1 radio, ILS deviation is displayed on both HSIs. A course and frequency for a navaid on the missed approach procedure can then be tuned into the VHF NAV 2 radio. In the event of a go-around, selecting NAV-2 on the remote datum selector will display the missed approach navaid on both HSIs.

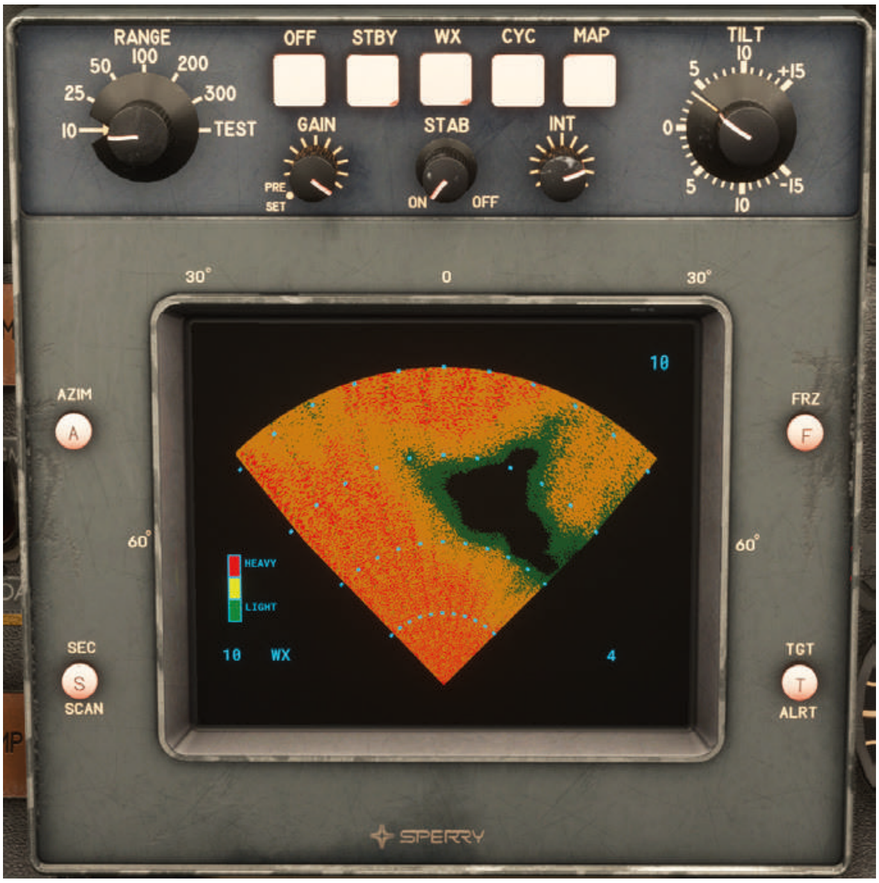
Two amber lights on either side of the panel indicate the currently selected VHF NAV receiver.

An amber NAV TRANSFER failure light will illuminate in the event of a NAV TRANSFER switch failure.

Weather radar

The weather radar system detects and locates precipitation along the aircraft's flight path and gives the pilot a visual indication, in contours, of its intensity. Intensity levels are displayed in bright colours contrasted against a deep black background.

The areas of heaviest rainfall will appear in red, the next level of rainfall in yellow and the least rainfall in green. A colour-bar legend to confirm each displayed colour and a range/mode alphanumeric to facilitate the evaluation of data are displayed on normally unused areas of the screen. After proper evaluation, the pilot can chart their course either through or around precipitation.



The indicator includes the following selectors:

INT – the intensity control adjusts the brightness of the WXR return shown on the display.

RANGE – rotary switch with seven detent positions, used to select one of six ranges or TEST mode. Range selections are 10, 25, 50, 100, 200 and 300 nautical miles. The TEST mode provides a special test pattern in which all colours are displayed. In TEST mode the range selection is automatically 100 nautical miles, gain is set to the preset level and transmitter energy is switched into a dummy load.

GAIN – system gain is controlled via the rotary control. Clockwise rotation increases gain and anti-clockwise rotation reduces it. Current gain is displayed in the bottom left corner of the display.

OFF – push-button switch used to turn radar off.

STBY – after the warm-up period it is ready to operate in any selected mode. Radar can also be turned on by depressing any other mode selection switch and it will automatically go into operation at the end of the warm-up period. STBY is displayed.

MAP – toggles whether airport ICAO codes are displayed on the WXR display.

WX – toggles whether the unit displays the WXR return.

TILT – antenna tilt is controlled from 15 degrees down to 15 degrees up and has a fidelity of one-degree adjustment. The current tilt setting is displayed on the bottom right corner of the display.

OXYGEN SYSTEM

Three independent oxygen systems are provided: a crew oxygen system, a passenger oxygen system and portable oxygen bottles.

Crew oxygen system

A supply cylinder is fitted in the aft right-hand side panel, with the upper part protruding through the panel, allowing access to the oxygen controls. An ON/OFF valve is fitted to the top of the supply cylinder. When in the ON position, high pressure oxygen (1,800 PSI) from the supply cylinder is supplied to the masks and is reduced to approximately 70 PSI by a pressure reducer.

A pressure gauge on the supply cylinder provides a visual indication of the oxygen pressure in the supply cylinder. The gauge is marked in increments of 100 PSI, between 0 PSI and 2,000 PSI. A red band indicates high pressure between 1,800 PSI and 2,000 PSI.

Two quick-donning-type masks hang on the aft cockpit wall, one behind each pilot. Each mask is fitted with a microphone and an oxygen regulator.

Passenger oxygen system

A ‘drop-out’ oxygen mask system is provided in the panels above each passenger seat row, above each cabin attendant position and in the lavatory. In the event of a sudden decompression, these drop-out boxes will automatically open, providing an oxygen mask for every person in the cabin.

A supply cylinder is fitted on the left-hand side of the cockpit entrance and a pressure regulator, a manual MASK RELEASE knob and a two-position MANUAL/AUTO control lever are fitted to the aft right-hand side panel.

Crew portable oxygen bottles

Portable oxygen bottles are provided for both the cockpit crew and the cabin attendants. These bottles can be used in conjunction with a full-face mask (providing 100% oxygen), or they can be used to provide a constant oxygen flow of approximately three litres/min. The duration of this flow can last for up to 1.5 hours.

The cockpit crew’s portable oxygen bottles are located in the entrance to the cockpit. The cabin attendants’ portable oxygen bottles are located on the front and rear cabin walls.

POWER PLANT AND CONTROLS

Two Rolls-Royce RB.183 Mk 555-15 Spey Junior low-bypass turbofan engines are fitted in pods on either side of the rear fuselage and produce up to 9,850 lbf (43.9 kN) of thrust.

The left-hand engine is designated engine 1 and the right-hand engine is designated engine 2.

Hydraulic, electrical, fuel and engine bleed system service lines are carried within the pylon structure.

Engine power is controlled directly by the pilots by means of two pairs of interconnected throttle levers located on both sides of the pedestal.

Later on in the F28's life, some Speys were fitted with hush kits to reduce the noise produced by the engines in order to meet newly introduced noise regulations. These hush kits can be seen fitted to the rear of the engines and utilise an exhaust mixer to mix cool ambient air with the hot air exiting the core of the engine. The hush kits can be toggled using the 'Hush kit' option on the EFB's Aircraft page.

Bleed air system

Bleed air taken from the 7th and 12th stages of the engine's high-pressure compressor is the primary source of air for air conditioning, pressurisation and anti-icing systems.

Ice detection system

An automatic ice detection system detects ice formation during flight and automatically activates the engine anti-icing system. Air from the 12th stage high-pressure compressor is ducted to a manifold surrounding the engine, where it is then routed to the inlet guide vanes, nose fairing and air intakes.

Two three-position anti-ice control switches are installed on the overhead panel. When the switches are in the ON position, hot air will be constantly supplied to the system. When the switches are in the OFF position, no air can be supplied to the system. When the switches are both in the AUTO position, this will result in:

- Engine anti-icing operative.
- An ICE DETECT caution light illuminating on the glareshield when icing is detected.
- Probe heating inoperative.

The ICE DETECT light will remain illuminated until ice is no longer detected.

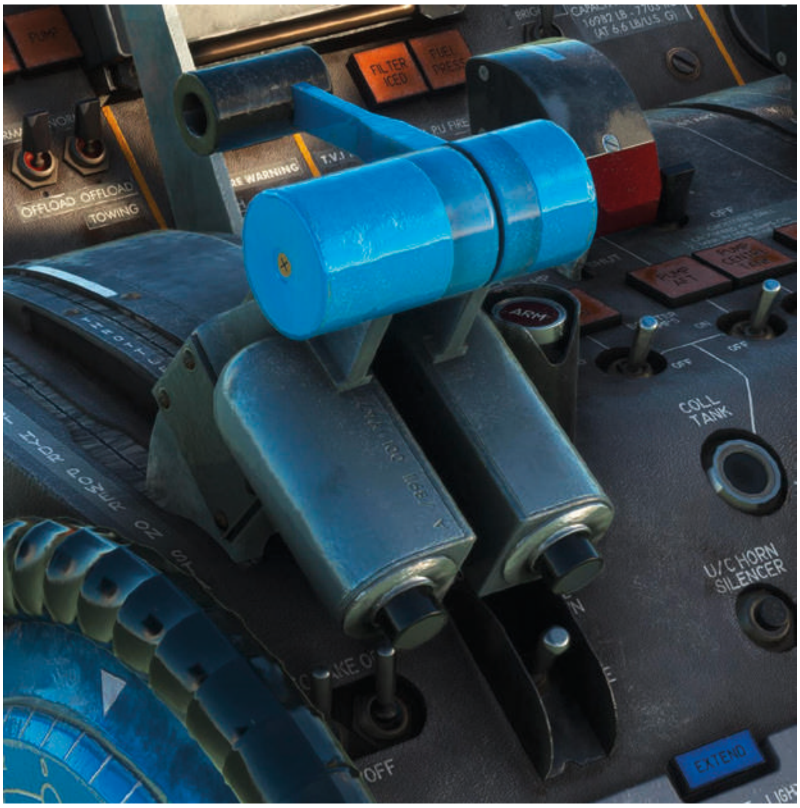
An anti-icing valve test switch is also installed on the overhead panel, allowing for the testing of both anti-icing valves and indicators.

Power plant controls

Throttle levers and high-pressure fuel valve control levers are installed on the pedestal.

The throttle levers are mechanically linked to the fuel regulator, allowing for thrust to be regulated from idle to take-off thrust.

High-pressure fuel valves provide a means of shutting off fuel flow to the engines.



Throttle control system

A pair of throttle levers are duplicated for each pilot and are interconnected.

The throttle levers are free moving, with a single throttle lever detent at the 95% position on the left-hand throttle.

Throttle control lock (gust lock)

A throttle control gust lock system prevents take-off with the flight control surfaces locked by the gust lock system.

If the flight control surfaces are locked by the gust lock system, the throttle levers cannot be advanced beyond 80% RPM if the three-position throttle control selector lever just aft of the First Officer's throttles is in the mid position.

Moving the throttle control selector lever to the No. 1 or No. 2 position will free the respective engine and will allow that engine to be advanced to maximum RPM. This procedure would typically be used if an engine run is required on the ground for maintenance.

To allow both engines to be advanced to maximum power, the flight control surfaces gust lock must be in the unlocked position.

High-pressure fuel valve control system

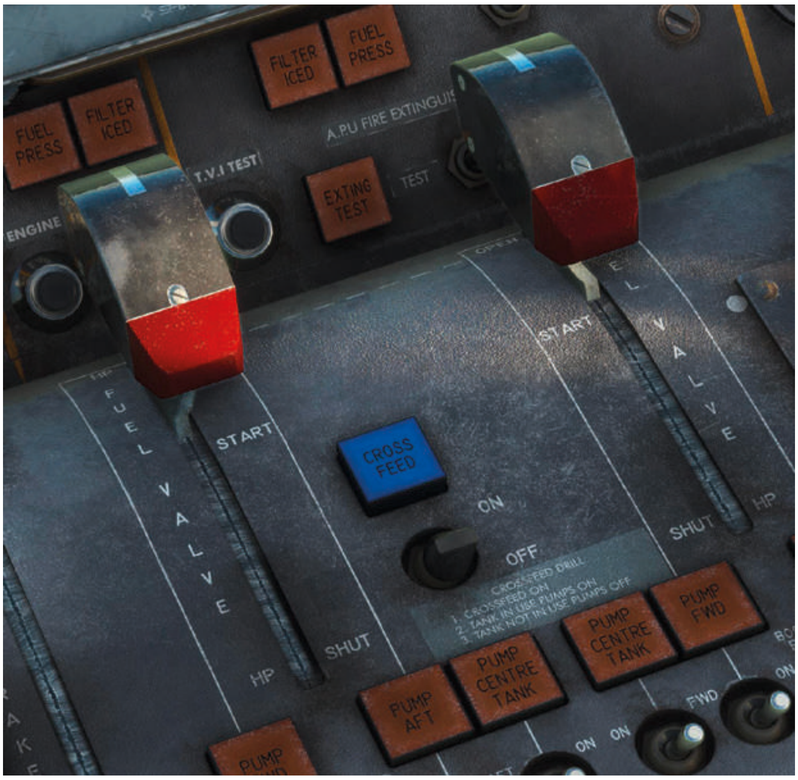
Two high-pressure fuel valve control levers are installed between the two pairs of throttle levers on the pedestal.

The high-pressure fuel valve control levers have three positions:

SHUT – high-pressure fuel valves are closed.

START – high-pressure fuel valves are open with supplementary fuel flow (used during engine start).

OPEN – high-pressure fuel valves are open with no supplementary fuel flow (normal operating position).



Top temperature control (TTC)

Top temperature control (TTC) is an automatic control system fitted in the engine fuel system and used to prevent the engine TGT from exceeding its take-off and climb limits.

Two TTC switches are installed on the left side of the pedestal, just aft of the Captain's throttle levers. These switches have three positions:

TAKE-OFF – limits the engine TGT to 520°C when the throttle is above 80% (limited to 470°C when the throttle is below 80% during engine starting).

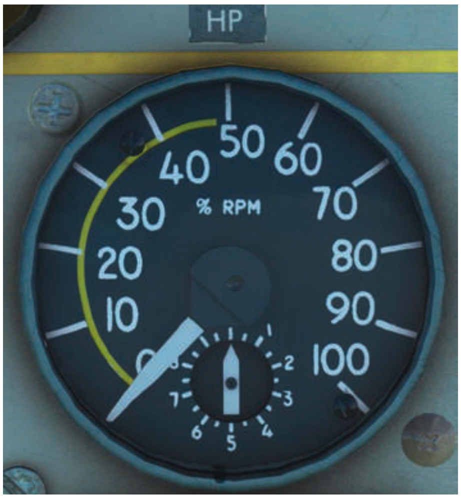
CLIMB – limits the engine TGT to 470°C. However, if the throttle is advanced above 98% RPM, or if the thrust switch is closed on the other engine (engine failure), the TGT limit will be increased to 520°C.

OFF – the TTC reverts to the minimum trip position and TGT control of the engines is by manual operation of the throttle levers.

Engine indication and warning systems

HP and LP shaft RPM indicators

Located on the main instrument panel, these dials provide a visual indication of shaft RPM on HP and LP RPM on each engine. The main dials are numbered in increments of 10% between 0% and 100%, with the sub-dial numbered in increments of 1% between 0 and 9.



Thrust indicators

Located on the main instrument panel, these dials provide a visual indication of developed thrust on each engine as a percentage of maximum thrust. The dials are numbered in increments of 10% between 50% and 110% and increments of 1% between 95% and 105%.

A setting knob on the lower left corner of the indicator is connected to the three-digit display inset and is used to set actual airport barometric pressure (QFE) and temperature before take-off.

Turbine gas temperature indicators

These dials on the main instrument panel provide a visual indication of turbine gas temperature (TGT) in each engine. The dials are marked in a range between 100°C and 800°C, with the scale expanded between 400°C and 650°C with a take-off thrust SET point marked by a red line at 520°C.

Engine vibration indicators

Located on the main instrument panel, these dials provide a visual indication of vibration in each engine; an irregularity here would be an early warning of an engine failure. The dials are marked in increments of 0.1 between 0 and 5.

Engine overheat warning

Located on both annunciator panels, ENGINE OVERHEAT warning lights illuminate when the air passing through the LP cooling air outlet exceeds a predetermined value.

Oil pressure indicators

Located on the main instrument panel, these dials provide a visual indication of oil pressure in the respective engine. The dials are marked in increments of 5 PSI between 0 PSI and 75 PSI.

A green band indicates the normal operating range between 30 PSI and 55 PSI. A yellow band indicates the abnormal operating range between 16 PSI and 30 PSI. A red mark indicates 16 PSI.

Low oil pressure warning

Located on both annunciator panels, ENGINE OIL PRESS warning lights illuminate when the engine oil pressure drops below a predetermined value.

Oil temperature indicators

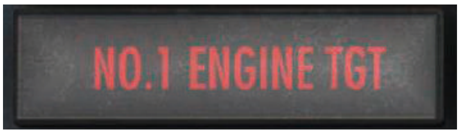
Located on the main instrument panel, these dials provide a visual indication of oil temperature in the respective engine. The dials are marked in increments of 10°C between -40°C and 120°C.

A green band indicates the normal operating range between -30°C and 90°C. Yellow bands indicate the abnormal operating range between -40°C and -30°C, and between 90°C and 120°C. A red mark indicates 120°C.

TGT over-temperature warning light

Located on both annunciator panels, ENGINE T.G.T. warning lights illuminate when the engine TGT exceeds the currently selected TTC limit by 25°C. During engine starting when the TCC is set to TAKE-OFF, the warning lights illuminate when TGT reaches 495°C.

If activated on the ground, the ENGINE T.G.T. warning lights are accompanied by an audio warning.

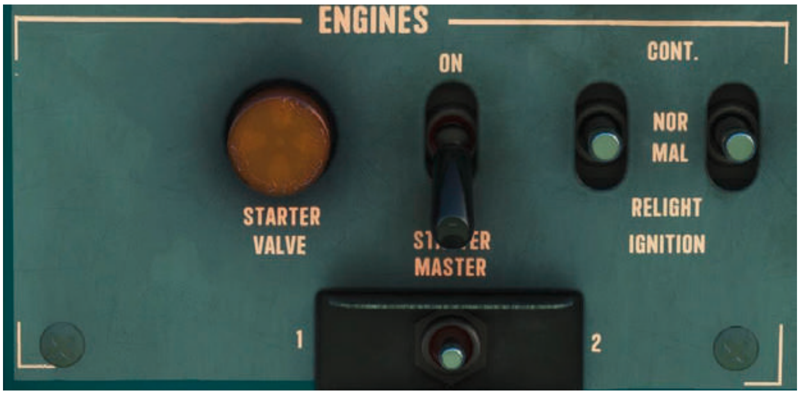


Engine start system

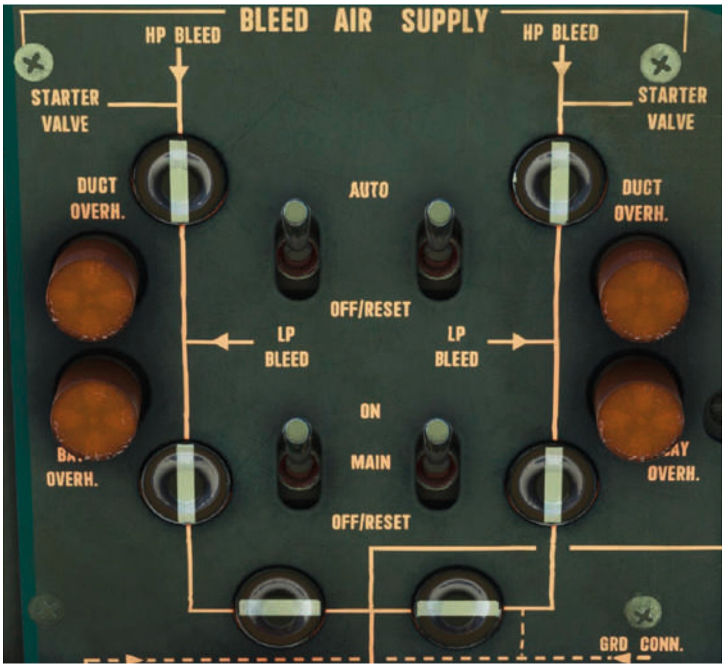
Engine starting is controlled from the ENGINES panel on the overhead panel.

The ENGINES panel consists of:

- STARTER MASTER switch (ON/OFF)
- Engine selector switch (1/OFF/2)
- Amber STARTER VALVE light
- Two ignition switches (NORMAL/CONT./RELIGHT)



Air used for engine starting is sourced from the APU or external power. The second engine can also be started by cross-bleeding air from the already running engine by setting the switches on the BLEED AIR SUPPLY panel to the AUTO and ON positions.



The engine start sequence is initiated when the STARTER MASTER switch is switched ON and the engine selector is switched to the appropriate engine. A start control relay is then energised, resulting in:

a) Illumination of the STARTER VALVE light, indicating the opening of the shut-off and pressure-regulating valves.

b) Automatic shut-off of the air supply to the cockpit, cabin and anti-icing system.

c) Arming of the ignition system.

d) Off-loading of the utility hydraulic system pump.

Air will then rotate the HP compressor, drawing air into the LP compressor. When the LP shaft RPM indicator shows rotation, the HP fuel valve lever can be moved to the START position. This action will open the high-pressure fuel valve and activate the AC ignition unit, illuminating a neon ignition light on the main instrument panel.

The start control relay automatically de-energises once the engine reaches its self-sustaining speed of 43% HP RPM, switching off the starter system, starter valve light and ignition light.

Cabin and cockpit air supply and anti-icing systems will automatically return in-line after the engine has stabilised and the utility hydraulic system pump will supply pressure.

After engine start, the HP fuel lever is to be moved to the OPEN position.

Ignition system

Each engine has two ignitor plugs fitted. One plug is fed by the ESS DC bus and the other from the AC bus.

The ignition switch is located on the overhead panel and has three positions:

NORMAL – AC ignition will be activated during the starting procedure, provided the HP fuel valve lever is in the START or OPEN position. AC ignition will be automatically deactivated when the engine reaches 43% HP RPM.

CONT. (CONTINUOUS) – AC ignition is activated (used when ice shedding is expected).

RELIGHT – both AC and DC ignition are activated (used for engine restarting during flight or when starting an engine without AC power).

Engine limitations

Speed, temperature and duration

12,136 HP RPM = 100%

8,393 LP RPM = 100%

CONDITION	RPM %		MAX TGT °C	TIME LIMIT
	HP	LP		
During starts	-	-	540	Momentary
Ground idling	47.0 to 53.0	-	590	Unrestricted
Max. continuous	98.5	108.5	590	Unrestricted
Max. take-off	101.0	108.5	520	5 minutes
Max. over-speed	104.5	112.0	-	20 seconds
Max. over-temperature	-	-	540	20 seconds

Lubrication system

Oil pressure

Minimum at idling RPM	18 PSI (yellow band)
Normal at maximum continuous	30-55 PSI (green band)
Minimum to complete flight at maximum conditions	25 PSI

Oil temperature

Minimum for starting	-40°C
Minimum for opening up	-30°C
Maximum for engine running	100°C

Note: *During flight, 120°C is permitted for a maximum of 15 minutes during transient overshoots on reducing RPM at top of climb.*

Fuel system

Maximum temperature at HP fuel pump inlet	90°C

Note: *During flight, 110°C is permitted for a maximum of 15 minutes.*

Amplifier datum settings

Top Temperature Control (TTC)	Take-off 520°C Climb 470°C

Vibration indication

Maximum permissible deflection	3
Maximum level change	1

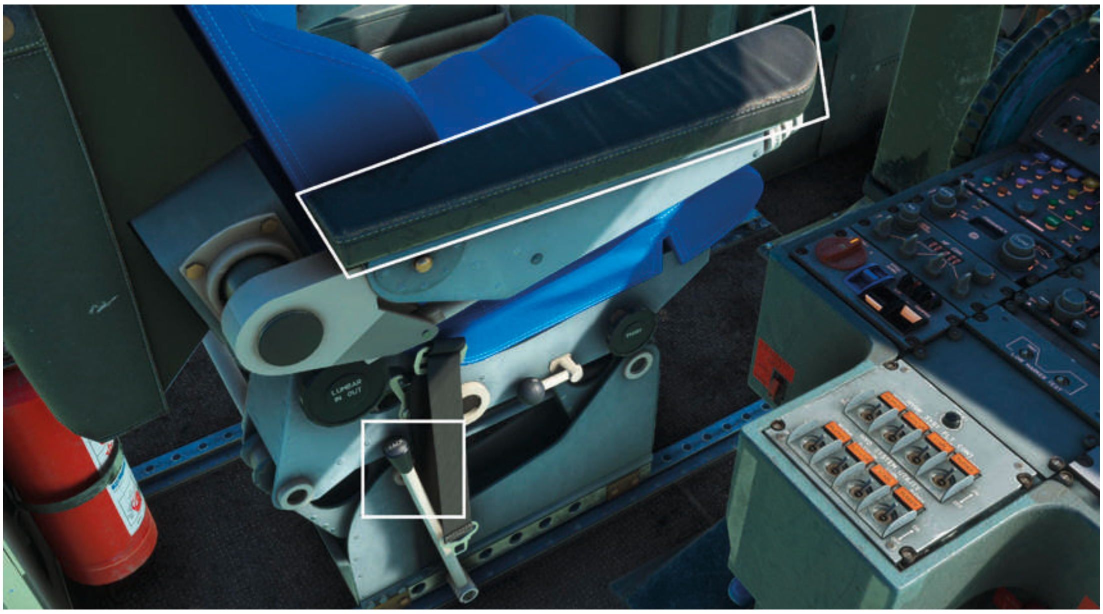
AIRCRAFT EQUIPMENT

Flight deck

The flight compartment normally provides accommodation for two crew members: the Captain and First Officer.

The crew seats are mounted on floor rails and the seats are manually operated to provide vertical and horizontal adjustment. Use the eye locator above the glareshield for correct positioning. Both seats are equipped with a full harness, including inertia reel shoulder straps.

Clicking on the seat handles labelled TRACK will move them into the desired position. The armrest can also be raised and lowered.



An additional stowable seat provides accommodation for an observer. The seat can be rotated and stowed when not in use by clicking on its base.

Side consoles, situated outboard of the Captain's and First Officer's stations, contain ashtrays, cup holders and stowage for both flight and operations manuals. Floor and side wall ventilation controls are also provided.

The two control columns can be hidden/shown independently by clicking on the floor immediately around the base of the control columns.

The cockpit door can be opened by clicking the door handle, allowing access to the passenger cabin.

Forward galley

The forward galley provides accommodation for one cabin attendant. A stowable cabin attendant seat is attached to the rear starboard (right) bulkhead.

A cabin attendant panel is fitted to the forward, port (left) side of the galley and is split into two panels. The upper panel provides control of the cabin announcements and cabin music, with the lower panel providing control for cabin lighting.

Upper panel controls

Reading light – two-position ON/OFF switch to toggle the reading lights ON/OFF.

STEW'DESS PHONE INT PH switch – two-position PH / INT PH switch. Press momentarily to PASS ADDRESS in order to connect handset to the PA system.

STEW'DESS PHONE HI/LO switch – two-position HI/LO switch which allows you to select PA volume high (HI) or low (LO).

PIL. CALL – three position pilot call switch:

- RESET – no pilot call
- Mid position – STEW CALL light on overhead panel illuminated
- CALL – spring-loaded to the mid position. STEW CALL illuminates, chime in cockpit is heard.

PILOT/CABIN/TOILET lights – illuminate from where the stewardess is called.

RESET switch – two-position switch spring-loaded to the down position. Press momentarily UP to reset PILOT light.

TEMP CONTROL rotary selector knob – rotary switch to control the cabin temperature if the TEMP CONTROL switch is in the AUTO position and the AUTHORITY switch on the overhead panel is set to STEW with the guard closed.

TEMP CONTROL switch – four-position temperature control switch provides an alternate means of temperature control:

- AUTO – allows for control of the cabin temperature via the rotary selector knobs above the temperature control switches.
- OFF – the temperature control system is deactivated and the airflow to the cabin will continue at the present settings. When using the COLD and HOT switch position, the switch is spring-loaded to the OFF position.
- COLD – decreases the temperature of the airflow to the cabin by providing direct control of the refrigeration unit bypass valve.
- HOT – increases the temperature of the airflow to the cabin by providing direct control of the refrigeration unit bypass valve.

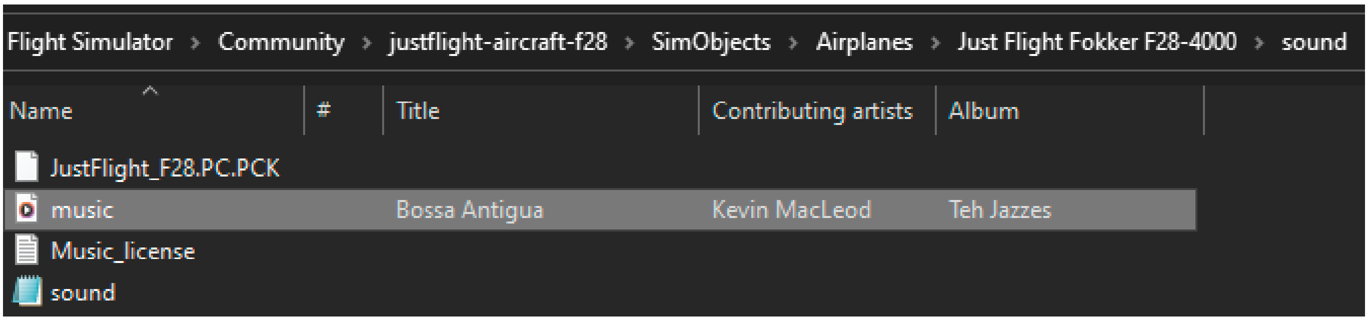
MUSIC REPROD VOLUME – controls the volume of the cabin music.

MUSIC REPROD switch – two position ON/OFF switch to toggle the music ON/OFF.

Importing custom cabin music

Cabin music is provided with the aircraft, but custom music can also be imported and played through the cabin speakers.

To import custom music, a .wav file named 'music' must be placed into the following file directory, replacing the original 'music' file: …\Community\justflight-aircraft-f28\SimObjects\Airplanes\Just Flight Fokker F28-4000\sound



Any custom .wav file placed into this file directory must conform to the limitations of the simulator's core sound engine, therefore any .wav file must not exceed 16-bit stereo 44.1 kHz. A lower value of 22 kHz or 11 kHz may be used to reduce the quality of the sound, replicating the poor-quality speakers fitted to vintage aircraft.

For users familiar with audio engineering, the imported music should also be normalised to approximately -27 dB to match the rest of the sound environment.

All the above requirements can be achieved using free audio software such as Audacity.

Note: *If the music.wav file does not conform to the MSFS sound engine limitations, the music will not be audible within the simulator.*

Lower panel controls

MAIN CABIN LIGHTS – two two-position ON/OFF switches which toggle the cabin lights ON/OFF. The left swich controls the forward cabin lights and the right switch controls the aft cabin lights.

EVAC LIGHTS – two-position guarded ON/NORMAL switch which toggles the cabin emergency lighting ON/OFF whenever the EMERG. light switch on the overhead panel is in the ARM position.

ENTRANCE LIGHTS – three-position BRIGHT/DIM/OFF switch controls the brightness of the lights in the forward galley.

Circuit breakers – various circuit breakers are provided to cut off the current flow to their respective systems.

Passenger cabin

The passenger cabin will accommodate 50-85 seats (Mk 1000 to Mk 4000) in a five abreast configuration.

Overhead stowage bins are provided on each side of the passenger cabin.

Seating and emergency exit configurations are customised to each F28 variant.

The passenger cabin can be toggled on/off to improve FPS/performance via the Configuration menu on the Aircraft page of the EFB.

Rear galley

The rear galley provides accommodation for one cabin attendant with a single stowable cabin attendant seat attached to the rear bulkhead.

A toilet compartment is located on the starboard (right) side of the galley.

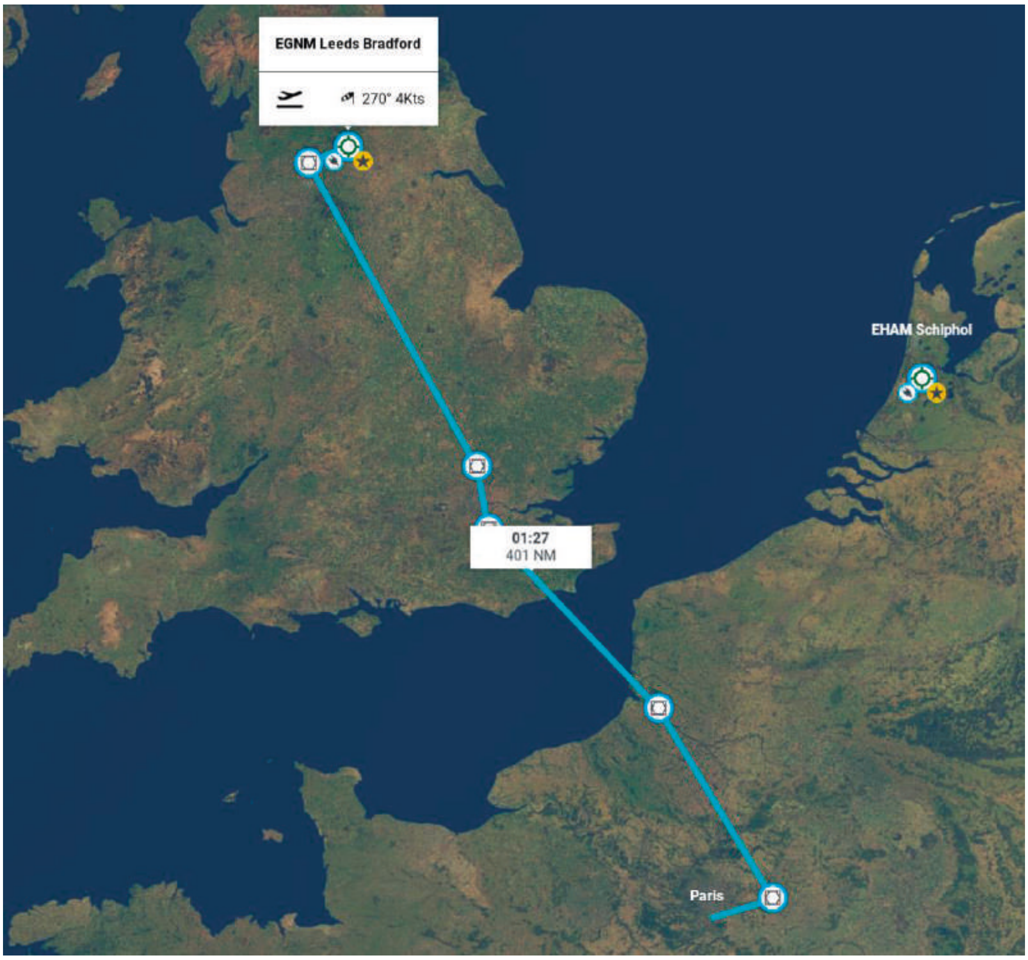
FLYING THE F28

In this tutorial flight we will be departing from Leeds Bradford Airport in West Yorkshire, England. Our route will take us down the centre of England, over London and the English Channel, then just to the east of Paris before starting our approach into Paris Orly, the second largest airport in Paris and approximately eight miles south of the city.

Covering approximately 400 nautical miles, this regional flight is the ideal length for learning about the important systems on board the F28.

Here are the details for today's flight:

EGNM > LBA (402.5) > POL (112.10) > BPK (117.50) > BIG (115.10) > ABB (108.45) > CLM (112.50) > POY (334.0) > LFPO



Estimated time en route: 90 minutes

Route distance: 400 nautical miles

Departure time: 1000 (local time)

Weather: Few clouds

Now that we are prepared for the flight, we can proceed to the cockpit to begin our pre-flight checks. To load up the F28 tutorial flight, follow these steps:

1. Start Microsoft Flight Simulator.
2. Click **World Map**.
3. Click **More** and then click **Load/Save**.
4. Choose **Load From This PC**.
5. Select **Just Flight F28 tutorial flight** from the list of saved flights.
6. Click on **OK**.
7. Click **Fly**.

You should now find yourself sitting in the cockpit on Stand 12 at Leeds Bradford Airport. As we have started the flight at the gate, the aircraft has automatically loaded in a 'cold and dark' state, with all the cockpit systems switched off, as you would find the aircraft prior to the first flight of the day. Beginning in this configuration means we will need to spend some additional time setting up the cockpit, but doing so will allow you to learn a considerable amount about the features and functions on board the F28.

If you wish to skip ahead and start this tutorial flight with more systems already set up, you can load the aircraft in a READY FOR TAKEOFF or TURNAROUND state via the EFB.

This tutorial will cover the necessary steps for you to get from point A to point B, but it will not explore each system in depth. Please refer to the rest of this manual for details of each system.

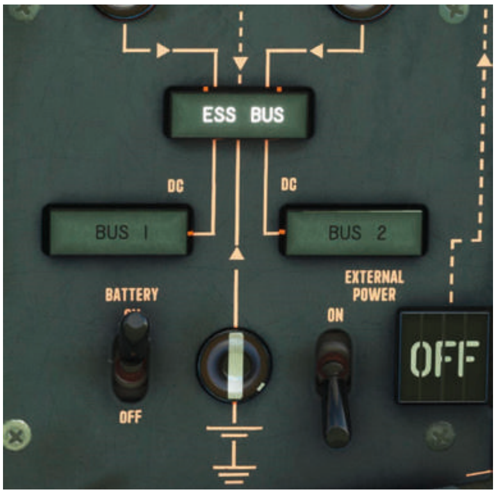
For today's flight we will be navigating using the 'traditional' methods on which the F28 cockpit was developed – VOR, ADF and ILS.

Powering on the aircraft

Before applying power to the aircraft, check the battery voltage by rotating the DC rotary selector on the overhead panel to the **BATT 1** position and confirming that the indicator displays a minimum of 23V.

Repeat this process for **BATT 2** before returning the switch to the **OFF** position.

On the ELECTRICAL POWER panel, set the BATTERY switch to **ON**.



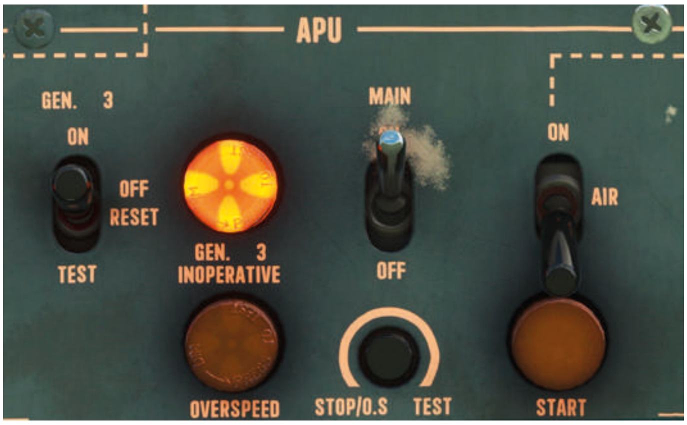
With electrical power now supplied to the aircraft, confirm the ESS BUS light is illuminated, indicating that the DC essential bus is energised.

The aircraft batteries only have a finite amount of charge so we need to supply further electrical power to the aircraft. We can do this either via the APU (Auxiliary Power Unit) or by external power. In this tutorial flight we will be using the APU.

Before starting the APU, we need to test the APU FIRE/EXTINGUISHING warning by holding the A.P.U FIRE EXTINGUISHER TEST switch on the secondary instrument panel to **TEST** for five seconds and confirming the EXTING TEST and APU FIRE warning lights illuminate.

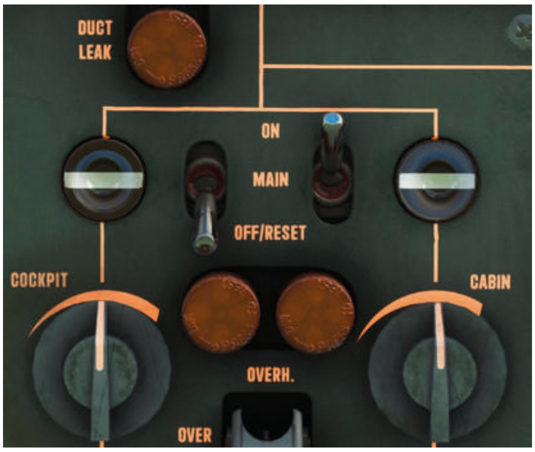
Complete the test by momentarily holding the TEST switch in the **RESET** position.

Moving up to the APU panel on the overhead, select the APU MAIN switch to **ON** and confirm the GEN. 3 INOPERATIVE light is illuminated.



Confirm the GEN 3 switch is in the **OFF/RESET** position and the APU AIR switch is set to **OFF** before attempting to start the APU.

Moving across to the AIR CONDITIONING panel, set one MAIN switch to **ON** and the other to **OFF/RESET**.

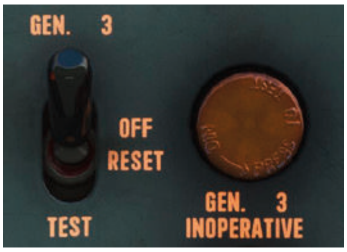


We are now ready to start the APU.

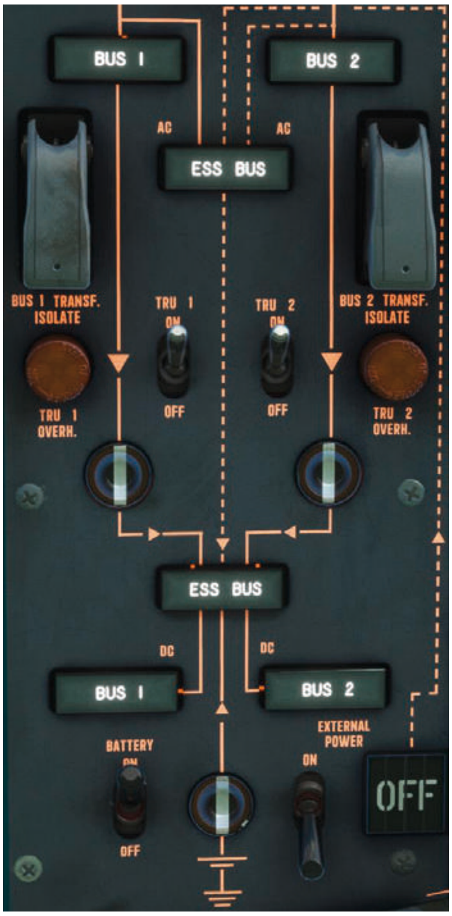
Ensure 10 seconds has passed since turning on the APU MAIN switch to ensure the APU inlet door is fully open, then press the APU **START** button. Confirm the START light illuminates.

Monitor the APU start and confirm a TGT and RPM rise, followed by the APU START light extinguishing at approximately 45% RPM.

When the APU RPM is above 95%, set the GEN. 3 switch to **ON**.



Confirm the GEN. 3 INOPERATIVE light is extinguished and that all buses are energised on the ELECTRICAL POWER panel. We can confirm that all voltages and frequencies are in the correct operating ranges by rotating the DC and AC rotary selectors to their respective positions.



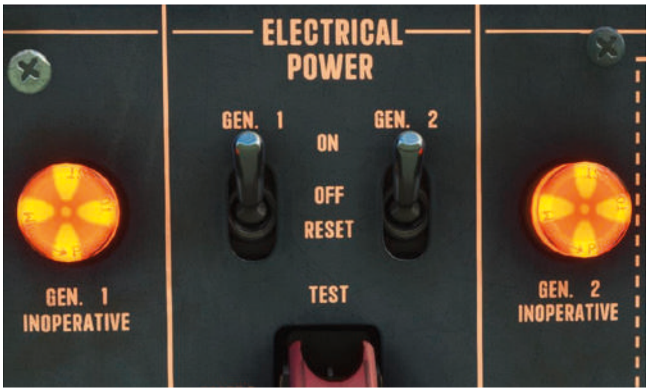
The APU AIR switch can now be set to **ON** to supply air to the cockpit or cabin.

Switch **ON** both MASTER RADIO switches on the pedestal.

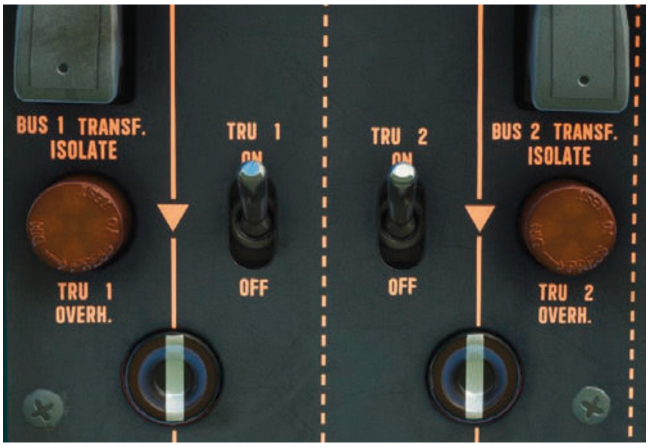
Pre-flight checks

We will now run through the pre-flight checks, beginning with the overhead panel.

Working our way down the ELECTRICAL POWER panel, confirm that the GEN. 1 and GEN. 2 switches are in the **ON** position with the respective INOPERATIVE lights illuminated.



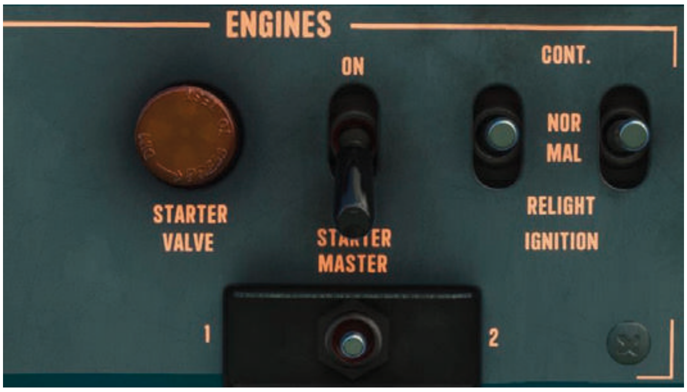
Confirm the TRU 1 and TRU 2 switches are in the **ON** position, with the two TRU mechanical indicators showing in-line.



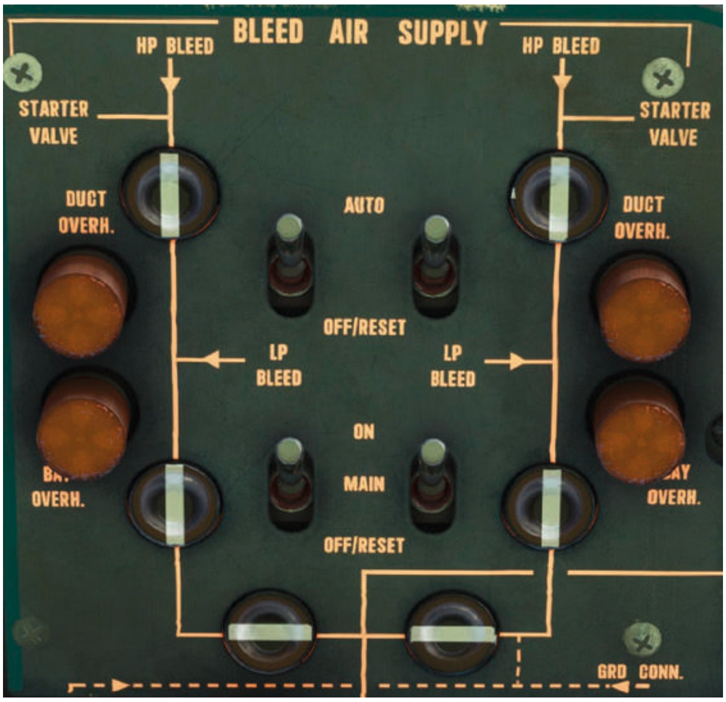
Confirm the battery mechanical indicator is showing in-line and the EXTERNAL POWER switch is set to **OFF**, with the OFF indicator visible.

Set the EMERG. LIGHT switch to **ARMED** and check the caution light is out.

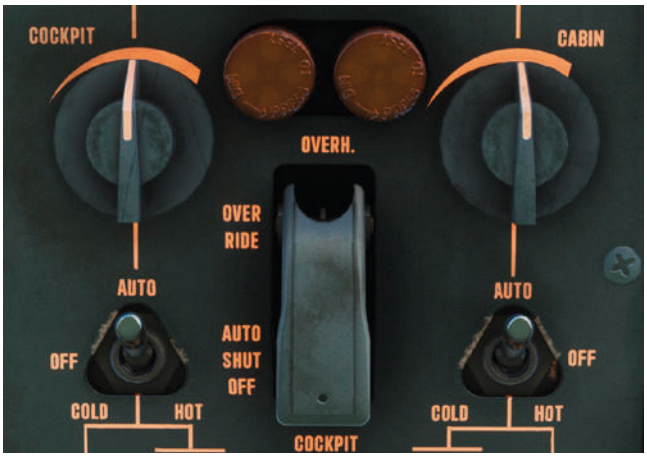
On the ENGINES panel, confirm the STARTER MASTER switch is set to **OFF** and the IGNITION switches are set to **NORMAL**.



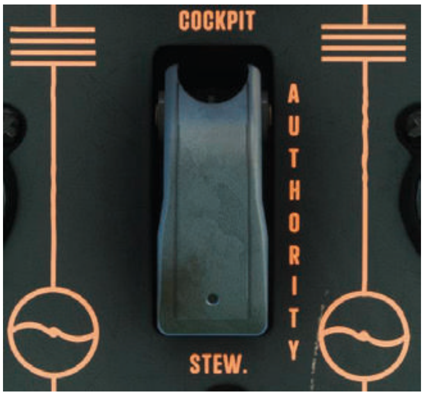
On the BLEED AIR SUPPLY panel, set both HP switches to **AUTO** and set both MAIN switches to **ON**.



On the AIR CONDITIONING PANEL, set both temperature selectors as desired and set both temperature control switches to **AUTO**.



Set the AUTHORITY switch to **STEW** with the guard closed to allow the cabin crew to control the temperature of the cabin. If the cabin temperature is to be controlled by the cockpit, open the guard and set the switch to COCKPIT.



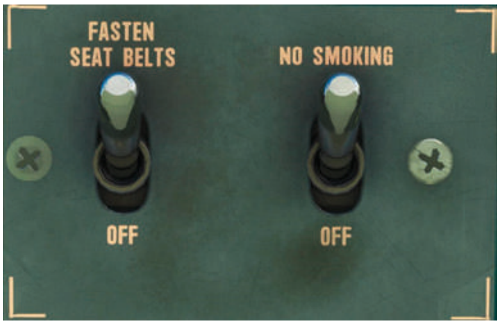
On the AIRFOIL ANTI-ICING panel, set both MAIN switches to **OFF/RESET** and set the indicator selector switch to **RH NORMAL**.

On the ENGINE ANTI-ICING panel, set both selector switches to **OFF**.

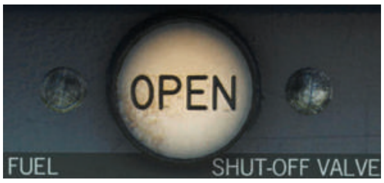
We can now test the ice detection system by pressing the ice detection **TEST** button and confirming that the ICE DETECT caution lights on the overhead and glareshield illuminate for approximately one minute.

Set the windshield heating priority switch to **LH**, and as the OAT is below 20°C we will also set the selector switches to **LOW**.

Switch **ON** the FASTEN SEAT BELTS and NO SMOKING switches.



On the glareshield, ensure that all three fire control guards are **CLOSED** and the FUEL SHUT-OFF VALVE indicators show **OPEN**. If either valve is indicated SHUT, press the respective RESET buttons.



Test the Ground Proximity Warning System by pressing the **GPWS TEST** button on the glareshield and confirm audible GPWS warnings can be heard.

On the left side panel, test the Central WARNING and CAUTION system by pressing and holding the **TEST** button and confirm all lights are illuminated. Release the test button and set the DIM/BRIGHT switch to **BRIGHT**.

Set the nose-wheel steering to **ON** and close the switch guard. Ensure the ALTERNATE WHEEL BRAKE handles are in the forward position.

Moving across to the main instrument panel, check that all failure flags are out of view on all instruments and set the altimeter to the current airfield pressure.

Test the skid control by holding the SKID CONTR TEST switch in the **OUTB** and **INB** positions and confirm the SKID CONTROL light illuminates.

Moving down to the hydraulic power section of the secondary instrument panel, confirm that the FLIGHT CONTROL and the four PUMP lights are illuminated and the four PUMP switches are in the **NORMAL** position.

On the fuel panel, confirm two FUEL PRESS lights are illuminated.

Any caution lights which aren't illuminated can be tested by depressing the respective caution light.

Test the ENGINE FIRE WARNING system by pressing the **LH** and **RH** buttons one by one, and confirm red lights are illuminated in the fire control guard and on the respective HP FUEL VALVE levers. Silence the warning bell using the BELL SILENCER button on the glareshield.

Press the T.V.I TEST button and confirm the engine VIB AMPLITUDE indicators increase to indicate approximately **4**.

We can now check the aircraft's fuel quantity. Today we will be flying with almost full wing tanks, so we can confirm via the fuel quantity indicators that we have approximately **3200 KG** in each wing tank.

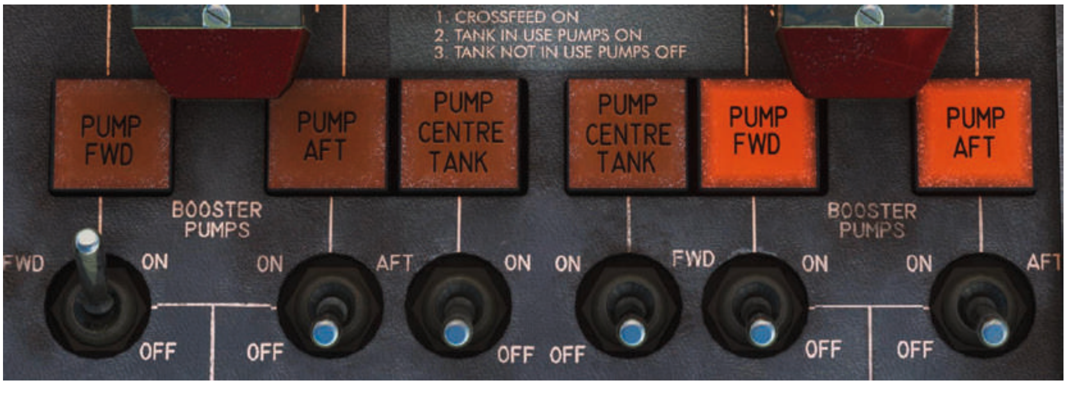
Moving further down the pedestal, ensure the lift dumper handle on the Captain's throttle is **DOWN**, the ARM light is out, and both lift dumper indicators on the glareshield are showing **IN**.

Ensure the speedbrake and flaps levers are in the **IN** and **UP** positions.

Located just aft of the Captain's throttles, set the TTC switches to **TAKE OFF**.

Ensure the CROSS FEED switch is in the **OFF** position.

Switch **ON** each of the fuel BOOSTER PUMPS one by one, checking that both PUMP lights extinguish when one pump is switched on. Return all fuel BOOSTER PUMPS switches back to **OFF**.

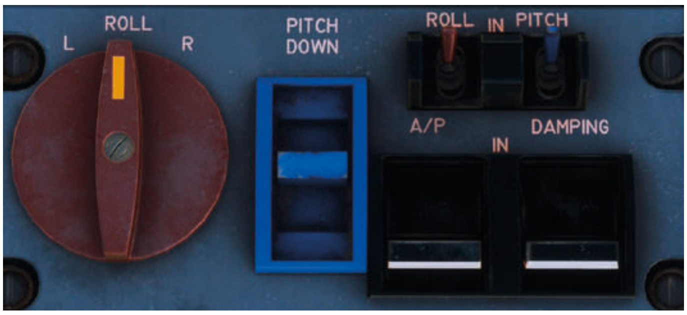


Although we won't be using ATC during this tutorial flight, increase the VOL and SQ controls for the COM 1 and COM 2 radios so that they are ready for use if necessary.

Set the ATC transponder to **STBY**.

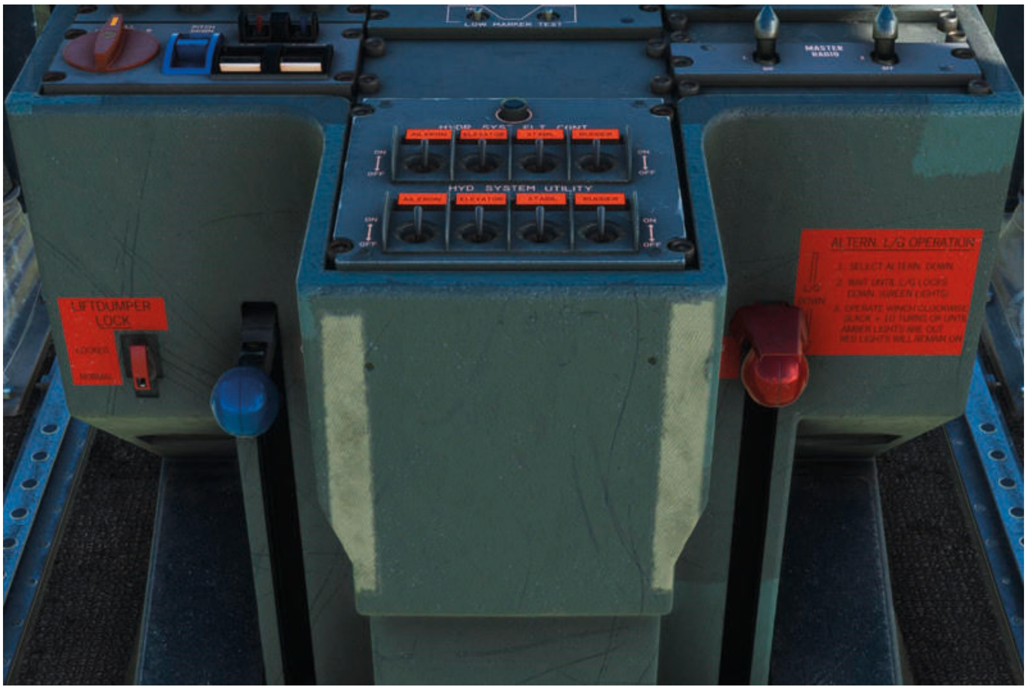
Set the weather radar to **STBY**.

On the autopilot controller, ensure the ROLL and PITCH channel switches are **IN** and the A/P and DAMPING switches are **OFF**.



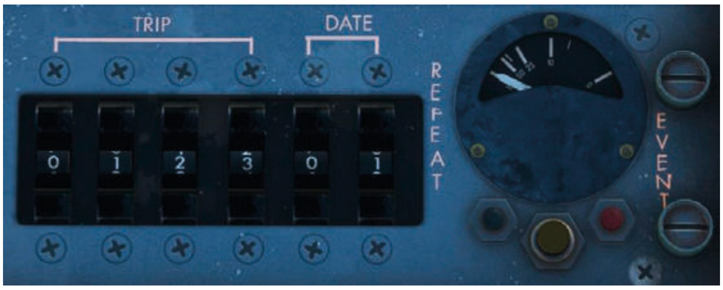
On the hydraulic system flight control panel ensure all eight switches are **ON** and all eight lights are illuminated.

Moving down the rear of the pedestal, confirm the GUST LOCK is in the **ON** position and the ALTERN L/G OPERATION handle is in the **UP** position.



Moving to the First Officer's secondary instrument panel, test the door lights either by pressing the individual buttons or by pressing the **LAMPTEST** button.

On the First Officer's right-side panel, enter the current flight number and date into the flight data recorder. For this flight we will simply enter **012301**.



Confirm the PAX. OXY. MASK RELEASE switch is in the **NORM** position with guard closed.

To complete the pre-flight checks, ensure all guarded switches on all cockpit panels are closed and all amber push-to-test caution lights have been tested.

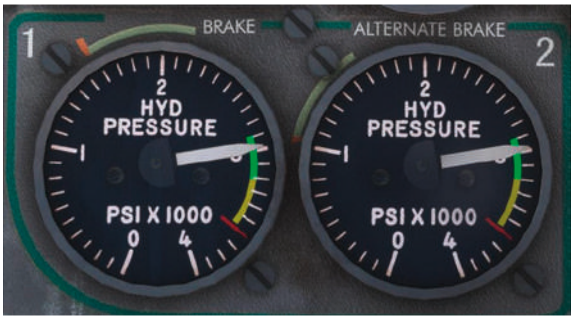
We can now open the forward passenger door and forward and aft cargo door to begin passenger boarding. The doors can be opened via the Aircraft page of the EFB or via the physical door controls in the forward galley.

If you visit the forward galley, you can also turn ON the music reproducer and control the cabin temperature to ensure that the cabin is a warm, welcoming environment for your paying customers.

Before engine start

Ensure all AC and DC buses remain energised and the APU bleed air pressure is reading in the green band range.

Check the brake pressure indicator on the secondary instrument is reading **higher than 1,600 PSI**.



If brake pressure has dropped below 1,600 PSI, switch **ON** the SYSTEM I ELECTR. PUMP to increase the pressure.

Confirm the parking brake is **ON** (blue handle pulled out).

On the pressurisation controller, set the CABIN ALT selector to 1,000 ft above the intended cruise level for the flight. For this tutorial flight our cruise altitude will be 29,000 ft so we need to set **30,000 ft**. Ensure the BAR. CORR is set to ISA sea level pressure **1013 mb** and the RATE selector is set on the mark.

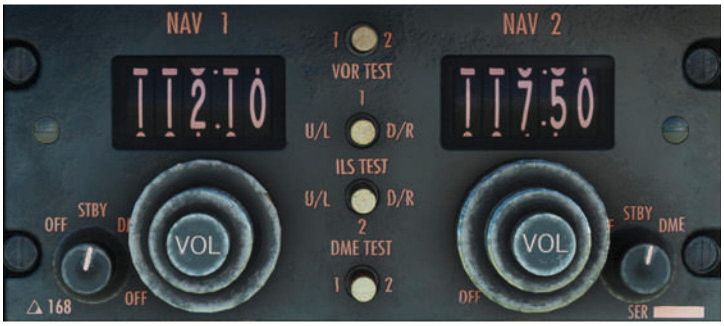
We now need to set our thrust index for departure. We will be performing a full-power take-off today with no derate, so we will set our thrust index directly from the thrust index charts (see the Thrust Index Tables. Based on the current temperature and altitude, we will use a thrust index of 170 for this flight.

With the thrust index determined, we can now set **170** on the thrust indicators. The thrust indicators should now display 100% when maximum power is achieved during the take-off run.

We can now also set up our navigation instruments for departure.

We will be taking off on runway 32 and initially flying a runway heading of 318 degrees. We can set the heading bug to **318 degrees** by rotating the HEADING control on the remote datum selector.

We can also input the frequencies for the first couple of VOR stations on our route into the VHF NAV radios. On the VHF NAV 1 radio we can enter the frequency for the POL VOR **112.10 MHz** and then turn the VHF NAV 1 selector switch to DME.



We can then set our inbound course to the VOR of **149 degrees** on the NAV 1 course selector.

Repeat this process by entering our second VOR on the route, BPK **117.50 MHz**, and the course of **149 degrees** into the VHF NAV 2 radios.

Press the **NAV-1** button on the remote datum selector to ensure the autopilot will track the course to the VOR inputted to the VHF NAV 1 radios.

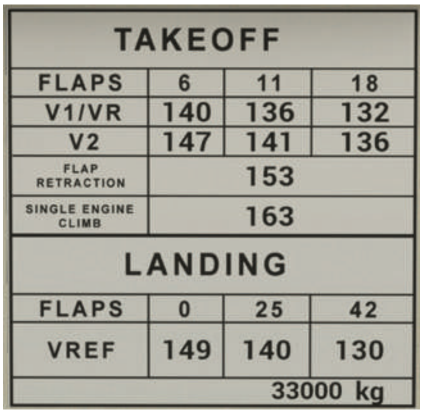
For additional situational awareness during our departure, we can also enter the frequency for the LBA NDB into the ADF 1 radio. On the ADF 1 panel, enter **402.5** and rotate the mode selector knob to **ADF**.

On the RMI, rotate the ADF/VOR control so that the VOR text is aligned with the edge of the RMI indicator. This will mean the bearing to the tuned VOR will be shown by the single-lined arrow and the bearing to the ADF is shown by the double-lined arrow.

As we aren't using ATC today, we will climb directly up to our cruising altitude of **29,000 ft**. We can preselect this altitude on the altitude preselector on the Captain's main instrument panel.

We can now obtain our take-off speeds via the reference card on the First Officer's main instrument panel. The reference card calculates the aircraft take-off and landing speeds based on the aircraft's current weight and flap setting. We will be taking off using flaps **11** today so we will be referencing the speeds listed in the flaps 11 column. Clicking the reference card will automatically assign the speed reference bug on the ASI.

V1 and VR speeds are considered equal in the F28, so our V1 and VR speed today will be **136 knots**. Our V2 speed is 146 knots, so we will climb out at the V2 +10 speed of **156 knots**, or at a maximum of 15 degrees nose up. We are safe to retract the flaps at any speed above 153 knots, although the flap 11 limit speed is 200 knots. In case of an engine failure, we will climb at 163 knots.



TAKEOFF			
FLAPS	6	11	18
V1/VR	140	136	132
V2	147	141	136
FLAP RETRACTION	153		
SINGLE ENGINE CLIMB	163		
LANDING			
FLAPS	0	25	42
VREF	149	140	130
			33000 kg

With our navigation instruments and take-off data set, we can now begin preparing the aircraft for pushback and engine start.

Set the gust lock to **OFF**.

On the EFB, **remove** the chocks and **close** all windows and doors, confirming that all door lights are extinguished on the First Officer's secondary instrument panel.

Engine start

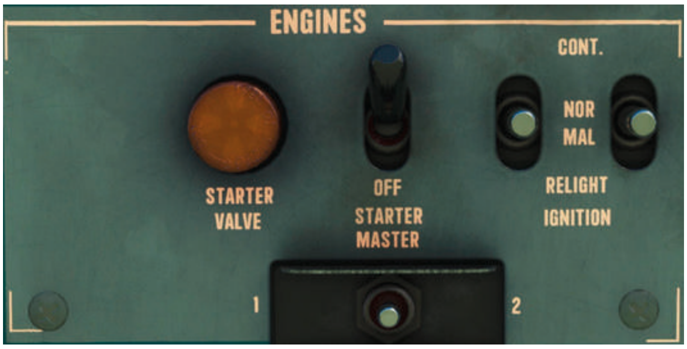
We can now request pushback and engine start. Release the parking brake and begin pushing back to the left, ending with the nose of the aircraft facing east on taxiway A.

Set the ANTI COLL and NAV light switches to **ON**.

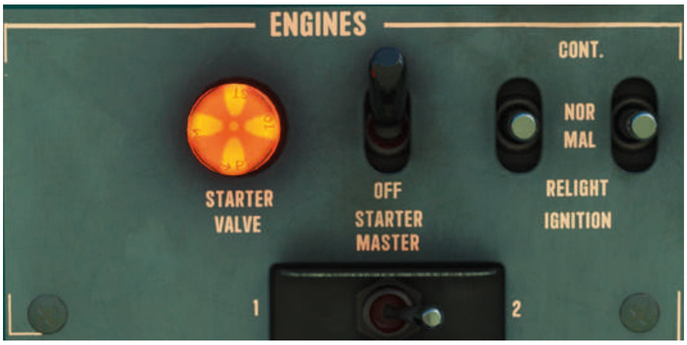
Confirm the throttle levers are at **IDLE** with the HP FUEL VALVE levers **SHUT**.

Set all four fuel BOOSTER PUMPS switches to **ON**.

Moving up to the ENGINES section of the overhead panel, set the STARTER MASTER switch to **ON**.



Use the engine start selector to select engine **2**.



A positive rotation of LP RPM should now be observed in engine No. 2 along with the illumination of the igniter light.

At 15-20% HP RPM, select the HP FUEL VALVE lever to **START**.

Monitor the oil pressure and TGT rising. Once TGT reaches 400°C or 50% HP RPM is obtained, select the HP FUEL VALVE lever to **OPEN**.

Once RPM and TGT have stabilised, check the oil pressure is greater than 16 PSI, HP RPM is between 47% and 53%, and LP RPM is approximately 27%.

Repeat this process for starting engine No. 1.

After engine start

With both engines started, confirm all lights on the central WARNING and CAUTION system are extinguished, and FUEL PRESS and igniter lights have also extinguished.

Returning to the overhead panel, confirm the STARTER VALVE light is extinguished before switching OFF the engine STARTER MASTER switch.

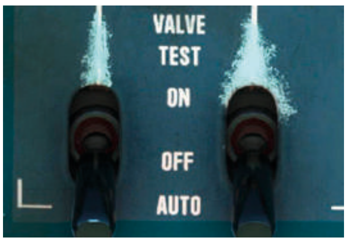
On the ELECTRICAL POWER panel, confirm all generator lights are extinguished before setting the GEN. 3 switch to **OFF/RESET**.

Set the APU AIR switch to **OFF** and check bleed air pressure decreases by at least 5 PSI.

Set both AIR CONDITIONING MAIN switches to **ON**.

Using the AC and DC rotary selectors, confirm all voltages and frequencies are operating in the green band range.

As we are not expecting any icing conditions on departure, we'll set the ENGINE ANTI-ICING switches to **AUTO**.



Turn **ON** the PITOT AND VANE HEATING switches and confirm all amber caution lights extinguish.

On the hydraulic panel, check all lights are extinguished and all hydraulic indications are in the green band range.

Confirm both ELECTR PUMP switch guards are closed and all hydraulic system FLIGHT CONTROL supply lights are extinguished.

We can now extend the flaps to our take-off configuration of **11 degrees**; we can confirm on the flap indicator that the flaps are set.

Taxi

Confirm that all flight instruments are set for take-off.

Rotate the PITCH COMMAND control to **10 degrees** nose up, which we use as a loose reference during the initial climb, and rotate the MODE SELECTOR to **HDG** mode. The flight directors on the ADI will now provide a visual reference of the required aircraft attitude needed to climb at 10 degrees nose up and on a heading of 318 degrees.

Set the stabilizer trim by clicking on the CG% SMC button on the Aircraft page of the EFB. The button will automatically set the correct take-off trim for the aircraft's current fuel and payload.

Confirm the COLL TANK indicators on the pedestal are black, indicating that there is more than 1,300 lb (590 kg) in the collector tanks.

We can now turn **ON** the TAXI lights, apply power and begin our short taxi to runway 32 via taxiways A and D.

Hold short of runway 32 at the D1 holding point and confirm the brake temperatures are in the green band or in the yellow band and decreasing.

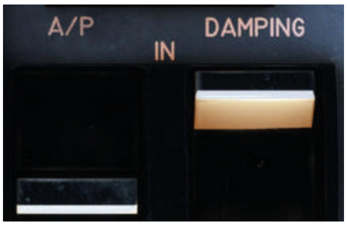
As our flight time will be longer than 30 minutes, we can shut down the APU by pressing and holding the **STOP/O.S / TEST** button on the APU panel, before then setting the APU MAIN switch to **OFF**.

The lift dumpers can now be **ARMED**, with the glareshield indicator showing RDY.

Confirm the gust lock is **OFF** and check the rudder, ailerons and elevator for full and free movement.

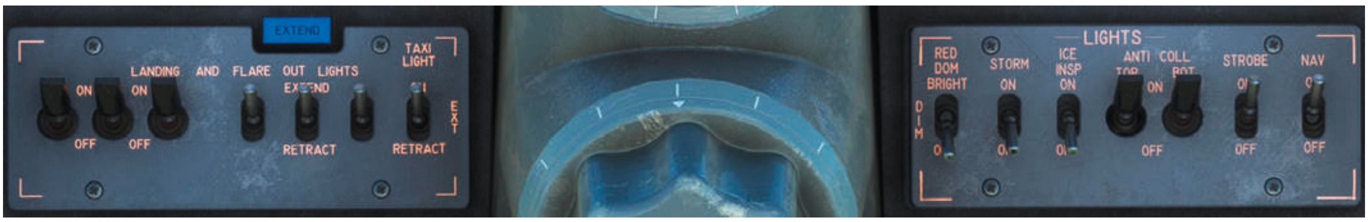
Check the hydraulic pressures all remain in the green band range.

On the autopilot controller, set the yaw DAMPING switch to **IN**.



Set the transponder to **ON** and set the altitude reporting switch to **ALT**.

Extend and turn **ON** the LANDING lights, FLARE OUT lights and STROBE lights.



Inform the cabin crew of our imminent departure by pressing the STEW CALL button on the overhead panel.

Enter the runway and turn left to begin a short backtrack to the threshold of runway 32. Once at the threshold, turn the aircraft 180° and come to a stop on the runway centre line.

Take-off

We are now ready for take-off.

Hold the aircraft on the brakes, slowly advance the throttles to the detent position and confirm 100% thrust is indicated by the thrust meters. If 100% thrust is not indicated at the detent position, continue to advance the throttles until 100% thrust is indicated.

Release the brakes and keep the aircraft on the centre line, using the nose-wheel steering up to 80 knots and then the rudder pedals.

As we approach **136 knots**, start to raise the nose of the aircraft. Continue to raise the nose to a nose-up attitude of approximately 10 degrees as we maintain our V2 +10 speed of **156 knots**.

Raise the landing gear and adjust elevator trim to maintain 156 knots. Maintain the runway heading (318 degrees).

At 800 ft AGL lower the nose to 10 degrees nose up, and once the speed is greater than **152 knots** select flaps **UP**.

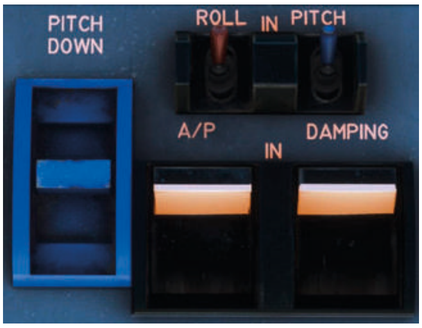
Once the flaps are fully retracted, reduce the throttles back to the detent position and set the TTC switches to **CLIMB**, confirming that the engine TGT is not more than **470°C**.

Climb

With the flaps retracted we can now begin to accelerate to our climb speed of **250 knots**.

Set the PITCH COMMAND knob to **5 degrees** nose up to use as a reference and engage the **HDG** autopilot mode.

On the autopilot controller, select the A/P **IN** to engage the autopilot and use the PITCH control to vary the aircraft's pitch when in autopilot PITCH mode.



Once we are in a stable climb at 250 knots, engage **IAS** mode and the autopilot will adjust the aircraft's pitch to maintain 250 knots.

We can now begin our turn to intercept the radial to the POL VOR. Turn the HDG bug to **200 degrees**, which will put us on a 45-degree intercept path for the VOR radial.

As the aircraft rolls out on a heading of 200 degrees, arm **BEAM** mode. This will allow the aircraft to automatically intercept and track the VOR radial once in range.

Rotating the mode selector to the **VOR/LOC** position will allow the flight directors to provide visual guidance for intercepting and tracking the VOR path.

We can run through our after take-off checks.

Confirm the landing gear and flaps are **UP** with all lights out, and that the lift dumper indicators show **IN**.

Ensure the ENGINE ANTI-ICING switches are in the **AUTO** position whenever the ICE DETECT lights are out. If the ICE DETECT light illuminates, set these switches to **ON**.

On the pressurisation panel, confirm the aircraft is pressurising and the CABIN V/S is indicating an increase in cabin pressure.

Passing through 10,000 ft, turn **OFF** and **RETRACT** the landing, flare and taxi lights and set the altimeter to the standard barometric pressure (1013 mb) by clicking the screw at the top left corner of the altimeter.

We can also switch **OFF** the Fasten Seatbelts and No Smoking signs.

Engage the autopilot **PITCH** mode again and use the PITCH control on the autopilot controller to lower the nose slightly to increase speed to 270 knots. Once **270 knots** has been reached, re-engage the autopilot **IAS** mode to climb at the new speed.

Now that we are flying our first outbound VOR leg in a steady climb, we can now start to plan ahead for our first VHF NAV radio change-over.

Once the HSI DME and IND-40 digital DME display read-outs both indicate 70 NM, this tells us that we are halfway between the POL and BPK VORs and we can now track the inbound course to the BPK VOR.

As we already pre-selected the course and frequency to the BPK VOR in VHF NAV 2 prior to departure, we can simply press the **NAV 2** button on the remote datum selector and the autopilot will now track the inbound radial to the BPK VOR.

Now that we have freed up the VHF NAV 1 radios, we can pre-select the course and frequency for the BIG VOR by selecting **115.10 MHz** and a NAV 1 course of **168 degrees**.

During the climb, continue to make small adjustments to the throttles as necessary to maintain the engine parameters within limits.

Cruise

On reaching our preselected cruise altitude of 29,000 ft, the autopilot will level off and hold the altitude.

Set the ALTITUDE HOLD switch on the flight director panel to **ON** and the flight directors will now provide guidance for level flight.

The F28 is not fitted with an auto throttle, so as the airspeed increases you will need to manually reduce thrust to maintain the desired cruise speed of **257 knots** or **Mach 0.70**.

As we approach the BPK VOR, we need to prepare to change VHF NAV radios.

When we are within 5 NM of the BKP VOR, synchronise the heading bug with the aircraft's current heading and engage **HDG** mode.

Select **NAV 1** on the remote datum selector panel and confirm the HSI is showing the correct course and distance to the BIG VOR. If so, engage **BEAM** mode.

The autopilot will now track the inbound radial to the BIG VOR and we can now enter the course and frequency for the ABB VOR into the VHF NAV 2 radios. Enter **108.45 MHz** and a NAV 2 course of **135 degrees**.

As the ABB VOR has a relatively small 100 NM range, we will need to fly an outbound radial from the BIG VOR until we are in range.

When we are within 5 NM of the BIG VOR, synchronise the heading bug with the aircraft's current heading and engage **HDG** mode. Rotate the NAV 1 course on the remote datum selector panel to **135 degrees** and engage **BEAM** mode. The aircraft will track the outbound radial from the BIG VOR, heading towards the ABB VOR.

We should be in range of the ABB VOR once we are 40 NM from the BIG VOR. We can confirm this on the IND-40 digital DME displays. To track the ABB VOR, press the **NAV 2** button on the remote datum selector.

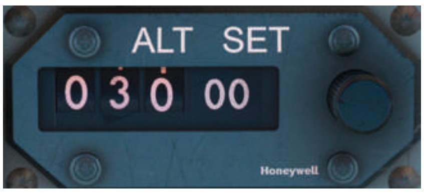
We need to repeat this process once more for the final leg our flight plan. We will be flying outbound of the ABB VOR on a course of **150 degrees** before then intercepting the CLM VOR (**112.90 MHz**), also on a course of 150 degrees. Enter 112.90 MHz and the course of 150 degrees into the NAV 1 radios.

When we are within 5 NM of the ABB VOR, synchronise the heading bug with the aircraft's current heading and engage **HDG** mode. Rotate the NAV 2 course on the remote datum selector panel to **150 degrees** and engage **BEAM** mode. The aircraft will track the outbound radial from the ABB VOR, heading towards the CLM VOR.

Descent

We will begin our descent when we are **5 NM** outbound of the ABB VOR.

Set **3,000 ft** on the altitude preselector.



Begin the descent by engaging the **IAS** autopilot mode and retarding the throttles to approximately 80% HP RPM to maintain a 1,000 ft/min descent down to 25,000 ft.

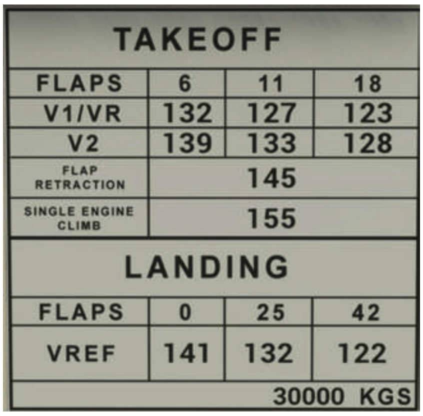
We can now begin our descent checks.

Set the Fasten Seatbelts switch to **ON**.

Rotate the CABIN ALT pointer on the pedestal to the field elevation of Paris Orly (**287 ft**) and confirm the CABIN V/S indicator is indicating a decrease in cabin pressure.

Set the TTC switches to **TAKE-OFF**.

Confirm our landing speeds using the speed reference card. We will be landing with **flaps 42** today, and at the current aircraft weight that gives us a VREF of **122 knots**. Click on the card to set the speed reference bug on the ADI.



TAKEOFF			
FLAPS	6	11	18
V1/VR	132	127	123
V2	139	133	128
FLAP RETRACTION	145		
SINGLE ENGINE CLIMB	155		
LANDING			
FLAPS	0	25	42
VREF	141	132	122
			30000 KGS

Set our decision height to **200 ft** using the SET/TEST knob at the bottom of the radio altimeter panel.

As we descend through 25,000 ft, slowly retard the throttles to idle and the aircraft will pitch down to increase the descent rate to approximately **-2,000 ft/min**. Use the U/C HORN SILENCER button on the pedestal to silence any gear warning alarms.

The CLM VOR should come into range once we are 40 NM outbound of the ABB VOR. When the DME displays become active on the IND-40 digital DME displays, press the **NAV 1** button on the remote datum selector to track to the CLM VOR.

We can now tune the ILS course and frequency for runway 25 ILS at Paris Orly.

In the VHF NAV 2 radio enter the ILS frequency **111.75 MHz** and the course **253 degrees**.

For additional situational awareness during the approach, we can also tune the POY NDB (**334.0**) into the ADF 1 radio.

As we descend through 10,000 ft, engage **PITCH** mode and extend the speedbrake so that the speed decreases below 250 knots. Once below 250 knots, re-engage **IAS** mode.

We should now be approximately 15 NM outbound of the CLM VOR with Paris Charles de Gaulle airport off our right wing.

Rotate the heading bug to **210 degrees** and engage **HDG** mode on both the mode selector and flight director panels. We will now begin a right-hand turn to the intercept point for the ILS approach.

With VHF NAV 1 now freed, we can input the ILS frequency and course into the VHF NAV 1 radios and press the **APPR** button on the remote datum selector.

If we had a navaid on the missed approach course, we could tune that into the VHF NAV 2 radios now and quickly switch to it during the missed approach by pressing the NAV 2 button on the remote datum selector.

We can now run through the approach checks.

Set the No Smoking switch to **ON**.

Check and cross-check the altimeters.

Confirm the ENGINE ANTI-ICING switch is set to **AUTO** and AIRFOIL ANTI-ICING is set to **OFF**.

Turn **ON** and **EXTEND** the landing light switches.

Approach and landing

As we prepare to intercept the ILS, arm both the **BEAM** and the **GLIDE** autopilot modes. With these modes armed, the autopilot will automatically intercept and capture both the localiser and glideslope beams.

As we pass 5,000 ft, engage PITCH mode and reduce speed to **200 knots**. Use speedbrakes as necessary.

As we level out at 3,000 ft, confirm speed is less than 200 knots and select **flaps 11**.

Reduce speed to **160 knots**.

Rotate the MODE SELECTOR switch to **GS AUTO**. The flight directors will now provide guidance for the approach.

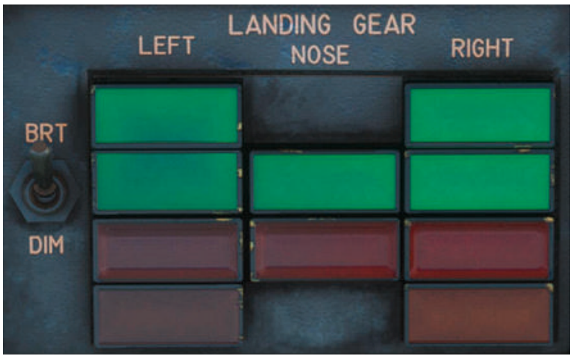
The aircraft will intercept the localiser and begin a right turn to line up with the runway.

When the glideslope indicator on the HSI indicates one dot above, select **gear down**.

Once the glideslope is captured, select flaps 25 and reduce speed to **142 knots**.

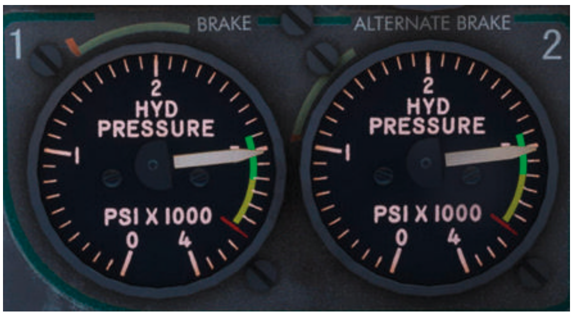
We can now carry out the before landing checks.

Confirm landing gear is down, **five green lights** are illuminated and all red and amber lights are out.



Perform a skid control test by holding the SKID CONTR TEST switch to the **OUTB** and **INB** positions and check the SKID CONTROL light illuminates.

Check the brake pressures are within the green band ranges.



ARM the lift dumpers.

At 1,500ft AGL, select **full flaps** and reduce speed to **132 knots**.

Disconnect the autopilot by pressing the cut-out button on the control wheel (or by using the AUTOPILOT OFF control assignment).

At 100 ft, gradually reduce speed to cross the threshold at **122 knots**.

As you cross the threshold, select speedbrake **OUT**.

A small flare should see the aircraft touch down smoothly.

Upon touchdown the lift dumpers will extend automatically.

Apply gentle braking and, once the aircraft has slowed, take the first available exit to the right.

We can now carry out the after landing checks:

Switch **OFF** and **RETRACT** the landing lights and strobe lights and switch **ON** and **EXTEND** the taxi light.

On the APU panel, set the MAIN switch to **ON**. Wait 10 seconds for the APU inlet door to open and then press the **START** button.

Select speedbrake and lift dumpers **IN** by disarming them and flaps **UP**.

Turn **OFF** the AIRFOIL ANTI-ICING and ENGINE ANTI-ICING switches.

Turn **OFF** the PITOT and VANE HEATING switches and confirm all four amber caution lights are illuminated.

Set the GEN 3 switch to **ON** and confirm the GEN 3 INOPERATIVE light is extinguished.

Set the weather radar and transponder to **STBY**.

On the autopilot controller, set the yaw DAMPING switch to **OFF**.

Set the gust lock to **ON**.

TEST the engine fire warning system in preparation for shutting down the engines.

Shutdown

Begin taxiing to the nearest available stand.

Switch **OFF** and **RETRACT** the taxi light as we turn onto the stand.

Once we have come to a stop on the stand, set the parking brake **ON**.

Set the HP FUEL VALVE levers to **SHUT** to shut down the engines.

Set the Fasten Seatbelts switch to **OFF**.

On the AIR CONDITIONING panel, set one MAIN switch to **OFF**.

Set the APU AIR switch to **ON**.

Turn **OFF** all FUEL BOOSTER PUMP switches.

Switch **OFF** the NAV and ANTI COLL lights.

On the EFB we can now insert the chocks, open the main passenger door and cargo doors and allow passengers to deboard the aircraft.

Leaving the aircraft

Once all passengers have deboarded, set the APU AIR switch to **OFF**.

Set both WINDSHIELD HEATING switches to **OFF**.

Turn **OFF** both MASTER RADIO switches.

Ensure all cockpit and external lights are **OFF**.

Set the EMERG LIGHT switch to **OFF**.

Set the GEN 3 switch to **OFF**.

Shut down the APU by pressing the **STOP/O.S TEST** button, before also moving the APU MAIN switch to **OFF**.

Finally, allow 10 seconds for the APU doors to close before setting the battery switch to **OFF**.

Congratulations – you have completed the F28 Professional tutorial flight!

LIMITATIONS

Operational limitations

Runway slope	+2% up to -2%
Limiting tailwind component	10 knots
Maximum operating altitude	35,000 ft
Maximum take-off and landing altitude	8,000 ft
Minimum take-off and landing altitude	-1,000 ft
Maximum take-off, landing and en route temperature	ISA +35°C
Minimum take-off and landing temperature	-54°C
Minimum en route temperature	-70°C
Maximum crosswind	30 knots

Centre of gravity

The centre of gravity limits of the F28 are listed in the tables below and must be strictly adhered to:

Landing Gear Extended							
Gross Weight		Forward			Aft		
kgf	lbf	Aft of Datum		% MAC	Aft of datum		% MAC
		mm	inches		mm	inches	
29,480	65,000	11466	451.43	19.07	12025	473.41	35.00
27,800	60,800	11429	449.95	18.00	12025	473.41	35.00
…and lower	…and lower	11420	440.05	10.00	12025	473.41	35.00

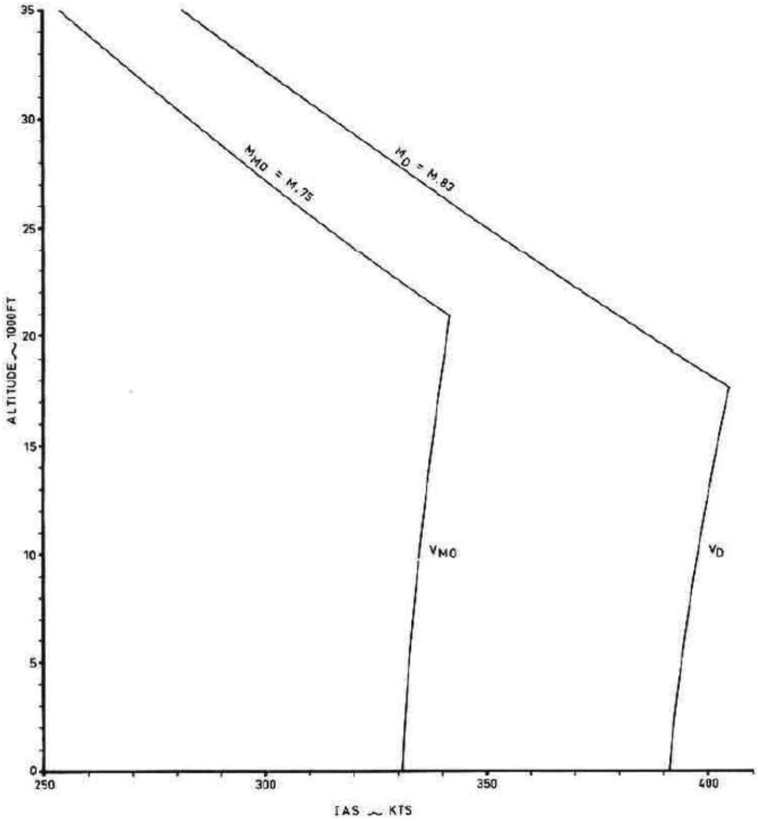
Landing Gear Retracted							
Gross Weight		Forward			Aft		
kgf	lbf	Aft of Datum		% MAC	Aft of datum		% MAC
		mm	inches		mm	inches	
29,480	65,000	11437	450.27	18.24	12095	476.17	37.00
27,800	60,800	11393	448.56	17.00	12095	476.17	37.00
…and lower	…and lower	11393	448.56	17.00	12095	476.17	37.00

Speed limitations

V_{MO} / M_{MO} – maximum operating speed

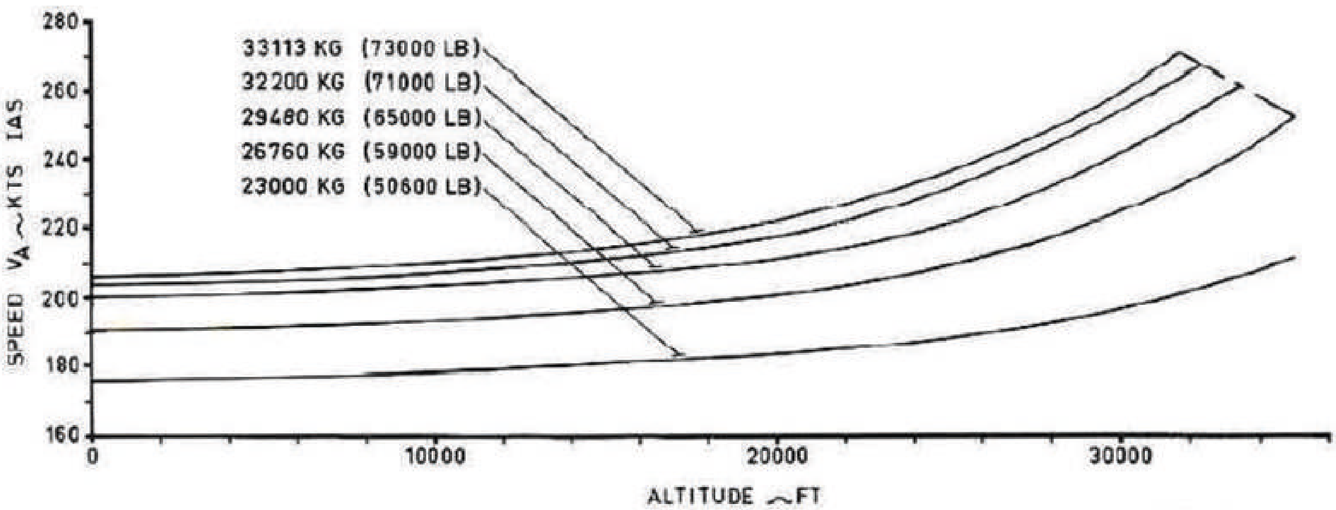
The maximum operating speed must be strictly adhered to and never exceeded in any phase of flight.

V_D / M_D – maximum design diving speed



V_A – manoeuvring speed

The aircraft's manoeuvring speeds are limited by those manoeuvres involving either angles of attack near the stall or by loads due to full application of rudder and aileron controls.



V_{FE} – maximum flap extended speed and altitude

Flap setting:	25° through 6°	200 knots IAS up to 15,000 ft
		180 knots IAS up to 20,000 ft
	42°	165 knots IAS up to 20,000 ft

V_{LE} – maximum landing gear extended speed and altitude

The maximum speed at which the landing gear may be extended or retracted is:

- 200 knots IAS up to 15,000 ft
- 180 knots IAS up to 20,000 ft

The maximum speed with landing gear extended and locked is:

- 200 knots IAS up to 15,000 ft
- 180 knots IAS up to 20,000 ft

The maximum landing, taxi and flare-out lights extended speed:

V_{MO} / M_{MO} is the maximum speed with the landing lights, taxi lights and flare-out light extended.

Main landing gear door, maximum alternate retraction speed:

The maximum speed during retraction of the landing gear doors by means of the winch is:

Flap setting:	25°	155 knots IAS
	42°	140 knots IAS

The maximum speed after retraction of the landing gear doors to the intermediate position (not fully retracted) by means of the winch is:

Flap setting:	25°	180 knots IAS
	42°	155 knots IAS

Flight load acceleration limits

The restrictions below are in place to restrict the permissible severity of pull-up manoeuvres and restrict the permissible angle of bank in coordinated steady level turns for flaps UP to 66° and for flaps DOWN to 60°:

Flaps up +2.5G and -1.0G

Flaps down +2.0G and 0.0G

Air conditioning, bleed air and pressurisation

The maximum cabin pressure differential (relief valve setting) is 7.75 PSI.

The cabin must be depressurised prior to landing.

Auto-flight

With the autopilot engaged, the following limits apply:

Manual pitch demand	0-2° / second
Manual roll demand	30° bank, cut out 45°
Bank angle after glide path capture	10° bank, cut out 20°
VOR or heading error	30° bank
Speed	Aircraft speed limitations

The aircraft is certified for CAT 2 operations and therefore may be used during coupled ILS approaches down to 50 ft.

Wind velocity limits for CAT 2 operations are:

Max. wind velocity	20 knots
Max. crosswind velocity	15 knots
Max. tailwind velocity	10 knots

Auxiliary power unit

Condition	Max. RPM (%)	Max. TGT (degrees C)
Start	–	705
Transient 10 seconds	110	705
Unrestricted	105	650

Electrical power

Generators (including APU generator)

Continuous rating of each generator	20 KVA (1.0 AC load meter)
Overload rating of each generator	25 KVA for 3 hours (1.25 AC load meter)

Transformer-rectifier units

Continuous rating of each TRU	100 A (28V DC)

CSD limitations

Only approved oils are to be used.

CSD oil temperature limits

Max. oil inlet temperature (unrestricted)	120°C
Max. oil inlet temperature (15 minutes)	140°C (maximum during transient overshoot on reducing RPM)
Max. oil temperature rise (normal operation)	10°C (T_{outlet} - T_{inlet})
Max. oil temperature rise (full generator load and/or single generator operation)	15°C (T_{outlet} - T_{inlet})

Fuel system

Maximum useable fuel

Main tanks (total)

Pressure fuelling	9,640 litres / 2,551 US Gal / 2,121 Imp. Gal
Over-wing fuelling	9,740 litres / 2,573 US Gal / 2,143 Imp. Gal
Centre wing tank	3,300 litres / 882 US Gal / 726 Imp. Gal

Asymmetric fuel load

The maximum permissible asymmetric fuel load between the wing tanks during flight is 1,500 lb.

Fuel temperature

Max. inlet temperature for continuous operation	90°C
Max. inlet temperature limited for 15 min. duration	110°C

Fuel pressure

Low fuel pressure caution light setting 15 PSI (+/- 0.5)

Hydraulic power systems

During normal operating conditions, hydraulic pressure must be 3,000 PSI (+200 PSI, -100 PSI).

Landing gear

Maximum landing gear operating speed and altitude

The maximum speed at which the landing gear may be extended or retracted is:

- 200 knots IAS up to 15,000 ft
- 180 knots IAS up to 20,000 ft

The maximum speed with landing gear extended and locked is:

- 200 knots IAS up to 15,000 ft
- 180 knots IAS up to 20,000 ft

Power plant

Engine limitations

CONDITION	RPM %		TGT °C	TIME LIMIT
	HP	LP		
Starting and relight	–	–	570	2 seconds
Max. take-off	102.5	109.5	565	10 minutes (see Note 1)
Max. continuous	98.5	108.5	520	Unrestricted
Ground idle	51.0-52.0	–	520	Unrestricted
Max. overspeed	105.5	115.5	–	20 seconds (see Note 2)
Max. over-temperature	–	–	585	20 seconds

Note 1: *Use of maximum take-off power under normal operating conditions is limited to a maximum time of five minutes. In the event of an engine failure, take-off power may be maintained in the remaining engine for a maximum of 10 minutes.*

Note 2: *If the overspeed limits are exceeded, the engine should be shut down.*

Lubrication system

Oil pressure

Minimum acceptance at max. take-off RPM	34 PSI
Minimum to complete flight at max. continuous RPM	25 PSI
Normal at max. continuous RPM	30-55 PSI
Minimum at ground idling	16 PSI

Oil temperature

Conditions	Temperature	Time	Remarks
Maximum	+120°C	15 minutes	Maximum during transient overshoots on reducing RPM at top of climb.
Maximum	+100°C	Unrestricted	
Minimum	-40°C	For starting	
Minimum	-30°C	For opening up	

Fuel system

Maximum temperature at HP fuel pump inlet: 90°C

Note: *During flight, 110°C is permitted for a maximum of 15 minutes.*

Amplifier datum settings

Top Temperature Control (TTC)	Take-off: 520°C
	Climb: 470°C

Vibration indication

Maximum permissible deflection	3
Maximum level change	1

NORMAL PROCEDURES

Auto-flight

Engagement of autopilot

Master radio switches 1 and 2	ON. Allow 1 to 2 minutes for gyro spin up. Gyro flag on First Officer's ADI out of view.
Gust lock	Unlocked, control surfaces free to move.
Hydraulic system	Pressurised or unpressurised.
Instrument and glareshield lighting	Fully on
Compasses	Synchronised
Remote datum selector	NAV 1
Engage/trim indicator	Zero trim indication on all three channels. Do not engage channel which show an 'out-of-trim' indication.

On A/P controller:

Pitch/Roll channel selector switch	IN
A/P engage switch	IN. Switch stays engaged. Pitch and Roll channels on engine/trim indicator show IN. Pitch and Roll buttons in mode selector illuminated.
Damping switch	IN. Yaw channel on engine/trim indicator shows IN.

The PITCH, ROLL and YAW channels are now engaged and the AP is now in the basic PITCH and ROLL mode.

Pitch attitude and heading are maintained at the time of engagement, unless bank angle is greater than 3 degrees, in which case the aircraft will roll to wings level first, then maintain the heading once the aircraft has reached the 3-degree angle of bank.

Attitude change in pitch and roll via manual controls

To change heading or bank angle:

Manual roll control	Left or right and return to mid-position. Bank angle is limited to 30 degrees.

To change pitch attitude:

Manual pitch control	Up or down and return to mid-position.

Note: *The manual Pitch and Roll control knobs are only operative when the appropriate channels are IN. The manual Roll control knob also overrides all other Roll modes and brings the autopilot back in the basic modes. The manual Pitch control knob also overrides all other pitch modes except Glidepath Capture and brings the autopilot back in the basic modes.*

Preselected heading

Heading knob on remote datum selector	Select new heading as indicated by heading bug on the HSI.
HDG button on mode selector	Press. Button will stay depressed and illuminate.

Note: *The HDG button will stay depressed during new heading selections on the remote datum selector.*

Altitude hold

HT button on mode selector	Press. The button will illuminate and all other buttons except GLIDE will extinguish.

Constant IAS

IAS button on mode selector	Press. The button will stay depressed and illuminate. All other buttons except GLIDE will come out and extinguish.

Note: *Maintaining IAS is at the cost of altitude.*

VOR coupling

There are two ways of intercepting the selected radial:

1. From HDG to BEAM (preselected heading)
2. From ROLL to BEAM (manual roll control)

On NAV 1 frequency controller	Select desired VOR frequency.
Course 1 on remote datum selector	Select desired VOR radial.
HDG button on mode selector	Press. The button stays depressed and illuminates.
Heading knob on remote datum selector	Select a heading to intercept the radial.
BEAM button on mode selector	Press. The button will stay depressed and illuminates. When the course indicator on the HSI indicates 1 dot, wind drift correction is automatically provided. Radial capture is indicated by the HDG button popping out and light extinguishing.

ILS approach

NAV 1 frequency controller	Select desired ILS frequency.
Course 1 on remote datum selector	Select QDM of the runway.
Heading button on mode selector	Select a heading to intercept the beam.
HDG button on mode selector	Press. The button will stay depressed and illuminates.
BEAM button on mode selector	Press. The button will stay depressed and illuminates.
HT button on the mode selector	Press. The button will stay depressed and illuminates. The aircraft's current altitude will be maintained until beam interception. Beam capture is indicated by the HDG button popping out and the light extinguishing.

Disengaging and safety features

Before disengaging, check the position on the trim indicator.

Disengaging the autopilot can be divided into two categories:

Manual disengagement

1. Disengage buttons on the control columns.
2. Palm switches on the throttles.
3. Operating the AP engage switch to OFF.
4. Operating the Pitch and Roll channel selector switches to OFF.

The Yaw channel is disengaged by moving the DAMPING switch to OFF. Any of the channels will disengage automatically via the fail-soft principle by one of the following faults:

Automatic disengagement

1. Disengage and cut out circuits, power, interlocks.
2. Roll attitude cut out.
3. Pitch trim failure.
4. Vertical gyro unit failure.
5. Stall warning system.

When the autopilot is automatically disengaged a warning tone will be heard via the cockpit speakers.

Silencing the tone can be done by pressing either AP cut-out button.

Auxiliary power unit (APU)

APU starting on the ground

Battery voltage	Check
Battery switch	ON
Fire warning	Test
Main switch	ON (check gen. inop. light on)
Generator 3	OFF
AIR switch	OFF

After 10 seconds from operating MAIN switch:

Starter button	Press momentarily
RPM indicator	Check
TGT indicator	Check
Starter button light	Check out (above 45% RPM)

When APU RPM is above 95%:

Generator 3 switch	ON (light out)
Voltage	Check
All buses	Check energised
Air switch	As desired

APU starting in the air

The in-flight starting procedure is similar to ground starting, except that normally booster pump fuel pressure is available before pushing the starter button.

If starting at high altitude is unsuccessful, a further attempt to start may be made at or below 20,000 ft.

Note 1: *Stop the APU by moving the MAIN switch to OFF if:*

- *Starting time exceeds 30 seconds under normal ambient conditions or 60 seconds under low ambient conditions (below -10°C).*
- *Starting button light (if installed) remains ON above 50% RPM or if no sudden battery load decrease at approximately 50% RPM indicates proper starter disengagement.*
- *TGT or RPM limitations are exceeded.*

Note 2: *Allow a two-minute drain period between consecutive start attempts. Do not attempt more than three successive starts.*

Note 3: *The APU cannot be started if the Generator 3 switch is in the ON position.*

Note 4: *If an attempt to start the APU is unsuccessful, check the position of switches and reset the APU main switch to OFF and again to ON before attempting another start.*

Note 5: *Booster pump operation is recommended but not strictly necessary on the ground.*

Note 6: *APU life will be prolonged by allowing a one- or two-minute warm-up period between starting and bleed air loading.*

Note 7: *If necessary, the APU can be started from an external DC power unit. When the DC connector is plugged in, the battery is disconnected from the APU and the APU can be started from the power unit only.*

APU pre-take-off

AIR switch	OFF
APU	As desired

Shutdown

AIR switch	OFF
Generator 3 switch	OFF
STOP/OVERSPEED test button	Press and hold until the overspeed protection circuit (light on the RPM 110%) shuts down the APU automatically.
MAIN switch	OFF

Automatic shutdown

Monitoring systems will shut down the APU automatically when any of the following faults occur:

While airborne:	**While on the ground:**
Overspeed	Generator 3 system fault
Low oil pressure	Overspeed
FIRE	Low oil pressure
	FIRE

After an APU shutdown in case of FIRE, the fire extinguisher will discharge automatically.

Fire warning and extinguishing test

If the extinguishing test light is ON, the APU should not be started but the extinguisher bottle should be checked for discharge.

If the light is OUT, proceed with the fire warning test as follows:

Fire warning test switch	Hold to TEST position
Fire warning light	ON (immediately)
Extinguisher test light	ON (after approximately 5 seconds)
Fire warning test switch	Release
Fire warning light	Out
Extinguisher test light	Remains on
Fire warning test switch	RESET
Extinguisher test light	Out

Bleed air, air conditioning and pressurisation

Bleed air – normal operation

Under all normal operating conditions:

Main bleed air switches	ON
HP bleed air switches	AUTO

Bleed air – minimum engine RPM proper operation

For proper cabin cooling below 15,000 ft at high ambient temperatures, bleed air pressure should not fall below 30 PSI for extended periods. Pressure can be maintained by increasing the minimum engine RPM of one engine to 80%.

Full cabin pressurisation requires a bleed air pressure of 15 PSI. To achieve this, the minimum engine RPM for at least one engine may have to be restricted to slightly above idling.

Bleed air – automatic shut-off system

An automatic shut-off system is provided to reduce thrust losses during take-off and single-engine flight at high RPM:

Engine Condition	Engine Start	2x < 97% RPM	2x > 97% RPM	1x < 95% RPM 1x OFF	1x > 95% RPM 1x OFF
Cabin Air Condition	OFF	ON	ON	ON	OFF <10,000ft ON >10,000ft
Cockpit Air Condition	OFF	ON	OFF	ON	OFF

Bleed air – excessive pressure

If the bleed air supply pressure exceeds 62 PSI, the back-up valve indicators shall be checked. If one or both back-up regulators show SHUT and one main valve is closed with the MAIN switch ON, this indicates a failure of the opposite main valve.

Main bleed air switch (opposite to closed MAIN valve)	OFF
Bleed air pressure	Check to fall below 62 PSI

Bleed air – duct overheat light (amber)

If a duct overheat light illuminates, this causes the relevant system to shut down automatically and no immediate action is required.

To extinguish the light, the system can be switched off as follows:

HP bleed air switch	OFF/RESET
Main bleed air switch	OFF/RESET
Overheat light	Check extinguished (within a few minutes)

If re-activation of the faulty system is required, reset the MAIN bleed air switch but leave the HP valve in the OFF/RESET position.

Bleed air – bay overheat light (amber)

If a bay overheat light illuminates, this causes the relevant system to shut down automatically and no immediate action is required.

To extinguish the light:

HP bleed air switch	OFF/RESET
Main bleed air switch	OFF/RESET
Overheat light	Check extinguished (within a few minutes)

Bleed air – duct leak light (amber)

Illumination of the duct leak light indicates a leak in the inner duct wall, in which case the outer duct will take over.

Avoid rapid throttle movements.

Bleed air – valve failed in closed position

HP bleed air valve does not open:

- No influence at climb and cruise engine speeds
- Marked influence on anti-icing capacity below 80% RPM
- Speed of other engine should be kept up

MAIN bleed air valve or back-up valve does not open:

- Speed of other engine should be kept up in icing conditions, as the system capacity is halved.

Air conditioning – normal operation

Under normal operating conditions, the automatic system should be operated as follows:

Temperature control switches	AUTO
Temperature selector	SET

The temperature selection ranges are approximately:

Temperature selector position	**Cold**	**Hot**
Cockpit inlet (duct) temperature	2°C 35°F	60°C 140°F
Cabin air temperature	15°C 60°F	27°C 80°F

Manual temperature control can be achieved by holding the switch in the COLD or HOT position, then releasing it to OFF.

Air conditioning – activation and shutdown

Under normal operating conditions:

Air conditioning MAIN switches	ON
Auto shut-off switch	AUTO SHUT-OFF (guard closed)

An automatic shut-off system is installed and is indicated in the table on the previous page.

The automatic shut-off system can be manually deactivated by means of a guarded switch in the centre of the air conditioning panel.

Air conditioning – during taxiing and waiting

The APU may be started immediately after landing to improve air conditioning during ground operations.

Take caution in tailwind conditions, as exhaust gases may be ingested into the APU and engines.

Air conditioning – overheat light (amber)

If an overheat light illuminates, this causes the relevant system to shut down automatically and no immediate action is required.

To extinguish the light:

Air conditioning MAIN switches	OFF/RESET
Valve indicator	Check shut
Overheat light	Check extinguished (within a few minutes)

If re-activation of the faulty system is required, the system can be reset as follows:

Temperature control switch	Hold to COLD until control valve indicator displays less than 25%
Air conditioning MAIN switch	ON
Temperature control switch	AUTO or control manually when required

Air conditioning – malfunction of auto temperature control

If a control malfunction is suspected:

Temperature control valve indicator	Hold to COLD until control valve indicator displays less than 25%
Temperature indicators	Check

If a control malfunction is confirmed, manual control can be achieved as follows:

Temperature control switch	Hold to COLD or HOT temporarily
Temperature control valve indicators	Observe
Duct temperature	Observe

The correction will be displayed almost immediately on the duct temperature indicator.

Air conditioning – main valve closed

If a main valve failure is suspected, descend to 25,000 ft at pilot's discretion.

Air conditioning – total failure of air conditioning system

In the event of a total failure of the air conditioning system, ram air ventilation may be used when cabin differential pressure is zero:

Ram air switch	Modulate

Note: *Ram air flow may cause extremely low cabin temperatures, therefore it is recommended to modulate the flow by selecting the ram air switch temporarily to ON or OFF and then to STOP.*

Air conditioning – smoke or fumes introduced through ventilation air inlets

If smoke or fumes are detected during ground operations with air conditioning fed from the APU, check air conditioning units individually. If smoke or fumes persist, shut down the APU.

Pressurisation – normal operation

At the full normal cabin pressure differential, the following relationship exists between the aircraft and the cabin altitude:

Cabin pressure differential 6.6 PSI		Cabin pressure differential 7.5 PSI	
Aircraft Altitude	Aircraft Altitude	Aircraft Altitude	Aircraft Altitude
15,000 ft	Sea level	20,000 ft	1,000 ft
20,000 ft	2,700 ft	25,000 ft	3,600 ft
25,000 ft	5,400 ft	30,000 ft	5,900 ft
30,000 ft	8,000 ft	35,000 ft	8,000 ft

Under normal operating conditions, the system operates in automatic mode by means of a pressure controller:

Rate of change knob — Desired rate of change (mark at 400 ft/min)

Cabin altitude pointer — Desired cabin altitude

Barometric correction — Barometric pressure for take-off and landing

Window — Indicates max. flight altitude at which selected cabin altitude can be maintained.

Setting for take-off

For the smoothest transition to pressure control after take-off, use either of the following settings:

Control regime	Barometric scale	Cabin alt. pointer	Aircraft altitude reading
Less than max. pressure differential	QNH	1,000 ft above field elevation	Not below cruise altitude
	1,013 mb	2,000 ft above field elevation	Cruise flight level
At max. pressure differential	1,013 mb	More than 3,000 ft above field elevation	Cruise flight level to 1,000 ft above cruise flight level

Setting for landing

Cabin altitude — Field elevation

Barometric correction — Barometric subscale QNH

Pressurisation – unpressurised flight

If altitude below 10,000 ft:

Cabin altitude selector — Above flight altitude

If necessary:

Manual control — Turn to DEPRESS carefully and slowly

Cabin rate of climb indicator — Monitor

Pressurisation – control failure

If a system failure results in a maximum differential pressure, reduce pressure manually as follows:

Manual control	Turn towards DEPRESS slowly until cabin rate of climb indicator shows an increase of altitude.

If operation of manual control is not effective:

Air conditioning main switches	OFF (both)

When differential pressure has decreased to less than 0.5 PSI:

Dump switch	ON

If a system failure results in a cabin altitude above 10,000 ft (amber light):

Descend and use oxygen.

Electrical power

Pre-flight check

Battery switch	ON
Essential DC bus	Check energised
Battery voltage	Check
Emergency light switch	ARM
Emergency light switch	OFF
Emergency light switch	ARM
TRU 1 and 2 switches	ON
Generator 1 and 2 switches	ON
Generator 3 switch	OFF/RESET
All guards	Closed
Start APU	

After APU starting

Generator 3 switch	ON
AC and DC buses	Check energised
TRU 1 and 2	Check indicators in line
TRU overheat lights	OUT (press to test)

After engine starting

Generator 1 and 2 INOP lights	OUT
Generator 3 switch	OFF
AC and DC	Check

Cruise

CSD oil temperature Check

After parking

Emergency light switch OFF

Battery switch OFF

Note: *Allow 30 seconds for APU air inlet to close before battery OFF selection.*

External power

External power can be obtained by an AC power source.

AC power is supplied directly to the AC buses, whilst DC power is supplied via the TRUs.

When connected to external power, the indicator on the overhead panel will display RDY, indicating that the external power switch can then be turned ON (the indicator will then display ON).

Malfunction of automatic transfer system

In normal operating conditions, AC bus 1 is fed by generator 1, AC bus 2 is fed by generator 2 and an automatic transfer will take place if one generator becomes inoperative.

If a bus fault occurs, the transfer system will become inoperative automatically and the buses will be separated. Bus separation can also be accomplished manually.

To isolate bus 1 from generator 2 or 3:

Bus 1 transfer isolate switch ISOLATE

To isolate bus 2 from generator 1 or 3:

Bus 2 transfer isolate switch ISOLATE

If both isolate switches are in the ISOLATE position, generator 3 is isolated from the buses.

GENERATOR INOPERATIVE light (amber)

Generator switch OFF/RESET

Generator operation (light, voltage and frequency) can be checked by holding the generator switch in the TEST position for at least five seconds. If indication is normal, the switch can be moved to the ON position.

If CSD oil temperature is excessive and/or a mechanical failure is suspected:

CSD DISCONNECT

Note: *The CSD cannot be reset in flight, and no attempt to disconnect the CSD should be attempted below idle RPM.*

Fire protection

Normal operations

Engine fire warning test

Electrical supply	ON
Engine fire warning test button	Press
Engine fire warning lights	Check ON

APU fire warning test

Electrical supply	ON
Fire warning test switch	Hold to TEST position
Fire warning light	On (immediately)
Extinguisher test light	On (after approx. 5 seconds)
Fire warning test switch	Release
Fire warning light	Out
Extinguisher test light	Remains on
Fire warning test switch	RESET
Extinguisher test light	Out

Flight controls

Normal operations

During normal operation, all switches on the flight control panel should be in the ON position.

Before starting engines

Flight control switches	ON

After starting engines

Pumps	Check pressurised (lights out)
Flight control master caution light	Out

If light on:

Flight control panel	Check lights and push RESET button if necessary

When all lights are out:

Gust lock	Select OFF
Controls	Check full and free movement (lights remain OUT)
Stabilizer	Set as required
Aileron trim	Neutral
Rudder trim	Neutral

Flight controls malfunction (master caution light flight controls on)

Flight control panel	Check lights

If one light is on in a system:

Associated flight control switch	OFF (flight control master caution light out)

Back-up systems will ensure unaffected operation.

If two lights are on in one system:

Associated flight control switches	OFF (flight control master caution light out)

Complete check of the flight controls

If a comprehensive check is required on the flight controls, face the aircraft into the wind and proceed as follows:

After starting engines:

All flight control switches	Check ON
Flight control switches Flight control system (4)	OFF (4 lights on)
Flight control switches Utility system (4)	OFF (4 lights on)
Flight control switches Utility system (4)	ON (4 lights out)
Reset button	Press (if necessary)
Flight control switches Flight control system (4)	ON (3 lights out, rudder light on)
Reset button	Press (4 lights out)
Master caution lights Flight controls	Check OUT
Gust lock	Select OFF
Controls	Check free movement (caution lights out)
Trim controls	Check free movement and proper functioning
Pump switches (4)	OFF LOAD

(8 flight control caution lights and the master caution light on)

Controls	Check free movement in manual mode
Aileron trim controls	Check free movement in manual mode
Stabilizer alternate switch	Trim both ways and check movement of stabilizer via the electrical position indicator
Pump switches Utility system (2)	NORMAL (all utility system lights out, flight control master caution light on, push reset button if necessary)
Controls	Check for full and free movement
Pump switches Utility system (2)	OFF

Pump switches Flight control system (2)	NORMAL (all flight control system lights out, flight control master caution light on, push reset button if necessary)
Controls	Check for full and free movement
Pump switches Utility system (2)	NORMAL (all lights out, if flight control master caution light on, push reset button)
Stabilizer	Set
Aileron trim	Neutral
Rudder trim	Neutral

Flaps

During normal operating conditions the flaps can be operated by means of a flap control lever on the pedestal. The position of the flaps is indicated on an indicator on the main instrument panel.

Alternate flap operation

A low-speed electrical mode is used to extend the flaps in an event of a hydraulic failure.

A switch is located on the pedestal labelled UP or DOWN. Flaps can be extended or retracted by holding the switch in the respective position.

Maximum flap extension speed and altitude

Flap setting:	25° through 6°	200 knots IAS up to 15,000 ft
		180 knots IAS up to 20,000 ft
	42°	165 knots IAS up to 20,000 ft

Speedbrake

The speedbrake can be operated by means of a speedbrake control lever on the pedestal.

A blowback feature is incorporated in the system to achieve constant aircraft deceleration over the speed range from 191 knots.

The speedbrake will be automatically retracted if either throttle lever is moved beyond the maximum continuous power position.

Speedbrakes – complete system check

With electrical and hydraulic power available, the speedbrake system can be checked as follows:

Speedbrake lever	IN	Blue light out, indicator displays IN
Speedbrake lever	Select OUT	Blue light out, indicator displays IN
Throttle	Open to max.	Speedbrake lever returns to IN, blue light out, indicator displays IN

Lift dumpers

Two manual extension systems are provided:

1. A lift dumper handle on the Captain's right-hand throttle.
2. An override switch on the left-hand forward side of the pedestal.

Lift dumpers – arming before take-off and landing

In order for lift dumpers to deploy automatically on touchdown or during an aborted take-off, they must be armed as follows:

Arming switch	Push (light on, switch holding)

The mechanical indicator will display RDY.

The system will disarm automatically if either throttle is advanced to full power, and the mechanical indicator will display IN.

Lift dumpers – after landing

After landing, the lift dumpers will extend automatically if the following conditions are met:

- The system has been armed.
- Both throttles are closed.
- The spin-up signal from either both left-hand main wheels or both right-hand main wheels is received.

Automatic activation should always be backed up by a manual selection of the throttle-mounted lift dumper handle.

The magnetic indicator will display OUT.

Lift dumpers – accelerate-stop

During an accelerate-stop manoeuvre (also known as a rejected take-off), the lift dumpers will extend automatically if the following conditions are met:

- The system has been armed.
- Wheel rotation is above the equivalent of 50 knots aircraft speed.
- Both throttles are closed.

Lift dumpers – magnetic indicator (barber pole)

Any prolonged display of a barber pole indicates improper functioning of the automatic system:

Before take-off	Abort flight, refer to allowable deficiency list
Before landing	Do not arm
After landing	Select lift dumpers manually (override switch or lift dumper handle)

Note: *A barber pole indication during take-off does not require action.*

Lift dumpers – failure of the arming circuit

If the arming circuit fails to hold:

Before take-off	Abort flight, refer to allowable deficiency list.
Before landing	Proceed and select lift dumpers manually after touchdown (override switch or lift dumper handle)

Lift dumpers – complete system check

With electrical and hydraulic power available, the system can be checked as follows:

Lift dumper warning light	OUT
Magnetic indicator	IN
Arming switch	Push (light on, switch holding)
Throttles	IDLE
Lift dumper handle or override switch	Select out
Magnetic Indicator	OUT
Lift dumper handle or override switch	Back to normal (lift dumpers remain out)
Throttles	Open

The lift dumpers will retract and the magnetic indicator will display RDY. The lift dumper warning light will not come on but the arming switch light remains illuminated.

Throttles	CLOSED
Arming switch	Pull (to disarm)

Lift dumpers – manual or override system check

With electrical and hydraulic power available, and the system not armed:

Lift dumper handle of override switch	Select out
Magnetic indicator	OUT
Lift dumper handle or override switch	Back to normal
Magnetic indicator	IN

Fuel system

Pre-flight (with AC supply available)

Fuel quantity gauge selector	1. TEST (gauge will revert to zero)
	2. COLLECTOR TANK (reading should be above 1,300 lb if collector tank indicator displays black, and below 1,200 lb if collector tank indicator displays barber pole)
	3. TOTAL (check quantity)
Fuel shut-off indicators (2)	OPEN
Booster pumps (4)	Check operation (if one pump is running, both lights of a pair of pumps will be out)

Before engine starting

Booster pumps	At least one per engine ON (lights out)

After engine starting

Fuel pressure caution light	Out

Take-off

Booster pumps	All ON (lights out)
Collector tank magnetic indicator	Displays black

Cruise

Booster pumps	At least one per engine ON (lights out)

Cross-feed operation

Cross-feed	ON
Booster pumps of tank in use	Both ON (lights out)
Booster pumps of tank not in use	Both OFF (lights on)

***Note:** A single pump is capable of supplying one engine with maximum flow or both engines with climb and cruise flow at nominal pressure.*

Booster pump failure (amber light on)

Serviceable booster pump	ON (lights out)
Failed booster pump	OFF

***Note:** Adequate cross-feed pressure is available with one booster pump operative at normal climb or cruise flow. Unusable fuel supply increases per tank by 45 lb (forward pump failed) or 215 lb (aft pump failed..*

Two booster pumps failed on one side (amber lights on)

Fuel pressure caution light	OUT

Altitude can be maintained.

Fuel pressure caution light	ON

Descend to altitude where light remains out.

With inoperative booster pumps, normal engine operation can be expected up to an altitude of 30,000 ft for kerosene and 15,000 ft for wide-cut gasoline.

FUEL PRESSURE caution (amber)

If the FUEL PRESSURE caution light illuminates:

Second booster pump	ON

If light does not extinguish:

Engine instruments	Monitor

Avoid rapid throttle movement and rapid changes of aircraft attitude.

Collector tank low level caution (magnetic indicator displays barber pole)

A barber pole on the collector tank magnetic indicator indicates that a less-than-normal quantity of fuel is present in the collector tank. This can be due to malfunctioning of the jet fuel pumps or an empty wing tank.

Both booster pump switches	ON (on affected side)
Collector tank quantity	Monitor

Extreme pitch and roll should be avoided when fuel level in the collector tank falls below 500 lb.

High fuel temperature

If fuel temperature exceeds 90°C	Check CSD oil inlet temperature.
If oil inlet temperature is between 120°C and 140°C	Reduce electrical load and increase fuel flow if practicable.
If oil inlet temperature exceeds 140°C	Switch off associated generator and increase fuel flow until temperature has dropped.
If oil inlet temperature does not drop	Disconnect CSD.

FILTER ICED caution (amber)

If the FILTER ICED caution light illuminates, retard one throttle back to 75% HP RPM and check for an increase in fuel temperature. Hold this condition for 10 seconds before restoring power. Repeat the process with second engine if required.

Fuel transfer centre wing tanks

Fuel transfer should be initiated once the main tanks each contain less than 6,500 lb:

Transfer pumps (2)	ON (caution lights out)

To stop transfer:

Transfer pumps (2)	OFF

Centre wing tank transfer pump failure (caution light ON)

Transfer to both main tanks will be maintained.

Inoperative transfer pump	OFF
Quantity indicators	Monitor asymmetry

If both transfer pumps fail, any remaining fuel in the centre tank should be considered unusable.

Hydraulic power systems

Normal operation

During all phases of flight, the four off-loader switches should be in the NORMAL position.

During engine starting, the UTILITY system hydraulic pumps are off-loaded automatically.

Overheat light ON (amber)

If the overheat light is illuminated, you must switch the pumps of the system concerned to OFF-LOAD one after the other; in order to check which pump is causing the overheat condition. Once the faulty pump is identified, leave the faulty pump in the OFF-LOAD position and return all other pump switches to the NORMAL position.

Low tank pressure light ON (amber)

No action required. Flight can be completed according to plan.

Fluctuating pressure

If hydraulic pressure fluctuates, you must switch the pumps of the system concerned to OFF-LOAD one after the other; in order to check which pump is causing the fluctuating pressure. Once the faulty pump is identified, leave the faulty pump in the OFF-LOAD position and return all other pump switches to the NORMAL position.

Pump pressure light ON

If illuminated, set the affected pump switch to OFF-LOAD.

Decreasing quantity indication

Flight control system

System pumps	OFF-LOAD

Utility system

System pumps	OFF-LOAD, reset before landing or use alternate system at pilot's discretion

Ice and rain protection

Normal operation

The airfoil anti-icing system is to be used whenever icing conditions are observed or suspected.

The system is designed for continuous operation, but it is good practice to keep the system turned OFF when not in use to assist in load shedding. The system would typically be turned ON in the following conditions:

- When ice accumulation becomes apparent on the windshield wipers, windshield post or wings, and before the ice has built up to a thickness of 0.5 inch on the leading edge of the wing.
- Before approach and landing, when the wings and stabilizer must be cleaned.

Activation In flight

MAIN switches (wing, tail)	ON
Anti-icing (outlet) temp. indicators	Check (Wing: 45°C to 50°C. Tail 55°C to 60°C)

Ice protection capability and engine speed

Protection against 'design maximum continuous' ice conditions is provided down to engine speed. During descent, reduced anti-icing is available to a minimum of 75% HP RPM.

With only one engine operative in icing conditions, up to 80% of the 'design maximum continuous' can be coped with in climb and level flight.

System testing

APU or main engine running:

Valve test switch	Select modulating valves and shut-off valves alternately
Valve position indicators	Check

Leading edge primary overheat light (amber)

If the light only comes on momentarily, no action is required.

If the light is cycling, the auto protection system is operating. To stop the cycling:

Anti-icing override switch	STOP

Continue to monitor the temperature indicator, ensuring a constant reading in the green band.

Temperature can be manually controlled by selecting the override switch momentarily to either the SHUT or AUTO (guard shut) position.

Leading edge secondary overheat light (amber)

The system will automatically shut down once the overheat light illuminates.

The system can be rested for a period of 30 seconds, if required, to shed accumulated ice.

Bay overheat light (amber)

The system will automatically shut down once the overheat light illuminates.

Anti-icing switch	OFF/RESET

Complete system failure

In the event of a complete failure of the anti-icing system, it is imperative that the aircraft leaves icing conditions as soon as possible.

If ice has already accumulated on the aircraft, it is recommended that you fly at the maximum practicable airspeed and at as low an altitude as possible, before starting the approach. During this procedure, it is recommended that you switch on CONTINUOUS IGNITION.

If a landing must be completed with ice on the leading edges of the stabilizer, do not extend the flaps beyond the 25-degree setting.

If a landing must be completed with ice on the leading edges of the wings, increase the approach speed by approximately 10 knots.

Windshield heating – normal operation

If indicated outside air temperature is +20°C or below, 5 to 10 minutes prior to take-off:

Windshield heating switches LOW

If fogging or icing is apparent:

Windshield heating switches HIGH

It is good practice to set the heating switch to LOW for a few minutes before switching it to HIGH.

If windshield heating is unserviceable and the altitude is below 10,000 ft:

Reduce airspeed to 230 knots IAS.

Cracked windshield

Windshield heating switches OFF

Determine if the crack is in the outer, centre or inner layer of windshield.

If crack is in the outer layer:

Below 10,000 ft Reduce airspeed to 230 knots IAS

If crack is in the inner or centre layer, heating may be switched on when circumstances require it. If heating is not re-established:

Below 10,000 ft Reduce airspeed to 230 knots IAS

Cracked sliding window

If crack is in outer layer:

Windshield heating switch OFF

Pull relevant circuit breakers.

Windshield heating switch HIGH or LOW

Instruments

Pitot-static system – normal position of switches

Static selectors NORMAL (both)

Pitot isolating valve NORMAL

Pitot heating switches ON

All lights will be out when the pitot heating systems are on.

It is good practice to restrict the use of the heaters on the ground, especially at higher ambient temperatures, in order to safeguard against excessive temperatures.

Pitot-static system – discrepancy between readings on Captain's and First Officer's flight instruments

If a discrepancy is noticed, check:

Pitot heater lights	OUT

If heaters are operating, check:

Static selectors	NORMAL

Select alternate sources one at a time and both together. A small discrepancy may exist if one pilot is on NORMAL and the other on ALTERNATE static source, but if both pilots have selected ALTERNATE, their readings should be equal.

If fault is still apparent, check:

Pitot system (First Officer)

Select:

Alternate source	NORMAL
First Officer's pitot isolating valve	ISOLATE

The First Officer's instruments are now isolated from the sub-system and allow for Captain's and First Officer's instruments to be compared.

If a leak in a sub-system connected to the First Officer's pitot-static system is apparent, leave the isolating valves in the ISOLATE position.

In this configuration, the following systems will be inoperative:

- Autopilot airspeed sensor
- Flight data recorder

Landing gear

Ground operation

Landing gear selector	DOWN (3 green lights on, red lights out)

Take-off

Landing gear selector	UP (in transit, green lights out, red lights on when gear doors open. When gear up and doors closed, red lights out)

Landing

Landing gear selector	DOWN (in transit, red lights on when gear doors open. When gear down, locked and doors closed, red lights out, green lights on))

Landing gear fails to extend or wheel door warning unsafe

Alternate landing gear selector	DOWN (In detent)

The door uplocks will unlatch and gravity extension occurs.

After all three gear are down and locked, the main inboard doors must be retracted partially by means of a hand-operated winch. Red lights will remain on.

Do not exceed 140 knots IAS during or after operation of the winch.

The alternate landing gear selector must be left in the down position until after servicing.

Landing gear red light(s) ON (selector UP)

An illuminated red light after landing gear retraction indicates that the wheel doors are not closed and locked. Do not exceed 200 knots IAS.

Navigation

Remote datum selector – heading selector

Use the heading control to select the heading on both the Captain's and First Officer's HSIs, and to control heading inputs to the autopilot and flight director systems.

Remote datum selector – radio switch in NAV 1

The VHF NAV 1 receiver supplies radio navigation input to both autopilot and flight director systems.

Left-hand course control should be used for HSI, autopilot and flight director.

Remote datum selector – radio switch in NAV 2

The VHF NAV 2 receiver and right-hand course control will be operative now.

Remote datum selector – radio switch in approach

The VHF NAV 1 receiver supplies radio navigation input to the autopilot.

The VHF NAV 2 receiver supplies radio navigation input to the flight director and is frequency-controlled by the VHF NAV 1 frequency selector.

Use the left-hand course control for inputs to the autopilot and flight director.

Note: *It is important to always prepare a missed approach procedure prior to approach:*

- Tune VOR station required for the missed approach procedure on VHF NAV 2 control panel.
- Select the required course on the right-hand course control.
- After commencing the missed approach, select NAV 2 position on the radio switch.

Flight director system – pitch

The PITCH COMMAND CONTROL should be used to set the desired pitch angle in all modes except after GLIDE capture or when ALTITUDE HOLD is ON.

Flight director system – mode operation

When the flight director system is in the OFF position:

Flight director computer	Not in use
Command bar	Out of view
Flight director indicator	Altitude reference only

When using the flight director system in HDG mode:

The heading control on the remote datum selector provides the means of selecting the required heading.

Upon selecting HDG mode, the flight directors then provide guidance to achieve and maintain the selected heading and pitch attitude.

If a new heading is required:

Selecting a new heading on the heading control will automatically provide updated guidance from the flight directors.

When using the flight director system in VOR/LOC mode:

Tune the VHF NAV 1 (or VHF NAV 2) receiver to the required VOR frequency.

Select NAV 1 (or NAV 2) on the radio switch on the remote datum selector.

Select the desired VOR radial by means of the left-hand (or right-hand) course control on the remote datum selector.

Upon selecting VOR/LOC mode, the flight director remains in HDG mode (with BEAM armed) and the intercept heading can still be adjusted as desired, unless a fixed intercept (45°) is made.

Upon selecting GS AUTO mode, the flight directors will continue to provide the pitch command as set by the PITCH COMMAND CONTROL, or ALTITUDE HOLD when selected (GS armed).

When the localiser deviation falls within a pre-determined value, the flight director computer automatically switches to VOR/LOC mode and the flight directors provide guidance to capture the localiser beam.

When the glideslope deviation falls to almost zero, the flight director computer automatically switches to GS AUTO mode and the flight directors provide guidance to capture the glideslope.

If selected, ALTITUDE HOLD is automatically switched OFF.

When established on the glideslope, engine power corrections are required to maintain the correct speed.

ILS approach procedures

An example of a typical ILS approach (CAT 1) procedure:

Call “Approach check”.

When entering downwind, reduce speed to 200 knots or below and select flaps 25°. The use of speedbrake is preferable over reducing engine RPM below 80% HP RPM.

Select T/O position of the TTC switches.

When speed is at or below 200 knots, select approximately 85% HP RPM and select flaps 25°. Speed will reduce to approximately 150 knots. Continue to use speedbrake as necessary.

When approaching the glideslope, begin a gradual transition to the final approach configuration:

- At two dots below the glideslope select gear down.
- At interception of the glideslope select flaps 42°.

During interception, set the desired power and stabilise on the glideslope at a speed of V_{THR} + 10 knots (V_{THR} + 25 + 10 for single engine).

Call “Final Check”.

On final approach, continue to maintain a speed of V_{THR} + 10 knots. In gusty conditions, approach speed may be increased by approximately 10 knots.

At 100 ft, reduce power to cross the threshold at V_{THR}, and fully extend the speedbrake.

Retard the throttles and flare to a slightly nose-high attitude.

After the main wheels touch down, the lift dumpers (if armed and the throttles are at idle) will automatically extend and the aircraft will ‘sit down’ on the runway.

During lift dumper extension there is a tendency for the nose of the aircraft to pitch down, which can be easily controlled with back pressure on the control column.

Lower the nose-wheel gently.

Apply wheel braking immediately after the nose-wheel is on the ground and continue to apply wheel braking until the aircraft is at taxi speeds.

When the landing run is complete, call “After landing check”.

An example of a go-around procedure for a two-engine and a single-engine configuration. The procedure is very similar in both configurations:

If the autopilot is engaged, disengage it by pressing the autopilot cut-out button on either control wheel.

Select full power (if extended, the speedbrakes will automatically retract).

Rotate to a climb attitude and maintain a speed of V_{THR} + 10 knots. Do not exceed 15° nose up. Disregard flight director indication if used for the initial approach.

Select flaps 25° and retract the gear.

Monitor heading (especially during a single-engine go-around).

When clear of obstacles:

- Two-engine go-around – accelerate to 0° flap retraction speed and retract the flaps.
- Single-engine go-around – accelerate to 11° flap retraction speed and select flaps 11°. Continue to accelerate to 0° flap retraction speed and retract the flaps.

Select NAV 2 on the remote datum selector.

Switch to VOR/LOC mode on the flight director mode selector. Reset pitch command bar using the pitch command control knob. The flight director will provide guidance to capture the selected VOR radial at a standard intercept angle of 45°.

ADF/VOR approach procedures

Approaching the beacon, reduce speed to 200 knots, using speedbrakes as necessary.

Call “Approach check”.

When speed is at or below 200 knots, set 85% HP RPM (single engine 88%) and select flaps 25°.

Intercept the track to be flown outbound before crossing the beacon.

Leave the beacon outbound at a speed of 150 knots (2.5 NM/min) and start outbound timing (correcting for wind).

Descend to the minimum altitude for the procedure turn at a speed of 150 knots.

At the end of the outbound leg, commence a procedure turn.

Upon completion of the procedure turn, select gear down, reduce speed to approach speed of V_{THR} 42 + 20 knots, and start to descend to the Minimum Decent Altitude (MDA).

Call “Final check”.

Level off at the MDA, maintaining approach speed.

At decision to land (runway in sight) select full flaps and reduce speed to V_{THR} + 10 knots.

ADF operation

Master radio switches	ON
On audio selector panels:	
ADF 1 and/or ADF 2 push-buttons	Press
On RMI indicators:	
VOR/ADF control knob	ADF – VOR pointers connected to ADF receiver
On appropriate ADF control panel:	
Mode switch	ADF
BFO switch	ON or OFF depending on the type of NDB signal to be received
Band switch	Select required frequency band
Gain control	Clockwise
Tune control	Select required frequency. The bearing of the station is indicated by the RMI pointers.
In case the automatic mode is inoperative:	
Mode switch	LOOP
Loop L-R switch	To the left or right. The pointer should rotate to the left or right. The ‘antenna’ is rotated to one out of two NULL positions (no signal). The TO direction is the end of the pointer that moves towards the aircraft tail when the NULL indication is maintained.

ATC transponder operation

Master radio switches	ON
On ATC control panel:	
Function selector	STBY
Function selector	ON (at take-off clearance or on request of ATC)
Code selectors	Rotate to obtain code as required by ATC or according to circumstances.
Mode selector	A
Altitude reporting switch	ON
Test switch	Press. The monitor light should illuminate.

Weather radar operation

Master radio switches	ON
On the control panel:	
Gain	Clockwise to AUTO
Tilt control	Zero degrees
Mode switch	STBY for at least 3-4 minutes
Mode selector	Normal (weather radar)
Tilt control	Depending on aircraft altitude (2°-5° down for maximum weather range detection. 3°-5° down for maximum terrain range.

Oxygen system

Crew oxygen system – pre-flight

Crew oxygen system	ON. Check pressure, mask adjustment and emergency flow. Select 100%, mask stowed.

Crew oxygen system – operation as supplemental oxygen

To obtain oxygen flow:

Oxygen mask	Don, dilute and normal
Microphone switch	Select MASK

Crew oxygen system – operation as protective oxygen

In the 100% position the regulator delivers oxygen at any altitude without dilution and is used if there is presence of smoke or fumes in the cockpit:

Oxygen mask	Don, 100%
Smoke goggle	Don
Microphone switch	Select MASK

If it is necessary to walk around whilst using protective oxygen:

ON/OFF valve on walk-around bottle	Turn to ON
Full face mask	Don

Power plant and controls

Normal operation – before starting

Electrical supply	ON (check bus voltage)
Fire warning system	Test
Engine overheat system	Checked
Throttles	IDLE
HP fuel valves	SHUT
Oil pressure lights	Check ON
Anti-icing switches	OFF
Ignition switches	NORMAL
Fire controls	Guards closed (check wire locked)
Engine instruments	Check
Oil temperature	Above -40°C, if below preheat engine
Vibration indicators	Checked
Booster pumps	ON (at least one per engine, lights out)
TTC switch	TAKE-OFF
Air pressure (sea level conditions)	Check

Air conditioning	Min. pressure PSI
OFF	33
COLD	22
¼ BY-PASS	18

Normal operation – engine starting

Main bleed air switches	Check ON and mechanical indicators in-line
HP bleed air switches	AUTO
Starter master switch	ON
Engine start/selector switch	Select to appropriate engine then release (starter valve light on, HP bleed valve indicator in-line, air conditioning valves closed)

Immediately correct LP shaft rotation is confirmed:

HP fuel valve	ON START
Igniter light	Check ON
Oil pressure and TGT	Check increase

When TGT reaches 400°C or 50% HP RPM is obtained:

HP fuel valve	OPEN

Ensure engine idling RPM stabilises between 47% and 53% HP RPM.

When idling RPM and TGT are stabilised:

Oil pressure	Check 18 PSI minimum
HP RPM	47% to 53%
LP RPM	27% approximately
Fuel pressure caution lights	Out
Starter air valve light	Check Out
Igniter light	Check Out

When both engines are started:

Starter master switch	OFF

Normal operation – engine overheat warning

If engine TGT exceeds a predetermined value during ground operations, a red ENGINE T.G.T master warning light will illuminate on the annunciator panel and an audible warning via the overspeed audio warning horn will play.

If engine TGT exceeds a predetermined value when in flight, only a red ENGINE T.G.T. master warning light will illuminate on the annunciator panel.

If the throttles are set to less than 80% HP RPM, the warning will be activated at 475°C or higher.

If the throttles are set to greater than 80% HP RPM and the TTC switch is in the TAKE-OFF position, the warning will be activated at 545°C or higher.

Normal operation – cross-bleed starting

After starting one engine from the APU or ground supply, the second engine may be started by cross-bleeding air from the already running engine:

Main bleed air switches	ON (both engines)
HP bleed air switches	AUTO (both engines)
RPM of running engine	Increase to obtain bleed air pressure of 35-45 PSI

Then proceed to follow the procedure in the Normal operation – engine starting section.

Normal operation – before take-off

Thrust meters	Set subscale
Booster pump switches	ALL ON (lights out)
Anti-icing switches	As required
Oil and fuel LP lights	Check out
TTC switches	TAKE-OFF

Normal operation – full power take-off

With the thrust meter subscale set corresponding with the actual airport barometric pressure (QFE) and temperature, open the throttles fully and check HP RPM and TGT are within limits and that the thrust meter indications and oil pressures are not below the minimum requirements.

If an engine fails to reach 100% indicated thrust, the take-off must be aborted.

Normal operation – P7 set take-off (throttle lever detent fitted)

With the thrust meter subscale set corresponding with the actual airport barometric pressure (QFE) and temperature, open the throttles until the detent is felt.

If the thrust meter indication is 100% or more, do not re-adjust.

If the thrust meter indication is below 100%, open the throttles further until 100% thrust is indicated.

If an engine fails to reach 100% indicated thrust, then the take-off must be aborted.

Normal operation – flexible take-off thrust (P7 set take-off with reduced thrust)

This method is only to be used when a throttle detent is fitted.

With the thrust meter subscale set corresponding with the actual airport barometric pressure (QFE) and the limiting temperature at which the aircraft can take off from the particular runway at that current take-off weight, open the throttles until the detent is felt.

If the thrust meter indication is 100% or more, do not re-adjust.

If the thrust meter indication is below 100%, open the throttles further until 100% thrust is indicated.

If an engine fails to reach 100% indicated thrust, the take-off must be aborted.

Normal operation – climb, cruise and descent

For reduction to climb thrust select:

Throttles	In detent position (approx. 96%)
TTC switches	CLIMB

To reduce noise levels in the cabin, synchronise HP RPM between both engines as accurately as possible.

Normal operation – approach

During the approach, select:

TTC switches	TAKE-OFF

Normal operation – shutdown

Fire warning system	Test
Throttle	IDLE
HP fuel valve	SHUT

Restarting an engine in flight – windmilling relight

Airspeed and altitude should be within the relight envelope.

Throttle lever	IDLE
Ignition switch	RELIGHT (igniter lights on)
HP fuel valve	START

When TGT reaches 400°C or 50% HP RPM:

HP fuel valve	OPEN

When the engine runs satisfactorily, open the throttle slowly to give the required RPM.

Ignition switch	NORMAL

Restarting an engine in flight – starter-assisted relight

If it is essential to restart an engine whilst the airspeed is less than 200 knots, bleed air can be used to effect a successful relight:

MAIN bleed air switches	ON (both engines)
HP bleed air switches	AUTO (both engines)
Bleed air pressure	Min. 35 PSI
Throttle	IDLE
HP fuel valve	SHUT

Proceed as covered in the Normal operation – engine starting section.

Restarting an engine in flight – failure to relight

Should an engine fail to relight withing 20 seconds of selecting the HP fuel valve to START, or appears unlikely for the HP RPM to accelerate to 50% after one minute:

HP fuel valve SHUT

Throttle lever IDLE

Allow one minute for the engine to drain before trying again at a lower altitude.

Engine anti-icing – ground operation

Ground operation of the engine anti-icing systems should be used in the following conditions:

- In icing conditions
- If Outside Air Temperature is below +10°C and visible moisture is present, or if runways are wet

Engine anti-icing switches ON (check pressure indication)

Engine anti-icing – normal operation

Engine anti-icing switches AUTO

Under normal operating conditions the engine anti-icing switches are left in the AUTO position. Engine anti-icing will then be automatically activated when ice is sensed by the ice detector. The system will automatically switch off 60-80 seconds after the ice detector light illuminates, provided no new ice has been detected in the meantime.

The pilots can also back up the automatic system. When the ice detector light comes on or icing is observed:

Engine anti-icing switches ON (check pressure indication)

When out of icing conditions:

Engine anti-icing switches AUTO

Engine anti-icing should not be switched on at Outside Air Temperatures above 15°C unless for a functional check.

Engine anti-icing – engine RPM

In icing conditions, normal engine speeds may be used during climb and cruise.

During descent, it is recommended that a minimum engine speed of 83% HP RPM is maintained.

Engine anti-icing – ice ingestion

If significant ice were to build up on the wing, the act of shedding the ice poses a small risk of ice being ingested into the engines. Significant ice build-up may be caused by:

- Excessive delay in activation of the wing anti-icing system
- Prolonged flight with engine speeds below 83% HP RPM

IGNITION CONTINUOUS

As soon as no further ice shedding is expected:

IGNITION NORMAL

Engine anti-icing – single-engine flight

In single-engine flight, do not switch off the anti-icing for the running engine until clear of icing conditions.

When HP RPM exceeds 97%, the anti-icing of the inoperative engine will be automatically switched off.

Engine anti-icing – pre-flight check on ice detector

Ice detector test button	Push
Ice detector lights	Check ON (lights remain on for approximately 60 seconds)

Engine anti-icing – testing the engine anti-icing pressure-regulating valves

Functioning of the shut-off and pressure-regulating valves can be checked as follows:

Engine running.

Move valve test switch alternately between positions 1 and 2.

Check pressures in each position. At sea level and HP RPM above 85%, pressure should be 45-57 PSI (a small pressure change is acceptable between systems).

Engine anti-icing – comprehensive check on ice detection and anti-icing system

Both engines running:

Engine anti-icing switch	AUTO (both)
Ice detector test button	Push
Ice detector light	Check ON (light remains on for about 60 seconds)
Air pressure indicators	Check indicating

Engine vibration indication – normal operation

The resonant frequency of the HP turbine occurs below idling speed at approximately 40% HP RPM. This vibration reading may be seen during engine starting and shutdown.

Two predominant resonances exist in the LP shaft at approximately 36% and 81% LP RPM and vibration readings may rise if engine RPM is slowly accelerated or decelerated though these speeds.

During rapid throttle movements, a momentary increase in engine vibration may be seen to exceed the level acceptable for steady running. Such indications can be disregarded.

In some icing conditions there may be an intermittent increase in engine vibration readings. No action is required unless other instruments indicate a mechanical failure.

To test the vibration system indicator and amplifier:

Push button	Check pointer deflects to approximately four scale deflections

CHECKLISTS

This chapter covers the normal checklists for the F28 Professional for all phases of flight.

The F28 Professional in MSFS also includes fully interactive checklists for each stage of flight, using the built-in MSFS checklist system. These checklists can be either carried out manually, or automatically using the automated co-pilot options in MSFS.

APU

Before starting APU

Battery voltage	Check
Battery switch	ON
APU FIRE/EXTINGUISHER warning	Test
APU MAIN switch	ON
GEN 3 switch	OFF/RESET
APU AIR switch	OFF
Air conditioning MAIN switches	One ON, one OFF/RESET

Starting APU

APU START button	Pressed
TGT and RPM rise	Check
APU START button light	Extinguished after approx. 45% RPM
TGT and RPM stabilised	CHECK

After starting APU

GEN 3 switch	ON
MASTER RADIO switch	ON

Pre-flight check

Overhead panel

Electrical power	Check
EMERG LIGHT switch	ARM
CONSTANT SPEED DRIVE DISCONNECT switch	Guards closed
ENGINES panel	Check

BLEED AIR SUPPLY panel	Check
AIR CONDITIONING panel	Check
AIRFOIL ANTI-ICING panel	Check
ENGINE ANTI-ICING panel	Check
PITOT AND VANE HEATING panel	Check
WINDSHIELD HEATING panel	Check
PRESSURISATION panel	Check
FASTEN SEATBELTS/NO SMOKING switches	ON

Glareshield panel

NAV sets	ON and set
FUEL SHUT-OFF valve indicators	OPEN
GPW system	Check

Left-hand side panel

Central WARNING and CAUTION system	Test
NOSEWHEEL STEERING switch	ON
ALTERNATE WHEEL BRAKE handles	Forward

Left-hand instrument panel

All indicators	Check
Speed attitude command system	Check
STATIC PRESSURE selector	NORMAL
Compass – UP for D/G switch	Guard closed
ELECTR PUMP switches	Guards closed
Skid control	Check

Central instrument panel and pedestal

All indicators	Check
Hydraulic supply	Check
FUEL PRESS lights	ON
Fuel FILTER ICED lights	Test
ENGINE FIRE WARNING	Test
TVIs	Test
Central CAUT LTS switch	BRIGHT or DIM
FUEL QUANTITY	Check
Lift dumpers	Check
TTC switches	TAKE-OFF

SPEEDBRAKE	Check
Flaps	Check
CROSS-FEED switch	OFF
BOOSTER PUMPS	Check
Transfer pumps	Check
LIGHT switches	ON or OFF
Communications and avionics	Check
AUTOPILOT	Check
Hydraulic flight control panel	Check
Flight control lock	ON
Alternate landing gear handle	Up

Right-hand instrument panel

All indicators	Check
STATIC PRESSURE and PITOT selector	NORMAL
DOOR lights	Test
L/G WARNING switch	NORMAL, guard closed
Compass – UP for D/G switch	Guard closed
SMOKE DETECT system	Test

Right-hand side panel

Central WARNING and CAUTION system	Test
Cabin ventilation shut-off valve	NORMAL
Flight recorder	Set

Pre-departure check (APU running)

Circuit breakers	In
Oxygen	Check
APU AIR switch	ON
WINDSHIELD HEATING switch	LOW or OFF
FASTEN SEATBELTS/NO SMOKING switches	ON
Central WARNING and CAUTION system	Test
Skid control	Test
ENGINE FIRE WARNING	Test
FUEL CONSUMED indicators	Set
A/C WEIGHT	Set
TTC switches	TAKE-OFF
NAV LIGHT switch	ON or OFF
Flight recorder	Set

Before starting engines

Rudder pedals, seats and harnesses	Adjusted and secured
ELECTRICAL POWER and BLEED AIR SUPPLY	Check
BRAKE pressure	Check
PARKING BRAKE	ON
FUEL QUANTITY	Check
PRESSURISATION	Set
Thrust index	Set
NAV aids	Set
Ship's papers	On board
Take-off data	Checked and bugs set
Ground locks	Removed
Windows and doors	Closed

Cleared for start

ANTI-COLL LIGHT switches	ON
THROTTLE levers	IDLE
HP FUEL VALVE levers	SHUT
BOOSTER PUMP switches	ON
STARTER MASTER switch	ON

Start engines

Engine start selector	2
Engine 2 LP RPM	Positive rotation
Engine 2 HP FUEL VALVE lever	START at 15-20% HP RPM
Engine 2 igniter light	ON
Engine 2 OIL pressure and TGT	Rising
Engine 2 HP FUEL VALVE lever	OPEN when TGT reaches 400°C or 50% HP RPM
Engine 2 OIL pressure, HP RPM and LP RPM	Check
Engine start selector	1
Engine 1 LP RPM	Positive rotation
Engine 1 HP FUEL VALVE lever	START at 15-20% HP RPM
Engine 1 igniter light	ON
Engine 1 OIL pressure and TGT	Rising
Engine 1 HP FUEL VALVE lever	OPEN when TGT reaches 400°C or 50% HP RPM
Engine 1 OIL pressure, HP RPM and LP RPM	Check

After starting engines

Central WARNING and CAUTION system	Out
HP FUEL VALVE levers	OPEN
FUEL PRESS lights	Out
Igniter lights	Out
STARTER VALVE light	Out
STARTER MASTER switch	OFF
Generator lights	Out
GEN 3 switch	OFF
APU AIR switch	OFF
AIR CONDITIONING MAIN switches	Both ON
AC and DC	Check
ENGINE ANTI-ICING switches	AUTO or LOW
WINDSHIELD HEATING switches	LOW
PITOT AND VANE HEATING switches	ON
Hydraulic supply	Check
ELECTR PUMP switches	OFF, guards closed
Flight control lights	Out
Flaps	Set

Taxiing

Flight instruments	Check and set
Trim	Set
COLL TANK indicators	Black
Flaps	…degrees
Crew briefing	Complete

Lining up

Brake temperature	Check
APU	OFF or ON
Lift dumpers	ARM
Flight controls	Check
Yaw DAMPING switch	IN
Transponder	ON or STBY
LANDING LIGHT switches	EXTEND and ON

After take-off

Landing gear	UP
Flaps	UP
Lift dumpers	IN
RPM, TGT and TTC	Check
Landing and FLARE OUT LIGHT switches	OFF and RETRACT
ENGINE ANTI-ICING switches	AUTO or ON
PRESSURISATION	Check
FASTEN SEATBELTS / NO SMOKING	ON or OFF

Descent

FASTEN SEATBELTS switch	ON
PRESSURISATION	Set
TTC switches	TAKE-OFF
Landing data	Checked and bugs set
Crew briefing	Complete

Approach

NO SMOKING switch	ON
Altimeters	Set
Anti-icing	Check
LANDING LIGHT switches	EXTEND and ON
L/G WARNING switch	NORMAL or ALTERNATE

Final

Landing gear	DOWN
Skid control	Check
BRAKE pressures	Check
Lift dumpers	ARM
Flaps	Set

After landing

APU	ON
SPEEDBRAKE	IN
Lift dumpers	IN
Flaps	UP or Set

AIRFOIL ANTI-ICING switches	OFF
ENGINE ANTI-ICING switches	OFF or ON
PITOT AND VANE HEATING switches	OFF
WINDSHIELD HEATING switches	OFF or LOW
GEN 3 switch	ON
Radar and transponder	STBY
Yaw DAMPING switch	OFF
Flight control lock	ON
ENGINE FIRE WARNING	Test

After parking

Through flights

PARKING BRAKE	ON
HP FUEL valve levers	SHUT
FASTEN SEATBELTS switch	OFF
AIR CONDITIONING MAIN switches	All OFF
Generators 1 and 4	Both OFF/RESET
Thrust levers	FUEL OFF
BOOSTER PUMP switches	OFF
LANDING AND FLARE OUT LIGHT switches	OFF and RETRACT
ANTI-COLL LIGHT switches	OFF
NAV LIGHT switch	ON or OFF
TECH LOG	Complete

Additional at final stop

APU AIR switch	OFF
WINDSHIELD HEATING switches	OFF
MASTER RADIO switches	OFF
PANEL and INSTR lighting	OFF
EMERG LIGHT switch	OFF
Oxygen system	OFF
SMOKE DETECT switch	OFF

Additional for APU shutdown

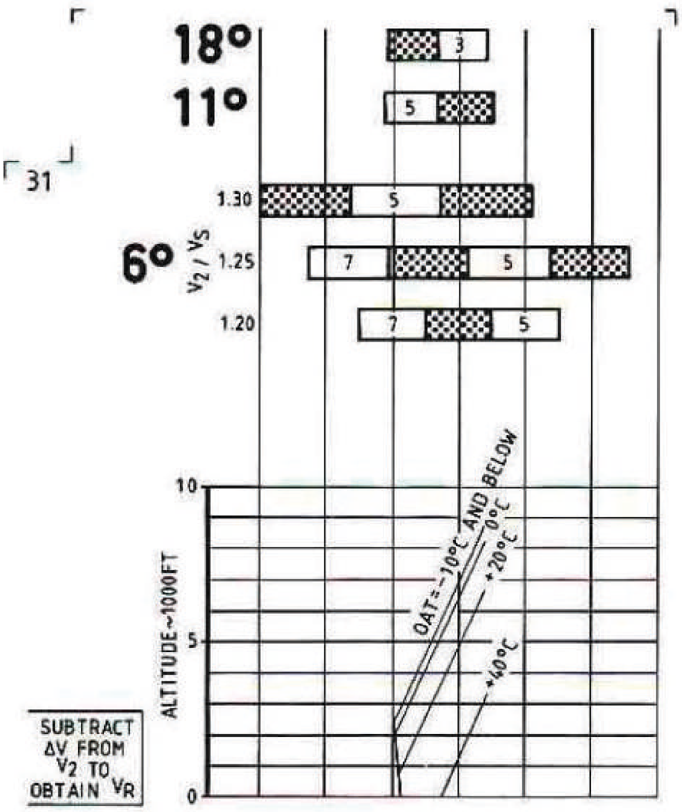
EXTERNAL POWER switch	OFF or ON
GEN 3 switch	OFF
APU	OFF
BATTERY switch	OFF

HANDLING NOTES

Take-off

Take-off and landing speeds

Take-off and landing speeds can be obtained from the speed chart located on the First Officer's main instrument panel. Take-off speeds are based on the aircraft's weight, centre of gravity and flap setting.



TAKE-OFF

FLAP	6°			11°	18°
V_2 / V_S	1.20	1.25	1.30		
V_2	142	148	153	136	131
V_{FR0}	151		153	151	
V_{FC}	178				

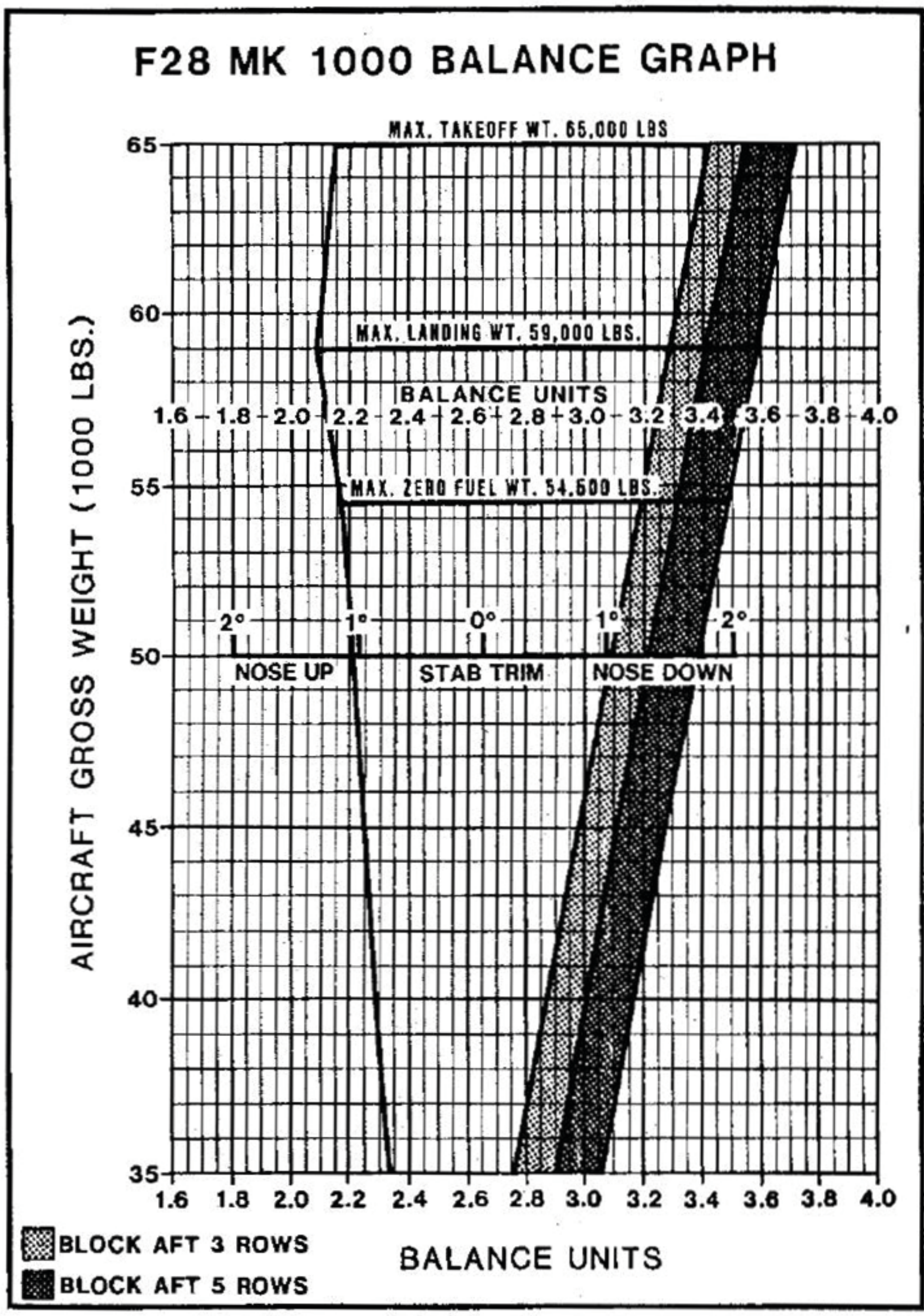
LANDING

FLAP	0°	25°	42°
V_{THR}	163	136	125

All V-speeds assume V1 = VR.

For take-off with flaps 11° or 18°, the take-off speeds are based on V2 = 1.20 x VS.

For take-off with flaps 6°, V2 will range from 1.20 to 1.30 x VS to allow for a greater take-off weight in conditions where sufficient runway length is available, but a climb limit exists.



AIRCRAFT STRUCTURAL LIMITS

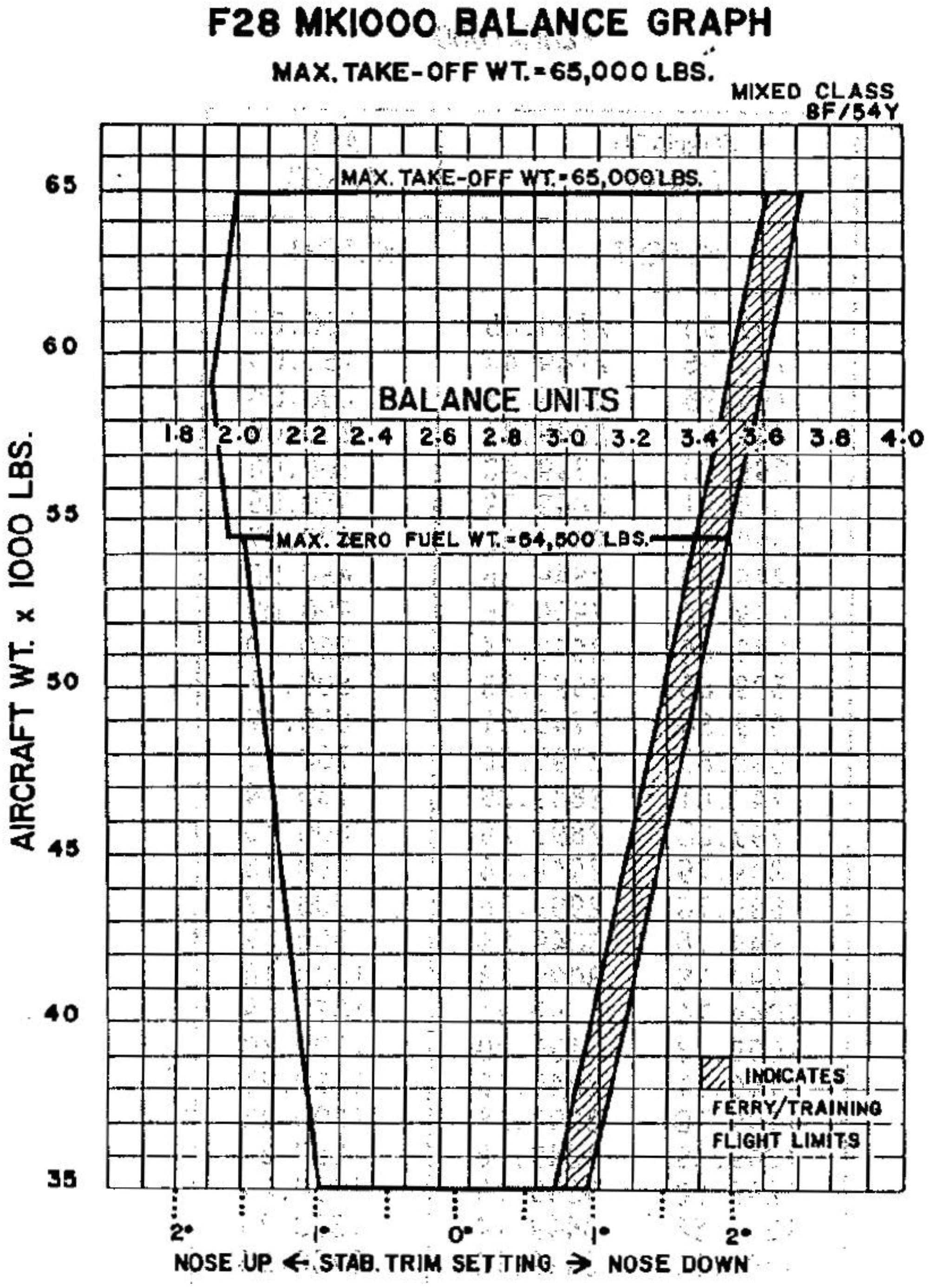
MAX TAKEOFF WT. = 65000 LBS.

MAX ZERO FUEL WT. = 54500 LBS.

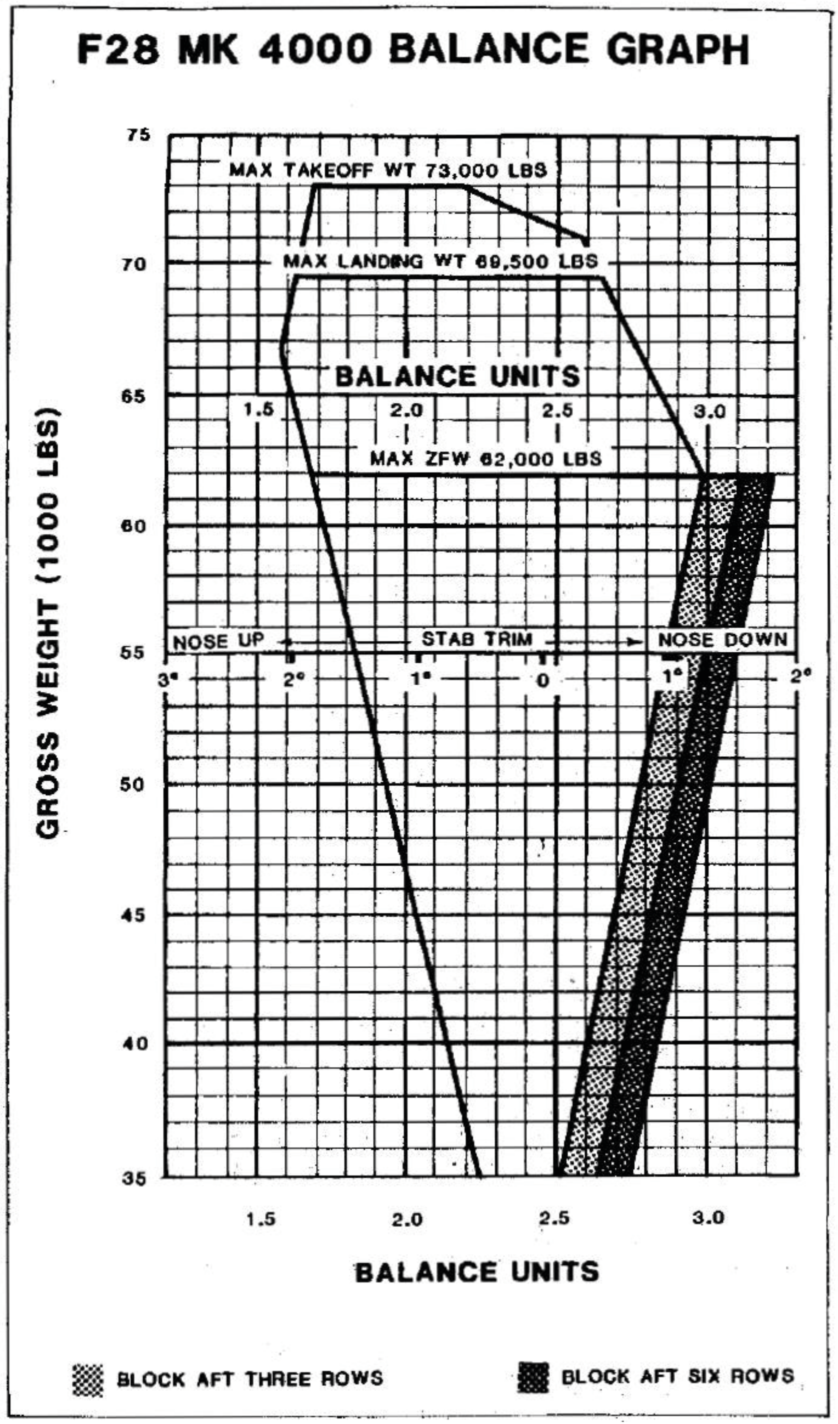
MAX LANDING WT. = 59000 LBS.

LOADING RULES

1. Use only the weights shown on the adjusted weights loading table.
2. Select representative weight for each load item from load tables. Do not interpolate.
3. Check that zero fuel weight and balance do not exceed limits.
4. Check that take-off weight and balance do not exceed limits.
5. Forward cargo should be loaded first.
6. Aft cargo should be unloaded first.


F28 MK1000 BALANCE GRAPH
MAX. TAKE-OFF WT. = 65,000 LBS.
MIXED CLASS 8F/54Y
MAX. TAKE-OFF WT. = 65,000 LBS.
BALANCE UNITS
1.8 2.0 2.2 2.4 2.6 2.8 3.0 3.2 3.4 3.6 3.8 4.0
MAX. ZERO FUEL WT. = 54,500 LBS.
AIRCRAFT WT. x 1000 LBS.
65 60 55 50 45 40 35
INDICATES FERRY/TRAINING FLIGHT LIMITS
2° 1° 0° 1° 2°
NOSE UP ← STAB. TRIM SETTING → NOSE DOWN

Balance graphs F28 Mk 4000



AIRCRAFT STRUCTURAL LIMITS

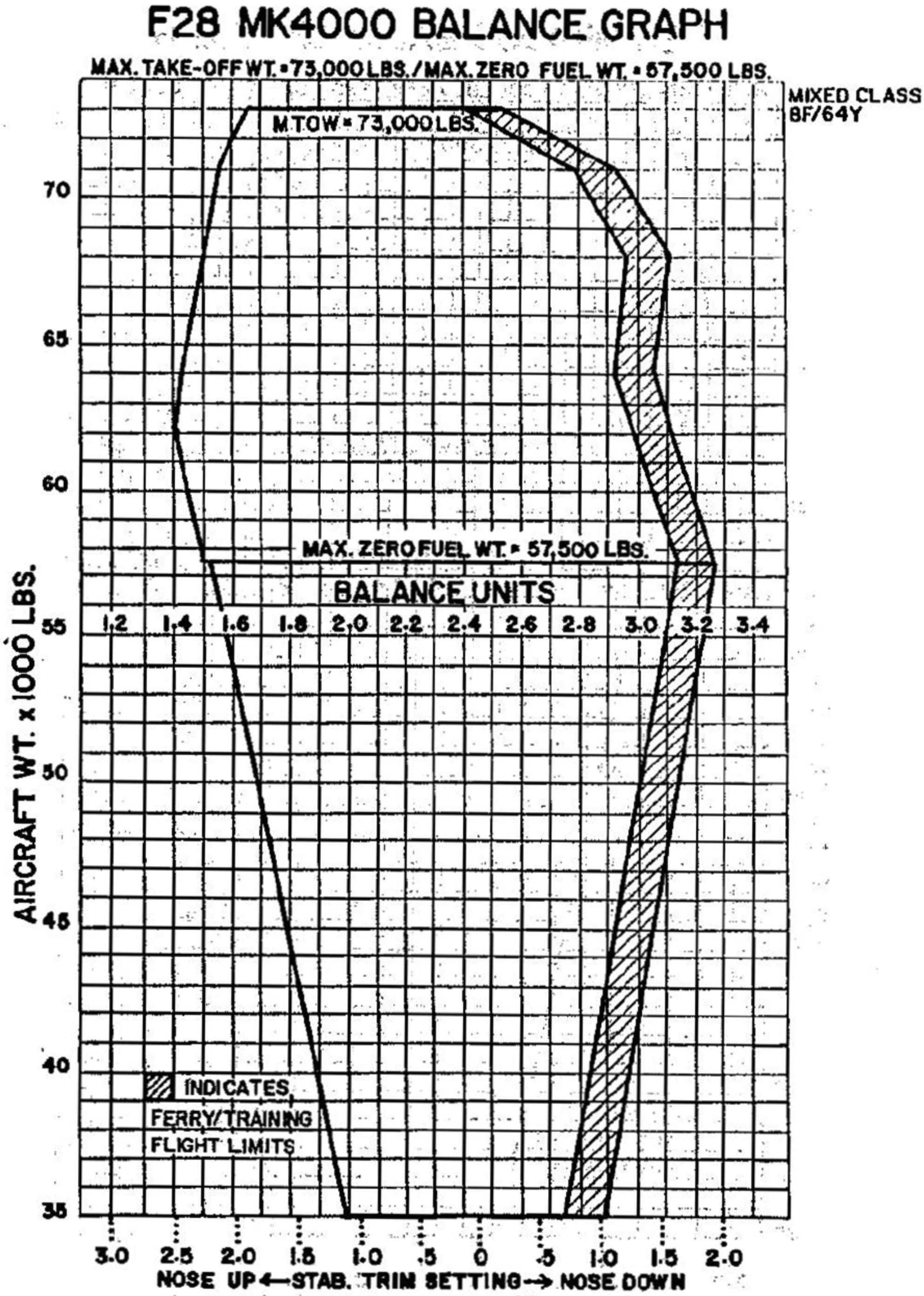
MAX TAKEOFF WT = 73000 LBS.

MAX ZERO FUEL WT= 62000 LBS.

MAX LANDING WT = 69500 LBS.

LOADING RULES

1. Use only the weights shown on the adjusted weights loading table.
2. Select representative weight for each load item from load tables. Do not interpolate.
3. Check that zero fuel weight and balance do not exceed limits.
4. Check that take-off weight and balance do not exceed limits.
5. Forward cargo should be loaded first.
6. Aft cargo should be unloaded first.



Rated thrust take-off

With the thrust meter sub-scale set to the corresponding pressure altitude and temperature, the throttle can be opened to the detent.

If 100% thrust is achieved, do not adjust the throttles.

If 100% thrust is not achieved, open the throttles further until 100% thrust is reached.

During a rolling take-off, ensure 100% thrust is achieved prior to reaching 60 knots, as the relation between thrust and exhaust pressure varies with forward speed.

An increase in thrust indication may be seen during the take-off roll as speed increases. This is normal and expected, and should not be corrected.

If at any time during the take-off roll an engine fails to reach 100% thrust, the take-off must be abandoned.

Flexible thrust take-off (reduced thrust)

'Flex' take-offs can be achieved by adjusting the thrust index setting for the limiting temperature at which the aircraft can safely take off from a particular runway at the existing weight, flap setting and wind conditions.

Set the thrust index setting on the thrust meter sub-scale.

Open the throttles to the detent.

If 100% thrust is achieved, do not adjust the throttles.

If 100% thrust is not achieved, open the throttles further until 100% thrust is reached.

During a rolling take-off, ensure 100% thrust is achieved prior to reaching 60 knots, as the relation between thrust and exhaust pressure varies with forward speed.

An increase in thrust indication may be seen during the take-off roll as speed increases. This is normal and expected, and should not be corrected.

If at any time during the take-off roll an engine fails to reach 100% thrust, the take-off must be abandoned.

Flexible thrust take-offs should not be used when:

- The runway surface is not paved.
- The runway is contaminated with standing water, ice, slush or soft snow.
- Windshear is reported or expected.

Thrust index tables

Cabin air ON
Engine anti-icing OFF

ALTITUDE ft	-1000	-800	-600	-400	-200	0	200	400	600	800	1000	1200	ALTITUDE ft
OAT °C													OAT °C
50	117	114	112	109	106	104	101	98	96	93	91	88	50
48	124	121	119	116	113	111	108	105	102	100	97	95	48
46	131	128	125	123	120	117	114	112	109	106	104	101	46
44	138	135	132	129	126	123	121	118	115	112	110	107	44
42	144	141	138	135	132	129	127	124	121	118	116	113	42
40	150	147	144	141	138	135	132	130	127	124	121	118	40
38	156	153	150	147	144	141	138	135	132	129	127	124	38
36	161	158	155	152	149	146	143	140	138	135	132	129	36
34	167	164	161	158	154	152	149	146	143	140	137	134	34
32	169	169	166	163	160	157	154	151	148	145	142	139	32
30	|	|	169	167	164	161	158	155	152	149	146	143	30
28	|	|	|	170	169	166	163	160	157	154	151	148	28
26	|	|	|	|	170	170	167	164	161	158	155	152	26
24	|	|	|	|	|	|	170	168	165	162	159	156	24
22	|	|	|	|	|	|	|	170	169	165	162	159	22
20	|	|	|	|	|	|	|	|	170	169	166	163	20
18	|	|	|	|	|	|	|	|	|	170	170	167	18
16	|	|	|	|	|	|	|	|	|	|	|	171	16
and below													and below

RB 183 Mk 555 - 15P - THRUST INDEX
PRESSURE ALTITUDE (1013.2 mb) - FEET

Cabin air ON
Engine anti-icing OFF

ALTITUDE ft	1400	1600	1800	2000	2200	2400	2600	2800	3000	3200	3400	3600	ALTITUDE ft
OAT °C													OAT °C
50	85	83	80	78	75	73	70	68	66	63	61	58	50
48	92	89	87	84	82	79	77	74	72	69	67	64	48
46	98	96	93	91	88	85	83	80	78	75	73	70	46
44	104	102	99	96	94	91	89	86	83	81	78	76	44
42	110	107	105	102	99	97	94	91	89	86	84	81	42
40	116	113	110	107	105	102	99	97	94	91	89	86	40
38	121	118	115	113	110	107	104	102	99	96	94	91	38
36	126	123	120	118	115	112	109	107	104	101	99	96	36
34	131	128	125	122	120	117	114	111	109	106	103	100	34
32	136	133	130	127	124	122	119	116	113	110	108	105	32
30	140	137	135	132	129	126	123	120	117	115	112	109	30
28	145	142	139	136	133	130	127	124	122	119	116	113	28
26	149	146	143	140	137	134	131	128	125	123	120	117	26
24	153	150	147	144	141	138	135	132	129	126	123	120	24
22	156	153	150	147	144	141	138	135	132	130	127	124	22
20	160	157	154	151	148	145	142	139	136	133	130	127	20
18	164	161	158	155	152	149	146	143	140	137	134	131	18
16	168	164	161	158	155	152	149	146	143	140	137	134	16
14	170	167	164	161	158	155	152	149	146	143	140	137	14
12	171	169	166	163	160	157	154	151	148	145	142	139	12
10	|	171	168	165	162	158	155	152	149	146	143	140	10
8	|	|	169	166	163	160	157	154	151	148	145	142	8
6	|	|	171	168	165	162	159	156	153	150	147	144	6
4	|	|	172	170	167	163	160	157	154	151	148	145	4
2	|	|	|	171	168	165	162	159	156	153	150	147	2
0	|	|	|	172	170	167	164	161	158	155	152	149	0
-2	|	|	|	|	172	169	166	162	159	156	153	150	-2
-4	|	|	|	|	|	170	167	164	161	158	155	152	-4
-6	|	|	|	|	|	172	169	166	163	160	157	154	-6
-8	|	|	|	|	|	173	171	168	165	162	159	155	-8
-10 and below	|	|	|	|	|	|	173	170	167	163	160	157	-10 and below

RB 183 Mk 555 - 15P - THRUST INDEX
PRESSURE ALTITUDE (1013.2 mb) - FEET

Cabin air ON
Engine anti-icing OFF

ALTITUDE ft	3800	4000	4200	4400	4600	4800	5000	5200	5400	5600	5800	ALTITUDE ft
OAT °C												OAT °C
50	56	54	51	49	47	44	42	40	38	35	33	50
48	62	60	57	55	52	50	48	45	43	41	39	48
46	68	65	63	61	58	56	53	51	49	46	44	46
44	73	71	68	66	63	61	59	56	54	51	49	44
42	79	76	74	71	69	66	64	61	59	56	54	42
40	84	81	79	76	74	71	69	66	64	61	59	40
38	89	86	83	81	78	76	73	71	68	66	63	38
36	93	91	88	85	83	80	78	75	73	70	68	36
34	98	95	93	90	87	85	82	80	77	74	72	34
32	102	100	97	94	92	89	86	84	81	79	76	32
30	106	104	101	98	96	93	90	88	85	83	80	30
28	110	108	105	102	100	97	94	92	89	86	84	28
26	114	111	109	106	103	100	98	95	92	90	87	26
24	118	115	112	109	106	104	101	98	96	93	90	24
22	121	118	115	113	110	107	104	102	99	96	94	22
20	124	122	119	116	113	110	108	105	102	99	97	20
18	128	125	122	119	117	114	111	108	105	102	100	18
16	131	128	126	123	120	117	114	111	109	106	103	16
14	134	131	128	126	123	120	117	114	112	109	106	14
12	136	133	130	127	124	121	119	116	113	110	108	12
10	137	135	132	129	126	123	120	117	115	112	109	10
8	139	136	133	130	127	125	122	119	116	113	111	8
6	141	138	135	132	129	126	123	120	118	115	112	6
4	142	139	136	133	131	128	125	122	119	116	113	4
2	144	141	138	135	132	129	126	123	121	118	115	2
0	146	143	140	137	134	131	128	125	122	119	116	0
-2	147	144	141	138	135	132	129	127	124	121	118	-2
-4	149	146	143	140	137	134	131	128	125	122	120	-4
-6	151	148	145	142	139	136	133	130	127	124	121	-6
-8	152	149	146	143	140	137	135	132	129	126	123	-8
-10 and below	154	151	148	145	142	139	136	133	130	127	125	-10 and below

RB 183 Mk 555 - 15P - THRUST INDEX
PRESSURE ALTITUDE (1013.2 mb) - FEET

Cabin air ON
Engine anti-icing OFF

ALTITUDE ft	6000	6200	6400	6600	6800	7000	7200	7400	7600	7800	8000	ALTITUDE ft
OAT °C												OAT °C
50	31	29	26	24	22	20	18	16	14	11	9	50
48	36	34	32	30	27	25	23	21	19	17	14	48
46	42	39	37	35	33	30	28	26	24	22	19	46
44	47	44	42	40	38	35	33	31	29	26	24	44
42	52	49	47	45	42	40	38	35	33	31	29	42
40	56	54	52	49	47	45	42	40	38	35	33	40
38	61	58	56	54	51	49	47	44	42	40	37	38
36	65	63	60	58	55	53	51	48	46	44	41	36
34	69	67	64	62	60	57	55	52	50	48	45	34
32	73	71	68	66	63	61	59	56	54	51	49	32
30	77	75	72	70	67	65	62	60	57	55	53	30
28	81	78	76	73	71	68	66	63	61	58	56	28
26	85	82	79	77	74	72	69	67	64	62	59	26
24	88	85	82	80	77	75	72	70	67	65	62	24
22	91	88	86	83	80	78	75	73	70	68	65	22
20	94	91	89	86	83	81	78	76	73	71	68	20
18	97	95	92	89	87	84	81	79	76	74	71	18
16	100	98	95	92	90	87	84	82	79	77	74	16
14	103	101	98	95	93	90	87	85	82	80	77	14
12	105	102	99	97	94	91	89	86	84	81	78	12
10	106	104	101	98	95	93	90	88	85	82	80	10
8	108	105	102	100	97	94	92	89	86	84	81	8
6	109	106	104	101	98	96	93	90	88	85	82	6
4	111	108	105	102	100	97	94	92	89	86	84	4
2	112	109	107	104	101	98	96	93	90	88	85	2
0	114	111	108	105	103	100	97	95	92	89	87	0
-2	115	112	110	107	104	101	99	96	93	91	88	-2
-4	117	114	111	108	106	103	100	97	95	92	89	-4
-6	118	116	113	110	107	104	102	99	96	94	91	-6
-8	120	117	114	112	109	106	103	101	98	95	92	-8
-10 and below	122	119	116	113	110	108	105	102	99	97	94	-10 and below

RB 183 Mk 555 - 15P - THRUST INDEX
PRESSURE ALTITUDE (1013.2 mb) - FEET

Cabin air ON
Engine anti-icing ON

ALTITUDE ft	-1000	-800	-600	-400	-200	0	200	400	600	800	1000	1200	ALTITUDE ft
OAT °C													OAT °C
10	172	173	173	174	174	174	174	175	175	176	176	173	10
8 and below	|	|	|	|	|	|	|	|	|	|	|	176	8 and below

ALTITUDE ft	1400	1600	1800	2000	2200	2400	2600	2800	3000	3200	3400	3600	ALTITUDE ft
OAT °C													OAT °C
10	170	166	163	160	157	154	151	148	145	142	139	136	10
8	173	170	167	164	161	158	154	151	148	145	142	139	8
6	175	173	170	167	164	161	158	155	152	149	146	143	6
4	|	174	172	169	166	164	161	158	155	152	149	146	4
2	|	175	173	171	168	165	162	159	156	153	150	147	2
0	|	|	175	172	169	167	164	161	158	155	152	149	0
-2	|	|	|	174	171	168	166	163	160	157	154	151	-2
-4	|	|	|	175	173	170	167	165	162	159	156	152	-4
-6	|	|	|	|	175	172	169	166	164	160	157	154	-6
-8	|	|	|	|	|	174	171	168	165	162	159	156	-8
-10 and below	|	|	|	|	|	175	173	170	167	164	161	158	-10 and below

RB 183 Mk 555 - 15P - THRUST INDEX
PRESSURE ALTITUDE (1013.2 mb) - FEET

Cabin air ON
Engine anti-icing ON

ALTITUDE ft	3800	4000	4200	4400	4600	4800	5000	5200	5400	5600	5800	ALTITUDE ft
OAT °C												OAT °C
10	133	130	127	124	121	118	115	112	109	107	104	10
8	136	133	130	127	124	121	119	116	113	110	107	8
6	140	137	134	131	128	125	122	119	116	113	110	6
4	143	140	137	134	131	128	125	122	119	116	113	4
2	144	141	138	135	133	130	127	124	121	118	115	2
0	146	143	140	137	134	131	128	125	123	120	117	0
-2	148	145	142	139	136	133	130	127	124	121	119	-2
-4	149	146	144	141	138	135	132	129	126	123	120	-4
-6	151	148	145	142	139	136	133	130	128	125	122	-6
-8	153	150	147	144	141	138	135	132	129	126	124	-8
-10 and below	155	152	149	146	143	140	137	134	131	128	125	-10 and below

ALTITUDE ft	6000	6200	6400	6600	6800	7000	7200	7400	7600	7800	8000	ALTITUDE ft
OAT °C												OAT °C
10	101	98	96	93	90	87	85	82	79	77	74	10
8	104	102	99	96	93	91	88	85	82	80	77	8
6	107	105	102	99	96	94	91	88	85	83	80	6
4	111	108	105	102	99	97	94	91	88	86	83	4
2	113	110	107	104	102	99	96	93	91	88	86	2
0	114	111	109	106	103	100	98	95	92	90	87	0
-2	116	113	110	107	105	102	99	96	94	91	88	-2
-4	117	115	112	109	106	103	101	98	95	93	90	-4
-6	119	116	113	111	108	105	102	100	97	94	92	-6
-8	121	118	115	112	109	107	104	101	98	96	93	-8
-10 and below	122	119	117	114	111	108	105	103	100	97	95	-10 and below

RB 183 Mk 555 - 15P - THRUST INDEX
PRESSURE ALTITUDE (1013.2 mb) - FEET

Take-off technique

Line up as near as possible to the runway threshold.

Keep the left hand on the nose-wheel steering wheel and the right hand on the throttles.

Advance throttles to the detent and check that 100% thrust is reached.

Release brakes.

Maintain directional control by using the nose-wheel steering up to 80 knots.

When reaching 80 knots, shift the left hand to the control column and use rudder for directional control.

At V1 release hand from the throttles.

At VR commence rotation at 3 degrees per second to approximately 10 degrees pitch.

As the speed increases through V2, continue rotation to climb-out attitude.

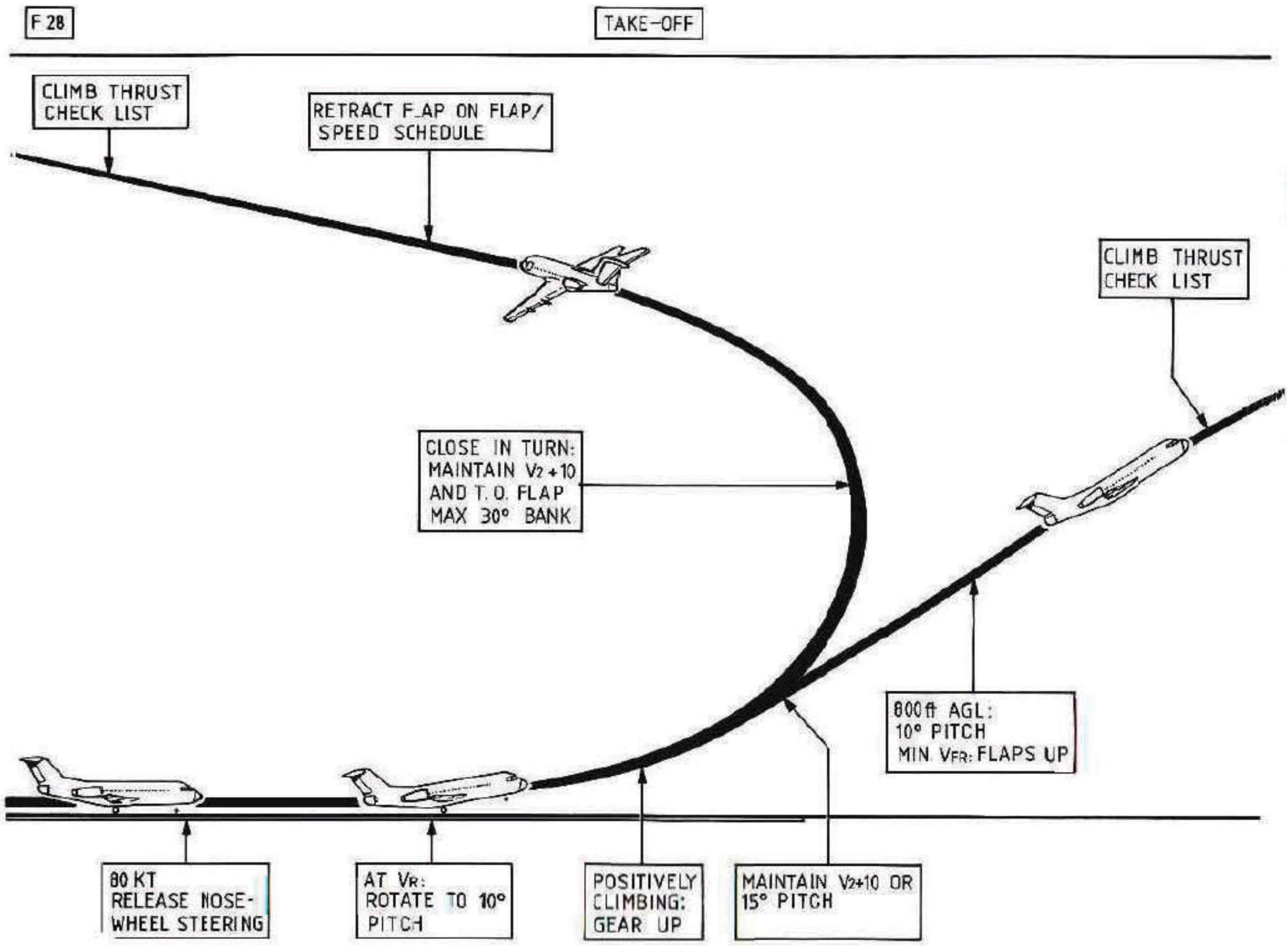
When positively climbing, select gear up.

Maintain a minimum speed of V2 + 10 or a maximum pitch angle of 15 degrees.

The lift dumpers will disarm automatically upon lift-off:

At 800 ft AGL reduce to 10 degrees pitch and at or above VFR select flaps up.

When the flaps are up, reduce to climb thrust.



Rolling take-off

When performing a rolling take-off, ground rolling distance will be slightly increased. However, if some speed is present at the beginning of the take-off run then the increased ground roll distance is negligible.

Crosswind take-off

The swept wing and T-tail make the upwind wing susceptible to lifting during take-off. To prevent this, the aileron control wheel should be held into wind during the initial roll.

Take-off warning system

This take-off warning system is installed to prevent the aircraft from taking off in an unsafe configuration.

The system is armed when the aircraft is on the ground and throttles are advanced beyond 90% HP RPM.

An alternating tone will indicate to the pilots to abort take-off should one or more of the following conditions be present:

- Parking brakes not released
- Flaps not at an approved take-off setting
- Stabilizer not in Mode 1
- Elevator not in Mode 1

Noise abatement take-off

When departing an airport in a noise-sensitive area, the following take-off procedure should be used:

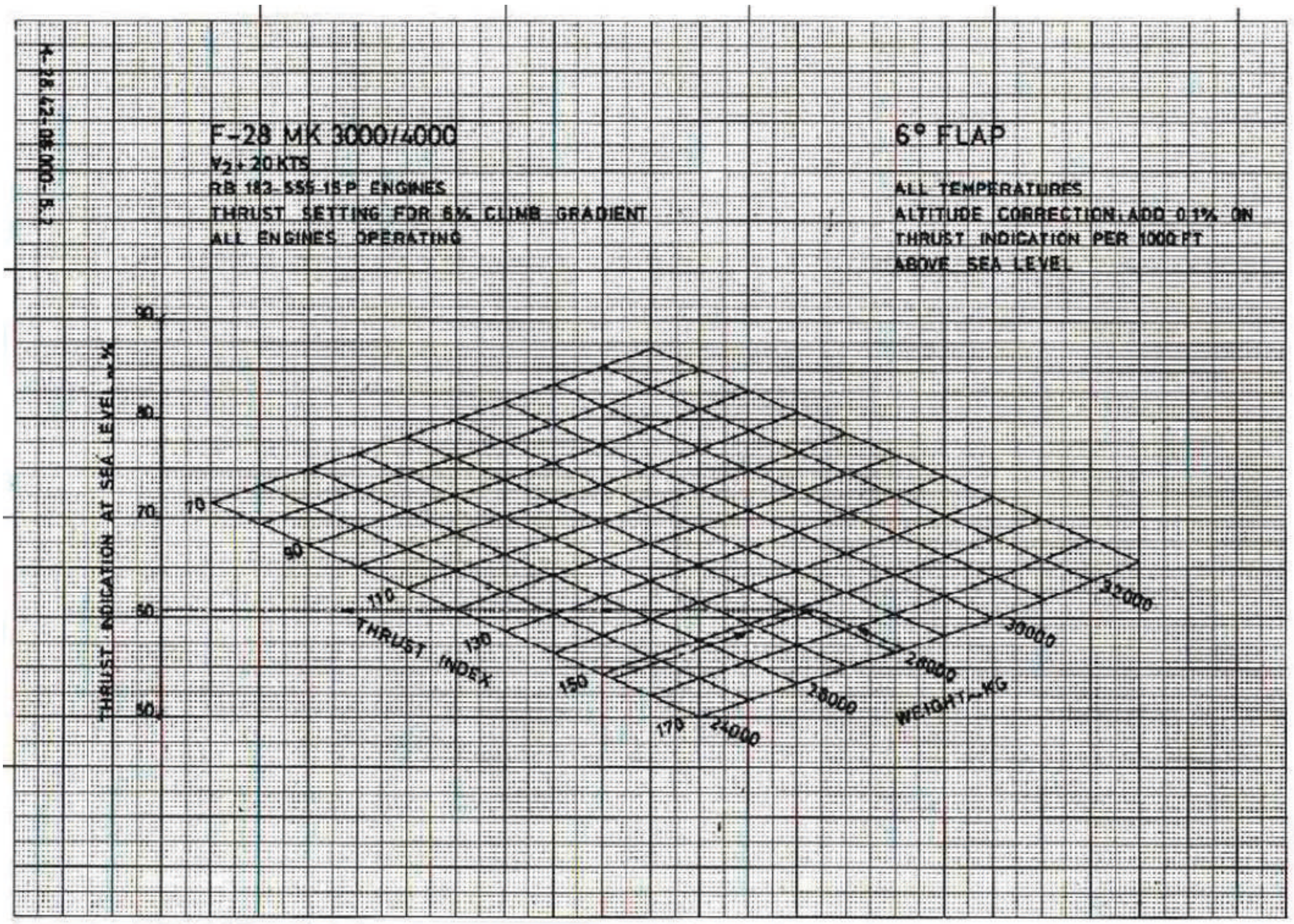
Maintain take-off thrust until reaching the specified cut-back altitude (1,500 ft AGL unless otherwise specified).

Maintain V_2 + 20 (or max. 15 degrees pitch) and take-off flap.

Upon reaching cut-back altitude, reduce the throttles to the thrust indication required to maintain a 6% climb gradient (see figures below). The resulting rate of climb should be approximately 900 ft/min.

If turns are necessary, use 15-30° bank.

When clear of the noise-sensitive area, select climb thrust, raise the flaps and continue as for a normal take-off.



Climb

After the take-off run, reduce throttles to the detent position and accelerate to the required climb speed.

Small RPM adjustments may be necessary to keep engine parameters within limits.

During the initial climb, the COLL TANK indicators may occasionally show a barber pole as the demand for the engines exceeds the jet pump capacity.

Climb schedules

Minimum fuel – 250 knots up to 10,000 ft, then 270 knots / 0.60 Mach up to cruise level.

Intermediate – 250 knots up to 10,000 ft, then 270 knots / 0.65 Mach up to cruise level.

High speed – 250 knots up to 10,000 ft, then 320 knots / 0.725 Mach up to cruise level.

In turbulent air, maintain 230 knots during climb.

Maximum rate of climb is obtained at 250 knots.

For maximum gradient or best angle climb maintain VFC.

Operational essential thrust

Operational essential thrust may be used if you require more thrust than normal climb thrust, but less than maximum continuous thrust.

Some examples of when operational essential thrust may be used are:

- In icing/turbulent conditions where a higher cruise level is required.
- If extra climb thrust is required to clear high terrain.
- If ATC instruct a specific climb performance which cannot be achieved with normal climb thrust.
- If after an engine failure, maximum continuous thrust is not necessary.

Cruise

Upon reaching cruising altitude, climb thrust should be maintained until the required IAS or Mach number is reached.

Cruise levels above FL 300 become uneconomical at high aircraft weights.

Speedbrake

The speedbrake has no speed limitations and can be selected OUT over the whole speed range.

A blowback feature will automatically limit the amount of extension at speeds greater than 190 knots to provide a deceleration of 0.1G.

A small nose-up trim change may be noticeable when extending the speedbrake at higher speeds.

The speedbrake will retract automatically and the throttle move forward if either throttle is advanced to the detent.

Fuel system

All fuel booster pumps should be in the ON position during normal operation. Each booster pump can supply one engine with maximum fuel flow, or two engines with climb fuel flow. The installation of engine-driven fuel pumps means a failure of booster pumps during take-off does not require immediate action.

In the event of an engine shutdown or two booster pumps failing on the same side, cross-feed can be used to prevent the fuel system from exceeding the maximum allowable asymmetric fuel load.

The transfer of fuel from the centre wing tank to the main tanks can begin as soon as the fuel load in the main tank reaches 3,000 kg.

Anti-icing systems

Engine anti-icing should be switched in the AUTO position after engine start, unless the OAT is lower than +10°C with rain, snow, slush or fog present, in which case the switch must be set to the ON position.

The system should also be switched ON if the ICE DETECTED light illuminates or if ice is anticipated. The switch can be placed back to the AUTO position when clear of ice.

Airfoil anti-icing should be switched ON if icing is anticipated or observed. This system is not normally used during take-off due to performance restrictions or when the OAT is greater than 15°C.

83% HP RPM must be maintained in icing conditions to ensure full anti-icing system capacity.

Descent

There are no restrictions on engine RPM settings during descent.

Begin the descent by adjusting the throttles to descend at -1,000 ft/min and maintaining the current cruise Mach number.

At FL 250, reduce to idle thrust and adjust the rate of descent to maintain an IAS stated in the descent schedules below.

When reaching 2,000 ft AGL (or the altitude specified for a particular approach procedure), spool up the engines to the power setting required to maintain speed.

In icing conditions, a minimum of 83% HP RPM must be maintained to ensure full anti-icing system capacity.

Descent schedules

Minimum fuel – 0.60 Mach / 230 knots.

Intermediate – 0.65 Mach / 270 knots until 10,000 ft, then 250 knots below 10,000 ft.

High speed – 0.725 Mach / 320 knots until 10,000 ft, then 250 knots below 10,000 ft.

In turbulent air, maintain 230 knots during descent.

RPM setting

A higher HP RPM setting may be used during descent to lower the rate of descent, therefore allowances should be made in increased descent time, distance and fuel burn.

Holding

Normal speed for holding is between 180 and 210 knots in a clean configuration.

If fuel consumption is not critical, a holding speed of 160 knots at flaps 11 can be used to improve speed stability.

Approach and landing

Initial approach

Unless otherwise instructed by ATC, high indicated airspeeds may be maintained until the aircraft is approximately 10 miles on final during a straight-in approach.

Speedbrakes may be used to provide a comfortable deceleration to approach speeds.

Whenever the aircraft levels off, initially set 85% HP RPM and adjust the throttle as required. Maintain a minimum of 80% HP RPM until landing is assured.

The recommended minimum manoeuvring speeds during approach are:

Clean – 180 knots

Flaps 6° – 170 knots

Flaps 11° – 160 knots

Flaps 25° – VTHR + 20

Full flaps – VTHR + 10

These speeds provide a sufficient safety margin against a stall for bank angles up to 30°.

Visual approach and landing

Carry out the approach check.

Enter downwind at or below 200 knots and select flaps 11°.

Maintain 160 knots.

Abeam the threshold, extend the landing gear and time 35 seconds (subtracting 1 second/knot headwind component during landing).

At the end of the downwind, select flaps 25 and stabilise in a descending turn on a base leg to final, whilst reducing speed to VTHR + 20.

Carry out the final check up to 'FLAPS'.

At 800 ft select full flaps and bleed off speed to VTHR + 10.

On final approach, maintain VTHR + 10.

At approximately 100 ft, gradually reduce the speed to cross the threshold at VTHR. Full speedbrake selection is recommended.

Begin to flare and reduce the throttles to idle.

After touchdown the lift dumpers will, if the throttles are at idle, extend automatically upon main wheel spin-up and the aircraft will 'sit down' on the runway.

Select manual lift dumpers after touchdown.

Check and confirm lift dumpers are extended.

Keep the aircraft straight using rudder, before switching to nose-wheel steering below 80 knots.

Carry out after landing checks once the landing run is complete.

Additional notes

Do not exaggerate the landing flare. This can lead to excessive floating and an increased landing distance.

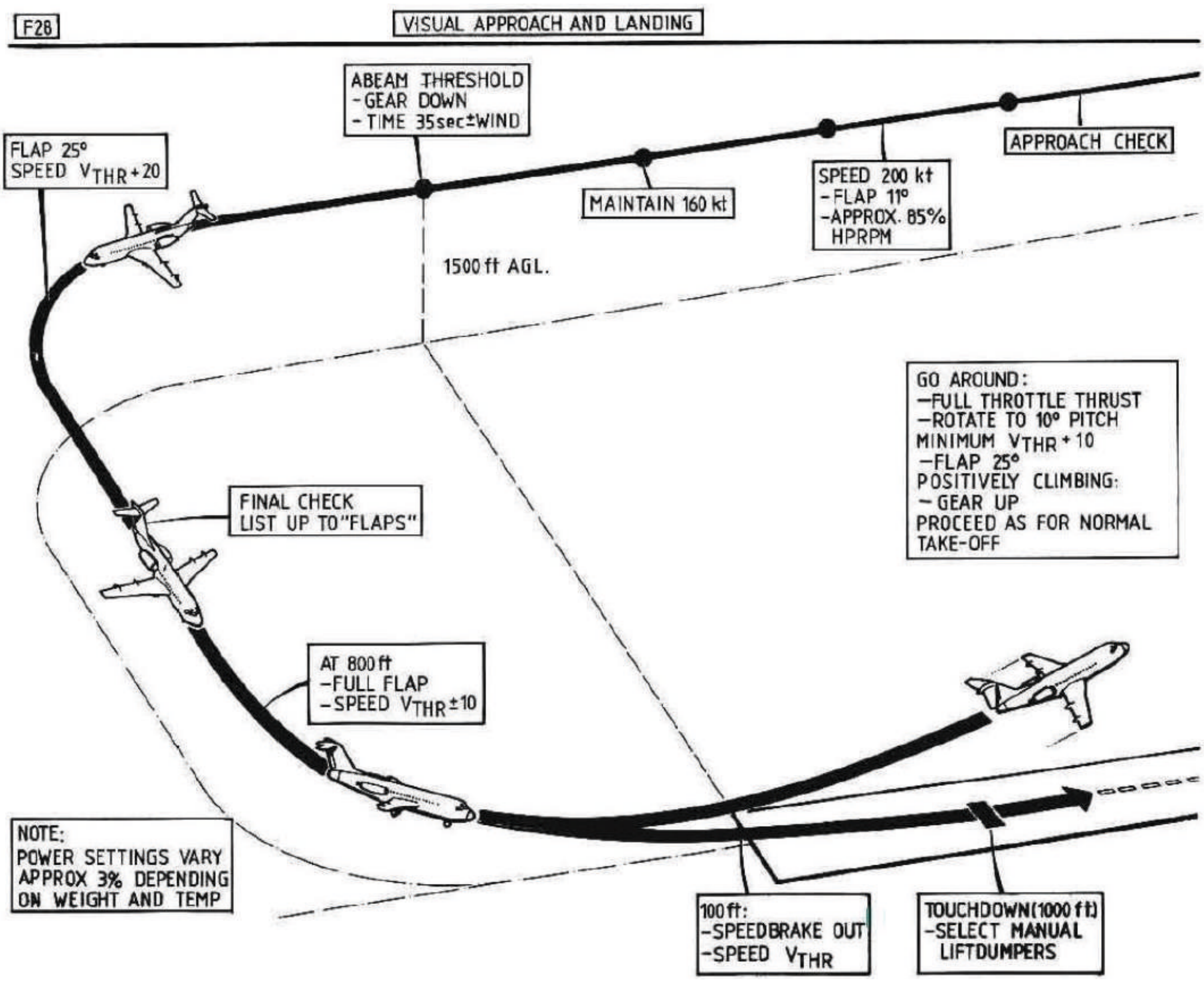
If gusts are reported, increase threshold speed by 10 knots.

During lift dumper operation, a slight nose-down tendency can be counteracted by some back pressure on the control column.

Lower the nose gently after touchdown and apply wheel braking after nose-wheel is on the ground.

If landing and taxiing is to take place in water or slush at near freezing temperatures, do not retract the flaps to less than 25° until a visual inspection has confirmed that the flap areas are clear of ice.

The standard landing configuration is landing gear extended, flaps 42°, speedbrake IN. However, certain combinations of aircraft weight, field elevation and ambient temperature may make this configuration impracticable due to high power settings required to maintain approach speed. In these conditions it is recommended that flaps 25° is used.



Crosswind landing

On final approach, maintain runway alignment by crabbing into the wind.

During the flare, start banking very gently into wind and apply opposite rudder to keep the aircraft along the runway centreline.

Touch down on the upwind wheels. Do not delay touchdown after de-crabbing is complete.

Keep straight with rudder and counteract any wing lift with aileron.

Low circuit

Select flaps 11° and reduce speed before descending to circuit height.

Maintain 160 knots on downwind.

Abeam the landing threshold, select gear down.

When the gear is down and locked, turn base leg and select flaps 25°.

Carry out the final check up to 'FLAPS'.

On base, maintain a minimum speed of V_{THR} + 20.

Aim to be established on final at or above 400 ft AGL.

When intercepting the visual glide path, select full flaps, reduce speed to V_{THR} + 10 and continue for a normal landing.

Steep approach

Attempt to intercept the normal glide path above 400 ft AGL.

Make use of speedbrake rather than reducing throttle below 80% HP RPM.

If speed stabilisation is not obtained when reaching 200 ft AGL, go around.

Landing with minimum ground roll

Fly a normal circuit at the correct speeds.

Positively control the aircraft to touch down at the intended landing point.

Lower the nose immediately after main wheels touch down, select lift dumpers manually and apply full wheel brakes until the aircraft has almost stopped.

Monitor the brake temperature indicators.

ILS approach (CAT 1)

Carry out the approach check.

At 200 knots or below select flaps 11°.

Reduce to and maintain 160 knots.

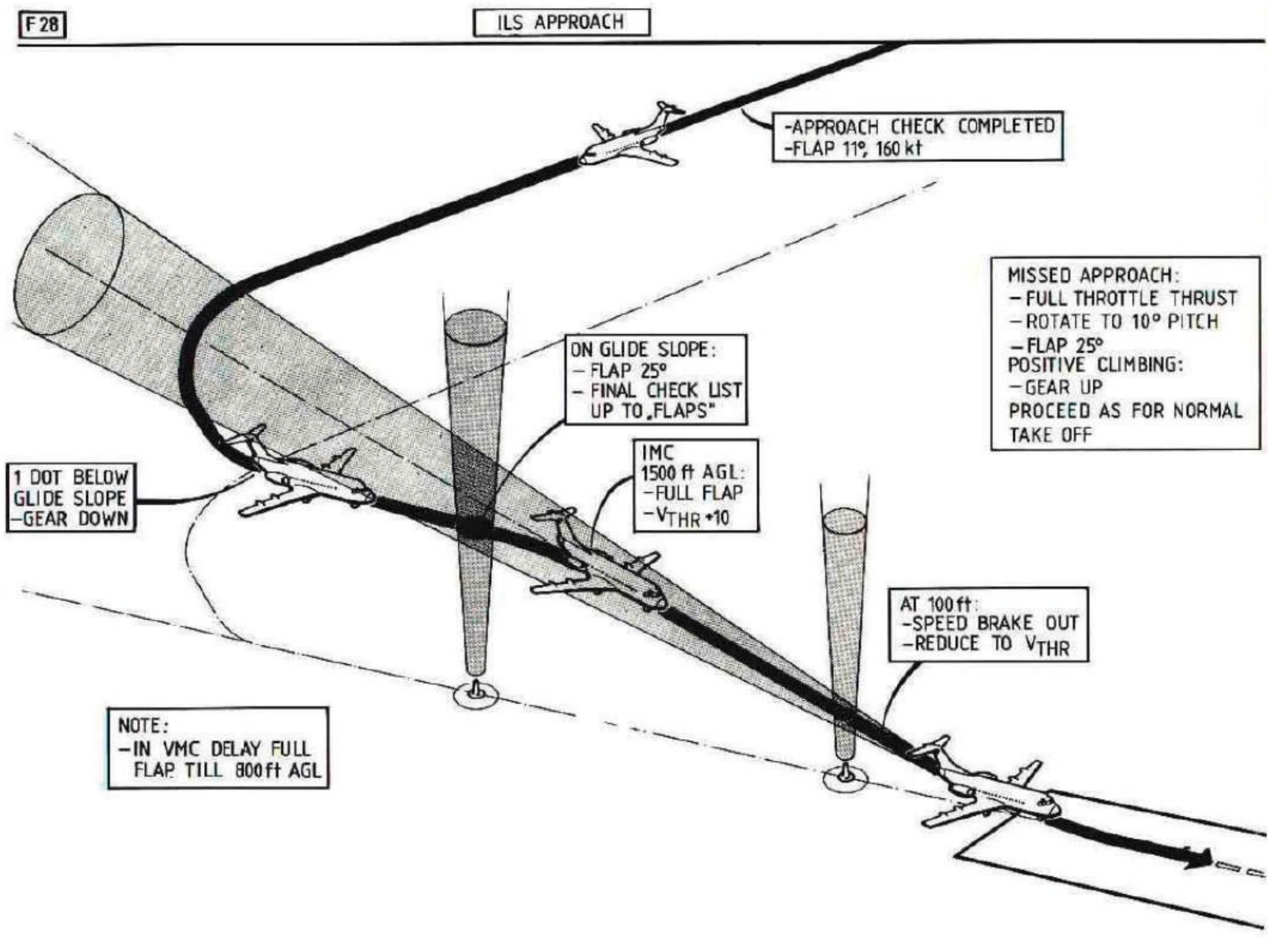
At approximately one dot below the glideslope, select flaps 25° and reduce speed to V_{THR} + 20.

Carry out the final checks up to ‘FLAPS’.

At 1,500 ft AGL, select full flaps and reduce to V_{THR} + 10.

At about 100 ft reduce the speed gradually to cross the threshold at V_{THR}.

Full speedbrake selection is required.



Flight director ILS approach (CAT 1)

This procedure is in addition to the normal ILS procedure outlined above.

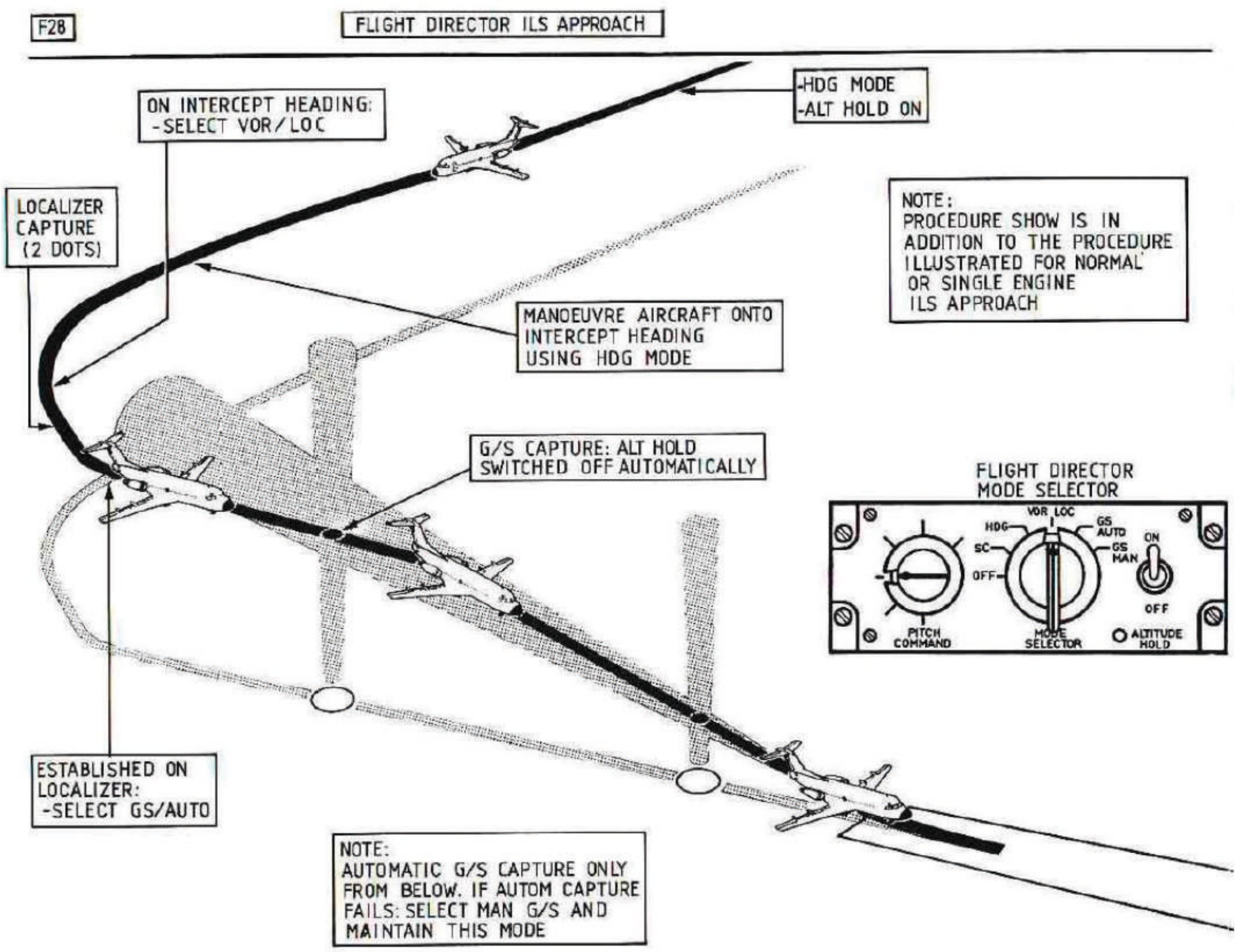
Manoeuvre the aircraft onto the localiser intercept heading using HDG mode (and ALTITUDE HOLD if required).

When established on the intercept heading, select VOR/LOC.

Upon localiser capture (two dots) follow the flight director guidance and select GS AUTO.

Upon glideslope capture (ALTITUDE HOLD is switched off automatically) follow flight director pitch guidance.

The flight director can then be set for a possible missed approach by turning the heading selector to the missed approach heading and setting the pitch command control for 10 degrees nose up (this attitude will not be optimal for all conditions; it only serves as a pilot aid for setting the approximate attitude).



Autopilot coupled ILS approach (CAT 1)

This procedure is in addition to the normal ILS procedure outlined above.

The approach should be initiated at least 2 NM before intercepting the glide path. Whenever possible, the glide path should be intercepted between 1,500 ft and 2,000 ft AGL.

Manoeuvre the aircraft onto the localiser intercept heading using either HDG or ROLL mode (and ALTITUDE HOLD if required).

When on the intercept heading, select VOR/LOC.

Localiser capture will occur at approximately two dots deflection (HDG mode automatically disengages).

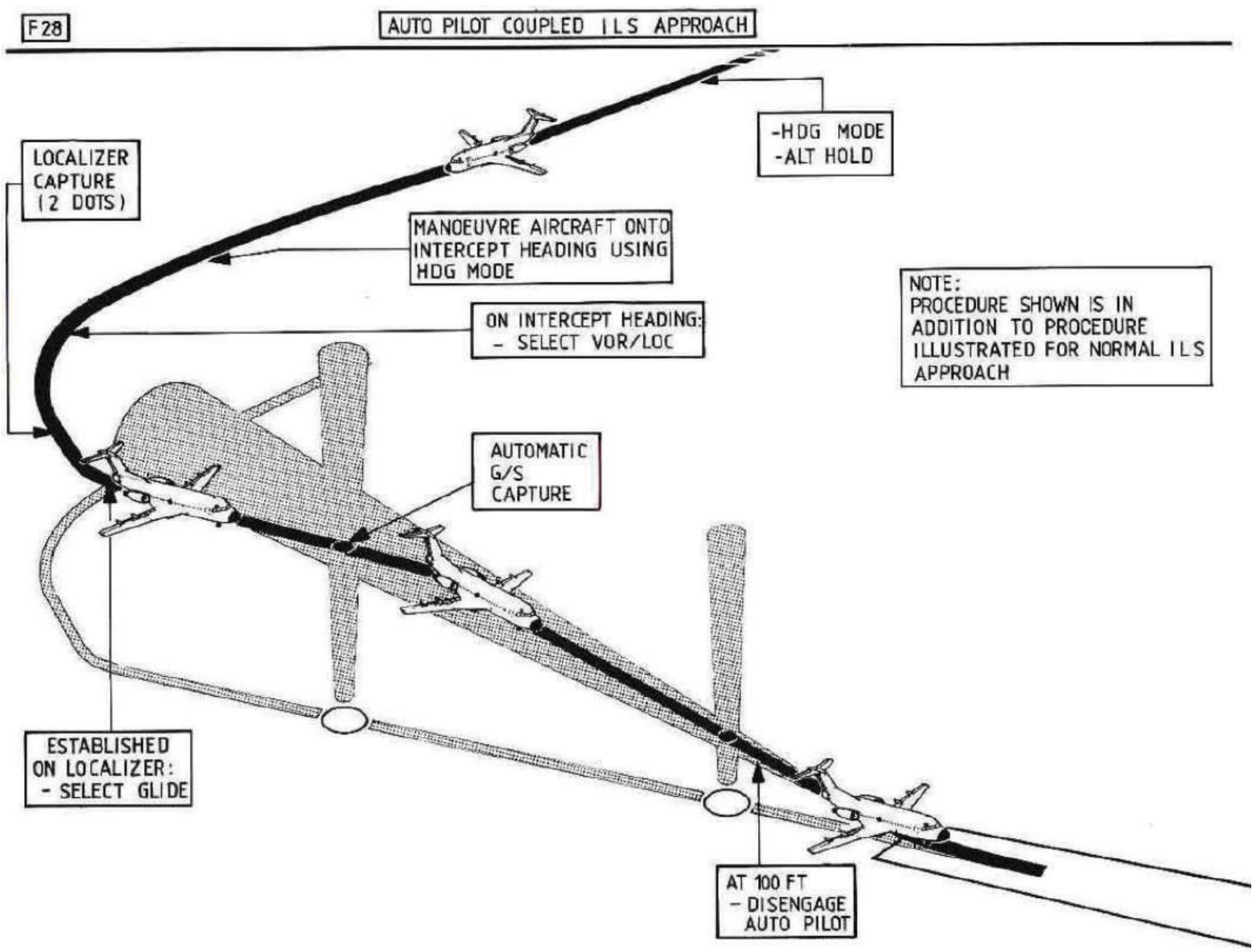
When established on the localiser, select GLIDE.

Upon interception of the glideslope, capture will take place (ALTITUDE HOLD automatically disengages).

The autopilot will control the aircraft to follow the localiser and glideslope beams, and automatically correct for wind.

In the event of a tailwind landing, select full flaps at 1,700 ft AGL.

At 100 ft, disengage the autopilot and land manually.



NDB/VOR approach

This procedure describes a typical NDB or VOR approach. This procedure should also be followed for all other types of non-precision approaches:

Carry out the approach check.

If prolonged holding is expected, maintain approximately 200 knots (clean) and decelerate to the initial approach configuration (160 knots, flaps 11°) two to three minutes prior to reaching the approach facility.

On leaving the approach facility outbound, maintain 160 knots and flaps 11°.

Descend on the outbound leg, in the procedure turn or on the final approach course as required by the specific procedure.

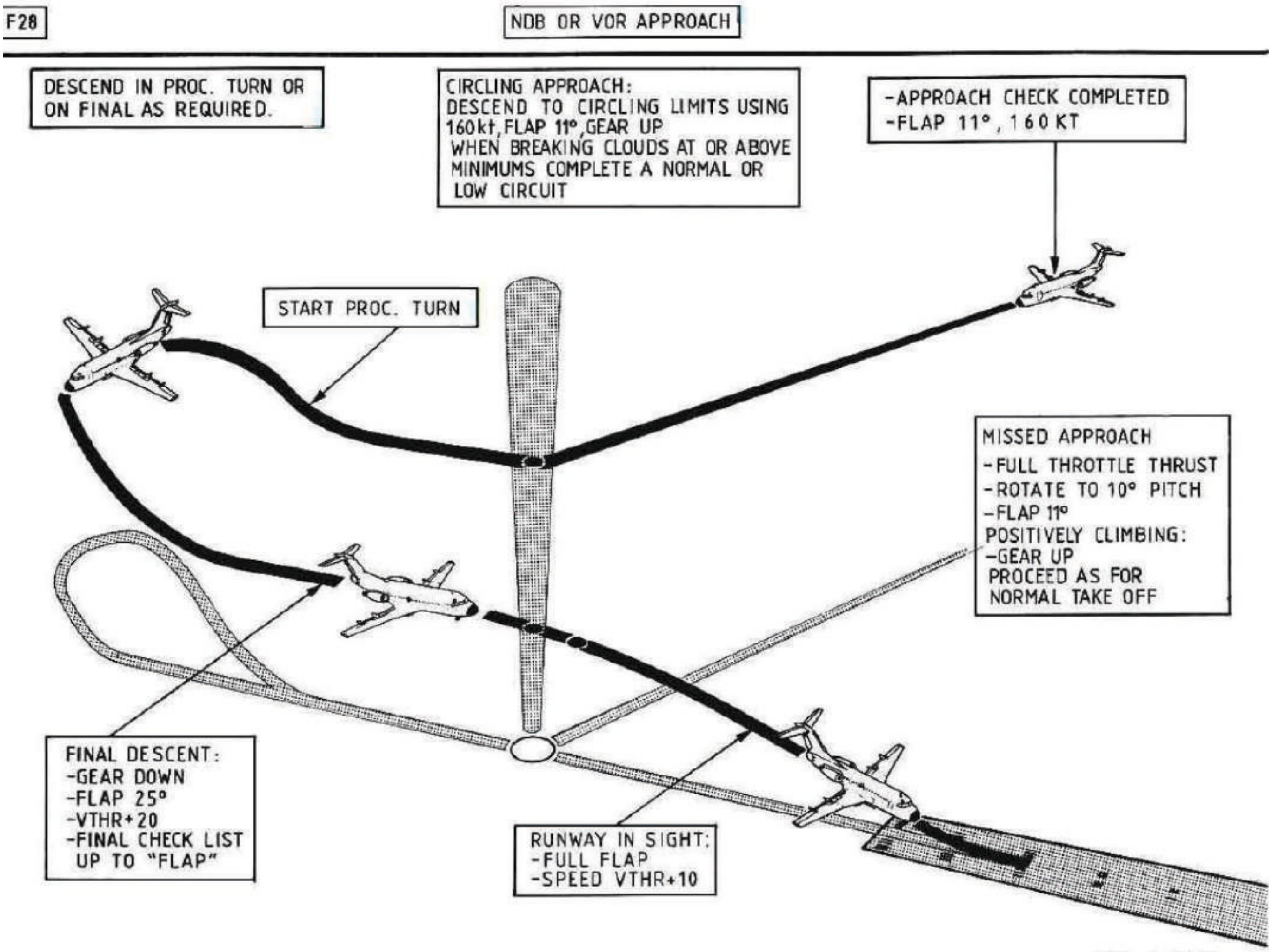
When starting the final descent to Minimum Decision Altitude (MDA), select gear down, flaps 25° and reduce speed to maintain V_{THR} + 20.

Carry out the final check up to 'FLAPS'.

Level off at MDA.

When 'runway in sight' and intercepting the visual glide path, select full flaps and reduce speed to V_{THR} + 10.

Proceed as for a normal landing.



CAT 2 ILS approach

Before approach:

Ensure the autopilot is in HDG and ALT (HT) mode.

Ensure the FD is in the HDG and ALTITUDE HOLD mode.

Tune VHF NAV 1 (and VHF NAV 2) receivers to the required ILS frequency.

Set the ILS localiser course with course selectors 1 and 2.

Select the desired intercept heading.

Select APPR mode on the remote datum selector.

Select the CAT 2 DH on the radio altimeter.

Select the AP to the VOR LOC (BEAM) mode.

Select the FD to VOR LOC mode.

Initial approach:

Reduce speed to less than 200 knots, select flaps 11° and maintain 160 knots.

When stabilised on the localiser, select the AP to the GLIDE mode and the FD to the GS AUTO mode.

Final approach:

At approximately one dot below GS extend the landing gear.

Upon intercepting the GS, select flaps 25° and reduce speed to V_{THR} + 20.

At 1,500 ft AGL select full flaps and reduce speed to V_{THR} + 10.

When the decision to land has been made, it is recommended to disengage the AP at 75 ft radio altitude.

Note: *The AP pitch trim is made inoperative below 250 ft and therefore a slight out-of-trim force may be noticed with the autopilot disengaged below this altitude.*

Go-around:

Push one or both throttle palm switches when selecting go-around power.

The FD will automatically revert to SC mode and the AP will disengage.

Follow the command bar for initial climb out and wings level guidance.

MSFS CONTROL ASSIGNMENTS

Microsoft Flight Simulator allows users to customise the controller scheme of their external hardware, which can allow for a much more immersive experience. You can set up these controls within MSFS by navigating to Options > Controls Options.

The following table shows a list of non-normal MSFS control assignments that can be used in conjunction with the Just Flight F28 Professional:

Aircraft control	**MSFS control assignment**
APU START button	APU STARTER
APU STOP/OS TEST button	APU OFF
Autopilot disconnect (yoke)	TOGGLE DISENGAGE AUTOPILOT
Autopilot engage/disengage (aft centre console)	TOGGLE AUTOPILOT MASTER
Autopilot pitch selector (aft centre console)	INCREASE AP PITCH HOLD REFERENCE DECREASE AP PITCH HOLD REFERENCE
Bell silencer	TOGGLE GPWS
GEN 3 switch	SET APU
HP fuel valves (OPEN/SHUT)	SET ENGINE 1 FUEL VALVE SET ENGINE 2 FUEL VALVE
Lift dumpers ARM/DISARM	TOGGLE ARM SPOILERS
Lift dumpers manual extension	DECREASE THROTTLE
Lift dumpers manual retraction	THROTTLE CUT
Nose-wheel steering tiller	NOSE WHEEL STEERING AXIS
U/C horn silencer	TOGGLE GPWS

Note: *This is not a complete list of all the MSFS control assignments that work with the F28 Professional and it does not include the basic control assignments for controls such as Pitch, Roll, Yaw, Throttles etc. which are shared between all aircraft.*

LVARs

Home cockpit users who require the use of LVARs to set up external hardware can find a complete list of LVARs used in the simulator by enabling Developer mode. Then, on the bar at the top of the screen, navigate to: Windows > Behaviours > Local Variables.

Entering instrument names or abbreviations into the ‘Filter’ box will vastly speed up the process of finding LVARs. For example, if you are trying to find the LVARs used for the strobe lights, you can search for ‘Strobe’ and you will find the following LVAR: **F28_PED_Lights_Toggle_STROBE_Switch**.

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EFB programming	Omniwise
Aircraft liveries	David Sweetman, Tom Koffeman
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