Rolls Royce AE3007A

Group 5

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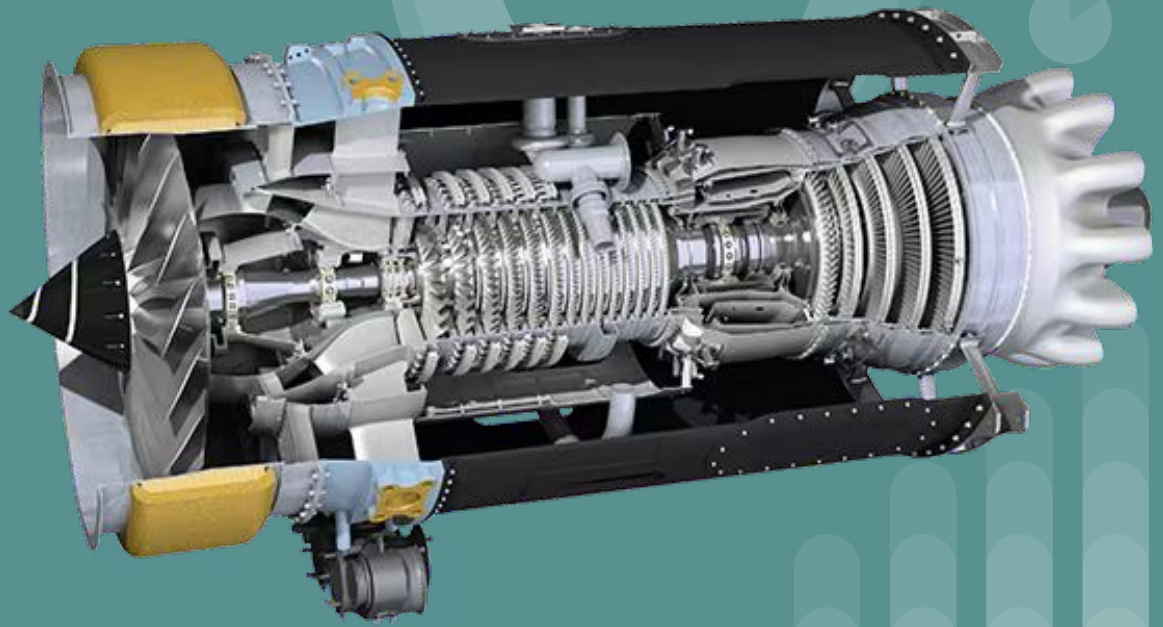


AIM

To convert this 2-Spool Unmixed Flow Fixed Bypass ratio Turbofan Engine to 2-Spool Mixed Flow Variable Bypass ratio Geared Turbofan Engine

Key features & Applications of RR AE3007A Engine

- **Key Features:-**

1. **High Efficiency**: The AE 3007A has a high bypass ratio, meaning it can provide significant thrust while maintaining good fuel efficiency. This is critical for both commercial airliners and business jets.
2. **Low Noise**: The engine is designed to be relatively quiet, which is important for both environmental standards and passenger comfort, especially in business jets.
3. **Thrust Range**: It typically provides around 8,000 to 9,000 pounds of thrust, which is suitable for smaller regional jets and mid-size business jets.

- **Applications:-**

1. **Business Jets**: The RR AE 3007A is used in the **Cessna Citation X**, one of the fastest business jets in the world. This engine helps provide the aircraft with exceptional speed and range.
2. **Regional Airliners**: It powers the **Embraer ERJ 145** family of regional jets, which are used by airlines for short to medium-haul routes. The engine's efficiency is critical for airlines looking to keep operational costs low while maintaining reliable service.
3. **Unmanned Aerial Vehicles (UAVs)**: Variants of the AE 3007A are used in military applications, such as in the **Northrop Grumman RQ-4 Global Hawk**, a high-altitude long-endurance (HALE) UAV. This showcases the engine's reliability and capability in long-endurance, high-altitude flight missions.

Plan of Action

Thrust Optimization

- **Variable Bypass Ratio**: Gasturb can model different bypass ratios to determine an optimal configuration for military missions, balancing thrust and fuel efficiency.

Fuel Efficiency Enhancement

- **TSFC Reduction**: Analyze ways to reduce the Thrust Specific Fuel Consumption (TSFC) by simulating improvements in **turbine** and **compressor efficiencies**. This is crucial for **long-endurance military missions**, especially in UAVs.

Engine Parameters

Take-off Thrust (kN)	**30.33 kN**
OPR	**23**
Bypass ratio	**5**
Length (m)	**2.92 m**
Fan Diameter (m)	**0.98 m**
Fan	**24 Blades**
Compressor	**Single stage fan, 14 HP**
Turbine	**2 Stage HP, 3 Stage LP**
Burner Exit Temperature	**1194-1243 K**
Fan Shaft RPM	**7,716-8,248 rpm**

Ground Condition Analysis

Altitude	m	0
Delta T from ISA	K	0
Relative Humidity [%]		0
Mach Number		0

Intake Pressure Ratio		0.99
No (0) or Average (1) Core dP/P		1
Inner Fan Pressure Ratio		1.2
Outer Fan Pressure Ratio		1.2
Compr. Interduct Press. Ratio		0.99
HP Compressor Pressure Ratio		19.36
Bypass Duct Pressure Ratio		0.98
Turb. Interd. Ref. Press. Ratio		0.98
Design Bypass Ratio		5
Burner Exit Temperature	K	1200
Burner Design Efficiency		0.9995
Burner Partload Constant		1.6
Fuel Heating Value	MJ/kg	42.0755
Overboard Bleed	kg/s	0
Power Offtake	kW	0
HP Spool Mechanical Efficiency		0.99
LP Spool Mechanical Efficiency		1
Burner Pressure Ratio		0.97
Turbine Exit Duct Press Ratio		0.98

Replication of the given ground conditions

Variation of Fan Diameter keeping TIT & BPR Constant

Station	W kg/s	T K	P kPa	WRstd kg/s
amb		288.15	101.325	
1	201.513	288.15	101.325	
2	201.513	288.15	100.312	203.548
13	167.927	381.85	246.943	79.319
21	33.585	305.46	120.374	29.107
25	33.585	305.46	119.170	29.401
3	32.578	753.67	2299.988	2.321
31	28.548	753.67	2299.988	
4	28.911	1200.00	2230.989	2.677
41	30.590	1176.61	2230.989	2.805
43	30.590	732.03	236.794	
44	32.605	733.36	236.794	
45	32.605	733.36	232.059	22.694
49	32.605	288.15	1.585	
5	33.613	296.98	1.585	2180.169
8	33.613	296.98	1.553	2224.663
18	167.927	381.85	242.004	80.938
Bleed	0.336	753.67	2299.987	

FN	=	30.33	kN	
TSFC	=	11.9756	g/(kN*s)	
WF	=	0.36322	kg/s	
BPR	=	5.0000		
s NOx	=	0.7000		
Core Eff	=	0.2914		
Prop Eff	=	0.0000		
P3/P2	=	22.93		
P2/P1	=	0.9900		
P16/P13	=	0.9800		
P25/P21	=	0.9900		
P45/P44	=	0.9800		
P6/P5	=	0.9800		
A8	=	0.09679	m²	
A18	=	0.34384	m²	
P8/Pamb	=	0.01533		
P18/Pamb	=	2.38839		
WBld/W25	=	0.01000		
CD8	=	0.78305		
CD18	=	0.97600		
XM8	=	-1.94644		
XM18	=	1.00000		
V18/V8,id	=	-0.35568		
Loading	=	100.00	%	
e444 th	=	0.84517		
PWX	=	0.00	kW	
WLcl/W25	=	0.03000		
WHcl/W25	=	0.06000		

Efficiencies:	isentr	polytr	RNI	P/P
Outer LPC	0.9000	0.9118	0.990	2.462
Inner LPC	0.8900	0.8928	0.990	1.200
HP Compressor	0.8700	0.9105	1.097	19.300
Burner	0.9995			0.970
HP Turbine	0.8800	0.8452	4.231	9.422
LP Turbine	0.8810	0.7786	0.759	146.437

HP Spool mech Eff 0.9900 Nom Spd 14000 rpm
LP Spool mech Eff 1.0000 Nom Spd 8000 rpm

hum [%]	war0	FHV	Fuel
0.0	0.00000	42.076	JP-10

Composed Values:
1: FanDia = 1.200000

Iteration Variables:
Outer Fan Pressure Ratio (1...5) = 2.46175
Inlet Corr. Flow W2Rstd kg/s (10...500) = 203.548

Iteration Targets:
cp_val1 = 1.2
Net Thrust = 30.33

Fan Dia = 1.2 m

Station	W kg/s	T K	P kPa	WRstd kg/s
amb		288.15	101.325	
1	145.526	288.15	101.325	
2	145.526	288.15	100.312	146.996
13	111.493	305.72	120.374	96.668
21	34.033	305.52	120.374	29.498
25	34.033	305.52	119.170	29.796
3	33.012	754.46	2307.138	2.346
31	28.928	754.46	2307.138	
4	29.296	1200.00	2237.924	2.704
41	30.998	1176.65	2237.924	2.834
43	30.998	731.26	236.304	
44	33.040	732.67	236.304	
45	33.040	732.67	231.578	23.033
49	33.040	661.42	148.549	
5	34.061	659.01	148.549	35.108
8	34.061	659.01	145.578	35.824
18	111.493	305.72	117.967	98.641
Bleed	0.340	754.46	2307.137	

FN	=	30.33	kN	
TSFC	=	12.1160	g/(kN*s)	
WF	=	0.36744	kg/s	
BPR	=	3.2760		
s NOx	=	0.7037		
Core Eff	=	0.2907		
Prop Eff	=	0.0000		
P3/P2	=	23.00		
P2/P1	=	0.9900		
P16/P13	=	0.9800		
P25/P21	=	0.9900		
P45/P44	=	0.9800		
P6/P5	=	0.9800		
A8	=	0.16549	m²	
A18	=	0.61242	m²	
P8/Pamb	=	1.43674		
P18/Pamb	=	1.16424		
WBld/W25	=	0.01000		
CD8	=	0.96414		
CD18	=	0.93409		
XM8	=	0.74558		
XM18	=	0.47124		
V18/V8,id	=	0.44734		
Loading	=	100.00	%	
e444 th	=	0.84513		
PWX	=	0.00	kW	
WLcl/W25	=	0.03000		
WHcl/W25	=	0.06000		

Efficiencies:	isentr	polytr	RNI	P/P
Outer LPC	0.8768	0.8800	0.990	1.200
Inner LPC	0.8871	0.8900	0.990	1.200
HP Compressor	0.8700	0.9106	1.097	19.360
Burner	0.9995			0.970
HP Turbine	0.8800	0.8451	4.244	9.471
LP Turbine	0.8810	0.8747	0.759	1.559

HP Spool mech Eff 0.9900 Nom Spd 14000 rpm
LP Spool mech Eff 1.0000 Nom Spd 8000 rpm

hum [%]	war0	FHV	Fuel
0.0	0.00000	42.076	JP-10

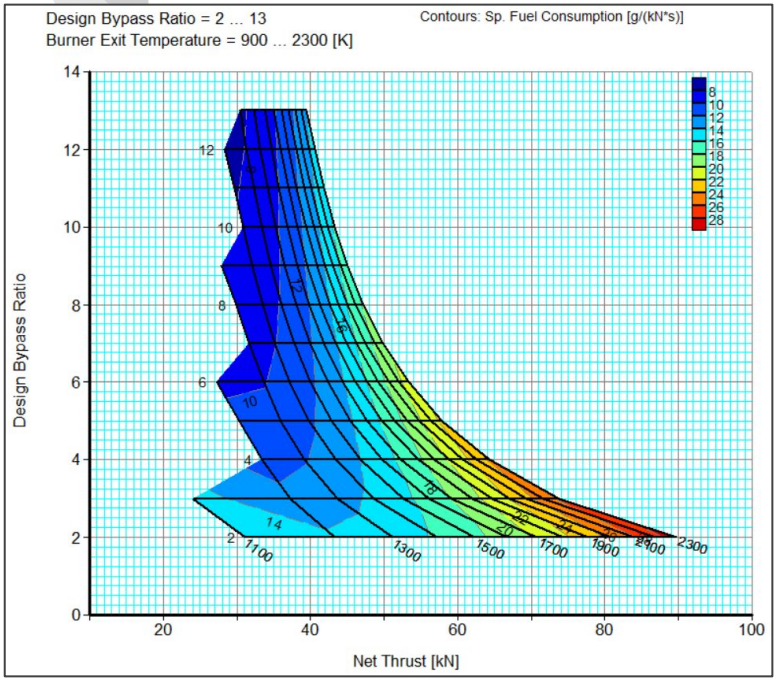
Composed Values:
1: Altitude = 0.000000
2: Fan_diameter = 0.980000

Iteration Variables:
Inlet Corr. Flow W2Rstd kg/s (10...300) = 146.996
Design Bypass Ratio (0...10) = 3.27598

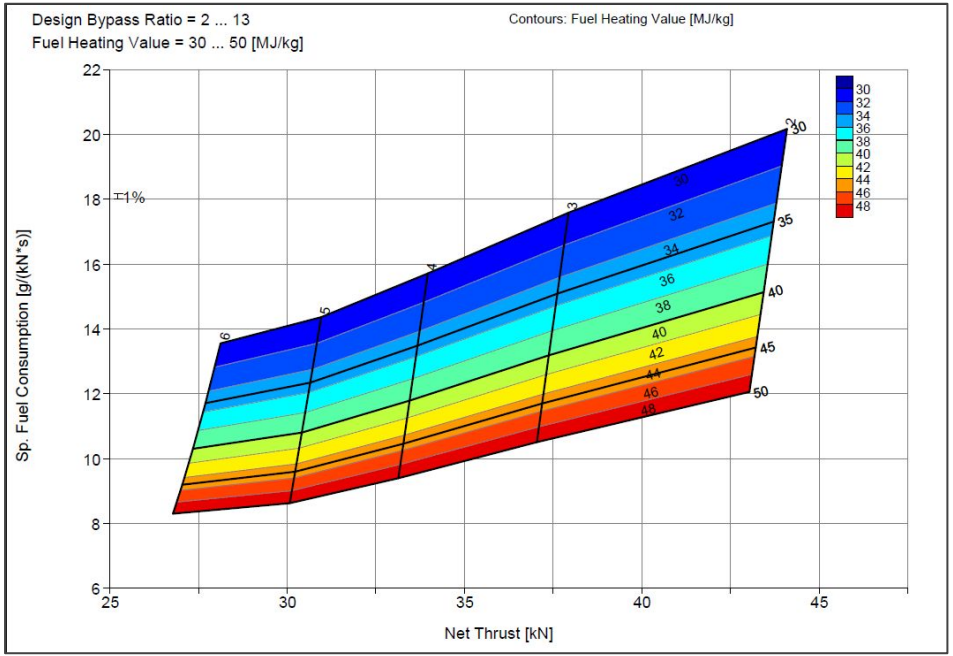
Iteration Targets:
Net Thrust = 30.33
cp_val2 = 0.98

Fan Diameter = 0.98 m

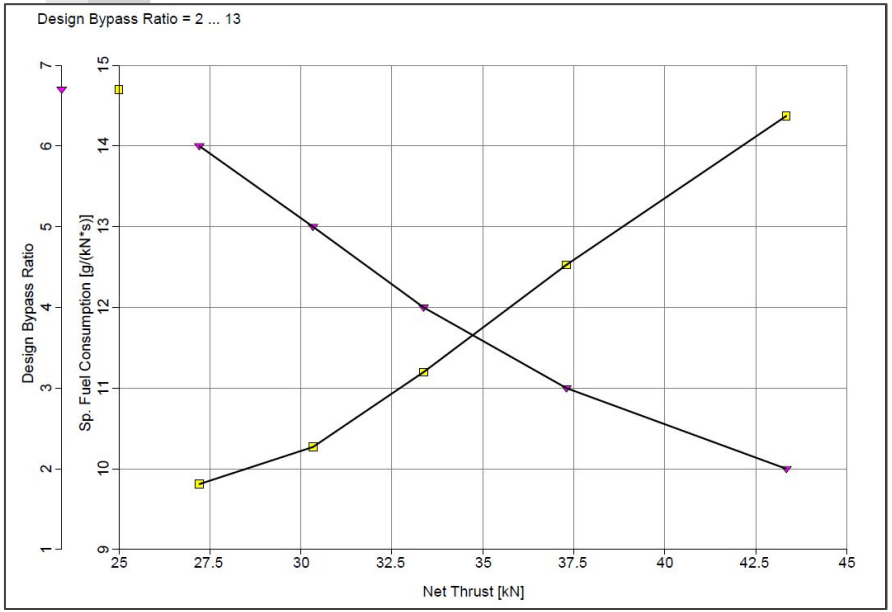
Parametric Analysis (Ground Condition)

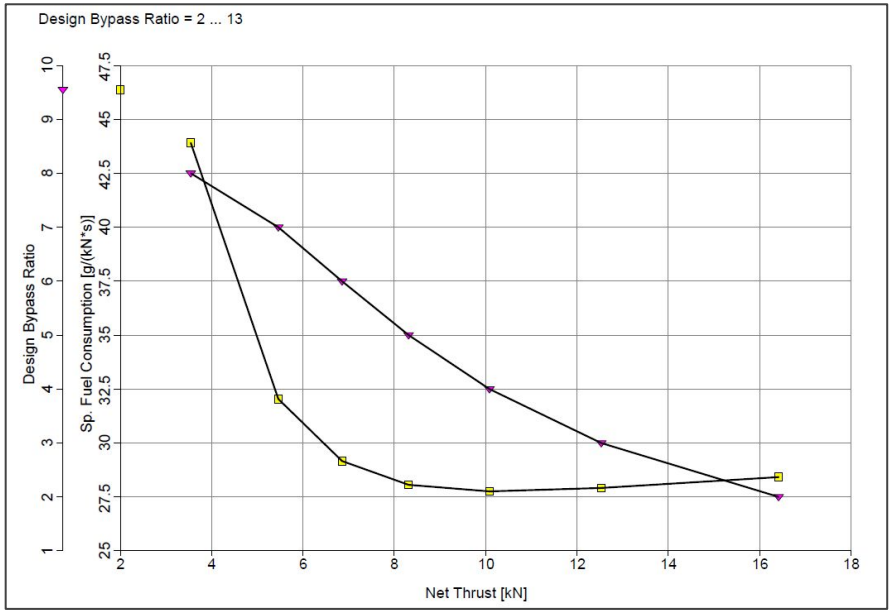


BPR VS Net Thrust with TIT Contour



TSFC VS Net Thrust with FHV Contour





BPR, TSFC vs Net thrust (Ground Condition)

BPR, TSFC vs Net thrust (h = 5 km)

Cruise Condition Analysis

Altitude	m	12000
Delta T from ISA	K	10
Relative Humidity [%]		0
Mach Number		0.8

Intake Pressure Ratio		0.99
No (0) or Average (1) Core dP/P		1
Inner Fan Pressure Ratio		1.2
Outer Fan Pressure Ratio		1.2
Compr. Interduct Press. Ratio		0.99
HP Compressor Pressure Ratio		19.36
Bypass Duct Pressure Ratio		0.98
Turb. Interd. Ref. Press. Ratio		0.98
Design Bypass Ratio		2.82973
Burner Exit Temperature	K	1200
Burner Design Efficiency		0.9995
Burner Partload Constant		1.6
Fuel Heating Value	MJ/kg	42.0755
Overboard Bleed	kg/s	0
Power Offtake	kW	0
HP Spool Mechanical Efficiency		0.99
LP Spool Mechanical Efficiency		1
Burner Pressure Ratio		0.97
Turbine Exit Duct Press Ratio		0.98

Station	W kg/s	T K	P kPa	WRstd kg/s
amb		226.65	19.330	
1	44.940	255.72	29.474	
2	44.940	255.72	29.179	147.012
13	33.205	271.34	35.015	93.244
21	11.734	271.16	35.015	32.941
25	11.734	271.16	34.665	33.273
3	11.382	674.94	671.108	2.630
31	9.974	674.94	671.108	
4	10.122	1200.00	650.974	3.212
41	10.709	1172.82	650.974	3.360
43	10.709	780.08	94.448	
44	11.413	773.74	94.448	
45	11.413	773.74	92.559	20.454
49	11.413	718.07	66.646	
5	11.765	712.31	66.646	28.098
8	11.765	712.31	65.313	28.671
18	33.205	271.34	34.315	95.147
Bleed	0.117	674.94	671.108	

Efficiencies:	isentr	polytr	RNI	P/P
Outer LPC	0.8768	0.8800	0.332	1.200
Inner LPC	0.8871	0.8900	0.332	1.200
HP Compressor	0.8700	0.9109	0.368	19.360
Burner	0.9995			0.970
HP Turbine	0.8800	0.8510	1.239	6.892
LP Turbine	0.8810	0.8764	0.285	1.389

HP Spool mech Eff 0.9900 Nom Spd 14000 rpm
LP Spool mech Eff 1.0000 Nom Spd 8000 rpm

hum [%]	war0	FHV	Fuel
0.0	0.00000	42.076	JP-10

FN	=	6.30 kN
TSFC	=	23.5167 g/(kN*s)
WF	=	0.14816 kg/s
BPR	=	2.8297
s NOx	=	0.2852
Core Eff	=	0.4358
Prop Eff	=	0.7754
P3/P2	=	23.00
P2/P1	=	0.9900
P16/P13	=	0.9800
P25/P21	=	0.9900
P45/P44	=	0.9800
P6/P5	=	0.9800
A8	=	0.12245 m²
A18	=	0.40641 m²
P8/Pamb	=	3.37878
P18/Pamb	=	1.77516
WBld/W25	=	0.01000
CD8	=	0.98000
CD18	=	0.97297
XM8	=	1.00000
XM18	=	0.94359
V18/V8,id	=	0.44063
Loading	=	100.00 %
e444 th	=	0.84891
PWX	=	0.00 kW
WLcl/W25	=	0.03000
WHcl/W25	=	0.06000

Composed Values:
1: Altitude = 12000.000000
2: Fan_diameter = 0.980000

Iteration Variables:
Inlet Corr. Flow W2Rstd kg/s (10...300) = 147.012
Design Bypass Ratio (0...10) = 2.82973

Iteration Targets:
Net Thrust = 6.3
cp_val2 = 0.98

Replication of the given Cruise Conditions

Station	W kg/s	T K	P kPa	WRstd kg/s			
amb		226.65	19.330		FN	=	6.30 kN
1	67.382	255.72	29.474		TSFC	=	21.7293 g/(kN*s)
2	67.382	255.72	29.179	220.427	WF	=	0.13689 kg/s
13	56.539	271.34	35.015	158.768	BPR	=	5.2145
21	10.843	271.16	35.015	30.437	s NOx	=	0.2852
25	10.843	271.16	34.665	30.744	Core Eff	=	0.4358
3	10.517	674.94	671.108	2.430	Prop Eff	=	0.8380
31	9.216	674.94	671.108		P3/P2	=	23.00
4	9.353	1200.00	650.974	2.968	P2/P1	=	0.9900
41	9.895	1172.82	650.974	3.104	P16/P13	=	0.9800
43	9.895	780.08	94.448		P25/P21	=	0.9900
44	10.546	773.74	94.448		P45/P44	=	0.9800
45	10.546	773.74	92.559	18.900	P6/P5	=	0.9800
49	10.546	682.90	53.466		A8	=	0.13744 m²
5	10.871	678.05	53.466	31.575	A18	=	0.69200 m²
8	10.871	678.05	52.396	32.220	P8/Pamb	=	2.71057
18	56.539	271.34	34.315	162.008	P18/Pamb	=	1.77516
Bleed	0.108	674.94	671.108		WBld/W25	=	0.01000
					CD8	=	0.98000

Efficiencies:	isentr	polytr	RNI	P/P
Outer LPC	0.8768	0.8800	0.332	1.200
Inner LPC	0.8871	0.8900	0.332	1.200
HP Compressor	0.8700	0.9109	0.368	19.360
Burner	0.9995			0.970
HP Turbine	0.8800	0.8510	1.239	6.892
LP Turbine	0.8810	0.8732	0.285	1.731

CD18	=	0.97297					
XM8	=	1.00000					
XM18	=	0.94359					
V18/V8,id	=	0.49225					
Loading	=	100.00	%				
e444 th	=	0.84891					
PWX	=	0.00	kW				
HP Spool mech Eff	0.9900	Nom Spd	14000	rpm	WLcl/W25	=	0.03000
LP Spool mech Eff	1.0000	Nom Spd	8000	rpm	WHcl/W25	=	0.06000

hum [%]	war0	FHV	Fuel
0.0	0.00000	42.076	JP-10

Composed Values:
1: Altitude = 12000.000000
2: Fan_diameter = 1.200000

Iteration Variables:
Inlet Corr. Flow W2Rstd kg/s (10...300) = 220.427
Design Bypass Ratio (0...10) = 5.21453

Iteration Targets:
Net Thrust = 6.3
cp_val2 = 1.2

Fan Dia = 1.2 m

Station	W kg/s	T K	P kPa	WRstd kg/s			
amb		226.65	19.330		FN	=	6.30 kN
1	44.940	255.72	29.474		TSFC	=	23.5167 g/(kN*s)
2	44.940	255.72	29.179	147.012	WF	=	0.14816 kg/s
13	33.205	271.34	35.015	93.244	BPR	=	2.8297
21	11.734	271.16	35.015	32.941	s NOx	=	0.2852
25	11.734	271.16	34.665	33.273	Core Eff	=	0.4358
3	11.382	674.94	671.108	2.630	Prop Eff	=	0.7754
31	9.974	674.94	671.108		P3/P2	=	23.00
4	10.122	1200.00	650.974	3.212	P2/P1	=	0.9900
41	10.709	1172.82	650.974	3.360	P16/P13	=	0.9800
43	10.709	780.08	94.448		P25/P21	=	0.9900
44	11.413	773.74	94.448		P45/P44	=	0.9800
45	11.413	773.74	92.559	20.454	P6/P5	=	0.9800
49	11.413	718.07	66.646		A8	=	0.12245 m²
5	11.765	712.31	66.646	28.098	A18	=	0.40641 m²
8	11.765	712.31	65.313	28.671	P8/Pamb	=	3.37878
18	33.205	271.34	34.315	95.147	P18/Pamb	=	1.77516
Bleed	0.117	674.94	671.108		WBld/W25	=	0.01000
					CD8	=	0.98000

Efficiencies:	isentr	polytr	RNI	P/P
Outer LPC	0.8768	0.8800	0.332	1.200
Inner LPC	0.8871	0.8900	0.332	1.200
HP Compressor	0.8700	0.9109	0.368	19.360
Burner	0.9995			0.970
HP Turbine	0.8800	0.8510	1.239	6.892
LP Turbine	0.8810	0.8764	0.285	1.389

CD18	=	0.97297					
XM8	=	1.00000					
XM18	=	0.94359					
V18/V8,id	=	0.44063					
Loading	=	100.00	%				
e444 th	=	0.84891					
PWX	=	0.00	kW				
HP Spool mech Eff	0.9900	Nom Spd	14000	rpm	WLcl/W25	=	0.03000
LP Spool mech Eff	1.0000	Nom Spd	8000	rpm	WHcl/W25	=	0.06000

hum [%]	war0	FHV	Fuel
0.0	0.00000	42.076	JP-10

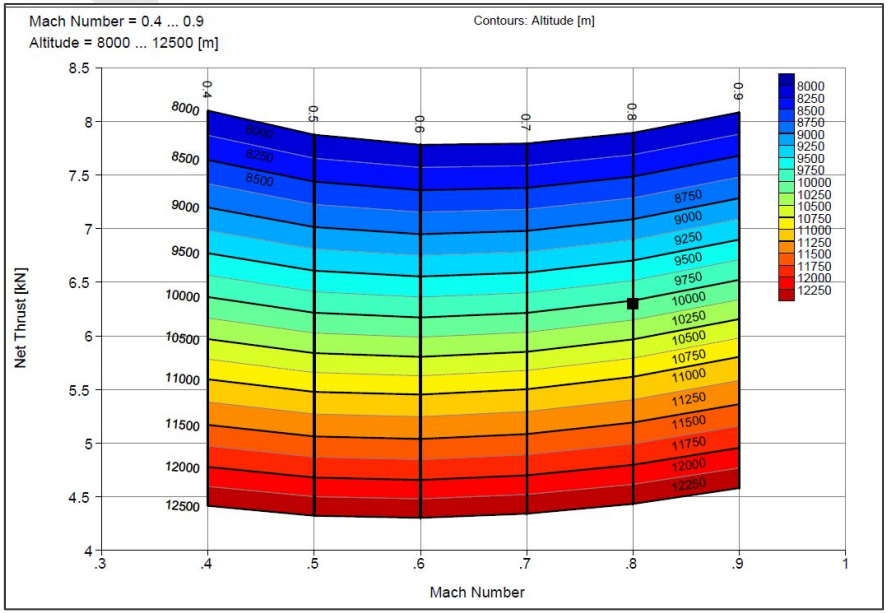
Composed Values:
1: Altitude = 12000.000000
2: Fan_diameter = 0.980000

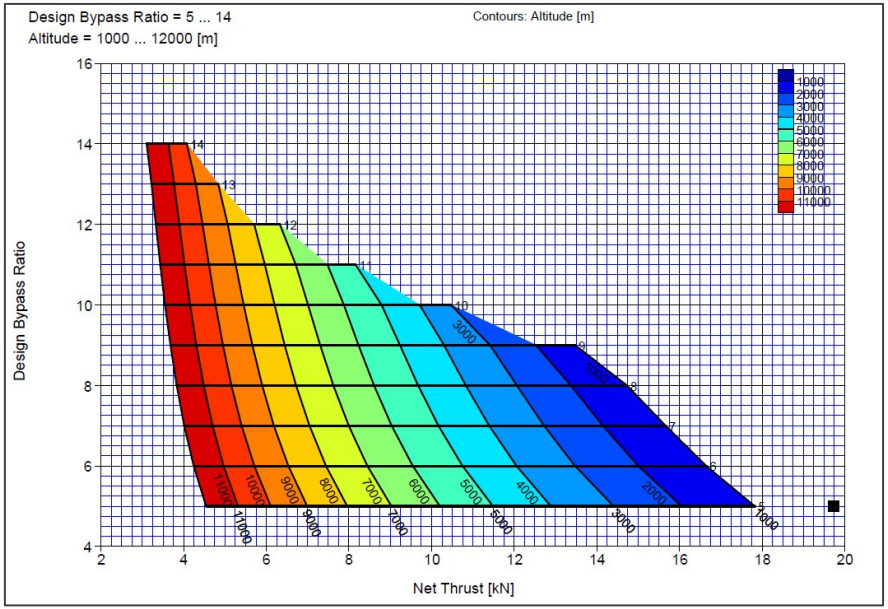
Iteration Variables:
Inlet Corr. Flow W2Rstd kg/s (10...300) = 147.012
Design Bypass Ratio (0...10) = 2.82973

Iteration Targets:
Net Thrust = 6.3
cp_val2 = 0.98

Fan Dia = 0.98 m

Cruise Condition





Net Thrust VS Mach Number keeping TIT and OPR Constant

BPR VS Net Thrust keeping TIT & OPR Constant

Geared Turbofan Engine

Altitude	m	0
Delta T from ISA	K	0
Relative Humidity [%]		0
Mach Number		0
Intake Pressure Ratio		0.99
No (0) or Average (1) Core dP/P		1
Inner Fan Pressure Ratio		1.34
Outer Fan Pressure Ratio		5.47329
Core Inlet Duct Press. Ratio		1
IP Compressor Pressure Ratio		4
Compr. Interduct Press. Ratio		0.98
HP Compressor Pressure Ratio		4.42
Bypass Duct Pressure Ratio		0.975
Turb. Interd. Ref. Press. Ratio		0.98
Design Bypass Ratio		5
Burner Exit Temperature	K	1200
Burner Design Efficiency		0.9995
Burner Partload Constant		1.6
Fuel Heating Value	MJ/kg	42.0755
Overboard Bleed	kg/s	0
Power Offtake	kW	0
HP Spool Mechanical Efficiency		0.98
Gear Ratio		1
LP Spool Mechanical Efficiency		1
Burner Pressure Ratio		0.95
Turbine Exit Duct Press Ratio		0.99

Ground Condition

Ground Condition Analysis

Station	W kg/s	T K	P kPa	WRstd kg/s
amb		288.15	101.325	
2	134.398	288.15	100.312	135.755
13	111.998	491.35	549.035	26.991
21	22.400	316.99	134.418	17.710
22	22.400	316.99	134.418	17.710
24	22.400	498.32	537.671	5.551
25	22.400	498.32	526.918	5.664
3	21.952	789.10	2328.976	1.580
31	19.488	789.10	2328.976	
4	19.717	1200.00	2212.527	1.841
41	20.837	1178.82	2212.527	1.929
43	20.837	889.71	613.103	
44	22.181	883.71	613.103	
45	22.181	883.71	600.841	6.546
49	22.181	288.15	0.237	
5	22.629	296.58	0.237	9803.362
8	22.629	296.58	0.235	9902.386
18	111.998	491.35	535.309	27.683
Bleed	0.000	789.10	2328.974	

FN	=	30.33	kN	
TSFC	=	7.5514	g/(kN*s)	
WF	=	0.2290	kg/s	
s NOX	=	0.8441		
Core Eff	=	0.2902		
Prop Eff	=	0.0000		
BPR	=	5.0000		
P2/P1	=	0.9900		
P3/P2	=	23.22		
P5/P2	=	0.0024		
P16/P6	=	2280.45705		
P16/P2	=	5.33645		
P6/P5	=	0.99000		
A8	=	0.07396	m²	
A18	=	0.11782	m²	
XM8	=	-2.18678		
XM18	=	1.00000		
WBld/W2	=	0.00000		
CD8	=	0.78046		
CD18	=	0.97600		
PWX	=	0.0	kW	
V18/V8,id	=	-0.37933		
WBLD/W22	=	0.00000		
Wreci/W25	=	0.00000		
Loading	=	100.00	%	
e444 th	=	0.86641		
WBLD/W25	=	0.00000		
WHNGV/W25	=	0.05000		
WHcl/W25	=	0.06000		
P6/P5	=	0.9900		
P16/P13	=	0.9750		

Efficiency	isentr	polytr	RNI	P/P
Outer LPC	0.8780	0.9029	0.990	5.473
Inner LPC	0.8700	0.8753	0.990	1.340
IP Compressor	0.8400	0.8673	1.185	4.000
HP Compressor	0.8500	0.8761	2.707	4.420
Burner	0.9995			0.950
HP Turbine	0.9050	0.8900	4.187	3.609
LP Turbine	0.9000	3.0668	1.5822	534.033

HP Spool mech Eff 0.9800 Nom Spd 14000 rpm
LP Spool mech Eff 1.0000 Nom Spd 8000 rpm

P22/P21=1.0000 P25/P24=0.9800 P45/P44=0.9800

hum [%]	war0	FHV	Fuel
0.0	0.00000	42.076	JP-10

Composed Values:
1: Altitude = 0.000000
2: FanDia = 0.980000

Iteration Variables:
Inlet Corr. Flow W2Rstd kg/s (50...500) = 135.755
Outer Fan Pressure Ratio (1...10) = 5.47329

Iteration Targets:
Net Thrust = 30.33
cp_val2 = 0.98

Fan Dia = 0.98 m

Station	W kg/s	T K	P kPa	WRstd kg/s
amb		288.15	101.325	
2	201.513	288.15	100.312	203.548
13	167.927	431.72	359.612	57.916
21	33.585	316.99	134.418	26.554
22	33.585	316.99	134.418	26.554
24	33.585	498.32	537.671	8.323
25	33.585	498.32	526.918	8.493
3	32.914	789.10	2328.976	2.370
31	29.219	789.10	2328.976	
4	29.563	1200.00	2212.527	2.761
41	31.242	1178.82	2212.527	2.892
43	31.242	889.71	613.103	
44	33.257	883.71	613.103	
45	33.257	883.71	600.841	9.814
49	33.257	288.15	0.237	
5	33.929	296.58	0.237	14698.919
8	33.929	296.58	0.235	14847.393
18	167.927	431.72	350.622	59.401
Bleed	0.000	789.10	2328.974	

FN	=	30.33	kN	
TSFC	=	11.3237	g/(kN*s)	
WF	=	0.3434	kg/s	
s NOX	=	0.8441		
Core Eff	=	0.2902		
Prop Eff	=	0.0000		
BPR	=	5.0000		
P2/P1	=	0.9900		
P3/P2	=	23.22		
P5/P2	=	0.0024		
P16/P6	=	1493.67632		
P16/P2	=	3.49532		
P6/P5	=	0.99000		
A8	=	0.11089	m²	
A18	=	0.25252	m²	
XM8	=	-2.18678		
XM18	=	1.00000		
WBld/W2	=	0.00000		
CD8	=	0.78046		
CD18	=	0.97600		
PWX	=	0.0	kW	
V18/V8,id	=	-0.31564		
WBLD/W22	=	0.00000		
Wreci/W25	=	0.00000		
Loading	=	100.00	%	
e444 th	=	0.86641		
WBLD/W25	=	0.00000		
WHNGV/W25	=	0.05000		
WHcl/W25	=	0.06000		
P6/P5	=	0.9900		
P16/P13	=	0.9750		

Efficiency	isentr	polytr	RNI	P/P
Outer LPC	0.8780	0.8975	0.990	3.585
Inner LPC	0.8700	0.8753	0.990	1.340
IP Compressor	0.8400	0.8673	1.185	4.000
HP Compressor	0.8500	0.8761	2.707	4.420
Burner	0.9995			0.950
HP Turbine	0.9050	0.8900	4.187	3.609
LP Turbine	0.9000	3.0668	1.5822	534.033

HP Spool mech Eff 0.9800 Nom Spd 14000 rpm
LP Spool mech Eff 1.0000 Nom Spd 8000 rpm

P22/P21=1.0000 P25/P24=0.9800 P45/P44=0.9800

hum [%]	war0	FHV	Fuel
0.0	0.00000	42.076	JP-10

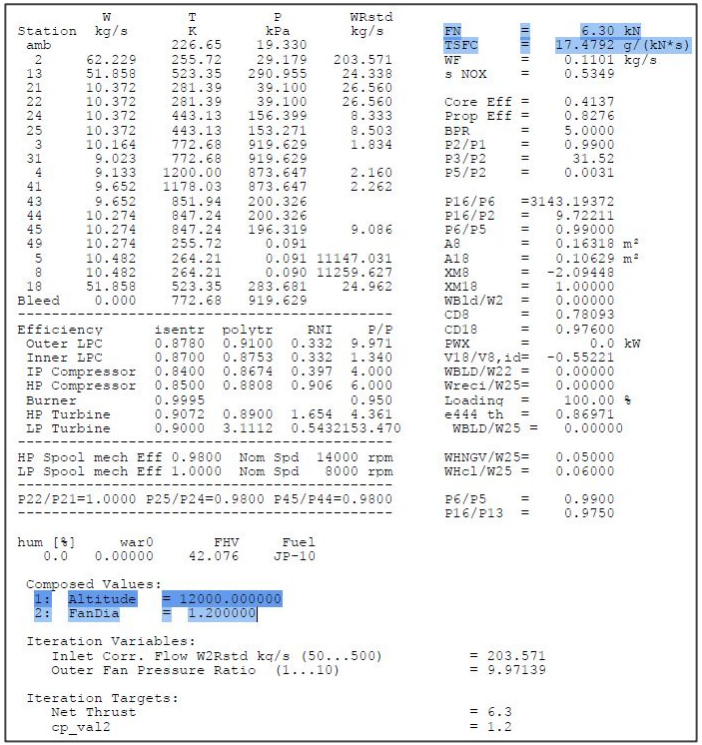
Composed Values:
1: Altitude = 0.000000
2: FanDia = 1.200000

Iteration Variables:
Inlet Corr. Flow W2Rstd kg/s (50...500) = 203.548
Outer Fan Pressure Ratio (1...10) = 3.58495

Iteration Targets:
Net Thrust = 30.33
cp_val2 = 1.2

Fan Dia = 1.2 m

Cruise Condition Analysis



Station	W kg/s	T K	P kPa	WRstd kg/s
amb		226.65	19.330	
2	62.229	255.72	29.179	203.571
13	51.858	523.35	290.955	24.338
21	10.372	281.39	39.100	26.560
22	10.372	281.39	39.100	26.560
24	10.372	443.13	156.399	8.333
25	10.372	443.13	153.271	8.503
3	10.164	772.68	919.629	1.834
31	9.023	772.68	919.629	
4	9.133	1200.00	873.647	2.160
41	9.652	1178.03	873.647	2.262
43	9.652	851.94	200.326	
44	10.274	847.24	200.326	
45	10.274	847.24	196.319	9.086
49	10.274	255.72	0.091	
5	10.482	264.21	0.091	11147.031
8	10.482	264.21	0.090	11259.627
18	51.858	523.35	283.681	24.962
Bleed	0.000	772.68	919.629	

Efficiency	isentr	polytr	RNI	P/P
Outer LPC	0.8780	0.9100	0.332	9.971
Inner LPC	0.8700	0.8753	0.332	1.340
IP Compressor	0.8400	0.8674	0.397	4.000
HP Compressor	0.8500	0.8808	0.906	6.000
Burner	0.9995			0.950
HP Turbine	0.9072	0.8900	1.654	4.361
LP Turbine	0.9000	3.1112	0.5432	53.470

HP Spool mech Eff 0.9800 Nom Spd 14000 rpm
LP Spool mech Eff 1.0000 Nom Spd 8000 rpm

P22/P21=1.0000 P25/P24=0.9800 P45/P44=0.9800

hum [%]	war0	FHV	Fuel
0.0	0.00000	42.076	JP-10

Composed Values:
1: Altitude = 12000.000000
2: FanDia = 1.200000

Iteration Variables:
Inlet Corr. Flow W2Rstd kg/s (50...500) = 203.571
Outer Fan Pressure Ratio (1...10) = 9.97139

Iteration Targets:
Net Thrust = 6.3
cp_val2 = 1.2

FN	=	6.30 kN
TSFC	=	17.4792 g/(kN*s)
WF	=	0.1101 kg/s
s NOX	=	0.5349
Core Eff	=	0.4137
Prop Eff	=	0.8276
BPR	=	5.0000
P2/P1	=	0.9900
P3/P2	=	31.52
P5/P2	=	0.0031
P16/P6	=	3143.19372
P16/P2	=	9.72211
P6/P5	=	0.99000
A8	=	0.16318 m²
A18	=	0.10629 m²
XM8	=	-2.09448
XM18	=	1.00000
WBld/W2	=	0.00000
CD8	=	0.78093
CD18	=	0.97600
PWX	=	0.0 kW
V18/V8,id	=	-0.55221
WBLD/W22	=	0.00000
Wreci/W25	=	0.00000
Loading	=	100.00 %
e444 th	=	0.86971
WBLD/W25	=	0.00000
WHNGV/W25	=	0.05000
WHcl/W25	=	0.06000
P6/P5	=	0.9900
P16/P13	=	0.9750

Fan Dia = 1.2 m

Comparison

- Fan Diameter = 0.98 m

TSFC	RR AE3007A	Geared Turbofan
Ground (h = 0 km)	12.1160	7.5514
Cruise (h = 5 km)	23.5167	-

- Fan Diameter = 1.2 m

TSFC	RR AE3007A	Geared Turbofan
Ground (h = 0 km)	11.9756	11.3237
Cruise (h = 5 km)	21.7293	17.4792

Conclusion

As the TSFC is lower for the “**Geared Turbofan Engine”** as compare to RR AE30007A engine, the “**Geared Turbofan Engine”** is better in terms of fuel economy.