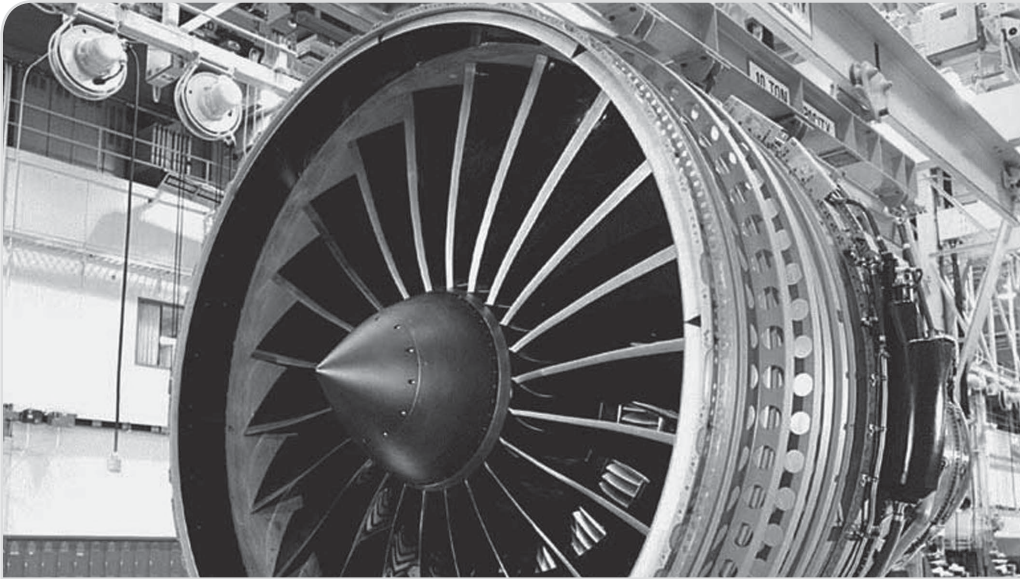


Appendix J Propulsion Data



- Allison T56-A-15, 5000-hp Turboprop
- WRI FJ 44 Family of Turbofans
- F 119 Class Afterburning Turbofan
- AE 3007H, 8000-lb Class Turbofan
- Honeywell TFE 731 Family of Turbofans
- GE 90 98,000-lb Class Turbofan

GE 90 high-bypass turbofan engine, which has an overall pressure ratio of 40, a bypass ratio over 8, and SLS thrust levels of 76,000 to 115,000 lb. It is the largest and highest thrust engine as of 2010; its thrust to engine weight of over 6 raises the bar throughout the engine community.

*Given enough thrust,
you can make anything fly.*

Ben Rich

J.1 Design Tasks and Propulsion Data

Very early in the conceptual design phase the designer will need information on the propulsion system to conduct the following design tasks:

- Flight envelope (Chapter 4), need engine operating envelope (Fig. 4.6)
- Estimate TOGW (Chapter 5), need engine fuel consumption (cruise, combat)
- Estimate wing loading (Chapter 6), need engine thrust (cruise, takeoff, combat, ceiling)
- Estimate fuselage length and c.g., need engine dimensions and weight
- Estimate takeoff distance (Chapter 10), need engine takeoff thrust
- Design inlet (Chapter 15), need turbine engine airflow
- Thrust sizing (Chapter 18), need engine thrust

J.2 Gas Turbine Engines

An excellent place to start for gas turbine engines is to review the summary data contained in Table J.1. This table can be kept current by adding new engine data from *Aviation Week and Space Technology* magazine, which publishes new engine data once each year (in January). The turbine engine data can be scaled up and down in thrust using the scaling information contained in Chapter 18.

J.3 Piston, Turboprop, and Turbofan Engines

Figure 14.2 contains a summary review of turboprop and piston aircraft engines. Chapter 14 discusses turbochargers for piston engines. Figure J.1 is the three-stage turbocharger for the HAARP aircraft example and is discussed in Section 14.2.1. Figure J.2 shows typical weights of the turbochargers, intercoolers, heat exchangers, and ducting as a function of maximum horsepower and altitude. Propulsion system information is contained in this appendix and elsewhere in the book:

- **F-100-PW-100** (afterburning turbofan), Table 14.3 and Fig. 14.8
- **TF-39-GE-1** [high-bypass-ratio (BPR) turbofan], Table 14.4 and Fig. 14.9
- **Lycoming O-360-A** (185-hp piston engine), Table 14.1
- **Allison T56-A-15** (5000-hp turboprop), Fig. J.3
- **WRI FJ 44 family** (2400-lb-class turbofan), Table J.2
- **F 119 class** (afterburning turbofan), Table J.3
- **AE 3007H** (8000-lb-class turbofan), Table J.4 and Fig. J.4
- **Honeywell TFE 731** (4000-lb-class turbofan), Table J.5 and Fig. J.5
- **GE 90 Turbofan** (98,000-lb-class turbofan), Table J.6

Table J.1 Turbine Engine Summary

Manufacture/ Model		Takeoff Conditions													
		Thrust		SFC							Max	Fan		Max	Application/ Comments
		Dry	A/B	Dry	A/B	FPR	OPR	BPR	Wa	Weight	Dia	Dia	Length	T/W	
		(SLS-lb)		(lb/s/lb)					(lbm/s)	(lb)	(in.)	(in.)	(in.)	(lb/lb)	
Honeywell (ex-Allied-Signal)															
F109-GA-100	Dry	1330		0.396			20.7	5.0		439	29.8	23.5	44.5	3.030	Squalus
TFE731-20	Dry	3641		0.440		1.54	14.3	3.7	123.0	836	39.4	34.2	59.7	4.355	Learjet 45
JETEC	Dry	4000		≤0.8			25+	2.5	55.0			19.0			
TFE731-40	Dry	4248		0.463			22.0			885	39.4	28.2	51.0	4.800	Falcon 50EX, IAI Astra APX
TFE731-5	Dry	4304		0.484			14.6	3.5	143.0	852	42.5	33.8	65.5	5.052	BAe 125, C101
TFE731-5A	Dry	4500		0.469			14.0	3.3	139.7	988	42.5	33.8	72.0	4.555	Falcon 900EX
TFE731-1042	Dry	4585		0.698											
TFE731-60	Dry	4999		0.409			22.0			988	42.5	30.7	72.0	5.060	Falcon 900EX
ATF3	Dry	5316		0.511							33.9		103.2		
ATF3-3	Dry	5440		0.506			22.8			1118	33.9		103.2	4.866	Falcon 2000, Guardian
ATF3-6A	Dry	5440		0.503			21.3			1125	33.9		102.3	4.836	Falcon 2000, Guardian
CFE738-1-1B	Dry	5918		0.351		1.60	35.0	5.3	210	1325	47.7	35.5	98.7	4.466	Falcon 2000, Guardian
F124	Dry	6332		0.788							36.0	23.3	66.8		
F124-GA-100	Dry	6400		0.810			19.4	0.5	93.8	1100	36.0	23.3	66.8	5.818	Aero Vodochody L-159 (dry)
F125-GA-100	A/B	6060	9491	0.785	1.98		19.0	0.5	92.60	1360	33.4	23.3	140.2	6.979	ROC IDF (A/B)
AS907	Dry	6619		0.398											
AS907	Dry	6500		0.420			21.0			1364	46.3		92.4	4.765	Bombardier Continental Jet

(continued)

Manufacture/ Model		Takeoff Conditions													Application/ Comments
		Thrust		SFC							Max	Fan		Max	
		Dry	A/B	Dry	A/B	FPR	OPR	BPR	Wa	Weight	Dia	Dia	Length	T/W	
		(SLS-lb)		(lb/s/lb)					(lbm/s)	(lb)	(in.)	(in.)	(in.)	(lb/lb)	
AE3007		7150		0.39			24.0	5		1581	43.5	38.5	106.5	4.522	Citation 10, Embraer ERJ-135, ERJ145, TII+
AE3007A		7580		0.39			24.0	5.3	260	1586	43.5	38.5	106.5	4.779	Citation 10, Embraer ERJ-135, ERJ145, TII+
AE3007C		6495		0.39			24.0	5.3	240	1581	43.5	38.5	106.5	4.108	Citation 10, Embraer ERJ-135, ERJ145, TII+
GEAE															
CF700		4501	—	0.651	—	1.60	6.22	2	130	767	33.0	33.0	53.6	5.868	Sabreline 75A, Falcon D/E/F
J85-GE-13		2720	4080	1.03	2.22	—	7.0	—	44	597	17.7	16.1	105.0	6.834	F-5B
J85-GE-17		2700	2850	0.99	—	—	7.0	—	44	400	17.7	16.1	40.4	7.125	Cessna A-37B
J85-21		3500	5000	1.00	2.13	—	8.3	—	53	684	21.0	18.1	112.5	7.310	F-5E
CFE738-1		5918	—	0.371	—	1.60	35.0	5.3	210	1325	47.7	35.5	98.7	4.466	Falcon 2000 (joint w/Allied)
TF34-GE-100		9065	—	0.37	—	1.50	19.8	6.2	333	1440	46.0	46.0	100.0	6.295	Canadair Challenger, Canadair Regional Jet
CF34-3		9330	—	0.35	—	1.50	19.8	6.3	334	1670	44.0	44.0	82.3	5.587	Canadair Challenger, Canadair Regional Jet
CF34-8C1		13790	—	0.37	—	1.80	27.0	5.0	440	2215	52.0	52.0	128.5	6.226	Canadair CRJ-X
F101-GE-102		18473	33127	0.56	2.29	2.36	26.8	1.91	352	4468	57.8	36.1	180.8	7.414	B-1B Lancer

(continued)

Manufacture/ Model		Takeoff Conditions													Application/ Comments
		Thrust		SFC							Max	Fan		Max	
		Dry	A/B	Dry	A/B	FPR	OPR	BPR	Wa	Weight	Dia	Dia	Length	T/W	
		(SLS-lb)		(lb/s/lb)					(lbm/s)	(lb)	(in.)	(in.)	(in.)	(lb/lb)	
F110-GE-100		17265	28992	0.65	1.86	3.23	31.2	0.76	263	3923	46.5	36.1	187.6	7.390	F101 derivative fighter engine, F-16
F110-GE-400		16333	26950	0.67	1.85	3.19	30.4	0.83	270	4494	46.5	36.1	232.2	5.997	F-14B/D Tomcat
F110-GE-129		17595	29474	0.67	1.85	3.30	31.2	0.74	270	3940	46.5	36.1	187.6	7.481	Lockheed Martin F-16C/D, Boeing F-15E
F110-GE-129EFE		17669	33093	0.68	1.90	3.83	36.4	0.68	275	3990	46.5	36.1	185.3	8.294	
F118-GE-100		20187	—	0.66	—	3.44	34.0	0.76	290	3163	46.5	36.1	100.5	6.382	Non-AB F110 derivative for Northrop Grumman B-2
F118-GE-101		15940	—	0.65	—	3.26	32.8	0.72	251	3150	47.0	38.0	100.5	5.060	Lockheed Martin U-2S
F136-GE-100		26090	40490												LM/NG/BAES F-35A
F136-GE-400		26090	40490												LM/NG/BAES F-35C
F136-GE-600		—	40490												LM/NG/BAES F-35B
F404/F1D2		10600	—	0.80	—	4.10	25.0	0.37	145	1730	35.0	27.7	87.0	6.127	Lockheed Martin/ USAF F-117A
F404/RM12		12150	18100	0.81	1.79		27.0	0.28	152	2325	35.0	31.0	159.0	7.785	Swedish JAS 39
F404-GE-100D		11000	—	0.80	—	4.30	25.0	0.30	142	1802	35.0	31.0	89.0	6.104	Singapore A-4S, dry version
F404-GE-400		10650	16000	0.80	1.91	4.30	28.8	0.30	146	2185	35.0	28.0	159.0	7.323	F/A-18A/B/C/D
F404-GE-402		11900	17700	0.81	1.79	4.30	28.6	0.26	146	2230	35.0	28.0	159.0	7.937	F/A-18C/D
F404-GE-F2J3			18300	—	1.81		27.0		152	2335	35.0	35.0	159.0	7.837	Indian LCA fighter
F414-GE-400		14447	21496	0.82	1.844	4.49	29.7	0.29	168	2512	39.0	31.2	153.4	8.557	F/A-18E/F

Manufacture/ Model		Takeoff Conditions												
		Thrust		SFC							Max	Fan		Max
		Dry	A/B	Dry	A/B	FPR	OPR	BPR	Wa	Weight	Dia	Dia	Length	T/W
		(SLS-lb)		(lb/s/lb)					(lbm/s)	(lb)	(in.)	(in.)	(in.)	(lb/lb)
GE56		5800	10100	0.6				2.0	118	835	34.3	24.0	58.3	6.946
GE56		4424	—		—			2.0	90	637	30.0	21.0	52.3	6.946
GE56		12288	—		—			2.0	250	1907	49.9	34.9	78.7	6.444
CF6-6D	Dry	40000					24.3	5.72	1303	7896		86.4	177.0	5.066
CF6-6D1	Dry	41500					25.2	5.76	1328	7896		86.4	177.0	5.256
CF6-45A2	Dry	46500					26.3	4.64	1393	8768		86.4	173.0	5.303
CF6-50C	Dry	51000					29.3	4.26	1450	8721		86.4	173.0	5.848
CF6-50E	Dry	52500					30.1	4.24	1470	8490		86.4	173.0	6.184
CF6-50C1	Dry	52500					30.1	4.24	1470	8721		86.4	173.0	6.020
CF6-50E1	Dry	52500					30.1	4.24	1470	8490		86.4	173.0	6.184
CF6-50C2	Dry	52500					30.4	4.31	1476	8731		86.4	173.0	6.013
CF6-50E2	Dry	52500					30.4	4.31	1476	8768		86.4	173.0	5.988
CF6-50C2B	Dry	54000					31.1	4.25	1476	8731		86.4	173.0	6.185
CF6-50E2B	Dry	54000					30.9	4.24	1476	8768		86.4	173.0	6.159
CF6-50C2-F	Dry	46500					26.3	4.64	1393	8731		86.4	177.0	5.326
CF6-80A/A1	Dry	48000					28.0	4.66	1435	8420		86.4	157.4	5.701
CF6-80A2/A3	Dry	50000					29.0	4.59	1460	8420		86.4	157.4	5.938
CF6-80C2-A1	Dry	59000					30.4	5.15	1754	9135		93.0	160.9	6.459

(continued)

Manufacture/ Model		Takeoff Conditions													
		Thrust		SFC							Max	Fan		Max	Application/ Comments
		Dry	A/B	Dry	A/B	FPR	OPR	BPR	Wa	Weight	Dia	Dia	Length	T/W	
		(SLS-lb)		(lb/s/lb)					(lbm/s)	(lb)	(in.)	(in.)	(in.)	(lb/lb)	
CF6-80C2-A3	Dry	60200					31.1	5.09	1769	9135		93.0	160.9	6.590	A300-600, A310-300
CF6-80C2-A5	Dry	61500					31.5	5.05	1781	9135		93.0	160.9	6.732	A300-600
CF6-80C2-A2	Dry	53500					27.8	5.15	1677	9135		93.0	160.9	5.857	A310-300
CF6-80C2-B2	Dry	56700					29.3	5.19	1710	9135		93.0	160.9	6.207	B747-200, B747-300
CF6-80C2-B1F	Dry	57900					29.9	5.15		9135		93.0	160.9	6.338	B747-400
CF6-80C2-B2	Dry	52500					27.4	5.31	1650	9135		93.0	160.9	5.747	B767-200, B767-300, B767-200ER
CF6-80C2-B4	Dry	57900					29.9	5.15	1727	9135		93.0	160.9	6.338	B747-400
CF6-80C2-B6	Dry	60800					31.1	5.06	1790	9164		93.0	160.9	6.635	B767-300ER
CF6-80D1F	Dry	61500					31.5	5.05				93.0	160.9		MD-11
CF6-80E1	Dry	67500					32.7	5.20		10323		93.0		6.539	A330
GE90-B4	Dry	87400					39.3	8.40	3037	14185		123.0	192.8	6.161	B777
GE90-90B	Dry	90000					40.0				134.0		204.0		B777-200, B777-200IGW, B777-300
GE90-92B	Dry	92000					40.0				134.0		204.0		B777-200IGW, B777-300
CFM															
CFM56-2	Dry	22000		0.36			24.7	6.00	821	4612	72.0	68.3	95.7	4.770	DC8-70, KC135, E-3/KE-3/E6
CFM56-3	Dry	23500		0.39			22.6	5.00	655	4280	63.0	60.0	93.0	5.491	B737-300, B737-400, B737-500
CFM56-5-A1	Dry	25000		0.33			26.5	6.00	852	4860	72.0	68.3	95.4	5.144	A320
CFM56-5C-2	Dry	31200		0.32			31.5	6.60	1027	5700	76.6	72.3	103.0	5.474	A340
CFM56-5C-3	Dry	32500		0.32			32.6	6.60	1027	5700	76.6	72.3	103.0	5.702	A340
CFM56-5C-4	Dry	34000		0.33			33.9	6.60	1027	5700	76.6	72.3	103.0	5.965	A340

Manufacture/ Model		Takeoff Conditions													
		Thrust		SFC							Max	Fan		Max	Application/ Comments
		Dry	A/B	Dry	A/B	FPR	OPR	BPR	Wa	Weight	Dia	Dia	Length	T/W	
		(SLS-lb)		(lb/s/lb)					(lbm/s)	(lb)	(in.)	(in.)	(in.)	(lb/lb)	
CFM56-5B2	Dry	31000		0.35			32.9			5250	72.0	68.3	103.0	5.905	A321
Microturbo															
TRS 18		259		1.22			3.7	0		92.6	11.8		23.6	2.792	A215J Glider, C22J
TRS 18-1		360		1.18			4.7	0		92.6	11.8		23.6	3.885	MU200/Mirach 100-2/100-3/100-5
TRI 40		764						0		99.2	11.0		26.8	7.705	NSM Antiship missile (Norway)
TRI 60-1		787		1.19			3.7	0		143.3	13.5		33.1	5.491	Sea Eagle
TRI 60-2		832		1.26			3.8	0		143.3	13.5		33.1	5.805	RB15 missile, MQM 107B Raytheon
TRI 60-3		944		1.29			3.9	0		143.3	13.5		33.1	6.589	C22 drone
TRI 60-5		990		1.30			4.1	0		143.3	13.5		33.1	6.909	Super MQM & MQM 107D Raytheon, MQM 107E Tracor
TRI 60-20		1214		1.15			6.3	0		143.3	13.7		33.5	8.472	Super MQM Raytheon
TRI 60-30		1214		1.10			6.3	0		143.3	13.7		33.5	8.472	Apache stand-off weapon; British Storm Shadow
TRI 60-6								0							
P&WA															
ADS9778		4000								600			105.0	6.667	
JT15D-5/5A		2900		0.551			12.6	3.30	75	632	27.3	22.7	63.0	4.589	Cessna T-47A
JT15D-5C TP		3190		0.573			13.5	1.8	92	665	27.0	22.7	45.5	4.797	Augusta S211A
JT15D-5D		3045		0.560			13.1			627	27.3	22.7	63.0	4.856	Cessna Citation Ultra

(continued)

[illegible]

Manufacture/ Model		Takeoff Conditions													
		Thrust		SFC							Max	Fan		Max	Application/ Comments
		Dry	A/B	Dry	A/B	FPR	OPR	BPR	Wa	Weight	Dia	Dia	Length	T/W	
		(SLS-lb)		(lb/s/lb)					(lbm/s)	(lb)	(in.)	(in.)	(in.)	(lb/lb)	
PW600		3000		≤0.46						830		27.5		3.614	FJ44 Competitor
F100-PW-100		14100	22600	0.70	2.10	3.12	24.9	0.63	222	3209	46.5	34.8	196.3	7.043	Boeing F-15A/B/C/D. With A/B
F100-PW-200		14100	22600	0.70	2.10	3.12	24.9	0.63	223	3209	46.5	34.8	196.3	7.043	Lockheed Martin F-16A–D. With A/B Production ended.
F100-PW-220		14590	23770	0.70	2.10	3.23	25.6	0.60	224	3234	46.5	34.8	206.1	7.350	F-15C/D/E, F-16A/B/ C/D. With A/B
F100-PW-220E		14590	23770	0.70	2.10	3.23	25.6	0.60	224	3234	46.5	34.8	206.1	7.350	Upgrade for F100- PW-100/200. F-15C/D, F-16A–D. + A/B
F100-PW-229		17800	29100	0.74	2.05	3.70	31.6	0.39	245	3830	46.5	34.8	191.2	7.598	F-15E/I/S, F-16C/D. Increased performance
F100-PW-229A		20100	32500	0.71	1.86	3.95	34.2	0.370	275	4065	46.5	36.0	190.7	7.995	F100-PW-229 performance & durability upgrade
F119-PW-100		Class.	35000	Class.		4.90	28.0	0.29	Class.	Class.		Class.			Lockheed Martin– Boeing F-22
F135-PW-100		28000	43,000								51.0		229.0		Lockheed Martin/ NG/BAES F-35A
F135-PW-400		28000	43000								51.0		229.0		Lockheed Martin/ NG/BAES F-35C

(continued)

Manufacture/ Model		Takeoff Conditions													
		Thrust		SFC		FPR	OPR	BPR	Wa (lbm/s)	Weight (lb)	Max	Fan	Length (in.)	Max	Application/ Comments
		Dry	A/B	Dry	A/B						Dia	Dia		T/W	
		(SLS-lb)		(lb/s/lb)							(lb/lb)				
F135-PW-600		—	43000							51.0		369*		Lockheed Martin/ NG/BAES F-35B,* Includes lift-fan	
PW2037	Dry	38350		0.34		27.6	6.00	1210	7185	84.8	78.5	141.4	5.338	B757-200, C-17	
PW2040	Dry	41700		0.35		30.1	5.90	1255	7185	84.8	78.5	141.4	5.804	B757-200, C-17	
PW2043	Dry	43000		0.35		32.1			7185	84.8	78.5	141.4	5.985	B757	
PW4052/4152	Dry	52200		0.31		27.5	5.00	1700	9400		94.0	132.7	5.553	B767, A310-300	
PW4056/4156	Dry	56750		0.32		30.2	4.80		9400		94.0	132.7	6.037	B767-200ER, B767- 300ER, B747- 400, A300-600	
PW4158	Dry	58000				30.6	4.75		9400		94.0	132.7	6.170	A300-600R	
PW4060/4360	Dry	60000		0.33		31.5	4.70		9400		94.0	132.7	6.383	B767-300ER, MD-11	
PW4050	Dry	50000				26.6	5.10		9400		94.0	132.7	5.319	B767-200ER, B767- 300ER	
PW4168	Dry	68000				33.9	5.34	1934	11700		100.0	163.1	5.812	A330	
PW4084	Dry	87900				34.4	6.41	2550	15740	119.0	112.0	191.7	5.584	B777	
PW4090	Dry	90000				39.0			15740	119.0	112.0	191.7	5.718	B777	
PW4098	Dry	98000				42.8			15740	119.0	112.0	191.7	6.226	B777	
PW6116	Dry	16000													
PW6122	Dry	22000		0.36		27.2			5080		56.5	107.4	4.331	A318	
PW6162	Dry	24000		0.37		29.6			5080		56.5	107.4	4.724	A318	
PW80XX	Dry	25000													
PW80XX	Dry	35000													
GE-P&W Engine Alliance															
GP7170	Dry	70000				40			11500	99.0		169.0	6.087	B747-400X stretch	
GP7275	Dry	75000				39			13300	110.0		179.0	5.639	A3XX	

Manufacture/ Model		Takeoff Conditions													
		Thrust		SFC							Max	Fan		Max	Application/ Comments
		Dry	A/B	Dry	A/B	FPR	OPR	BPR	Wa	Weight	Dia	Dia	Length	T/W	
		(SLS-lb)		(lb/s/lb)					(lbm/s)	(lb)	(in.)	(in.)	(in.)	(lb/lb)	
IAE															
V2500-A1	Dry	25000		0.35			29.7	5.40	783	5074	67.5	63.0	126.0	4.927	A320-200
V2522-A5	Dry	22000		0.34			25.2	5.00	738	5252	67.5	63.0	126.0	4.189	A319
V2524-A5	Dry	23500		0.36			26.5	4.80	784	5252	67.5	63.0	126.0	4.474	A319
V2525-D5	Dry	25000		0.35			27.7	4.80	784	5252	67.5	63.0	126.0	4.760	MD-90-30, MD-90-30ER
V2527-A5	Dry	26500		0.36			30.0	4.70	825	5252	67.5	63.0	126.0	5.046	A320-200
V2528-D5	Dry	28000		0.35			30.4	4.70	825	5252	67.5	63.0	126.0	5.331	MD-90-30, MD-90-30ER
V2530-A5	Dry	31400		0.36			31.6	4.60	848	5139	67.5	63.0	126.0	6.110	A321-100
V2530-D5	Dry	30000		0.36			31.6	4.60	848	5139	67.5	63.0	126.0	5.838	MD90-50
V2533-A5	Dry	33000		0.36			33.4			5074	67.5	63.0	126.0	6.504	A321-200
RR/Turbomeca															
Adour Mk. 861		5710		0.74			11.3	0.8	95	1240	30.0	22.3	77.0	4.605	Hawk
Adour Mk. 871 (F405-RR-401)		5990		0.78			11.3	0.8	97.6	1306	30.9	22.3	77.0	4.587	T45
Adour Mk. 811/815		8400		0.78			11.3			1633	30.8		114.0	5.144	T45
EJ2000		13500	20000		0.81		26.0	0.4	170	2280		29.0	157.0	5.921	Eurofighter 2000
RB199-104		9100	16400		0.60		23.5	≥1.08	160	2151		28.3	142.0	4.231	Tornado ADV
BR700-710		15500		0.40			24.0	4.2	445	4640		48.0	89.0	3.341	Nimrod MRA4
BMW															
Rolls-Royce															
BR710-15		13700					24.0	3.80	396	2950		44.0	85.5	4.644	Gulfstream IV, Bombardier Global Express, Nimrod 2000

(continued)

Manufacture/ Model		Takeoff Conditions													
		Thrust		SFC							Max	Fan		Max	Application/ Comments
		Dry	A/B	Dry	A/B	FPR	OPR	BPR	Wa	Weight	Dia	Dia	Length	T/W	
		(SLS-lb)		(lb/s/lb)					(lbm/s)	(lb)	(in.)	(in.)	(in.)	(lb/lb)	
BR715-17		18700					16.0	3.04	561	3600		53.0	95.0	5.194	B717
BR715-20		22000					34.0	4.70	636	3900		55.0	102.4	5.641	
Rolls-Royce															
Spey 511-8	Dry	11400					18.4	0.64	197	2483		32.5	109.6	4.591	Gulfstream II, Gulfstream III
Spey 512-14DW	Dry	12550					21.0	0.71	208	2609		32.5	109.6	4.810	BAC 1-11
RB183 555-15P	Dry	9900					15.4	1.00	199	2257		32.5	96.7	4.386	F28 Mk4000
Tay 610-8	Dry	12420					14.6	3.18	389	3135		44.0	94.7	3.962	Gulfstream IV
Tay 611-8	Dry	13850					16.0	3.04	414	3135		44.0	94.7	4.418	Gulfstream IV
Tay 620-15	Dry	13850					16.0	3.04	414	3185		44.0	94.7	4.349	Folker 100
Tay 650	Dry	15100					16.4	3.10	425	3340		45.0	94.8	4.521	Folker 100, BAe 1-11, B727 Re- engine
Tay 670	Dry	18000					20.1	2.90	501	3750		49.0	112.0	4.800	MD-95 (B727-200, B737, DC-9 Re-engine)
RB211-535C	Dry	37400					21.1	4.40	1140	7294		73.2	118.5	5.128	B757-200
RB211-535E4	Dry	40100					25.8	4.30	1151	7264		74.1	117.9	5.520	B757-200
RB211-535E4-B	Dry	43100					25.8	4.30	1151	7264		74.1	117.9	5.933	B757-200
RB211-22B	Dry	42000					24.5	4.80	1380	9195		84.8	119.4	4.568	L1011-1, L1011- 100
RB211-524B/B2	Dry	50000					28.4	4.50	1513	9814		84.8	119.4	5.095	L1011-200, L1011- 500, B747-200, B747SP
RB211-524B4	Dry	50000					29.0	4.40	1500	9814		85.8	122.3	5.095	L1011-500
RB211-524B4 Improved	Dry	50000					28.6	4.40	1512	9814		85.8	122.3	5.095	L1011-250, L1011- 500
RB211-524C2	Dry	51500					28.6	4.50	1532	9859		84.8	119.4	5.224	B747-200, B747SP

Manufacture/ Model		Takeoff Conditions													
		Thrust		SFC							Max	Fan		Max	Application/ Comments
		Dry	A/B	Dry	A/B	FPR	OPR	BPR	Wa	Weight	Dia	Dia	Length	T/W	
		(SLS-lb)		(lb/s/lb)					(lbm/s)	(lb)	(in.)	(in.)	(in.)	(lb/lb)	
RB211-524D4	Dry	53000					29.3	4.40	1548	9874		85.8	122.3	5.368	B747-200, B747SP
RB211-524D4 Improved	Dry	53000					29.6	4.40	1548	9874		85.8	122.3	5.368	B747-200, B747-300, B747SP
RB211-524G	Dry	58000					33.0	4.30	1605	9670		86.3	125.0	5.998	B747-400, B767-300
RB211-524H	Dry	60000					33.0	4.30	1605	9670		86.3	125.0	6.205	B747-400, B767-300
Trent 768	Dry	67500					35.82	4.88	2015	13669		97.4	154.0	4.938	B747-200, B747SP
Trent 772	Dry	71100					37.68	4.78	2060	13669		97.4	154.0	5.202	B747-200, B747SP
Trent 870	Dry	74900					34.75	6.28	2500	16150		110.0	172.0	4.638	B747-200, B747SP
Trent 882	Dry	84700					39.04	6.01	2640	16150		110.0	172.0	5.245	B747-200, B747SP
Teledyne CAE															
304		59		1.20		0	5.50	0	1.0	8.5	4.0	0	9.3	6.941	Prototype engine
305		90		1.26		0	5.70	0	1.3	19	6.6	0	10.7	4.737	Prototype engine
312		173		1.23		0	5.70	0	2.6	38	8.3	0	13.4	4.553	Prototype engine
J700-CA-400		177		1.21		0	5.70	0	2.6	39	8.5	0	14.8	4.538	ITALD (ADM-141C)
320-1		240		1.13		0	5.70	0	3.7	50	9.9	0	17.5	4.800	Prototype engine
320-2		350		1.09		0	7.90	0	4.9	58	9.9	0	19.3	6.034	Prototype engine
J402-CA-401		640		1.21		0		0	9.5	114	12.5	0	34.0	5.614	Never produced
J402-CA-700		640		1.20		0	5.50	0	9.5	113	12.5	0	29.7	5.664	RPVs, targets
J402-CA-400		660		1.20		0	5.60	0	9.6	101.5	12.5	0	29.4	6.502	Boeing Harpoon, SLAM, SLAM-ER missiles
370-9B		640		1.20		0	5.50	0	9.6	119	12.5	0	23.6	5.378	Improved performance JASSM
372-11A		725		1.20		0		0	10.1	113	9.9	0	19.3	6.416	Never produced

(continued)

Manufacture/ Model		Takeoff Conditions													Application/ Comments
		Thrust		SFC							Max	Fan		Max	
		Dry	A/B	Dry	A/B	FPR	OPR	BPR	Wa	Weight	Dia	Dia	Length	T/W	
		(SLS-lb)		(lb/s/lb)					(lbm/s)	(lb)	(in.)	(in.)	(in.)	(lb/lb)	
J402-CA-702		960		1.03		0	8.50	0	13.7	138	12.5	0	33.3	6.957	MQM-107D, Scarab RPV
F408-CA-400		1008		0.97		0	8.50	0	16.0	145	13.2	8.6	37.0	6.952	Ryan BQM-145A
J69-T-25A		1025		1.14		0	3.90	0	20.0	358	22.3	0	35.4	2.863	Cessna T-37B
J69-T-29		1700		1.10		0	5.30	0	29.9	340	22.3	0	45.0	5.000	Ryan BQM-34A
J69-T-41A		1920		1.10		0	5.50	0	29.9	350	22.3	0	45.0	5.486	Ryan BQM-34A
J69-T-406		1920		1.11		0	5.50	0	29.9	360	22.5	0	45.0	5.333	Ryan BQM-34E/F Supersonic target
Williams International															
WJ119-2		105						0		33.5		7.0	23.2	3.134	Missile applications
F121-WR-100		150						0		42	8.3		26.0	3.571	Missile applications
WJ24-8		240		1.20				0		50	15.5	10.8	19.7	4.800	Northrop BQM-74C
F107-WR-101		635		0.69		2.1	13.8	0.91	13.6	141	21.0	12.0	48.5	4.504	Boeing ALCM
F107-WR-402		700						0.81	14.6	142	17.2	12.0	25.7	4.930	Boeing/Raytheon Tomahawk
FJX-2		700								≤100		14.5	41		General aviation aircraft
EJ-22		770								85		14.5	41		Eclipse 500
FJ33-1		1200								≤300	24.2	19.0	37.8		Aerostar, Century Jet
WJ38-10		1000						0		150		13.5		6.667	Missiles
WJ38-15		1500						0		150		13.5	27.5	10.000	Taurus missile

Manufacture/ Model		Takeoff Conditions													Application/ Comments
		Thrust		SFC							Max	Fan		Max	
		Dry	A/B	Dry	A/B	FPR	OPR	BPR	Wa	Weight	Dia	Dia	Length	T/W	
		(SLS-lb)		(lb/s/lb)					(lbm/s)	(lb)	(in.)	(in.)	(in.)	(lb/lb)	
FJ44-1C		1500		0.46				3.4	58.4	459	28.3	20.9	40.2	3.268	Saab SK60 (joint w/RR)
FJ44-1A		1900		0.46			12.8	3.2	63.3	452	28.3	20.9	40.28	4.204	TIII-, Citation (joint w/RR)
FJ44-2A		2300		0.46						445	28.3	21.8	47.2	5.169	Premier 1, SJ30-2 (joint w/RR)
FJ44-2C		2400		0.46							28.3	21.8	47.2		Citation CJ2 (joint w/RR)
F112-WR-100		732		0.68		2.39	16.24	0.86	14.6	161	18.3		33.3	4.547	Advance cruise missile, AGM-129A
F122-WR-100		1000 ^a									13.5	11.0	35.7		
F122-13		1300 ^a													
F122-15		1500 ^a													
P8300		1000 ^a		1.29				0	24.6	150	13.5		27.0		Missiles
WTS117		125 hp		0.69 lb/hp-h					1.2	72	12.9		20.9		Canadair CL-327
WTS124		240 hp		0.68 lb/hp-h				1.2	76						
P9508		528					6.0	0.11	8.2	60	9.0		23.5	8.800	
P9701		1501		≤0.65				high		83.4	19.4	18.2	35.1	17.998	UCAV
P9702		1244						mod		74	12.5	11.9	34.5	16.811	UCAV
P9704		1146						low		72	11.5	10.5	33.6	15.917	UCAV
P9705		5720						low			25				A/B

^aSea level, Mach 0.8, standard day
Abbreviations: SFC, specific fuel consumption; A/B, afterburner; fan pressure ratio (FPR); OPR, overall pressure ratio; BPR, bypass ratio; SLS, sea level static

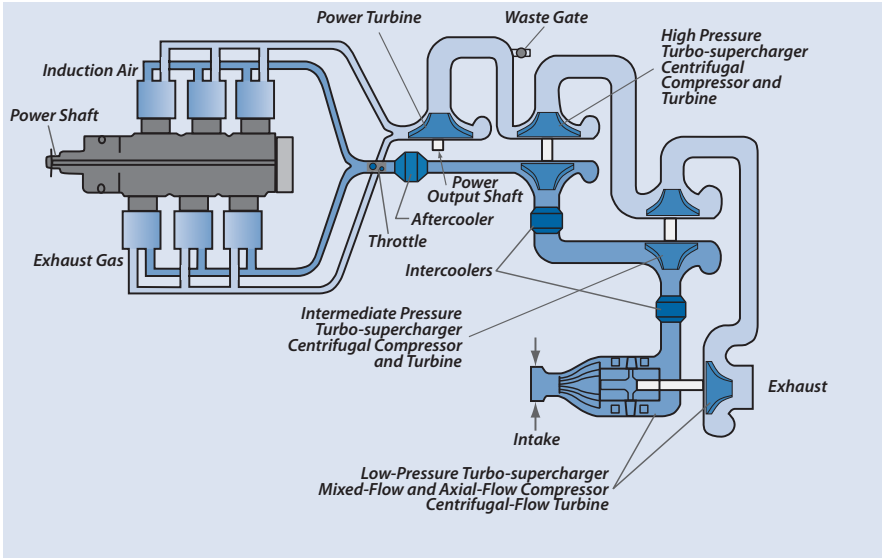


Figure J.1 Schematic of three-stage turbocharged IC engine.

See Fig. J.3 for information about the Allison T56-A-15, Table J.2 for the WRI FJ 44 family, Table J.3 for the F 119 class, Table J.4 and Fig. J.4 for the AE 3007H, Table J.5 and Fig. J.5 for the Honeywell TFE 731, and Table J.6 for the GE 90.

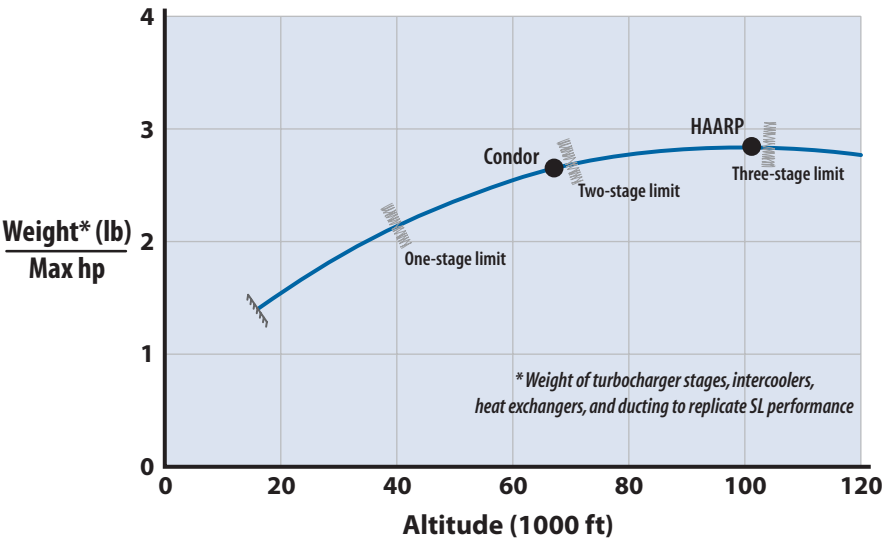


Figure J.2 Piston engine turbocharger weight for altitude boost.

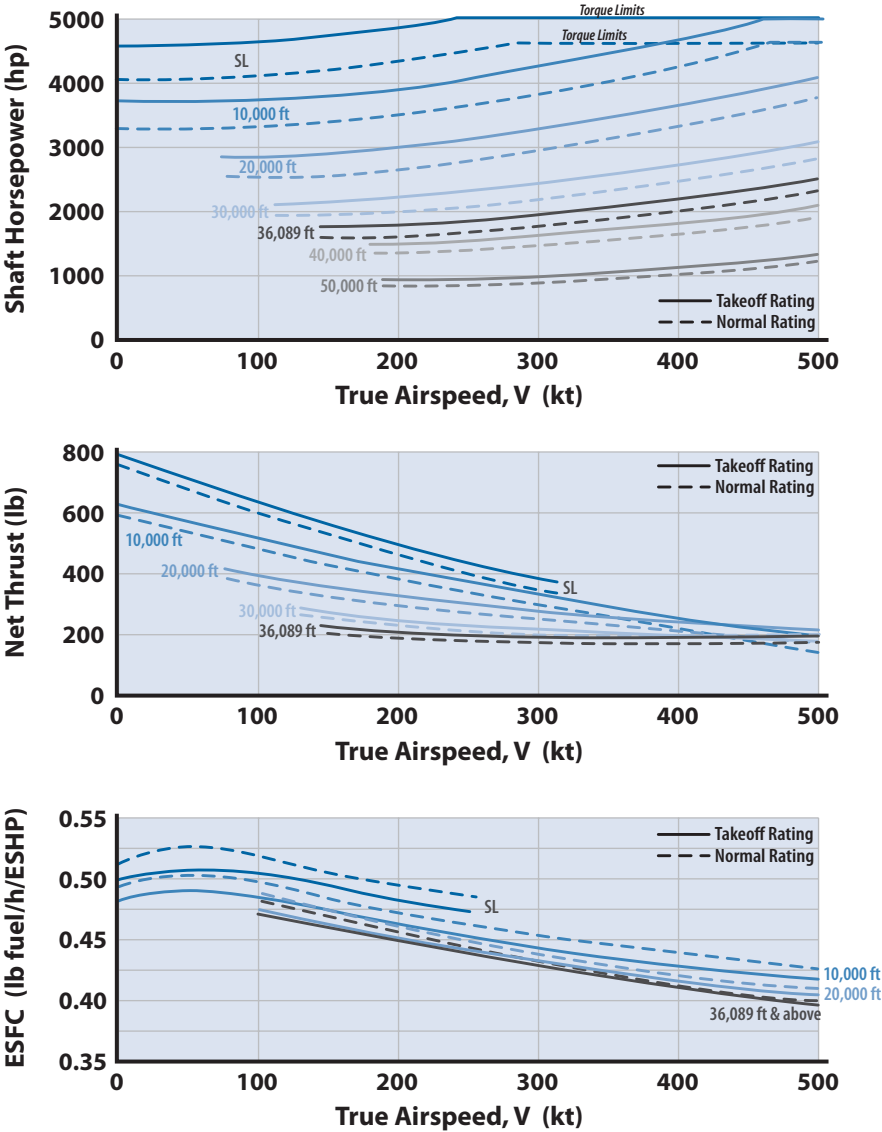


Figure J.3 Characteristics of Allison 501-M7 (T56-A-15) turboprop (standard day, no accessories or bleed, 100% ram efficiency).

Table J.2a Williams FJ 44 Turbofan Family

Manufacturer: Williams International					
Applications: Cessna Citation, Raytheon Premier, Saab SK 60, SCI Proteus, LM Tier 3– Darkstar and LM Polecat					
Specifications: Uninstalled					
Model	SLS Thrust (lb)	TSFC	Weight (lb)	Length (in.)	Diam. (in.)
FJ 44-1A	1900	0.456	445	40.2	20.9
FJ 44-1AP	2100	0.456	445	40.2	20.9
FJ 44-1C	1500	0.46	445	40.2	20.9
FJ 44-2A	2300	0.46	475	47.2	21.8
FJ 44-2C	2400	0.46	475	47.2	21.8
FJ 44-3A	3000	0.48	490	48	23
FJ 44-3A-24	2400	0.47	490	48	23
FJ 44-3E ^a	2700	0.49	490	48	23

^aHigh-altitude variant of FJ 44-3A.

Table J.2b Williams FJ 44 3E Turbofan Tabular Engine Data

Performance Data for an FJ 44-3E Installed in an Engine Pod							
Horsepower extraction is 20 hp everywhere.							
Horsepower bleed is 12.5 lb/min up through 20,000 ft and 1 lb/min above that.							
Installation Factors							
Installation		Inlet Recovery		Nozzle Coefficient		Nozzle C_d	
Podded		0.995		0.997		0.99	
The thrust and TSFC for the other FJ 44 variants are determined by multiplying the FJ 44-3E thrust and TSFC by the SLS ratios of thrust and TSFC.							
Altitude = 0 ft							
Mach = 0		Mach = 0.2		Mach = 0.3		Mach = 0.35	
F_n	TSFC	F_n	TSFC	F_n	TSFC	F_n	TSFC
2254	0.51	1862	0.62	1671	0.68	1581	0.72
1667	0.51	1344	0.64	1203	0.72	1140	0.76
1096	0.537	828	0.715	717	0.83	667	0.9
708	0.595	488	0.868	396	1.07	355	1.20
474	0.66	293	1.066	216	1.44	180	1.74
323	0.766	175	1.40	108	2.24	75	3.19

Altitude = 10,000 ft							
Mach = 0		Mach = 0.2		Mach = 0.3		Mach = 0.4	
F_n	TSFC	F_n	TSFC	F_n	TSFC	F_n	TSFC
2023	0.51	1751	0.59	1641	0.641	1549	0.69
1509	0.49	1254	0.6	1140	0.66	1043	0.73
1006	0.50	794	0.64	701	0.73	621	0.83
619	0.567	450	0.78	379	0.94	317	1.129
414	0.61	273	0.92	213	1.185	158	1.6
268	0.71	158	1.21	111	1.73	65	2.93
196	0.80	101	1.54	59	2.62		
Altitude = 20,000 ft							
Mach = 0.2		Mach = 0.3		Mach = 0.4		Mach = 0.5	
F_n	TSFC	F_n	TSFC	F_n	TSFC	F_n	TSFC
1376	0.59	1304	0.63	1255	0.67	1224	0.71
1113	0.57	1035	0.62	969	0.67	900	0.72
740	0.59	668	0.66	607	0.728	555	0.80
411	0.713	358	0.83	312	0.956	272	1.11
254	0.82	210	1.0	170	1.24	135	1.56
151	1.01	114	1.33	80	1.91	46	3.3
87	1.38	56	2.12	25	4.7		
Altitude = 30,000 ft							
Mach = 0.3		Mach = 0.4		Mach = 0.5		Mach = 0.6	
F_n	TSFC	F_n	TSFC	F_n	TSFC	F_n	TSFC
948	0.63	924	0.667	914	0.70	914	0.74
822	0.6	791	0.638	764	0.678	741	0.718
618	0.6	568	0.65	527	0.707	493	0.763
342	0.71	308	0.796	279	0.89	254	0.99
198	0.84	170	1.0	145	1.17	123	1.40
113	1.05	90	1.33	69	1.76	48	2.54
59	1.52	39	2.32	18	4.94		

(continued)

Altitude = 40,000 ft							
Mach = 0.3		Mach = 0.4		Mach = 0.5		Mach = 0.6	
F_n	TSFC	F_n	TSFC	F_n	TSFC	F_n	TSFC
603	0.627	598	0.67	605	0.708	610	0.74
565	0.61	547	0.65	536	0.68	531.5	0.718
460	0.59	433	0.64	413	0.68	395	0.724
276	0.672	253	0.74	234	0.815	217	0.89
164	0.78	144	0.89	127	1.03	112	1.18
93	1.0	77	1.19	63	1.47	50	1.87
Altitude = 50,000 ft							
Mach = 0.3		Mach = 0.4		Mach = 0.5		Mach = 0.6	
F_n	TSFC	F_n	TSFC	F_n	TSFC	F_n	TSFC
372	0.64	369	0.68	373	0.72	376	0.74
360	0.64	347	0.67	340	0.71	337	0.74
294	0.62	277	0.66	263	0.707	252	0.75
181	0.70	166	0.766	154	0.84	143	0.91
109	0.82	97	0.93	86	1.05	76	1.2
Altitude = 60,000 ft							
Mach = 0.4		Mach = 0.5		Mach = 0.6		Mach = 0.65	
F_n	TSFC	F_n	TSFC	F_n	TSFC	F_n	TSFC
231	0.71	233	0.747	235	0.75	238	0.79
222	0.70	218	0.738	216	0.77	216	0.785
180	0.69	170	0.737	162	0.78	159	0.81
114	0.788	105	0.858	97.5	0.933	94	0.97

Table J.3 Afterburning Turbofan Engine (F 119-PW-100 Class) Engine data

Afterburning Turbofan Engine (F 119-PW-100 Class)		
Specifications: Uninstalled		
Thrust class: 35,000 lb SLS (afterburner)		
27,000 lb SLS (dry)		
Weight: 4700 lb		
Length: 229 in.		
Diameter: 51 in.		
OPR: 30		
BPR: 0.25		
Corrected airflow: 290 lb/s		
Performance Data for Afterburning Turbofan Engine		
Installation Factors		
Horsepower extraction: 200 hp everywhere		
Bleed extraction: 30 lb/min up through 20,000 ft and 3 lb/min above that		
PC (power condition): 100 = Maximum afterburner; 80 = Partial afterburner; 50 = Maximum dry power (intermediate); 30 = Partial dry		
Inlet total pressure recovery schedule per MIL-E-5008B (see Fig. 16.2)		
Altitude = Sea Level		
Mach = 0		
PC	Thrust	TSFC
100	35,128	1.832
80	33,265	1.628
80	30,060	1.351
80	26,380	1.078
50	26,847	0.887
30	20,609	0.888
30	16,041	0.857
30	11,752	0.839
30	5,743	0.845

(continued)

Altitude = 10,000 ft						
PC	Mach = 0.4		Mach = 0.6		Mach = 0.8	
	Thrust	TSFC	Thrust	TSFC	Thrust	TSFC
100	26,738	1.963	29,569	1.991	33,916	2.016
80	25,160	1.756	27,726	1.787	31,673	1.816
80	22,422	1.478	24,546	1.514	27,834	1.55
80	18,352	1.132	20,167	1.2	23,931	1.317
50	17,232	1.026	18,894	1.098	21,539	1.177
30	14,557	0.992	16,176	1.065	20,156	1.161
30	11,368	0.975	12,788	1.053	16,964	1.143
30	5,813	1.015	6,641	1.129	9,797	1.211
Altitude = 20,000 ft						
PC	Mach = 0.6		Mach = 0.8		Mach = 1.0	
	Thrust	TSFC	Thrust	TSFC	Thrust	TSFC
100	20,465	1.993	23,683	2.009	27,800	2.05
80	19,204	1.787	22,137	1.809	25,848	1.855
80	16,996	1.515	19,454	1.544	22,498	1.599
80	13,518	1.157	15,604	1.228	18,191	1.329
50	12,599	1.05	14,520	1.127	16,872	1.234
30	10,753	1.021	12,491	1.099	16,217	1.226
30	8,517	1.012	9,939	1.098	13,653	1.214
30	6,296	1.033	7,407	1.137	10,552	1.248
Altitude = 20,000 ft						
PC	Mach = 1.2		Mach = 1.4		Mach = 1.6	
	Thrust	TSFC	Thrust	TSFC	Thrust	TSFC
100	31,007	2.142	32,568	2.282	37,339	2.244
80	28,659	1.95	29,898	2.092	34,284	2.056
80	24,649	1.701	25,349	1.85	29,093	1.817
80	19,532	1.445	19,346	1.605	23,201	1.596
50	17,946	1.352	17,518	1.514	19,792	1.461
30	16,403	1.35	15,637	1.533	18,002	1.47
30	12,487	1.397	10,594	1.7	12,626	1.54
30	8,367	1.591	5,604	2.381	8,097	1.749

Altitude = 30,000 ft						
PC	Mach = 0.6		Mach = 0.8		Mach = 1.0	
	Thrust	TSFC	Thrust	TSFC	Thrust	TSFC
100	13,721	1.995	15,917	2.007	18,927	2.036
80	12,885	1.788	14,891	1.805	17,620	1.84
80	11,400	1.515	13,085	1.541	15,343	1.585
80	8,410	1.062	10,123	1.182	11,982	1.277
50	8,135	1.006	9,361	1.076	11,053	1.178
30	7,151	0.984	8,079	1.053	9,469	1.157
30	5,929	0.976	6,477	1.056	7,452	1.179
30	3,508	1.031	4,832	1.097	5,393	1.265
Altitude = 30,000 ft						
PC	Mach = 1.2		Mach = 1.6		Mach = 2.0	
	Thrust	TSFC	Thrust	TSFC	Thrust	TSFC
100	23,186	2.054	30,550	2.104	31,831	2.322
80	21,482	1.865	28,136	1.922	29,068	2.140
80	18,542	1.621	24,011	1.689	24,340	1.916
80	14,778	1.37	18,585	1.446	16,755	1.651
50	13,639	1.28	16,931	1.356	14,742	1.554
30	13,132	1.274	15,298	1.356	10,046	1.634
30	10,934	1.267	11,671	1.383	5,622	2.047
30	8,214	1.329	8,506	1.466	2,117	3.70
Altitude = 36,089 ft						
PC	Mach = 0.6		Mach = 0.8		Mach = 1.0	
	Thrust	TSFC	Thrust	TSFC	Thrust	TSFC
100	10,564	1.996	12,274	2.006	14,621	2.031
80	9,926	1.788	11,489	1.803	13,621	1.835
80	8,780	1.516	10,095	1.539	11,862	1.58
80	6,634	1.096	7,646	1.158	9,040	1.247
50	6,122	0.981	7,041	1.048	8,303	1.145
30	5,378	0.962	6,089	1.028	7,119	1.127
30	4,450	0.957	4,866	1.033	5,606	1.151
30	3,513	0.974	3,637	1.077	4,044	1.24

(continued)

Altitude = 36,089 ft						
PC	Mach = 1.2		Mach = 1.6		Mach = 2.0	
	Thrust	TSFC	Thrust	TSFC	Thrust	TSFC
100	17,953	2.046	26,364	2.033	29,856	2.168
80	16,648	1.857	24,318	1.855	27,360	1.991
80	14,375	1.613	20,809	1.626	23,090	1.77
80	11,151	1.334	16,309	1.393	16,898	1.522
50	10,243	1.242	14,916	1.306	15,133	1.429
30	8,875	1.227	13,582	1.301	14,524	1.431
30	7,084	1.26	10,396	1.312	10,560	1.462
30	5,212	1.366	7,440	1.379	6,918	1.642
Altitude = 40,000 ft						
PC	Mach = 0.6		Mach = 0.8		Mach = 1.0	
	Thrust	TSFC	Thrust	TSFC	Thrust	TSFC
100	8727	1.996	10,412	2.006	12,084	2.033
80	8202	1.787	9,497	1.803	11,262	1.835
80	7255	1.515	8,344	1.539	9,808	1.581
80	5514	1.105	6,357	1.166	7,516	1.254
50	5090	0.991	5,856	1.057	6,906	1.153
30	4370	0.97	5,057	1.037	5,915	1.136
30	3472	0.971	4,039	1.045	4,654	1.162
30	2591	1.005	3,015	1.093	3,354	1.255
Altitude = 40,000 ft						
PC	Mach = 1.2		Mach = 1.6		Mach = 2.0	
	Thrust	TSFC	Thrust	TSFC	Thrust	TSFC
100	14,844	2.047	21,586	2.041	24,648	2.172
80	13,772	1.857	19,921	1.861	22,601	1.993
80	11,891	1.613	17,044	1.631	19,076	1.771
80	9,278	1.341	13,364	1.399	14,028	1.528
50	8,519	1.249	12,218	1.312	12,569	1.436
30	7,375	1.235	11,095	1.308	11,880	1.438
30	5,878	1.27	8,480	1.323	8,646	1.475
30	4318	1.38	6,079	1.394	5,688	1.659

Altitude = 50,000 ft						
PC	Mach = 0.8		Mach = 1.2		Mach = 2.0	
	Thrust	TSFC	Thrust	TSFC	Thrust	TSFC
100	6211	2.008	9100	2.053	14,964	2.187
80	5820	1.804	8451	1.86	13,742	2.004
80	5113	1.54	7295	1.616	11,595	1.781
80	4190	1.252	5790	1.365	8,645	1.552
50	3674	1.091	5321	1.275	7,754	1.462
30	3164	1.073	4486	1.261	6,974	1.467
30	2529	1.088	3389	1.32	5,094	1.527
30	1875	1.151	2280	1.506	3,398	1.724
Altitude = 60,000 ft						
PC	Mach = 0.8		Mach = 1.2		Mach = 2.0	
	Thrust	TSFC	Thrust	TSFC	Thrust	TSFC
100	3750	2.028	5521	2.065	8539	2.245
80	3513	1.822	5130	1.87	7848	2.055
80	3089	1.554	4425	1.626	6604	1.832
80	2505	1.252	3606	1.407	4909	1.611
50	2325	1.146	3320	1.319	4384	1.523
30	2004	1.132	3066	1.311	3926	1.534
30	1603	1.157	2492	1.334	2630	1.64
30	1192	1.241	1837	1.445	1480	2.050

Table J.4 AE 3007 A/A1/H Turbofan Characteristics

Manufacturer: Rolls Royce/Allison, Indianapolis, IN
Applications: Embraer ERJ 135 & 145, RQ-4A Global Hawk
Specifications: Uninstalled
SLS thrust: 8917 lb
SLS TSFC: 0.64
Weight = 1581 lb
OPR = 23
BPR = 5
Length = 115.1 in.
Maximum diameter = 41.2 in.
INSTALLED PERFORMANCE: See Fig. J.4
Standard day
Inlet total pressure recovery = 0.96 for all altitudes, Mach, and throttle settings
Nozzle coefficient = 0.96
Horsepower extraction = 32 hp
Compressor bleed = 0

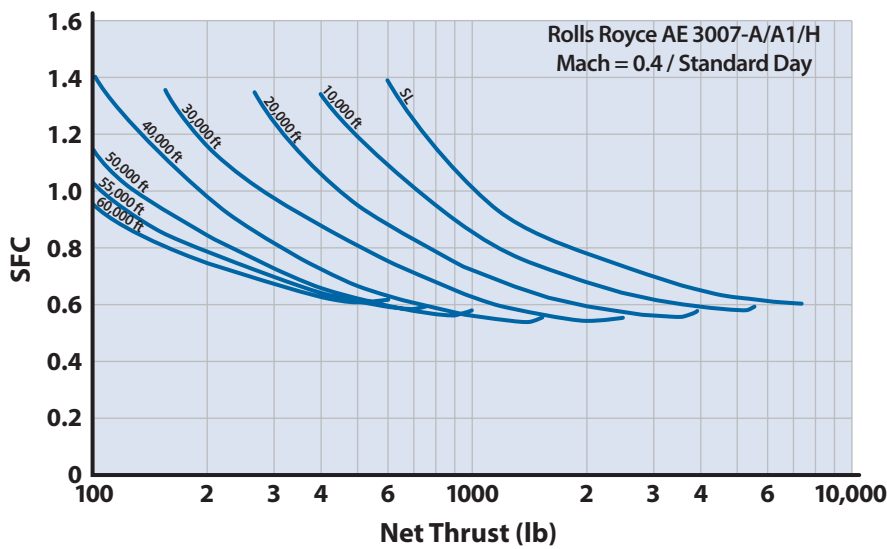


Figure J.4a Installed SFC vs net thrust.

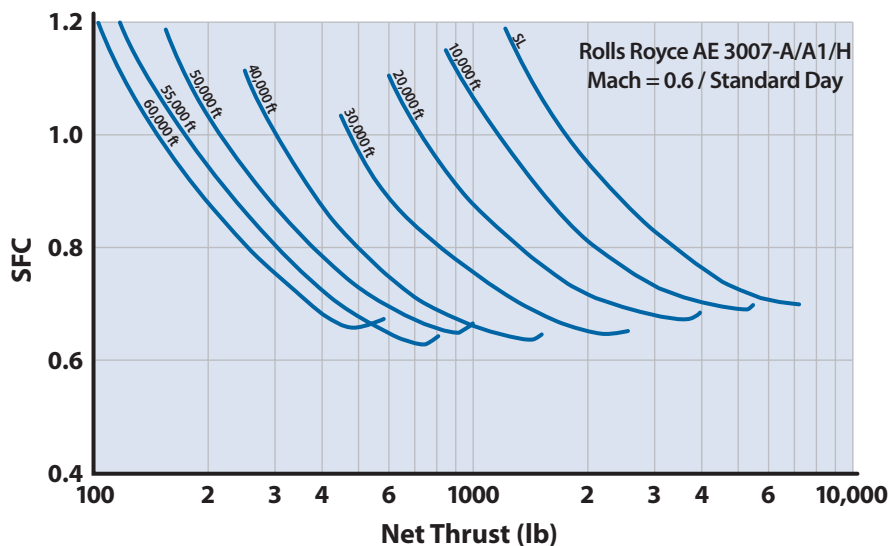


Figure J.4b Installed SFC vs net thrust.

Table J.5a TFE 731 Turbofan Engine Family

Manufacturer: Honeywell (formerly Allied Signal and Garrett)
Applications: Subsonic business jets (Learjet 45, Falcon 20, Citation III/IV/V, Falcon 50X, Falcon 900 EX, Falcon 2000)
Specifications: TFE 731 Variants (uninstalled)
TFE 731-1069
Maximum SLS thrust = 3200 lb installed (short-term takeoff)
Maximum static thrust at 5000 ft = 2980 lb installed (short-term takeoff)
Rated airflow = 115 lb/s
OPR = 13.1
BPR = 3.0
Turbine inlet temperature = 1842°F
Installation factors (typical of installation in a pod):
Inlet recovery = 0.995
Nozzle coefficient = 0.997
Horsepower extraction = 25 hp
Compressor bleed = 15 lb/min up to 20,000 ft, 2 lb/min above 20,000 ft

Table J.5b TFE 731 Turbofan Engine Data

Model	SLS Thrust	SLS TSFC	Weight	Length	Max. Diam.
-1069 ^a	3410	0.48	783	49.73	34.2
-20	3641	0.44	836	59.7	39.4
-3	3700	0.511	853	51	39.4
-4	4080	0.517	822	51	39.4
-40	4248	0.463	885	51	39.4
-5	4304	0.484	852	65.5	42.5
-5A	4500	0.469	988	72	42.5
-60	4999	0.409	988	72	42.5

^aThe installed performance data for the -1069 are presented in Fig. J.5. The data for any of the variants can be estimated by correcting the -1069 thrust by the ratio of the two SLS thrusts, and the TSFC by the ratio of the two SLS TSFCs.

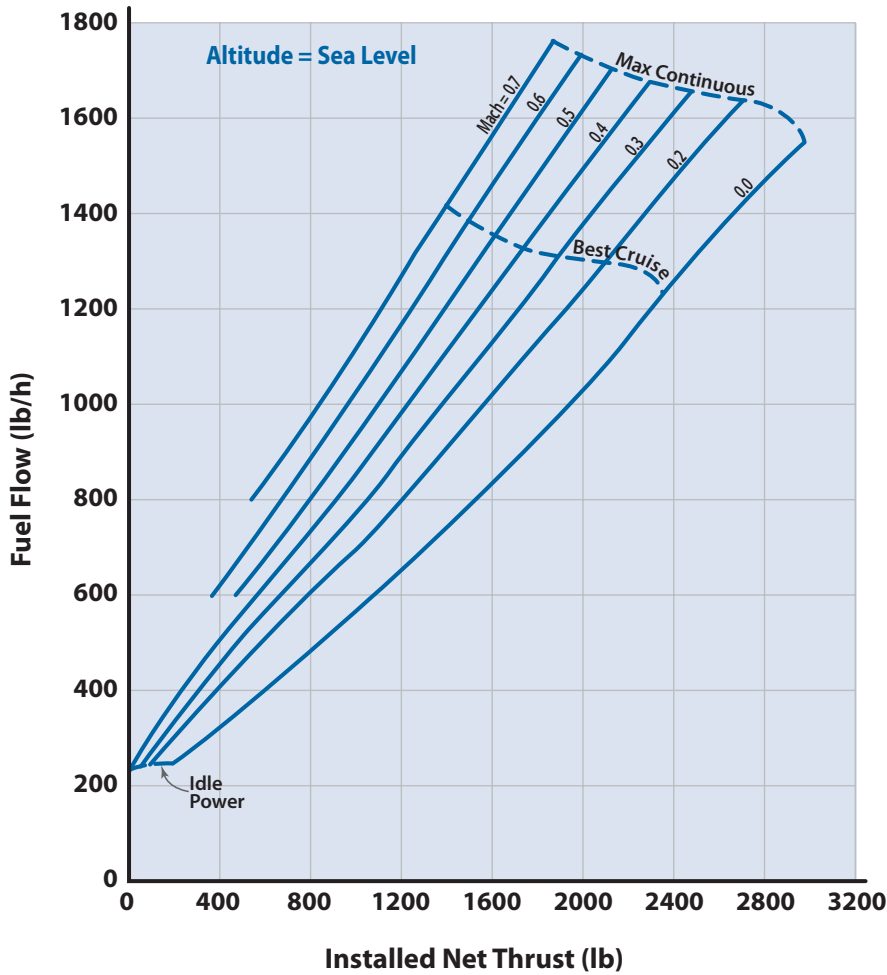


Figure J.5a TFE 731 model 1069-1 installed fuel flow vs net thrust (sea level, standard day).

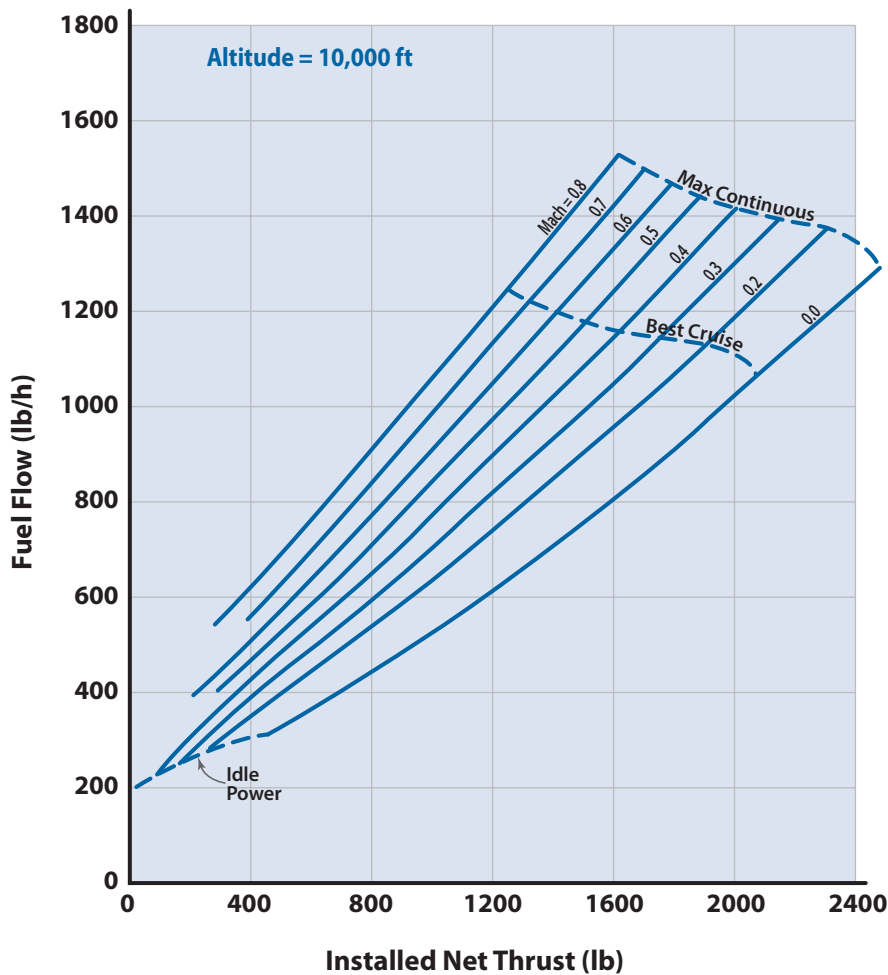


Figure J.5b TFE 731 model 1069-1 installed fuel flow vs net thrust (10,000 ft, standard day).

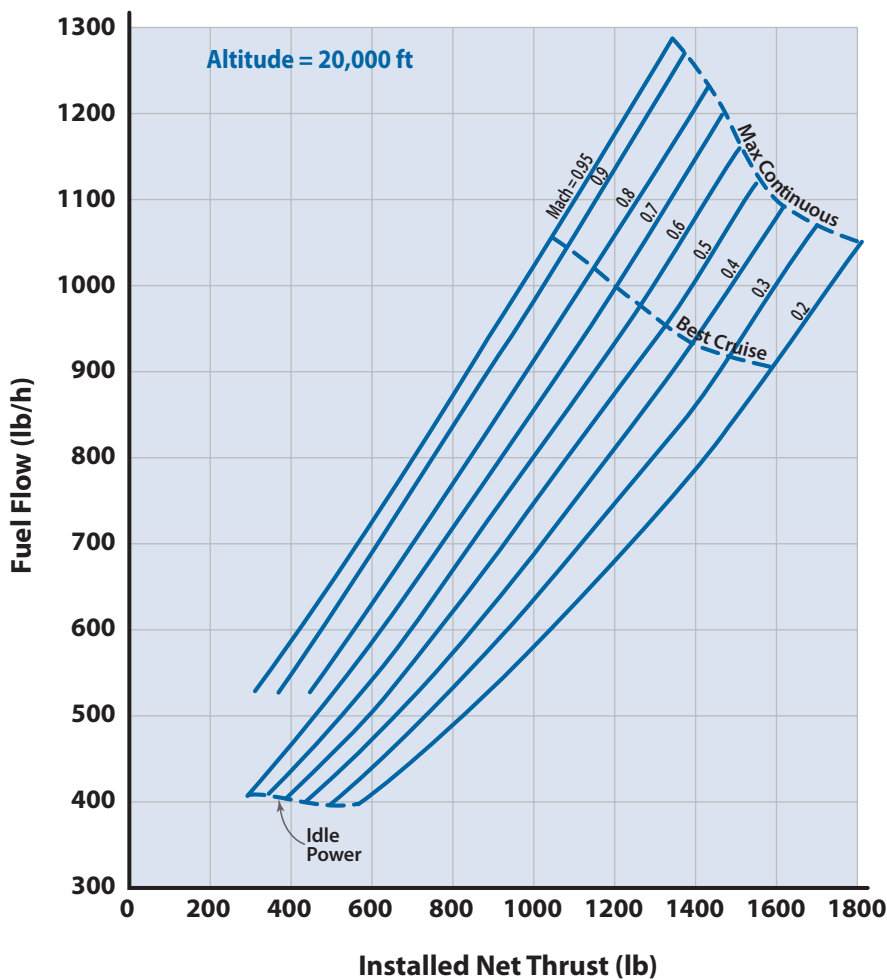


Figure J.5c TFE 731 model 1069-1 installed fuel flow vs net thrust (20,000 ft, standard day).

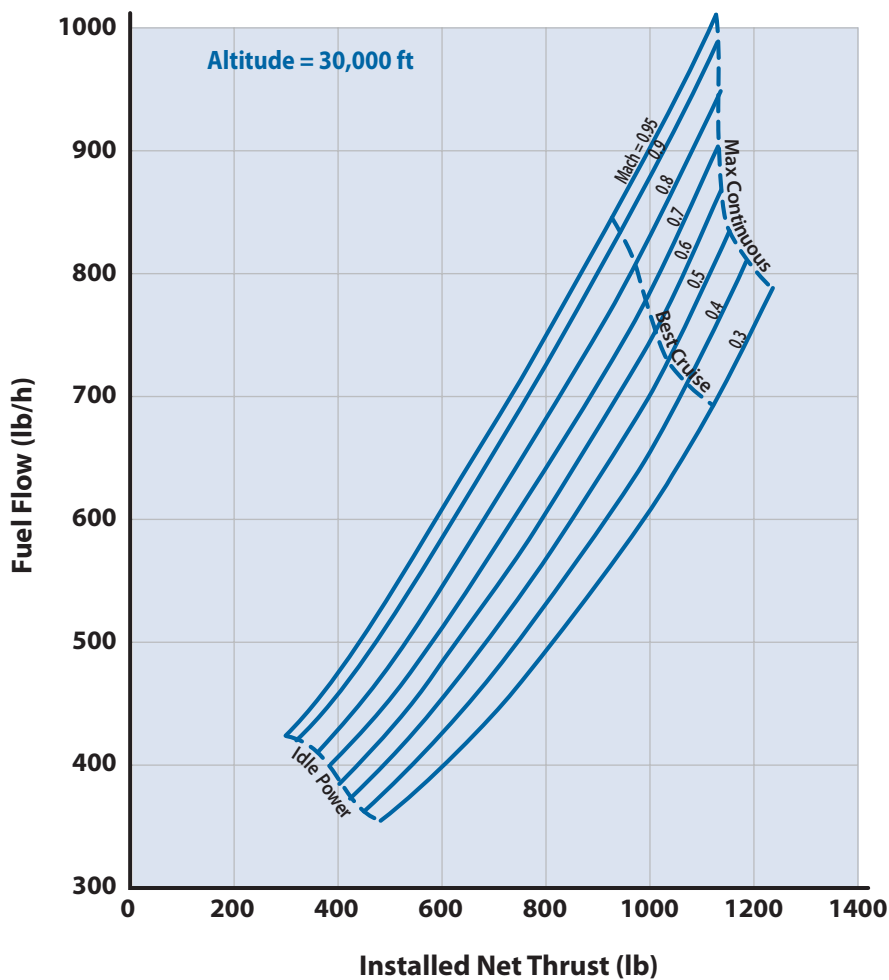


Figure J.5d TFE 731 model 1069-1 installed fuel flow vs net thrust (30,000 ft, standard day).

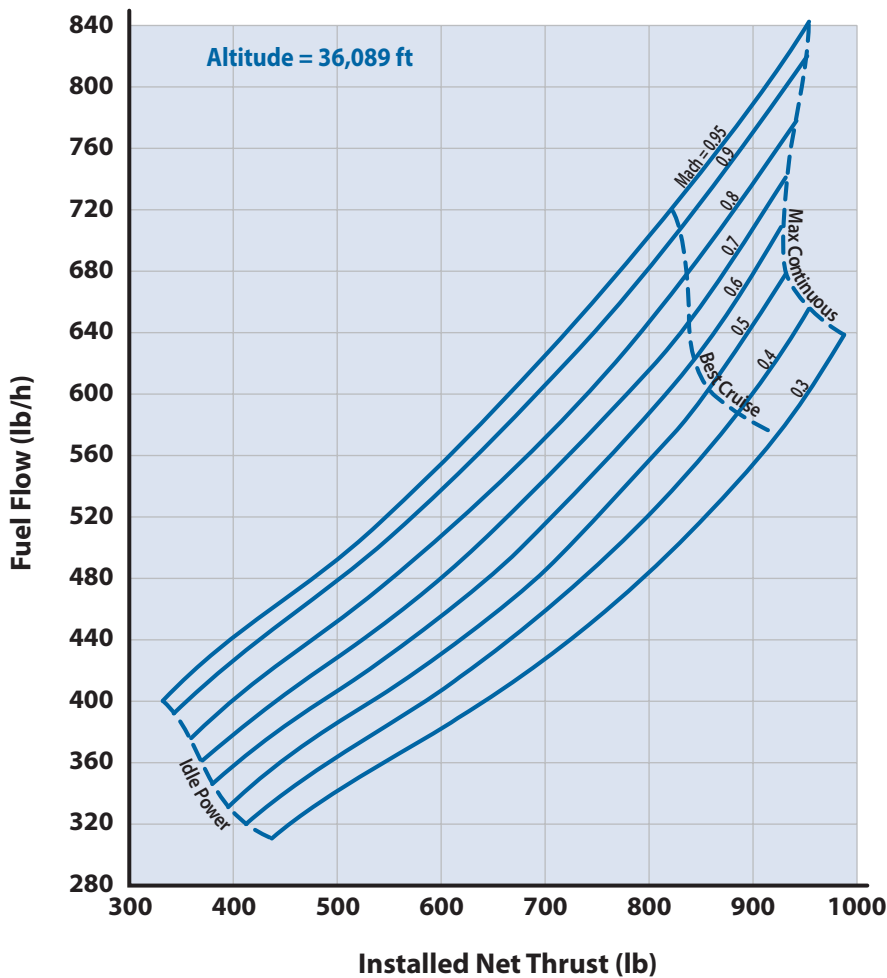


Figure J.5e TFE 731 model 1069-1 installed fuel flow vs net thrust (36,089 ft, standard day).

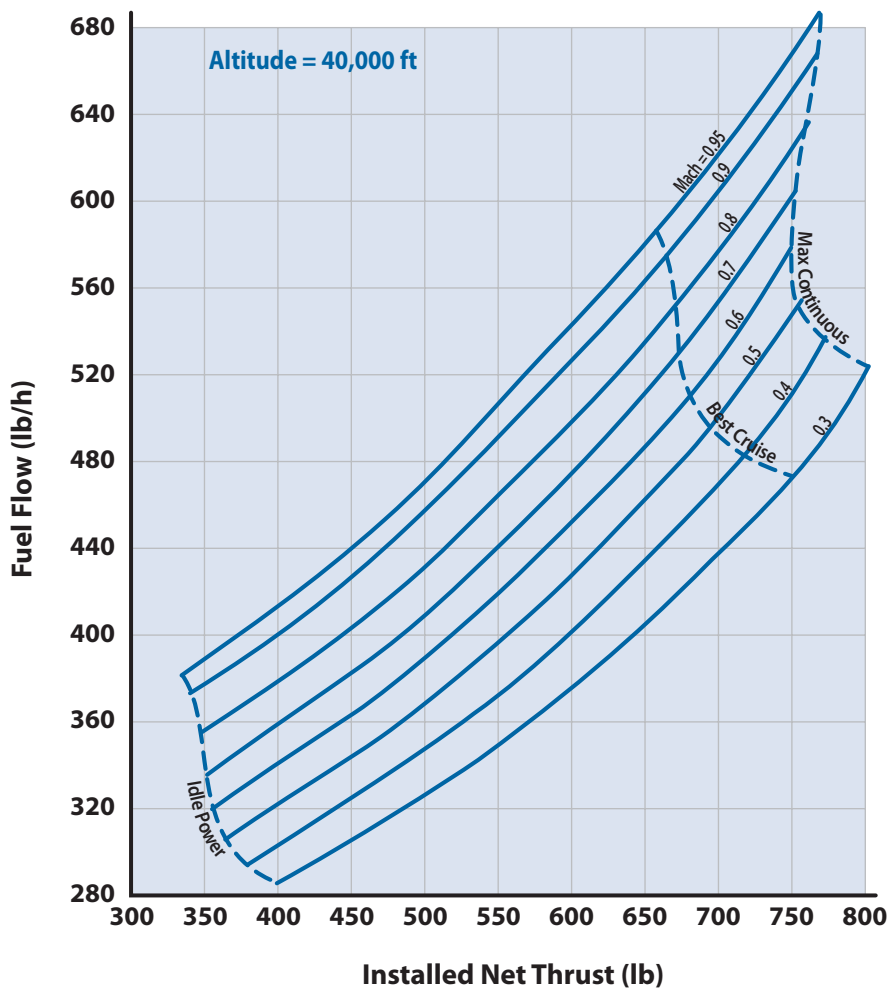


Figure J.5f TFE 731 model 1069-1 installed fuel flow vs net thrust (40,000 ft, standard day).

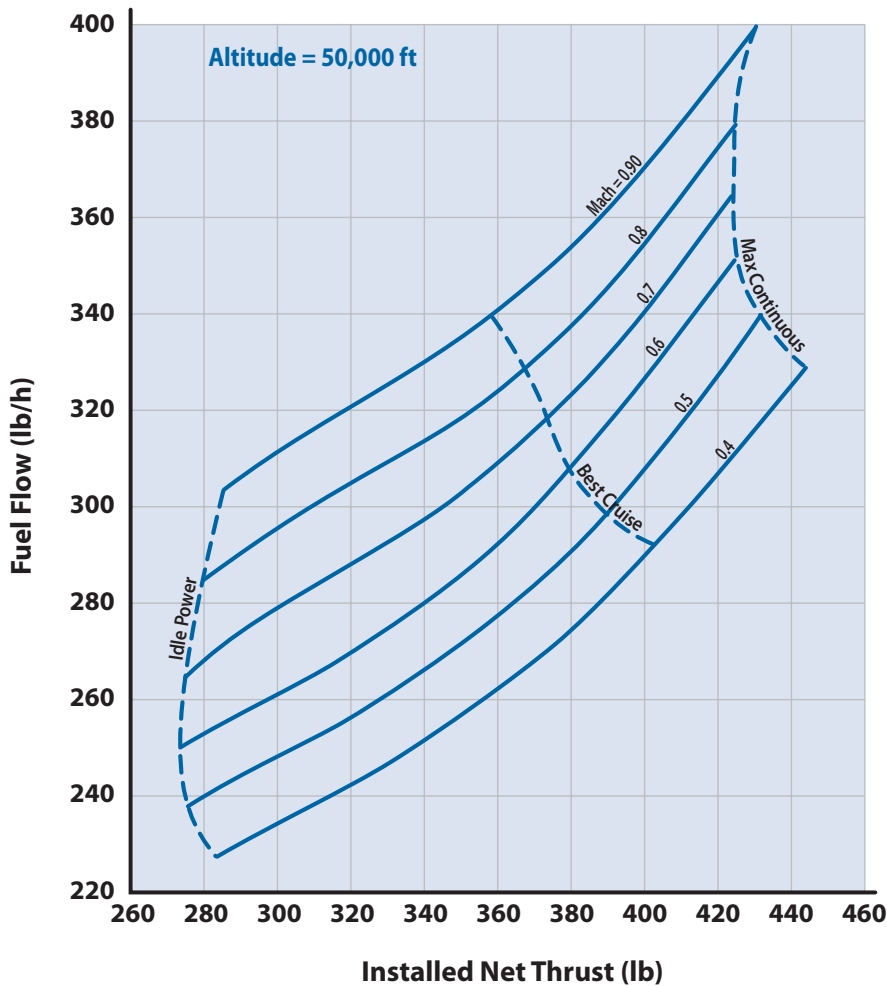


Figure J.5g TFE 731 model 1069-1 installed fuel flow vs net thrust (50,000 ft, standard day).

Table J.6 GE 90 Turbofan Engine Data

Manufacturer: General Electric					
Application: Boeing 777					
Specification: Uninstalled					
SLS thrust: Ranges from 76,000 lb (777-200) to 115,000 lb (777-300ER)					
SLS SFC: 0.29–0.31					
Weight = 17,300 lb					
Length = 287 in.					
Maximum diameter = 134 in.					
OPR = 40					
Takeoff Thrust: Uninstalled thrust/SFC, limited to 5 minutes					
Altitude	$M = 0$	$M = 0.1$	$M = 0.2$		
SL	98,000/0.29	87,762/0.32	79,585/0.356		
2000	92,908/0.289	83,569/0.322	75,929/0.358		
4000	87,390/0.292	7877/0.325	71,741/0.361		
Climb Thrust: Uninstalled thrust/SFC					
Altitude	$M = 0.4$	$M = 0.5$	$M = 0.6$	$M = 0.7$	
5,000	53,071/0.417	49,185/0.459	45,899/0.502	—	
10,000	—	44,660/0.459	42,091/0.495	—	
15,000	—	39,268/0.461	37,509/0.497	—	
20,000	—	33,138/0.463	32,364/0.50	31,798/0.532	
25,000	—	—	26,886/0.50	26,971/0.534	
30,000	—	—	21,777/0.492	22,177/0.532	
35,000	—	—	17,282/0.482	17,581/0.52	
40,000	—	—	13,699/0.486	13,936/0.524	
Cruise Partial Power: Uninstalled thrust/SFC					
Altitude	$M = 0.75$	$M = 0.75$	$M = 0.75$	$M = 0.75$	$M = 0.75$
30,000	22,568/0.551	20,275/0.523	18,300/0.51	16,514/0.51	14,904/0.51
35,000	17,888/0.539	16,538/0.512	14,925/0.50	13,469/0.497	12,156/0.50
40,000	14,170/0.542	13,077/0.513	11,801/0.50	10,651/0.497	9610/0.499
45,000	11,238/0.55	10,199/0.515	9204/0.502	8307/0.5	7497/0.503
50,000	8777/0.55	7948/0.518	7173/0.506	6474/0.504	5843/0.507
55,000	6840/0.553	6172/0.521	5570/0.509	5027/0.509	4539/0.512